8516927

THE UNITED STATES OF AMERICA

TO ALL TO WHOM THESE PRESENTS SHALL COME:

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office

August 20, 2024

THIS IS TO CERTIFY THAT ANNEXED IS A TRUE COPY FROM THE RECORDS OF THIS OFFICE OF THE FILE WRAPPER AND CONTENTS OF:

APPLICATION NUMBER: ***18/328,730***
FILING DATE: ***June 3, 2023***

By Authority of the
Under Secretary of Commerce for Intellectual Property
and Director of the United States Patent and Trademark Office

Sylvia Holley
Certifying Officer

PTO/AIA/15 (03-13)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	SDC010
First Named Inventor	Brandon Dale Kofford
Title	SCREW-ATTACHED PICK-UP DENTAL COPING SYSTEMS AND METHODS
Express Mail Label No.	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. ☐ **Fee Transmittal Form** (PTO/SB/17 or equivalent)
2. ☑ **Applicant asserts small entity status.** See 37 CFR 1.27
3. ☐ **Applicant certifies micro entity status.** See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
4. ☑ **Specification** [*Total Pages* 54] Both the claims and abstract must start on a new page. *(See MPEP § 608.01(a) for information on the preferred arrangement)*
5. ☑ **Drawing(s)** (35 U.S.C. 113) [*Total Sheets* ____]
6. **Inventor's Oath or Declaration** [*Total Pages* 4] *(including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e))*
   a. ☑ Newly executed (original or copy)
   b. ☐ A copy from a prior application (37 CFR 1.63(d))
7. ☑ **Application Data Sheet** ** See note below.* See 37 CFR 1.76 (PTO/AIA/14 or equivalent)
8. **CD-ROM or CD-R** in duplicate, large table, or Computer Program (*Appendix*)
   ☐ Landscape Table on CD
9. **Nucleotide and/or Amino Acid Sequence Submission** (*if applicable, items a. – c. are required*)
   a. ☐ Computer Readable Form (CRF)
   b. ☐ Specification Sequence Listing on:
      i. ☐ CD-ROM or CD-R (2 copies); or
      ii. ☐ Paper
   c. ☐ Statements verifying identity of above copies

ADDRESS TO:

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

ACCOMPANYING APPLICATION PAPERS

10. ☐ **Assignment Papers** (cover sheet & document(s))
    Name of Assignee _____
11. ☐ **37 CFR 3.73(c) Statement** (*when there is an assignee*) ☐ **Power of Attorney**
12. ☐ **English Translation Document** (*if applicable*)
13. ☐ **Information Disclosure Statement** (PTO/SB/08 or PTO-1449)
    ☐ Copies of citations attached
14. ☐ **Preliminary Amendment**
15. ☐ **Return Receipt Postcard** (*MPEP § 503*) (*Should be specifically itemized*)
16. ☐ **Certified Copy of Priority Document(s)** (*if foreign priority is claimed*)
17. ☑ **Nonpublication Request** Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.
18. ☑ **Other:** Track One AIA0424

***Note**: (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 **must** be included in an Application Data Sheet (ADS).
(2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

19. CORRESPONDENCE ADDRESS

☑ The address associated with Customer Number: 112823 **OR** ☐ Correspondence address below

Name					
Address					
City		State		Zip Code	
Country		Telephone		Email	

Signature	/Daniel John Whittle, #54,537/	Date	June 3, 2023
Name (Print/Type)	Daniel John Whittle	Registration No. (Attorney/Agent)	54537

This collection of information is required by 37 CFR 1.53(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82A (07-13)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	
Filing Date	2023-06-03
First Named Inventor	Brandon Dale Kofford
Title	SCREW-ATTACHED PICK-UP DENTAL COPING SYSTEMS AND METHODS
Art Unit	
Examiner Name	
Attorney Docket Number	SDC010

SIGNATURE of Applicant or Patent Practitioner

Signature	/Daniel John Whittle, #54,537/	Date (Optional)	
Name	Daniel John Whittle	Registration Number	54,537
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ *Total of 2 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82B (07-13)
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POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 000112823

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☐ The address associated with the above-mentioned Customer Number

OR

☑ The address associated with Customer Number: 000112823

OR

Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

☑ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☐ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature	/Brandon Dale Kofford/	Date (Optional)	2023-05-31
Name	Brandon D Kofford		
Title			

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ Total of 2 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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PTO/AIA/82C (07-13)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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POWER OF ATTORNEY BY APPLICANT

No more than ten (10) patent practitioners total may be appointed as set forth below by name and registration number. This page need not be submitted if appointing the Patent Practitioner(s) associated with a Customer Number (see form PTO/AIA/82B):

Name	Registration Number

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

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1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Straumann USA Exhibit 1015

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
www.uspto.gov

ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/328,730	06/03/2023 04:47:22 PM ET	SDC010

Title of Invention

Screw-attached Pick-up Dental Coping System and Methods

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	2867	FILED BY	Daniel Whittle
PATENT CENTER #	62192092	AUTHORIZED BY	-
CUSTOMER #	112823	FILING DATE	-
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Brandon Dale Kofford

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 5436	E202363G51488501	Daniel Whittle

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
2830	PROCESSING FEE, EXCEPT IN PROVISIONAL APPLICATIONS	56.00	1	56.00
2817	REQUEST FOR PRIORITIZED EXAMINATION	1680.00	1	1680.00
2111	UTILITY PATENT APPL. SEARCH FEE	280.00	1	280.00
4011	BASIC FILING FEE- UTILITY	64.00	1	64.00
2311	EXAMINATION OF ORIGINAL PATENT APPLICATION	320.00	1	320.00

2202	EACH CLAIM IN EXCESS OF 20	40.00	10	400.00
2201	EACH INDEPENDENT CLAIM IN EXCESS OF THREE	192.00	1	192.00
			TOTAL AMOUNT:	**$2,992.00**

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Application Data Sheet 37 CFR 1.76

The Application Data Sheet is part of the provisional or non-provisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.

Inventor Information

of inventors: 2

1. **Brandon Dale Kofford**

   Residence Information
   US Residency
   Apex, NC
   UNITED STATES

   Mailing Address
   P.O. Box 1690
   Apex, NC 27502
   UNITED STATES

2. **Charles Albert Rudisill**

   Residence Information
   US Residency
   Apex, NC
   UNITED STATES

   Mailing Address
   3908 Bamburgh Lane
   Apex, NC 27539
   UNITED STATES

Application Information

Customer number	112823 -
Correspondence address	----

Title of invention	**Screw-attached Pick-up Dental Coping System and Methods**
Attorney docket number	**SDC010**
Entity status	Small
Application type	Nonprovisional Application under 35 USC 111(a)
Subject matter	Utility
Total number of drawing sheets	26
Suggested figure for publication	75
Filing by reference	No
Publication request	**REQUEST NOT TO PUBLISH** under 35 U.S.C. 122(b) I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application has not and will not be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information

of representatives: 1

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).

Customer number 112823

Domestic Benefit/National Stage Information

of benefit claims: 5

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c), 386(c), or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78(a)(2) or CFR 1.78(a)(4), and need not otherwise be made part of the specification.

Prior app status	Pending
Application number	---
Continuity type	**Continuation of**
Prior app number	**17691108**
Filing Date	03/09/2022

Prior app status	Patented
Application number	---
Continuity type	**Continuation of**
Prior app number	**16596361**
Filing Date	---
Patent number	11311354

Prior app status	Expired
Application number	---
Continuity type	**Claims benefit of provisional**
Prior app number	**62742942**
Filing Date	---

Prior app status	Expired
Application number	---
Continuity type	**Claims benefit of provisional**
Prior app number	**62774402**
Filing Date	---

Prior app status	Expired
Application number	---
Continuity type	**Claims benefit of provisional**
Prior app number	**62818082**
Filing Date	---

Foreign Priority Information

of foreign priority claims: 0

This section allows for the applicant to claim benefit of foreign priority and to identify any prior foreign application for which

priority is not claimed. Providing this information in the Application Data Sheet constitutes the claim for priority as required by 35 U.S.C. 119 (b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Data was not provided for this section.

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

Checking this box will cause the application to be examined under the first inventor to file provisions of the AIA.

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013. NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 2016, 2013, will be examined under the first inventor to file provisions of the AIA.

Authorization or Opt-Out of Authorization to Permit Access

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE:
This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

Priority Document Exchange (PDX)

A. Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related

bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h) (1).

B. **Search Results from U.S. Application to EPO**

Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☑ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☑ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with the search results from the instant application.

NOTE:
Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

Applicant Information

of applicants: 0

The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46.

Data was not provided for this section.

Assignee Information including Non-Applicant Assignee Information

of assignees: 0

An assignee-applicant identified in the "Applicant" section will appear on the patent application as an applicant.

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Signature

NOTE:

This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c)**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See CFR 1.4(d) for the manner of making signatures and certifications.

Signature	First name	Last name	Registration #	Date
/Daniel John Whittle/	Daniel	Whittle	54537	06/01/2023

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APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/328,730	**06/03/2023 04:47:22 PM ET**	**SDC010**

Title of Invention

Screw-attached Pick-up Dental Coping System and Methods

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	2867	FILED BY	Daniel Whittle
PATENT CENTER #	62192092	FILING DATE	-
CUSTOMER #	112823	FIRST NAMED INVENTOR	Brandon Dale Kofford
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	-

Documents

TOTAL DOCUMENTS: 10

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
generatedADS62192092.pdf	6	Application Data Sheet	147 KB
aia0424.pdf	2	Track One Request	135 KB
aia0082SDC010CAR-signed.pdf	4	Power of Attorney	201 KB
aia0001SDC010CAR-signed.pdf	2	Oath or Declaration filed	188 KB
aia0082SDC010BDK.pdf	4	Power of Attorney	173 KB
aia0001SDC010BDK.pdf	2	Oath or Declaration filed	161 KB

SDC010figs.pdf	26	Drawings-only black and white line drawings	8646 KB
aia0015SDC010.pdf	2	Transmittal of New Application	270 KB
SDC010specfinal-APP.TEXT.docx	54	Application body structured text document	68 KB
SDC010specfinal.pdf	54	Auxiliary PDF of Application	395 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
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National Stage of an International Application under 35 U.S.C. 371

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SCREW-ATTACHED PICK-UP DENTAL COPING SYSTEMS AND METHODS

ABSTRACT

A temporary alignment system and method for holding a dental coping to an implant abutment using the same threads in the abutment that are used for definitive attachment are disclosed. The disclosed temporary fasteners initially orient and hold a coping against an abutment with a force along the same axis as the semi-definitive screw. The aligned coping can be picked-up in a closed-tray impression process without unscrewing the temporary fastener. Embodiments include threaded posts that release copings from the abutment through axial forces. Some embodiments include a threaded post with separable cap that is picked-up with the coping. Methods for converting an existing prosthesis for screw attachment to implants in a single visit and digital capture of the converted prosthesis are described.

1 Specification

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation of US Patent Application 17/691,108, filed on March 9, 2022, which is a continuation of US Patent Application 16/596,361, filed on October 8, 2019, and issued as US Patent 11,311,354 on April 26, 2022. This disclosure claims priority of US provisional patent application number 62/742,942, filed on October 9, 2018, and US provisional patent application number 62/774,402, filed on December 3, 2018, and US provisional patent application number 62/818,082, filed on March 13, 2019. All of the above non-provisional and provisional applications are incorporated herein by reference in their entirety.

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BACKGROUND OF THE INVENTION

[0003] Different systems have been introduced for attaching dental prostheses to dental implants to replace one or more natural teeth. In order to simplify future modification or replacement needs, it is desirable to have reversable attachment between the implants and prostheses using mechanical systems as opposed to directly bonding these components together. These systems require features to provide both proper alignment and retention for acceptable use by the patient. Intermediate components such as copings and separable abutments having different lengths or orientations are often employed to provide proper registration between a dental prosthesis, one or more implants embedded in the patient's

jawbone, and the soft-tissue and any remaining natural teeth. These intermediate elements may be mutually attached with screws or with ball-and-socket or other forms of snap-on mounts. In the case of a single-tooth crown attachment, the coping and abutment surfaces preferably include features to remove rotational symmetry in the mating of the abutment and coping surfaces. Rotational locking features may also be included in these single mount systems. When the prosthesis contains multiple copings for attachment to multiple abutments, this rotational fixation is not generally required. For example, 30-degree tapered mating surfaces for multiple interface locations are sufficient to provide complete registration.

[0004] It is common to attach a complete upper or lower denture to four or more implants. The multi-unit abutment system interfaces with mating surfaces of the final prosthetic. In some cases, these dentures may be designed or fabricated from scratch following the pulling of undesirable teeth and mounting of implants. In other cases, no teeth are pulled, but it is desirable to convert an existing removable denture to definitive mounting to new implants. In some cases, it is preferable to convert these existing dentures shortly after the implants are placed. This chair-side processing decreases patient discomfort by providing at least temporary dentures more quickly.

[0005] Dental impressions are often used to provide information on the location of implants, soft tissue and existing teeth for designing new prostheses or mounting copings in existing dentures for implant attachment conversion. Generally, the copings are mounted to implant abutments and an impression is made to provide location information for the prosthesis through the copings. Impression material is introduced and cured around the copings to define their position. In the case of transfer copings, less rigid impression material is used to form a cavity for each coping; the coping remains attached to the abutment and the cured impression is removed. Subsequently, copings are inserted into the impression.

In the case of pick-up copings, the coping is directly retained in the impression material after curing. That is, the copings are picked-up when the impression is removed from the mouth. The resulting alignment of pick-up copings is generally superior to transfer copings as a result of the direct transfer of coping location information. Transfer copings introduce an indirect secondary alignment reference since the insertion of the coping into the impression may not accurately duplicate the original position, particularly in insertion depth.

[0006] Pick-up copings can be used with either an open tray or a closed tray protocol. For snap-on systems, a closed impression tray pick-up technique may be done. The tray can be closed because there is no need to access the copings in order to disconnect them after the impression material sets. However, it is desirable to ensure that the assembly of snap-on copings can be removed without patient discomfort. The amount of force required to remove the tray or converted prosthesis depends upon the total number of implant abutment/coping sets and their position and mutual alignment. Some snap-on systems provide features to provide different retention levels, but this complicates the installation process. Special tools have been introduced to help separate impression trays or prostheses with snap-on systems but may still result in patient discomfort. Since snap-on systems are generally physically larger than dental screws, converting an existing denture may require large clearance cavities to be bored into the existing denture before it can be used as an impression tray in a pick-up coping process. These large holes may significantly reduce the mechanical stability of the existing denture. The mechanical precision required of snap-on system elements generally makes them more expensive than screw-attached systems.

[0007] The simplicity of screw-attached systems provides some benefits over snap-on systems beyond fabrication cost. The mounting pressure between the coping and abutment is readily controlled through the torque applied to the screw

to tighten it. This axial tension control and the self-aligning characteristics of engaged screw threads provides more certainty in the engagement force and relative orientation of the components. Even if a screw breaks, techniques are known for removing the pieces without damage to surrounding components. Screws also have a benefit of independence for removal since each coping can be loosened individually. Tilting the prosthesis after screw removal to disengage one coping cannot cause reengagement of another coping.

[0008] A disadvantage with commercially available screw-attachment systems for pick-up copings is the requirement for using an open-tray impression in order to release the coping from the abutment after the impression material sets. By having an opening in the tray or existing denture, impression screws may be used. These impression screws extend through the tray beyond the impression material and can be unscrewed after the material sets. The impression screws use the same abutment threads as the semi-permanent screws used to attach the prosthesis later. As a result, the introduction of alignment uncertainty through a secondary reference may be avoided or minimized. The copings used with the impression screws are often relatively long and require modification for denture conversion. This customization may result in larger clearance holes in dentures and require additional process time by the dental practitioner. The length of the impression screws sticking through the tray can cause patient discomfort and a gag reflex. In the case of denture conversion, clearance for a set of impression screws at different angles may require additional material removal leading to a weakened denture. A schematic representation of the larger through-holes 136 required using conventional denture conversion processes for screw attachment are illustrated in FIGS. 93-94. The impression screws can also prevent the patient from applying bite pressure during the pick-up process to ensure proper registration of the modified denture and opposing teeth.

[0009] Prosthetic dentistry has rapidly moved into the realm of digital design and manufacturing. Typically, this requires that a digital model is created from a physical model or impression to allow digital design and manufacturing techniques to produce a physical prosthetic that can be delivered to a patient for restoration of dental and oral structures. When making a dental restoration with implants in this manner, an implant impression coping is often used in the mouth to reference the position of the implant geometry relative to surrounding structures such as gingiva, adjacent teeth, opposing teeth, etc. Once removed from the mouth, an implant analog is attached to the impression coping that was picked-up or transferred. With the lab implant analog attached to the impression coping in the elastomeric impression, dental stone is flowed into the impression and allowed to harden before separation from the impression with a resultant dental cast. A scan flag is attached to the lab analog on the dental stone model and is scanned in by laser or optical scanning technology. The scan flag is used for design software to reference and replicate the accurate positioning of the virtual implant relative to the adjacent teeth, gingiva and opposing tooth, as well as the timing of the implant and other pertinent implant geometries. Once the virtual implant is accurately brought into the design software, a prosthetic can be designed by following the workflow in the design software. A completed design is post-processed, and a CAD file is used in CAM software to direct either the 3-D printing or milling of the designed prosthesis. The manufactured prosthesis is verified on the physical model in a remote prosthetic manufacturing lab prior to delivery to the dentist or is verified directly on the dental patient if the prosthesis was manufactured in the local dental clinic. It is currently the standard of care to verify the fit, form, and function on a physical model.

[0010] Recently, an impression scan flag was introduced to the market for a few major implant systems and the most common multi-unit geometry. This scan flag allows for an impression to be digitized without the creation of a stone model. A digital model is created directly from the elastomeric impression, a prosthesis is

designed digitally and processed with CAM software and both a 3-D printed model and 3-D printed or milled prosthesis is finished and tested on the 3-D printed model. The disadvantage of the 3-D printed model for full arch implant prosthetics is the positioning of the implant lab analog within the 3-D printed model introduces a degree of inaccuracy. Additionally, an impression only captures the implant or multi-unit abutment relative to the tissues and requires cumbersome steps to incorporate a provisional prosthesis or wax-up into the design software relative to the scan of the impression.

[0011] A properly converted denture provides a valuable source of information of the relative location of the implant and its abutment surfaces, copings and soft tissue and any remaining teeth of the patient. It can be used as a model for digital scanning to produce a duplicate denture if needed in the future or as a starting digital model for manipulation to improve aesthetics or other characteristics. However, if the mechanical integrity of the converted denture is compromised, the scanned information may not faithfully represent the relative geometry of these elements and result in a poor fit.

[0012] Other alignment systems have been proposed which use silicone or melting screw threads to allow closed tray transfer for definitive screw attachment, but the practicality of providing adequate alignment and seating forces with a screw diameter in the range of existing systems or overcoming the lack of disengagement independence required in melting all threads simultaneously without patient discomfort has not been documented. Details on removing any residual material in the abutment threads or in the prosthesis after the pick-up process have not been disclosed. Other hybrid systems that use a snap-on engagement for the pick-up coping during transfer and subsequent screw-attachment have also been proposed, but detailed information on the tradeoffs in precision and associated complexity or size required for equivalent performance to open-tray impression screw techniques have not been disclosed.

A general need exists for systems that improve clinical efficiency, implant to prosthesis alignment accuracy, application to a wide range of coping designs and sources and patient comfort over existing systems.

[0013] The present disclosure includes systems and methods that address one or more of these issues in the prior art.

BRIEF SUMMARY OF THE INVENTION

[0014] Some embodiments of the invention include a screw-in fastener system used to temporarily retain a coping on an abutment during bonding of the coping into a blind hole located in the tissue-side of a removable dental element such as a removable complete denture. The temporary fastener system disclosed has features to allow easy removal of the dental prosthesis from the fastener post after pick-up of the coping into the dental prosthesis is complete, without the need for special tools or access to the fastener system to unscrew it.

[0015] Some embodiments include a temporary fastener with a male-threaded bottom portion that is installed into the screw threads of an abutment, and an axially separable top portion, or cap, that retains the coping onto the abutment. The separable portion allows removal of the coping picked-up in the dental prosthesis without requiring mechanical access to the fastener. The inventive concepts disclosed facilitate easier installation and removal on multiple abutments that may be oriented at different compound angles when compared to the conventional open-tray processes and long impression screws. The temporary fastener may engage the same screw threads of the abutment that are used to definitively attach the prosthesis. In this manner, the coping is held against the abutment for the pick-up process with a force oriented identically to that of the final screw mounting. The retention of the cap on the screw post can

be designed to provide a desired force holding the coping to the abutment through the applied torque on the temporary fastener. The cap can be attached to the post through a combination of known mechanical attachment means including but not limited to interference fits, adhesives, snap fits or other elastic and inelastically deforming retention elements. The cap may also be formed as an integral part of the screw post that has portions that fracture as a result of an applied axial force. In addition to applied axial forces, the cap may separate from the post as a result of retention changes resulting from chemical or thermal processes and or the application of electromagnetic energy during or subsequent to the pick-up process.

[0016] Other embodiments include a threaded post that has a temporary retention feature that engages the coping without a separable cap. These embodiments engage the abutment threads in mounting the coping but release the coping after bonding to the prosthesis.

[0017] The disclosed systems and methods can be applied to single tooth prostheses with copings and abutments with orientational features or for multiple tooth prostheses using copings and abutments with symmetrical mating surfaces such as 30-degree tapers.

[0018] In some embodiments, the temporary fastener is driven into the abutment threads by a tool that engages the post. In other embodiments, the temporary fastener is driven into the abutment threads by a tool that engages the cap. The drive torque can be designed to be sufficient for holding the coping to the abutment accurately, but less than the torque that would result in movement of the cap relative to the post.

[0019] In some embodiments, the threaded end of the post portion of the temporary fastener has a deflecting feature that allows the post to engage or disengage the abutment threads through axial motion instead of a rotary screw motion.

[0020] One embodiment describes a system for aligning a dental implant abutment, coping and separable dental element for definitive screw-attachment comprising:

a. a temporary alignment fastener comprising:

b. a post having an axis, a first post end and second post end, wherein the first post end is threaded for screw attachment to the implant abutment;

c. a cap, wherein the cap is attached to the second post end;

[0021] and wherein the temporary alignment screw is configured to hold the coping against the implant abutment when the first post end is screwed into the implant abutment and wherein the cap is separable from the post through a release force directed away from the first post end.

[0022] One embodiment describes a system for aligning a separable dental element for installation to a threaded implant abutment with a definitive screw having a head and threaded shaft portion comprising:

[0023] a coping having a distal end shaped to engage with the implant abutment and a proximal end with an aperture sized to allow the shaft portion of the definitive screw to pass through;

[0024] a temporary screw having a distal end portion adapted to engage the threads of the implant abutment and a proximal end portion having temporary engagement means for attachment adjacent to the proximal end of the coping wherein the temporary screw holds the distal end of the coping in alignment

against the implant abutment when the distal end portion of the temporary screw engages the implant abutment threads and wherein the temporary engagement means releases the coping without disengaging the post portion of the temporary screw upon the application of a predetermined axial force in the proximal direction.

[0025] In some embodiments, an existing removable denture is converted to a screw attached denture by milling pockets to allow copings to be bonded in a pick-up process. In this process, the denture acts in an equivalent manner to a closed impression tray. Proper registration can be confirmed by having the patient bite down on the denture during the pick-up process. After coping pick-up, clearance for the definitive screws can be drilled using the coping as a guide. The converted denture can be used with scan flags to provide a 3-dimensional digital capture. Thus a digital model can be used to make a duplicate prosthesis or as the starting point for a new custom prosthesis.

[0026] One embodiment describes an alignment system for converting an existing denture for screw attachment to threaded implant abutments designed to perform the process of:

a. mounting pick-up copings to the implant abutments with temporary fasteners,
b. adhering the copings to cavities formed in the existing denture,
c. pulling the denture with secured pick-up copings away from the implant abutments,
d. unscrewing the threaded portions of the temporary fasteners from the implant abutments,
e. forming definitive screw clearance holes in the denture,
f. mounting the denture to the implant abutments with definitive screws that engage the same implant abutment threads as the temporary fasteners,

wherein the unscrewing the threaded portions of the temporary fasteners and the forming definitive screw clearance holes in the denture may occur in either order.

[0027] For the purposes of this disclosure, a separable dental element is defined to be anything that incorporates one or more dental copings that can be mounted and removed from one or more implant abutments. Different coping designs are known in the dental industry, and the systems and methods disclosed here can be adapted to work with many commercially available types of copings including pick-up copings, temporary cylinders, inserts and impression copings. Implant abutments are known in the dental industry having compatible interfaces to these copings. Since the mechanical interface is the same, for the purposes of this disclosure, implant abutment is considered a generic term that includes abutment analogs. Description of alignment systems and process methods with copings and implant abutments that are installed in a patient's jaw should be considered to also describe equivalent inventive concepts that may be used with copings and implant abutment analogs in a dental lab. The inventive concepts disclosed herein can be used with different types of separable dental elements. The separable dental element can be any form of impression used in a dental lab to assist in creating and testing dental prostheses. A separable dental element can also be a dental prosthesis fabricated in the dental lab using a physical model made from the impression, a dental prosthesis newly fabricated, or an existing prosthesis being converted for screw attachment. A dental prosthesis is defined to include a single-tooth appliance such as a crown, or any multiple-tooth bridge or denture. These prostheses may incorporate copings to provide a separable interface to provide orientation with an appropriate abutment attached to a patient's jaw or gingiva. The abutments for use with the inventive concepts disclosed herein include screw threads to mount the prosthesis with copings onto the abutments. While the concepts describe female threads in the abutment mating with male threads on a mounting screw, this is for convenience in

disclosure. The inventive concepts could be applied with systems having male threads in the abutment engaging a screw with female threads for mounting the prosthesis. These are considered to be straightforward variations of the inventive concepts.

[0028] For the purposes of this disclosure, the abutments may be integral to the implants embedded into the patient's jaw or gingiva, or they may be separate units that are attached to the implants. The inventive concepts disclosed apply to both configurations.

[0029] For the purposes of this disclosure, an existing denture should be interpreted broadly to include any prosthesis that has been created prior to the use of the innovative systems and methods disclosed. An existing denture may be a loose denture that was worn by the patient prior to the installation of implants were installed, or it may be a new denture that is in the process of first fitting in the patient's mouth.

[0030] The systems and methods disclosed herein can be used with prostheses for attachment to both the upper and lower jaw. As a result, portions of the system that are oriented downward for the lower jaw will be oriented upward for the upper jaw and vice versa. For convenience, a disclosure of an embodiment of inventive concepts that is limited to a single jaw orientation, is considered to disclose an embodiment for the opposite jaw orientation. When referring to the perspective of a clinician, proximal portions are nearer to the clinician than distal portions. While a term such as top is the opposite of the term bottom, and proximal is the opposite of distal, their actual relative orientation will be determined by the context of their use. The term tissue-side is used interchangeably with intaglio to indicate the side of a prosthesis that is opposite the occlusal or cameo surface.

[0031] The inventive systems disclosed are beneficially applicable to screw-attached prostheses. Key benefits of screw-attachment are variable tightening torques and reversibility. The terms permanent, semi-permanent, definitive and final when referring to screw-attachment are used interchangeably in this disclosure. A conventional screw that is definitively attached can still be removed by accessing the screw and rotating it in the opposite direction that was used for attachment. For the purposes of screw-attached prostheses for this disclosure, the attachment is semi-permanent, permanent or definitive in the sense that frequent attachment and removal is not anticipated for normal use. In contrast, the temporary screw attachment is applied for a planned process duration or other anticipated interval. Removal of a semi-permanent or definitive screw is generally motivated by a problem or an opportunity for an improvement. Access to the screw to apply a tool for removal may require removal of material covering the screw for aesthetic reasons.

[0032] Other terms in the specification and claims of this application should be interpreted using generally accepted, common meanings qualified by any contextual language where they are used. The terms "a" or "an", as used herein, are defined as one or as more than one. The term "plurality", as used herein, is defined as two or as more than two. The term "another", as used herein, is defined as at least a second or more. The terms "including" and/or "having", as used herein, are defined as comprising (i.e., open language). The term "coupled", as used herein, is defined as connected, although not necessarily directly, and not necessarily mechanically. The terms “about” and “essentially” mean ±10 percent. Reference throughout this document to "one embodiment", "certain embodiments", and “an embodiment" or similar terms means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention.

Thus, the appearances of such phrases or in various places throughout this specification are not necessarily all referring to the same embodiment. Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner in one or more embodiments without limitation. The term "or" as used herein is to be interpreted as an inclusive or meaning any one or any combination. Therefore, "A, B or C" means any of the following: "A; B; C; A and B; A and C; B and C; A, B and C". An exception to this definition will occur only when a combination of elements, functions, steps or acts are in some way inherently mutually exclusive.

[0033] The drawings featured in the figures are for the purpose of illustrating certain convenient embodiments of the present invention and are not to be considered as limitation thereto. The term “means” preceding a present participle of an operation indicates a desired function for which there is one or more embodiments, i.e., one or more methods, devices, or apparatuses for achieving the desired function and that one skilled in the art could select from these or their equivalent in view of the disclosure herein and use of the term “means” is not intended to be limiting. Other objects, features, embodiments and/or advantages of the invention will be apparent from the following specification taken in conjunction with the following drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034] FIG. 1 is a top exploded isometric view of a first embodiment of a system for aligning a dental implant abutment, coping and prosthesis for definitive screw-attachment.

[0035] FIG. 2 is a side plan view of a first embodiment of a system for aligning a dental implant abutment, coping and prosthesis for definitive screw-attachment.

[0036] FIG. 3 is a top plan view of a first embodiment of a system for aligning a dental implant abutment, coping and prosthesis for definitive screw-attachment.

[0037] FIG. 4 is a side cross-sectional view of the system for aligning a dental implant abutment, coping and prosthesis for definitive screw-attachment along the line indicated in FIG. 3.

[0038] FIG. 5 is a side cross-sectional view of the embodiment of FIG. 4 attached to the jaw and prosthesis prior to the pick-up process.

[0039] FIG. 6 is a side cross-sectional view of the embodiment of FIG. 5 after the pick-up process.

[0040] FIG. 7 is a side cross-sectional view of the embodiment of FIG. 6 showing a drill bit creating a pilot hole for a definitive screw.

[0041] FIG. 8 is a side cross-sectional view of the embodiment of FIG. 7 showing a stepped drill bit creating a clearance for the head and shaft of a definitive screw.

[0042] FIG. 9 is side cross-sectional view of the embodiment of FIG. 8 showing the definitive screw holding the prosthesis to the implant.

[0043] FIG. 10 is an exploded top isometric view of a second embodiment of a system for aligning a dental implant abutment, coping and prothesis for definitive screw-attachment illustrating a single abutment and a temporary screw with breakaway tool.

[0044] FIG. 11 is an exploded side isometric view of the second embodiment of FIG. 10 prior to installation to the implant abutment.

[0045] FIG. 12 is an exploded side isometric view of the embodiment of FIG. 10 with the breakaway tool pushed onto the post and the coping placed on the implant abutment.

[0046] FIG. 13 is an exploded side isometric view of the embodiment of FIG. 10 schematically showing the tool being rotated to screw the post into the implant abutment.

[0047] FIG. 14 is an exploded side isometric view of the embodiment of FIG. 10 schematically showing the tool breaking away from the cap after the coping is secured on the abutment.

[0048] FIG. 15 is an exploded side isometric view of the embodiment of FIG. 10 schematically showing the prosthesis being marked for positioning a clearance hole.

[0049] FIG. 16 is a side isometric view of the marked prosthesis from FIG. 15.

[0050] FIG. 17 is a side isometric view of the marked prosthesis from FIG. 16 with blind clearance hole and boring tool.

[0051] FIG. 18 is an exploded side isometric view of the prepared embodiment of FIG. 17 as adhesive is schematically applied to the coping fixed to the abutment with the temporary screw.

[0052] FIG. 19 is a side view of the prosthesis in position for curing of the adhesive applied in FIG. 18.

[0053] FIG. 20 is a bottom side isometric exploded view of the coping incorporated in FIG. 19 being picked up as the prosthesis is removed from the implant abutment.

[0054] FIG. 21 is a top side isometric view schematically showing the post of the temporary screw being unscrewed from the implant abutment.

[0055] FIG. 22 is a top side isometric view of the implant abutment prepared for attachment of a prosthesis with a definitive screw.

[0056] FIG. 23 is a bottom isometric view of the prosthesis with picked-up coping from FIG. 20 being drilled from the bottom to provide clearance for the threaded shaft of a definitive screw following coping pick-up.

[0057] FIG. 24 is a top isometric view of the prosthesis with picked-up coping from FIG. 20 with a drill applied from the top to provide clearance for the definitive screw head.

[0058] FIG. 25 is top exploded isometric view of the prepared prosthesis from FIG. 24 with the definitive screw.

[0059] FIG. 26 is a top isometric view of the prepared prosthesis from FIG. 24 after attachment to the implant abutment with the definitive screw.

[0060] FIG. 27 is a schematic description of a process for aligning dental implant abutments, copings and a prosthesis for definitive screw-attachment.

[0061] FIG. 28 is an exploded bottom isometric view of a third embodiment of a system for aligning a dental implant abutment, coping and prosthesis for definitive screw-attachment with tool oriented for assembly.

[0062] FIG. 29 is an assembled bottom isometric view of the embodiment of FIG. 28 with temporary screw and coping inserted into tool.

[0063] FIG. 30 is a side view of the system of FIG. 29 after assembly with the implant abutment.

[0064] FIG. 31 is a cross-sectional view of the assembly of FIG. 30 along C-C.

[0065] FIG. 32 is a side view of the assembly of FIG. 28 after the pick-up process showing the removal end of the tool engaging the retained temporary screw post.

[0066] FIG. 33 is a cross-sectional of the assembly of FIG. 32 along D-D.

[0067] FIG. 34 is an exploded isometric view of another embodiment of a temporary screw of a system for aligning a dental implant abutment, coping and prosthesis for definitive screw-attachment.

[0068] FIG. 35 is an isometric view of the temporary screw of FIG. 34 from the screw thread end.

[0069] FIG. 36 is an isometric view of the temporary screw of FIG. 34 from the cap end.

[0070] FIG. 37 is a bottom isometric view of a jaw with multiple abutments in preparation of marking a prosthesis as part of the process for aligning a dental implant abutment, coping and prosthesis for definitive screw-attachment.

[0071] FIG. 38 is a top isometric view of the prosthesis of FIG. 37 showing abutment location markings.

[0072] FIG. 39 is a top isometric view of the prosthesis with clearances milled to receive copings for pick-up.

[0073] FIG. 40 is a bottom isometric view showing installed copings and the assembly of a coping to an implant abutment with a temporary screw and torque driver.

[0074] FIG. 41 is a top isometric view showing adhesive being dispensed in recesses of the prosthesis.

[0075] FIG. 42 is a bottom isometric view of the abutments with attached copings in the process of being positioned into the recesses of the prothesis after adhesive is dispensed.

[0076] FIG. 43 is a top isometric view of the copings attached to the prosthesis after adhesive curing and pick-up.

[0077] FIG. 44 is a bottom isometric view showing the removal of temporary screw posts from the implant abutments after the pick-up process.

[0078] FIG. 45 is a top view of a drill in position to create a pilot hole in the prosthesis of FIG. 43.

[0079] FIG. 46 is bottom view showing the pilot holes from the process of FIG. 45 extending through the prosthesis to exit on the occlusion side.

[0080] FIG. 47 is a bottom isometric view showing a counterbore positioned on the occlusion side of the prosthesis to provide clearance for the definitive screw.

[0081] FIG. 48 is a bottom isometric view illustrating a reamer positioned to clean residue from the bore.

[0082] FIG. 49 is a bottom isometric view of the prepared prosthesis with definitive mounting screws prior to fastening to the abutments.

[0083] FIG. 50 is a top isometric view corresponding to FIG. 49.

[0084] FIG. 51 is a top isometric view of an embodiment of a component suitable for use as a scan flag for digital capture and a laboratory analog for physical model creation.

[0085] FIG. 52 is a bottom isometric view of the component from FIG. 51.

[0086] FIG. 53 is a bottom isometric view showing the component of FIG. 51 positioned for screw attachment to the converted prosthesis of FIG. 49.

[0087] FIG. 54 is a top isometric view of FIG. 53.

[0088] FIG. 55 is a top isometric view showing the assembly of FIG. 54 mounted on a stand in preparation for scanning.

[0089] FIG. 56 is a side view of FIG. 55.

[0090] FIG. 57 is an isometric view of the assembly of FIG. 54 with reinforcing bars mounted prior to pouring of dental stone.

[0091] FIG. 58 is a schematic flow chart illustrating options for creating and attaching a permanent prosthesis.

[0092] FIG. 59 is an exploded isometric view of the torque driver shown in FIG. 40.

[0093] FIG. 60 is a top isometric view of the torque driver of FIG. 59 partially assembled.

[0094] FIG. 61 is a top isometric view of the post removal tool shown in FIG. 44.

[0095] FIG. 62 is a top isometric view of an embodiment of a temporary screw similar to FIG. 1 schematically illustrating axial motion of the cap away from the post threads from screwing after the coping contacts the abutment.

[0096] FIG. 63 is a top isometric view of the embodiment of FIG. 62 in which the temporary screw post end has become flush with the top of the cap.

[0097] FIG. 64 is a top isometric view of a temporary screw post embodiment having a cylindrical stem.

[0098] FIG. 65 is a top isometric view of a split temporary screw post embodiment having deflecting sections.

[0099] FIG. 66 is an isometric view of a temporary screw post embodiment having symmetric axial splines.

[0100] FIG. 67 is an isometric view of a temporary screw post embodiment having a weakened portion facilitating lateral movement during pick-up.

[0101] FIG. 68 is a bottom isometric view of a temporary screw embodiment having a spring cap.

[0102] FIG. 69 is a bottom isometric view of a one-piece temporary screw embodiment designed to fracture under axial loading.

[0103] FIG. 70 is a cross-sectional view of a temporary screw embodiment incorporating a rounded interface between cap and post facilitating pivotal movement as illustrated.

[0104] FIG. 71 is a cross-sectional view of a temporary screw embodiment incorporating a restricted interface between cap and post facilitating pivotal movement and protective film.

[0105] FIG. 72 is a cross-sectional view of a temporary screw embodiment incorporating a spring cap with preferential axial movement in the pick-up direction.

[0106] FIG. 73 is a cross-sectional view of a temporary screw embodiment incorporating a laminar cap fixed to the end of the post.

[0107] FIG. 74 is a cross-sectional view of a temporary screw embodiment incorporating a compliant interface between the cap and post.

[0108] FIG. 75 is a cross-sectional view of a temporary screw embodiment incorporating a split post that has deflecting sections with screw threads shaped to facilitate axial separation without unscrewing the post threads.

[0109] FIG. 76 is a cross-sectional view of a temporary screw embodiment incorporating an interface material between the cap and post.

[0110] FIG. 77 is a cross-sectional view of a temporary screw embodiment incorporating an O-ring interface between the cap and post.

[0111] FIG. 78 is a cross-sectional view of a temporary screw embodiment incorporating a cup-shaped interface material between the cap and post.

[0112] FIG. 79 is a bottom isometric view of a temporary screw embodiment incorporating a split collar cap.

[0113] FIG. 80 is a top isometric view of a temporary screw embodiment incorporating a planar spring that flexes when pulled perpendicular to the diameter indicated.

[0114] FIG. 81 is a top isometric view of a temporary screw embodiment incorporating a planar spring that flexes when pulled parallel perpendicular to the diameter indicated.

[0115] FIG. 82 is a cross-sectional view of an embodiment of a system for aligning a dental implant abutment, coping and prosthesis for semi-permanent screw-attachment in which the coping is held by mechanical interference to the proximal end of the threaded post.

[0116] FIG. 83 is a cross-sectional view of an embodiment of a system for aligning a dental implant abutment, coping and prosthesis for semi-permanent screw-attachment in which the coping has spring fingers holding the proximal end of the threaded post.

[0117] FIG. 84 is a cross-sectional view of an embodiment of a system for aligning a dental implant abutment, coping and prosthesis for semi-permanent

screw-attachment in which the coping has collet-type spring fingers holding the proximal end of the threaded post.

[0118] FIG. 84A is a top view of the embodiment of FIG. 84.

[0119] FIG. 85 is a cross-sectional view of an embodiment of a system for aligning a dental implant abutment, coping and prosthesis for semi-permanent screw-attachment in which the proximal end of threaded post has a slotted spring section holding the coping.

[0120] FIG. 86 is a cross-sectional view of an embodiment of a system for aligning a dental implant abutment, coping and prosthesis for semi-permanent screw-attachment in which a compressed ring holds the coping to the proximal end of the threaded post.

[0121] FIG. 87 is a cross-sectional view of an embodiment of a system for aligning a dental implant abutment, coping and prosthesis for semi-permanent screw-attachment in which a compressed ring with a u-shaped cross-section holds the coping to the proximal end of the threaded post.

[0122] FIG. 88 is a cross-sectional view of an embodiment of a system for aligning a dental implant abutment, coping and prosthesis for semi-permanent screw-attachment in which a thin cap fixes the coping to the proximal end of the threaded post.

[0123] FIG. 89 is a cross-sectional view of an embodiment of a system for aligning a dental implant abutment, coping and prosthesis for semi-permanent screw-attachment in which a filler material is placed in the bore of the coping at the proximal end of the threaded post.

[0124] FIG. 90 is a cross-sectional view of an embodiment of a system for aligning a dental implant abutment, coping and prosthesis for semi-permanent screw-attachment showing a tool engaging features of the coping to screw in the threaded portion of the post.

[0125] FIG. 91 is a bottom isometric view schematically illustrating the material removed from an existing denture necessary with inventive concepts disclosed in preparation for pick-up.

[0126] FIG. 92 is a top isometric view schematically illustrating the material removed from an existing denture necessary with inventive concepts disclosed in preparation for pick-up.

[0127] FIG. 93 is a bottom isometric view schematically illustrating the material removed from an existing denture necessary using prior art impression screw systems.

[0128] FIG. 94 is a top isometric view schematically illustrating the material removed from an existing denture necessary using prior art impression screw systems.

DETAILED DESCRIPTION OF THE INVENTION

[0129] FIG. 1 shows an exploded view of one embodiment of a temporary alignment system 12 for use in a direct coping pick-up process for screw attachment of a prosthesis. Implant abutment 8 has a distal end which may include attachment feature portion 135 illustrated as a screw thread for direct attachment to the patient's jaw and a proximal end with an abutment shaped to accommodate a coping 9. The abutment includes threaded section 18. The coping has a central bore 16 to accommodate screw fastening and may include ridges 17 or other structures or surface treatments to increase retention to the prosthesis with adhesive. The coping and abutment mating surfaces as shown in FIG. 1 are symmetrical. The inventive concepts of this disclosure may also be applied to abutment and coping systems that are keyed to restrict mating orientation. The coping may be mounted onto the abutment through rotation of a temporary adjustment screw comprising a threaded post 10 and cap 11. The cap

11 is mechanically attached to post 10 in a manner that allows relative axial motion with the application of a predetermined force. As illustrated in FIG. 1, cap 11 has a square central bore 13 that is press-fit onto a square portion 14 of post 10. The cap 11 temporarily retains coping 9 onto the implant abutment 8 during the pick-up process of the coping into the prosthesis with a force aligned directly along the same axis as the semi-permanent screw that will be used for definitive prosthesis mounting. The portion of the post engaging the abutment threads also prevents any pick-up material from contacting the abutment screw threads. After the coping is picked-up into the prosthesis, the cap and coping may be released from the abutment by applying an axial force. In the embodiment shown, the post threads 15 remain engaged with abutment threads 18 after the pick-up process. The post can then be removed from the abutment by unscrewing it. The prosthesis with embedded coping can be subsequently processed to accommodate semi-permanent screw attachment as will be described later.

[0130] FIGS. 2 and 3 show a side and top view of the assembled system of FIG. 1; FIG. 4 shows a cross-sectional view along the axis as indicated. As shown in FIG. 4, matching conical surfaces on the exterior of the implant abutment 8 and the interior of the coping 9 are engaged. The coping is pulled into alignment by an axial force from the lower surface of the cap 11 pushing against the upper surface of the coping from screwing the threads of post 10 into the implant abutment. The distal end of the abutment may be directly attached to the patient's jaw or attached to a separate implant attached to the jaw. The inventive concepts are not dependent upon the nature of the implant, so the distal end attachment feature 135 is represented schematically.

[0131] The capability for relative axial movement between the cap 11 and temporary attachment post 10 allows separation of the temporary attachment post from the cap without tools after retaining the coping onto the abutment during fitting and bonding of the coping into the prosthesis. These parts are

accurately aligned during the bonding process since the temporary post engages the abutment threads to provide an axial force holding the coping to the abutment just like the screw used for final attachment.

[0132] The cap may be sized to have an amount of press-fit mechanical interference to the temporary attachment post to provide an axial retention force of approximately 20 to 900 grams, this force being sufficient to retain coping 9 during assembly while allowing relatively easy pick-up removal of the coping and prosthesis from the temporary attachment post after assembly. The temporary attachment post 10 may include indicators (not shown) in the end by the cap 11 to provide intermediate visual and/or tactile feedback on the depth of threaded engagement of the post during screw attachment of the coping to the abutment.

[0133] In this embodiment, screw driving torque is provided by the square cross-section of the cap aperture and temporary attachment post. In the cross-sectional view of FIG. 4, the post 10 has been screwed in so that only a small beveled surface of the post extends above the top of the cap when the post threads bottom out in the abutment. During installation, this optional configuration provides feedback to the dental practitioner when the torque increases as the threads bottom. The square drive tool engagement can also be designed to disengage at a pre-designed minimum extension of the square post above the top of the cap. Alternatively, a tool with a specified maximum torque may be used to ensure engagement of the coping and abutment surfaces.

[0134] The screw driving torque function may be accomplished by engaging other features on the temporary attachment post such as hex or spline or asymmetric features. Alternately, the cap may be used to engage a screwdriver or other tool for torqueing. For example, in the case of a cylindrical temporary attachment post top portion, driving torque can be provided by the friction of the press-fit

between the cap and temporary attachment post. For example, a medium press-fit of a 3 mm diameter 1 mm thick nylon cap onto a 1.3 mm diameter stainless steel cylindrical rod may produce approximately 500 grams of axial retention force and 17 gram-cm driving torque. A typical screw thread size for appliances is m1.4 x 0.3. The retention/axial force of the cap to the temporary attachment post may be determined by the degree of press-fit and frictional properties between the cap and temporary attachment post, and/or spring features incorporated into the temporary attachment post and/or cap.

[0135] In actual trial installations, polymer caps of approximately 1.2 mm thickness press fit onto posts of approximately 1.4 mm diameter with cylindrical axial bores have been sufficient for installation and pick-up removal of a single prosthesis from multiple implant abutments in which the axes of the screw threads in the implant abutments are not mutually parallel.

[0136] The separable mechanical attachment means may include any combination of techniques, including frictional forces from interference, adhesives, waxes, chemical bonding, solders, elastically or inelastically deformable spring, snap or interlocking structures, thermally or electromagnetically fusible materials, fracturing structures, etc.

[0137] FIG. 5 through FIG. 9 show example cross-sectional views of some of the different stages of installation of the temporary fastener system into a denture. FIG. 5 shows a cross-sectional view of the assembly of the first embodiment during the initial phase of the coping pick-up process. As illustrated, the implant abutment 8 is attached to a schematic implant 70. The implant 70 has an interface 7 (shown schematically) that is attached to the patient's jawbone 22. The coping 9 is held against the implant abutment 8 through the temporary screw comprising the post 10 and cap 11. A blind clearance hole 5 in the prosthesis 3 is

sized to accommodate the coping and temporary screw. Pick-up material 71 is positioned in the clearance hole 5 to capture the coping in proper alignment within the prosthesis. After the pick-up material has set up, the prosthesis 3, coping 9 and temporary screw cap 10 assembly is pulled off the patient's jaw as shown by the arrows in FIG. 6. The coping 9 and cap 11 are released from the implant abutment 8 and post 10, while the threads of the post 10 keep it engaged in the implant abutment 8. The post 10 is subsequently removed to make the abutment threads 18 available for holding the prosthesis in proper alignment with a definitive screw.

[0138] The prosthesis/coping assembly must be processed after the pick-up process for screw attachment. A pilot hole is drilled with bit 72 from the bottom side of the assembly. As shown in FIG. 7, the diameter of the bit may be selected to use the interior bores of the coping and cap to act as guides for hand processing. Alternately, a drill guide may be employed that engages a portion of the interior of the coping may be used to align the pilot hole. The pilot hole provides guidance for a tool to provide clearance for the definitive screw shaft and head. FIG. 8 shows a stepped drill 73 that cuts both clearances in a single process. Alternatively, the shaft and head clearance may be drilled with two drills in two process steps. If desired, the cap 11 of the temporary screw can be fabricated of a material that is easier to drill than the coping material to provide feedback on the drill position. It has been found that it is possible to distinguish where the drill is positioned by feel at the interfaces between the pick-up adhesive and the top of the cap (as shown in FIG. 8) and the bottom of the cap and the top of the coping. Since pick-up material was blocked from entering the coping, drilling resistance decreases rapidly upon breaking through the bottom of the cap and entering the interior channel of the coping. Color differences in the materials can also be detected. Alternatively, a tool can be configured to fit within the bore of the coping to limit the depth of the drill.

[0139] Once clearance for the definitive screw has been made from the top of the prosthesis, the prosthesis is ready for mounting to the implant with definitive screw 75 as shown in FIG. 9. The screw clearance hole in the prosthesis may be filled with Teflon tape and color-matching composite materials for aesthetic purposes. In the illustrated embodiment, the coping bore has a shoulder to engage a flat surface on the underside of head of the screw. Alternate configurations are possible without deviating from the temporary screw system for coping pick-up disclosed.

[0140] FIG. 10 is another exploded isometric view of parts of an embodiment of the invention. In this example, cap 11 is integrated into a breakaway installation tool 18. The tool portion 19 may be used to install the temporary attachment post 10, and then section 19 broken away at mechanically weak separation feature 20, for example, when the post bottoms out in the abutment leaving the cap portion 11 in position. Alternatively, the tool can be designed to increase stress on the separation feature as the top of the post moves axially down relative to the weakened section. As illustrated, after the cap portion 11 breaks away from the tool portion 19, drive feature 21 in the tool portion may be used to remove the post 10 after the pick-up process. One or both ends of the tool may be shaped to subsequently engage and remove the temporary attachment post 10 after installation of coping 9 into the denture.

[0141] FIGS. 11-26 provide schematic isometric views of the process steps for using the elements of an exemplary embodiment introduced in FIG. 10 for a single implant system such as a crown. In FIG. 11, a schematic isometric view of a portion of the patient's jaw 22 is shown with an implant 70 (not shown) installed, and implant abutment 8 installed into the implant. The coping 9 is placed onto the implant abutment 8, the top portion of temporary attachment post 10 is assembled onto cap 11. The top portion of temporary attachment post 10 and cap 11 are configured such that there is a means to drive the temporary

attachment post into the abutment, while allowing axial movement of the cap 11 relative to the temporary attachment post axis, the cap/temporary attachment post interface having sufficient retention force to keep the coping in place on the abutment during subsequent installation steps, and the temporary attachment post being removable after picking up the coping into the prosthesis. Cap 11 may be attached to a break-away installation/removal tool 18.

[0142] FIG. 12 shows the coping 9 placed on the implant abutment 8 and the cap/tool 18 installed onto temporary attachment post 10. The coping-abutment surfaces may comprise a conical or spherical concave feature on the coping 9 that mates with a complementary feature on the top of the implant abutment 8, as illustrated. Alternatively, keying features may be employed to restrict relative rotational orientation, particularly in the case of single implants.

[0143] FIG. 13 shows the temporary attachment post being threaded into the implant abutment 8, through a clearance hole in the coping 9. The cap abuts the coping to secure the coping to the abutment. The cap 11 is free to move axially along the temporary attachment post with a frictional retaining force of the cap to the temporary attachment post. A known amount of retention force of the coping to abutment is provided by the design and materials used in the cap and temporary attachment post.

[0144] FIG. 14 shows the tool portion of the cap being removed after the cap has broken away; the tool may be used for removal of the temporary attachment post at a later step.

[0145] FIG. 15 shows marking of the position of the coping onto the appliance for drilling a recess for the coping in the prosthesis.

[0146] FIG. 16 shows the prosthesis with coping drilling location marking 23.

[0147] FIG. 17 shows the prosthesis after boring the cavity for the coping; the cavity for the coping may be accurately drilled slightly larger than the coping, without significant unwanted material removal from the prosthesis.

[0148] FIG. 18 shows pick-up material being applied to the coping and/or prosthesis after confirmation of freedom to provide proper occlusion during dry testing. Although not illustrated, the cavity of the prosthesis or the coping may optionally include features to provide venting of excess pick-up material if desired.

[0149] FIG. 19 shows the bonded coping being picked up into the prosthesis

[0150] FIG. 20 shows the prosthesis removed from the temporary attachment post; the temporary attachment post/cap design allows removal of the prosthesis from the temporary attachment post. The coping is now incorporated into the prosthesis.

[0151] FIG. 21 shows the temporary attachment post being removed with the tool portion of the cap.

[0152] FIG. 22 shows the abutment installed in the implant with the temporary attachment post removed.

[0153] FIG. 23 shows drilling a small guide-hole (for example 1-2 mm diameter), through the clearance hole of the coping, into and through the prosthesis. This guide hole provides a small reference hole for enlargement of the hole to accommodate the prosthesis retaining screw.

[0154] FIG. 24 shows enlarging the guide hole to a clearance hole for prosthesis retaining screw, approximately the diameter of the head of the retaining screw (e.g., 1.5-2.5 mm). The clearance hole would typically be drilled down to the top surface of the coping.

[0155] FIG. 25 shows the prosthesis being installed onto the implant abutment by placing the prosthesis coping onto the abutment and installing the prosthesis retaining screw.

[0156] FIG. 26 shows the assembled prosthesis on the implant.

[0157] FIG. 27 contains a summary of a generalized process extending the basic process described above for a prosthesis attached to multiple implant abutments.

[0158] Another embodiment of a prosthesis and implant alignment system and tool are shown in FIG. 28. In this case, the cap is in the form of a hex nut 63 that is press fit onto alignment post 62 to act as the temporary alignment screw. The drive tool 64 includes a concave hex socket 68 that fits temporary post nut 63, and coping retaining portion 69 that retains coping 61 with a slight interference fit. Thus, as shown in FIG. 29, the temporary screw comprising nut 63 with post 62 is engaged with the socket portion of the tool, and the coping 61 is retained in the tool. The coping is seated onto the abutment 60 by using the hex portion of the

driver to rotate the nut and engage the threads 66 on the temporary screw post 62. FIGS. 30 and 31 show an exterior and cross-sectional view of the mounting of the coping on the abutment with the tool. The tool may also have an integrated feature for removing the post as shown in FIG. 32. For example, FIG. 33 shows a tapering feature 170 on the narrow end of tool 64 which may be used to unscrew the post. FIG. 28 illustrates optional undercut 67 for stronger adhesive locking. Optional anti-rotation flat 65 is shown. Such an anti-rotation flat may be used on mating surfaces in circumstances in which there is a preferred orientation around the axis of the screw threads.

[0159] Another embodiment of the inventive concepts in which the cap of the temporary screw is shaped to engage the driving tool is shown in FIGS. 34-36. Cap 102 is mechanically attached to alignment post 101 at end portion 101A to form temporary alignment screw 100. This mechanical attachment may result from press-fitting a polymeric cap 102 onto a metal post 101 to provide adequate resistance to rotary slip to temporarily attach the coping to the implant abutment while still allowing relative axial movement during the pick-up process. The cap 102 may include a tapered surface 102B shaped to match the mating surface of an associated coping 112. A hexalobular internal (Torx) drive feature is shown in the end of the cap 102, although other bit socket shapes are possible. As previously discussed, other mechanical engagement means besides an interference fit are possible. The post may be made of different materials than these, or even be of unitary construction with weakened sections that fracture or otherwise breakaway under a desired pick-up axial force.

[0160] In a preferred embodiment the post 101 is made from stainless-steel or titanium, and the cap of polymer such as PEEK or acetal. The short length of the post and threaded fastener in this embodiment allows separation at high degrees of angularity of the assembled parts in use. This tolerance for off-axial removal has been found to be particularly advantageous when the prosthesis is to be definitively screw mounted to

multiple implant abutments. Testing has verified cap axial release forces of up to about 5 pounds and the application of torque to the cap of about 1.6 inch-ounces without slipping.

[0161] The general process for converting an existing removable denture for definitive screw attachment onto four implants with this embodiment is illustrated in FIGS. 37-50. This prosthesis may be, for example, a removable denture that was used prior to implant surgery or a duplicate of such an existing denture as described in US Provisional Patent Application 62/774,402 incorporated herein in its entirety.

[0162] FIG. 37 shows a schematic representation of a human jaw portion 106 with implant abutments 107 installed. It does not matter for this discussion if the abutments are separable from the implanted portion of the implant or not. Prosthesis 103 is shown with occlusion side 104 and intaglio side 105. Pick-up marking caps 108 are installed onto abutments 107. The location of implant abutments 107 is marked onto the prosthesis using customary methods by mating the prosthesis with the abutments. FIG. 38 shows the abutment positions 109 marked onto prosthesis 103. FIG. 39 shows the boring of blind holes 110 slightly larger than copings 112 in marked locations with burr tool 111.

[0163] FIG. 40 shows the installation of copings 112 onto abutments 107 using separable fastener assembly 100, and torque driver 113 (described in more detail later). The torque driver 113 prevents over-tightening of temporary screw 100 and possible separation of the cap 102 from the post 101 due to rotary motion. The cap 102 and/or post 101A of each separable fastener 100 may be mechanically captured or adhered to the coping 112, or may be designed to loosely fit into the bore of the coping as illustrated with axial force from tightening the separable fastener holding the copings to the abutments 107. The prosthesis is placed over the mounted copings to ensure proper fit.

[0164] FIG. 41 shows application of acrylic or other adhesive 144 into cavities 110 of prosthesis 103, which is subsequently fitted onto copings 112.

[0165] FIG. 42 shows prosthesis 103 being mated with copings 112. After the adhesive sets, the separable fasteners allow easy removal of the prosthesis from the abutments with the copings incorporated into the prosthesis. The angular tolerance for removing the prosthesis from multiple abutments allows applying pick-up forces sequentially around the edge of the prosthesis to work the caps 102 off the posts 101. The caps 102 remain in the prosthesis with the copings 112, while the posts 101 remain in the abutments.

[0166] FIG. 43 shows the prosthesis with incorporated copings 112 after the pick-up process.

[0167] FIG. 44 shows the removal of the threaded post 101 from the implant abutment with removal tool 115. This allows the implant abutment threads to be accessible for subsequent definitive screw attachment.

[0168] FIG. 45 shows the drilling of the small pilot hole 117 (e.g., using a drill bit 116 of approximately 1.4 mm diameter), from the intaglio side 105 of the prosthesis out through the occlusion side 104. It has been found that the bore of the coping 112 and the bore of the cap provide adequate guidance for this hole, although a tooling guide could readily be designed to mate with the particular coping used. The pilot hole is drilled completely through the prosthesis to the occlusion side 104 as shown in FIG. 46.

[0169] FIG. 47 shows enlarging of the pilot hole 117 to allow clearance for a prosthetic mounting screw 121. The clearance holes 119 are drilled down to the top of the coping using counterbore drill 118. This requires only a small diameter enlargement (for example, approximately 2.4 mm).

[0170] FIG. 48 shows a step of a final hand reaming with reamer 120 of the coping bore to clean out any debris or remaining material from the cap that would interfere with the definitive screw.

[0171] FIGS. 49 and 50 show the final installation of prosthesis 103 onto abutments 107 using definitive prosthetic screws 121. The screw holes may be subsequently filled to use the modified prosthesis depending upon the anticipated use as a short-term or more permanent prosthesis. This sequence of process steps essentially follows the material provided in FIG. 27.

[0172] Note that in the above procedure very little material is removed from the prosthesis during the coping pick-up installation process. The boring process in FIG. 39 need only be sufficient to provide clearance for the coping and temporary screw. Angular variation in the axes of the implant abutments does not appreciably increase the size of the cavity boring required in this closed tray process compared to the additional prosthesis material that must be removed with relatively long impression screws and sleeves in a conventional open tray conversion process for definitive screw attachment. FIGS. 91-92 provide a schematic comparison of the size of the recess borings required using the concepts disclosed compared to the prior art conversion process with larger through holes in FIGS. 93-94.

[0173] The converted prosthesis with copings and screw-access channels may also be used as an accurate digital scan model of abutment positioning for creating a new prosthesis. In this embodiment, dual purpose scan flag and lab analogs 122 shown in FIGS. 51-52 may be fastened to the provisional or duplicate prosthesis 103, for example, after the clearance hole cleaning shown in FIG. 48. Features that may be present on the scan-flag/analog include a scan-flag reference portion 123 near the top of the analog, reference scan-flag features such as flats 124, axial and radial retention feature 128, screw attachment 125 for scanning fixture and/or reinforcement wire attachment. The abutment features 126 are specific to various systems commercially available. The figures show a tapered abutment mating surface 126 and female thread 127.

[0174] FIGS. 53-54 show scan flag/analogs 122 attached to converted prosthesis 103 with copings 112 using definitive screws 121.

[0175] FIGS. 55-56 show converted prosthesis 103 with scan flags/analogs 122 mounted to fixture 130 by attaching one or more scan flags 122 to the base with adjustable means to orient the prosthesis properly for scanning. For illustration an approximate mounting angle of 45 degrees is shown. In this example, the converted prosthesis 103 is mounted to articulated arm 131 with screw 129 that fits into the threaded hole of scan-flag/analog 122. Base 132 is mounted onto the base of the scanning machine.

[0176] The provisional or duplicate prosthesis with attached scan flags/lab analogs is scanned into the design software. This process captures the accurate position of the implant multi-unit abutment relative to the soft tissues and it also captures the tested prosthetic contours to aid in the design of the definitive prosthesis. After the prosthesis has been scanned in, a physical model may optionally be created by creating a soft tissue moulage and pouring dental stone into the provisional or duplicate prosthetic utilizing the scan flags as the laboratory analogs.

[0177] FIG. 57 schematically shows the application of solder or brazing preforms 133 to attach reinforcement bars 134 prior to pouring dental stone. Preforms 133 may be inserted into holes in the scan-flag/analogs and heated to attach bars 134. Low-temperature solders, brazing compounds, and hot-melt or other adhesives may be utilized in a preform or dispensed method to increase the rigidity of the analog assembly prior to casting.

[0178] This method ensures a fast and efficient means of transferring all pertinent and relevant information from a converted denture required for designing a definitive prosthesis from digital scanning and creating the most accurate and precise physical

model that can be mounted in an articulator with the aid of a bite registration in preparation for post-processing of the machined prosthesis, for example to verify passivity of fit, occlusion, etc.

[0179] In addition to the screw attachment of the scan flags to the modified prosthesis, scan flags may be attached to the prosthesis with incorporated copings of FIG. 43 prior to the drilling operations shown in FIGS. 45-47. In this case, another embodiment of the scan flag (not shown) with a post feature equivalent to post feature 101A of separable screw would be inserted into copings 112 of the modified prosthesis and retained by the embedded cap 102. If the separable fastener uses a snap-fit feature to retain the cap to the post, drilling may not be required through the prosthesis to mount the scan flags or lab analogs to the prosthesis or to attach the modified prosthesis to the abutments after lab use. For example, US Provisional Patent Application 62/774,402 describes the use of spring fingers and O-rings for separable fastening of the coping to the abutment for lift-off, and the use of films to prevent adhesive from entering interior portions of the separable fastener. Scan flags and lab analogs may also be engaged with transferred copings using similar mounting features as the post used in the transfer pick-up process. The referenced patent application also includes separable systems in which the post attaches directly to the coping without a cap which may be applied for mounting scan flags or lab analogs as variations of the methods described above. Since the dimensions of the coping and its engagement with the abutment is precisely controlled, having snap-in scan flags engage with a cavity between the top of the coping and the separable cap or an internal groove or other feature of the coping may be desirable.

[0180] Variations of using the modified prosthesis as a digital scan model, or using the inventive concepts disclosed to create a permanent prosthesis will be recognized as possible to dental practitioners. For example, instead of using a dual-purpose scan flag and lab analog, single purpose scan flags can be mounted into the provisional prosthesis for scanning, and subsequently replaced with lab analogs prior to casting. In addition to the attachment of scan flags to a modified prosthesis for digitization, the separable fastener may be used to transfer a coping and cap to a new impression after implant surgery. A scan flag or lab analog may be attached and held to the impression

with transferred coping for digitization or casting by substituting the new impression for the modified prosthesis in any of the processes above. FIG. 58 describes a workflow for using the temporary alignment fasteners with a permanent prosthesis fabricated from a digital model based on an impression.

[0181] FIGS. 59-60 show an embodiment of a simple torque-driver 113 that can be used for the temporary coping attachment process discussed in reference to FIG. 40. Shaft assembly 135 contains a spring friction cylinder portion 141 and drive portion 138 designed to engage the temporary screw 100. Spring 136 has an interference fit with cylinder 141, and thus when spring 136 is rotated in the "unwind" direction of the spring, a designed amount of slip torque is present between the spring and cylinder. In the "wind" direction, the spring binds on the cylinder. This provides unequal drive torque capability in the two rotation directions. Slot 139 in drive cap 137 engages spring end 140, and snaps onto the end of the shaft assembly, thus when the cap is rotated in the clockwise direction, cylinder and drive slip at a known torque. When the cap is rotated in the counterclockwise direction, the spring binds on the shaft to provide a higher screw removal torque before slipping.

[0182] FIG. 61 shows an embodiment of a temporary screw post extractor 115 which may be used to remove post 101 after the pick-up process as shown in FIG. 44. The extractor utilizes a hollow metal tubular split-cylinder end portion 142 that deflects to grip the end of the temporary screw post 101, allowing removal of the separable fastener posts or other types of fasteners. FIG. 61 illustrates a hand-operated knurled end, but other torque tool systems known in the dental industry such as 3/32" friction and latch designs may be used.

[0183] FIGS. 62-63 schematically illustrate how the position of the temporary screw post 10 of the first embodiment relative to the implant abutment can be determined. As the temporary screw is rotated clockwise, the cap 11 will be pushed axially away from the screw threads of the post by the coping. The depth of threaded engagement and the

length of the temporary screw post 10 and cap can be designed to have the top of the post 10 coincide with the top of the cap 11 as shown in FIG. 63 when the temporary screw is properly positioned. At this point, a drive tool with a square socket cavity (not illustrated) would disengage from the temporary screw assembly since the post 10 would no longer extend into the tool socket cavity.

[0184] FIGS. 64-66 illustrate different embodiments of the end of the temporary screw post that engages the cap. FIG. 64 shows a modified version of the cylindrical post 101 designed for frictional engagement on cylindrical portion 85 with a cap having a circular bore similar to that shown in FIG. 34. In FIG. 65, the cylindrical post is slotted, and the resulting beam portions 86 sprung open to provide additional frictional retention of a cap through spring action with the deflecting beams. Various features such as symmetric axial splines 87 (FIG. 66), asymmetric splines or grooves, and textures may also be used to tailor driving torque and axial retention force of the cap to the temporary attachment post. Non-symmetric features may also be utilized to tailor different installation torque and extraction forces. Surface finish and coefficients of friction of the mating materials may also be used to control the driving and retention properties. Temporary attachment posts and caps may be made from metal and polymer materials such as titanium, stainless steels, nylon and PEEK and other non-corrosive biocompatible materials.

[0185] If additional off-axis accommodation is desired when extracting the temporary attachment post from the coping after pick-up, some flexibility may be incorporated into the temporary attachment post, such as the necked down portion 88 of the temporary attachment post shown in FIG. 67, which allows the temporary attachment post to flex slightly off-axis during the pick-up process. Under tension, the alignment of the temporary screw axis with this necked-down portion can be designed to align the axis of the implant abutment threads with the coping threads but allow some bending when the tension is released. Note that this alignment flexibility will generally not be required during the final screw attachment process. The final attachment process is more accommodating of axial misalignment of multiple abutments than the coping pick-up process. During pick-up, the prosthesis with copings incorporated must be removed

from all abutments simultaneously. For final attachment, each definitive screw is attached individually after the copings of the prosthesis are positioned on the implant abutments.

[0186] FIG. 68 shows an embodiment of a temporary screw cap 94 that includes spring features 95 that engage the outer diameter 96 of the temporary post. If desired the portion of the temporary screw cap with the spring features may be made of a different material than the remainder of the cap.

[0187] Although the temporary screw of FIG. 69 has a similar appearance to that shown in FIG. 68, it has distinct functionality. FIG. 69 shows an embodiment of a temporary alignment screw 58 having threaded portion 62, breakaway flange 60 and hex drive portion 61. The flange 60 pushes down on the top of the coping as the temporary alignment screw threads 62 are rotated into the implant abutment. The flange portion may be molded onto a temporary attachment post with threaded portion 62 and drive portion 61 by insert molding if different materials are desired. Preferable, all portions of the alignment screw are molded integrally of a single material. The cap and post do not slide axially relative to one another. Instead, small break-away tabs 59 in the flange portion are designed to yield under axial force during the prosthesis and coping assembly removal after the bonding step. The breakaway portions are designed to fracture at an axial force exceeding the force applied to align the coping to the implant abutment for pick-up.

[0188] FIG. 67 employed a temporary alignment screw post with a waist that can bend during prosthesis removal in the pick-up process. It is also possible to provide additional off-axis accommodation during coping pick-up with temporary screws that do not bend. For example, in FIG. 70, a temporary alignment screw post 25 includes a rounded portion 27 that bears against the central straight bore of cap 26. FIG.71 shows a tapered profile 29 on cap 30 which engages a straight cylindrical portion of post 28. It is preferable to prevent the incursion of adhesive in the gaps between the post and cap

that allow the post to pivot. FIG. 71 includes a thin protective film 56 for this purpose. This film should be chosen to deform easily when the post is pivoted.

[0189] FIG. 72 shows a thin retaining ring 32 that engages temporary attachment post 31. The retaining ring 32 also provides a one-way insertion direction of temporary attachment post 31. This preferential insertion direction also corresponds to the relative motion of the post and retaining ring for release in the pick-up process.

[0190] FIG. 73 shows another embodiment of a temporary alignment screw that does not have relative axial sliding between the post and cap. In this embodiment a thin retainer 35 that may be comprised of a metallic or polymer sheet is attached to the top portion of temporary attachment post 33 and optional cap 34. The sheet 35 may be attached to temporary attachment post 33 using adhesives, plastic or metal welding, etc. After the adhesive has cured holding the coping to the implant abutment, the mechanical connection between the post and cap is overcome by axial force in the pick-up process. The mechanical connection can be designed to fail by adhesive failure or by fracture of the joint or the sheet 35.

[0191] FIG. 74 shows another embodiment of a temporary alignment screw without relative sliding between the cap portion and the post portion. In this embodiment, a compliant or frangible portion of the post 37 is used to attach a cap 38 to the post. Under tension, the cap portion 38 holds the coping in position against the abutment for pick-up into a prosthesis. Compliant portion 37 may be for example an elastomeric material to provide some angular motion during prosthesis removal after the pick-up material sets. The compliant portion 37 itself or one of its interfaces with the cap or post may provide a separable interface with controlled axial breakaway force. Other methods of separating a compliant portion may include exposure of compliant portion 37 made from a material easily affected by heat, any wavelength of electromagnetic energy, or a chemical reaction that may be applied externally or as part of the pick-up process.

[0192] The inventive concepts disclosed are not meant to be restricted to a temporary attachment post with standard screw threads that both engage and disengage the threads in the implant abutment through rotations. For example, alternate separable temporary attachment posts embodiments are possible providing features that allow the post to removably hold the coping to the abutment by other means than a separable cap. For example, as shown in FIG. 75 an alignment fastener 39 may contain a separable threaded or serrated portion 40 that engages the screw threads in the abutment for pick-up, but that will release with axial force after. FIG. 75 shows a temporary attachment post 39 having a slot 41 and asymmetric threads or serrations 40 that allow the temporary attachment post to be inserted through rotation for alignment for coping pick-up but may be subsequently extracted with a separation force in the axial direction. Although the threads could be designed to provide engagement with the implant abutment threads through axial motion in the opposite direction to the arrow shown in FIG. 75, rotation to a design torque on engagement is generally preferred. If the post 39 is designed to be pulled out of the abutment during the coping pick-up process, it will subsequently need to be removed from flange 42 and the prosthesis assembly. Since there is no processing impact on patient comfort, higher mechanical forces or a broader range of energy or chemical processing may be employed to remove the post from the prosthesis after coping pick-up.

[0193] Further permutations of the separable alignment screw features disclosed above are possible. FIG. 76 shows an embodiment where axial flexibility and/or controlled retention between cap 44 and temporary attachment post 43 is provided by an interface material 45 such as adhesives, silicones, and elastomeric materials contained in the space between the bore of the cap 44 and the post 43. FIG. 77 shows cap 47 retained with an O-ring 48 held in grooves in the cap 47 and temporary attachment post 46. FIG. 78 shows a cup-shaped interface material 57 located within the bore of the cap 44 and extending over a portion of the end of the post 43. FIG. 79 shows a split-collar feature 51 on cap 50 which presses onto the temporary attachment post 49. FIGS. 80 and 81 show alternate designs of flexure beam features in caps gripping a post. In FIG. 80, the pressure on the post 49 is reduced by pulling the cap 52 perpendicular to a diagonal of the cap as indicated by the arrows. In FIG. 81, the pressure on the post 49

is reduced by pulling in opposite directions with moment arms as shown to open the spring.

[0194] It is understood that the concept of the temporary attachment of the coping with the abutment with an axially separable temporary post is not dependent upon having a separate cap 11 or nut 63 on the post. If desired the cap or nut can be eliminated and the coping may be directly fixed and axially separable from the temporary attachment post. That is, the coping can be designed to have an equivalent mechanical interface to the post as the caps in the embodiments above. The mechanical interface between the coping and post may be tailored to provide equivalent rotational engagement and relative axial movement above a designed minimum axial force.

[0195] Example embodiments of the coping and post being the separable components include the following:

[0196] FIG. 82 shows temporary attachment post 71, engaging an interference fit of coping 72 at a position above the threaded portion. Metal, metal-reinforced, ceramic, and polymer copings, posts and fasteners may be included in this and other embodiments. Any of the parts may have surface treatments to control friction or adhesion.

[0197] FIG. 83 shows temporary attachment post 71 engaging integral spring-finger features 78 of coping 73.

[0198] FIG. 84 shows a temporary attachment post 71 engaging collet-type spring fingers 77 of coping 74, these collet-type features may be formed using slots in the coping 74 as shown in FIG. 84A.

[0199] FIG. 85 shows a slotted spring feature 79 formed in the temporary attachment post 76. The spring-features engage a smaller bore portion 90 of the coping 75. Such features may be of varied shapes including slots, eyelets, swaged portions, tubular swaged parts, etc. A film 56 (not shown) may be used to prevent the ingress of pick-up material into any voids at the top of the post/coping assembly similar to that shown in FIG. 71.

[0200] FIG. 86 shows temporary attachment post 71 and coping 75 engaged using an O-ring or washer 80. Such washers may be elastomers, polymers, metals, etc. and may be forms in varied shapes, such as the u-shaped retainer 81 of FIG. 87.

[0201] FIG. 88 shows temporary attachment post 71 retained to coping 75 using a sheet cap 82. Sheet cap 82 may be a tape, or other polymers or metals joined using adhesives, thermal and ultrasonic bonding, welding, and brazing, etc. This is similar to the embodiment shown in FIG. 73, except the sheet cap 82 does not have thicker cap element 34.

[0202] FIG. 89 shows temporary attachment post 71 retained using a filler material 83 in the counterbore of coping 75. Fillers may include a variety of polymer adhesives or fillers, such as silicones, acrylics, epoxies, and/or soft metallic materials. Since the coping 75 in this embodiment is fixed to the post 71, the mating surfaces of the coping 75 and implant abutment must allow relative rotational motion until the predetermined torque is achieved.

[0203] Installation of these embodiments may also be accomplished with simple polymer or metal tools 84, for example, as shown in FIG. 90 that engage the flats or other features of the coping 75, and/or of features on top of the threaded post 71.

[0204] Although the descriptions above use rotational engagement of the bottom of the post with internal threads of the abutment as a preferred approach, this is not meant to

be limiting. Alternate approaches for engaging a temporary attachment post with abutment threads through axial insertion without rotation are considered to be part of this disclosure. For example, the split post bottom structure shown in FIG. 75 which allows axial extraction can also be used for axial insertion. Similarly, an interference fit between the bottom of the post with the threads may also be designed to provide sufficient engagement to provide adequate alignment and fixing of the coping for the pick-up bonding process described earlier. For non-rotary extraction of the post, it is not necessary to have the extraction force of the post-abutment thread interface greater than the force required for relative movement of the coping or cap with the upper end of the post. That is, if the temporary attachment post remains fixed to the coping during the pick-up step, the post can be removed from the dental appliance after removal from the patient's mouth.

[0205] Although axially symmetric interfaces between coping and abutment have been described for most embodiments, the inventive concepts may also be applied to asymmetric abutments and copings as long as the coping doesn't need to rotate on the implant abutment as noted, for example, with the embodiment of FIG. 89 .

[0206] Various embodiments have been described to illustrate the disclosed inventive concepts, not to limit the invention. Combining inventive elements of one or more of the embodiments with known materials, components and techniques in dental science to create further embodiments using the inventive concepts is considered to be part of this disclosure.

[0207] Any of the embodiments may contain a film or deposited material on top of the cap and temporary attachment post to prevent adhesion to the temporary attachment post of materials used for pick-up, as shown in the film 56 of FIG. 71.

[0208] Temporary attachment posts may be rotationally driven into the abutment threads using either the cap, coping or the temporary attachment post itself. Temporary attachment posts and caps may have varied drive features such as male or female

knurls, hex, spines, spanner notches/holes. These design alternatives are driven by functional requirements of a particular implementation.

[0209] Other means of attaching/joining a secondary separable portion include insert-molding, use of adhesives, waxes, solders or other metallic materials, heat-staking, and ultrasonic bonding.

[0210] Break-away portions may also be formed by two-shot molding, dispensing or otherwise placing a secondary mechanically, thermally, or electromagnetically fusible material on a portion of the fastener to provide the break-away function.

Thin-film or thick-film metallic and polymer coatings may be applied to portions of the fastener to tailor friction and insertion and extraction forces, enhance adhesion of pick-up materials, and other properties such as corrosion-resistance.

Straumann USA Exhibit 1015

Claims

We claim:

1. A dental system for attachment of a coping to a threaded implant abutment comprising:

   a coping having a proximal end with an aperture sized to allow a shaft portion of a definitive screw to pass through ; and

   an implant abutment having helical threading for securing the coping with a definitive screw; and

   a definitive screw having a proximal head end having a tool interface and a distal post portion having threads for securing the coping to the implant abutment after processing; and

   a temporary screw having an axis with a length measured along the axis and a width measured perpendicular to the axis, the temporary screw comprising:

      a proximal head portion with a width larger than the coping aperture; and

      a distal shaft portion shaped for rotary engagement with the implant abutment threads;

   wherein rotating the temporary screw to engage the shaft portion of the temporary screw with the implant abutment threads through an engagement depth and to a predetermined torque causes the head portion of the screw to hold the coping into alignment with the implant abutment for processing, and wherein an axial force in the proximal direction releases the coping from the implant abutment, and wherein the shaft portion does not contact the implant abutment threads continuously above the most distal engagement position.

2. The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the temporary screw shaft includes a narrower region having a width that is less than the width of the temporary screw shaft threaded region, and wherein the narrower region is located between the distal end of the temporary screw head and the proximal end of the temporary screw shaft threading.

3. The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the temporary screw shaft comprises asymmetric threading.

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4. The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the axial release force is applied through a pick-up process in which the coping is adhered to a separable dental element.

5. The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the axial release force is less than about 5 pounds.

6. The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the temporary screw shaft threading is not a continuous helical structure over the engagement depth.

7. The dental system for attachment of a coping to a threaded implant abutment of Claim 6 wherein the definitive screw post threading comprises a continuous symmetrical helical form.

8. The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the temporary screw shaft threading deforms under the axial force to release the coping.

9. The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein only mechanical energy is applied to release the coping.

10. The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the temporary screw shaft comprises an open space located toward the axis from the threading.

11. The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the temporary screw shaft threading makes contact with the implant abutment threading over a temporary screw threading contact area when holding the coping against the implant abutment and the definitive screw post makes contact with the implant abutment threading over a definitive screw threading contact area when holding the coping against the implant abutment, and wherein the temporary screw threading contact area is less than the definitive screw threading contact area.

12. The dental system for attachment of a coping to a threaded implant abutment of Claim 11 wherein the volume of the definitive screw post material located distally of the proximal end of the implant abutment threading when holding the coping against the implant abutment is greater than the volume of the temporary screw shaft material

holding the coping against the implant abutment when holding the coping against the implant abutment.

13. A dental system for attachment of a coping to a threaded implant abutment for pick-up processing comprising:

a threaded implant abutment, and

a coping having a proximal end with a central aperture, and

a temporary screw having a longitudinal axis with a length measured along the axis and a width measured perpendicular to the axis comprising:

a head with a proximal end having a drive tool interface for rotating the temporary screw to a predetermined torque and wherein the head portion does not fit through the central aperture of the coping, and

a shaft having an axis with a length measured along the axis and a width measured perpendicular to the axis comprising:

a distal portion having shaft threading with a shaft threading width that fits within the central aperture, and

a proximal portion having a width smaller than the shaft threading width, and

wherein inserting the shaft of the temporary screw into the coping central aperture and rotating the temporary screw to a predetermined torque aligns and seats the coping with the implant abutment for pick-up processing, and wherein applying an axial force above a predetermined value in the proximal direction releases the coping and temporary screw from the implant abutment.

14. The dental system for attachment of a coping to a threaded implant abutment for pick-up processing of Claim 13 wherein the shaft threading is asymmetrical.

15. The dental system for attachment of a coping to a threaded implant abutment for pick-up processing of Claim 14 wherein the asymmetrical threading allows axial movement of the shaft in the proximal and distal directions relative to the implant abutment threading when an axial force is applied above a threshold force for movement in each direction

and wherein the axial force threshold for movement is smaller in the proximal direction than in the distal direction.

16. The dental system for attachment of a coping to a threaded implant abutment for pick-up processing of Claim 13 wherein the distal portion of the shaft deforms during the axial release.

17. The dental system for attachment of a coping to a threaded implant abutment for pick-up processing of Claim 16 wherein the distal portion of the shaft includes an open space for shaft deformation towards the axis.

18. A dental system for attachment of a coping to a threaded implant abutment comprising:

an implant abutment having symmetric helical threading for a definitive screw; and

a definitive screw having an axis with a length measured along the axis and a width measured perpendicular to the axis, the definitive screw having a proximal head end having a tool interface and a distal post portion having threading matching the implant abutment threading; and

a coping having a proximal end with an aperture, wherein the aperture is larger than the definitive screw post and smaller than the definitive screw head; and

a temporary screw having an axis with a length measured along the axis and a width measured perpendicular to the axis, the temporary screw comprising:

a proximal head portion with a width larger than the coping aperture; and

a distal shaft portion with threading that is shaped differently from the definitive screw threading;

wherein rotating the temporary screw to engage the shaft portion of the temporary screw with the implant abutment threads to a predetermined torque causes the head portion of the temporary screw to hold the coping into alignment with the implant abutment, and wherein an axial force in the proximal direction from pick-up processing releases the coping and temporary screw from the implant abutment.

19. The dental system for attachment of a coping to a threaded implant abutment of Claim 18 further comprising a temporary screw torque driver, wherein the temporary screw torque driver comprises:

    a spring friction cylinder, and

    a drive cap, and

    a coil spring,

    wherein the torque driver limits the torque applied to the temporary screw to the predetermined torque.

20. The dental system for attachment of a coping to a threaded implant abutment of Claim 18 wherein the temporary screw threading is asymmetric.

21. The dental system for attachment of a coping to a threaded implant abutment of Claim 18 wherein the temporary screw can be inserted into the implant abutment threading with an axial force in the distal direction, and wherein the axial force in the distal direction needed for insertion is higher than the axial force in the proximal direction needed for release.

22. The dental system for attachment of a coping to a threaded implant abutment of Claim 18 wherein the width of the threaded region of the temporary screw shaft is smaller than the width of the threaded region of the definitive screw post.

23. The dental system for attachment of a coping to a threaded implant abutment of Claim 18 wherein the shaft of the temporary screw has a portion with a smaller width than the threaded region of the shaft of the temporary screw and wherein the smaller width portion is located between the head and the threaded region.

24. The dental system for attachment of a coping to a threaded implant abutment of Claim 18 wherein the threading of the temporary screw deforms during the release of the temporary screw from the implant abutment threading.

25. The dental system for attachment of a coping to a threaded implant abutment of Claim 18 wherein the temporary screw shaft has a hollow portion and wherein a portion of the temporary screw shaft deflects into the hollow portion when the axial force in the proximal direction is applied.

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26. A dental system for attachment of a coping to a threaded implant abutment comprising:

an implant abutment having female threading having an implant abutment thread profile; and

a definitive screw having a longitudinal axis and a length measured along the axis and a width measured perpendicular to the axis, the definitive screw comprising:

a shaft with male threading, wherein the male threading profile matches the implant abutment thread profile; and

a head with a definitive screw drive interface; and

a coping having a proximal end with an aperture sized to allow the definitive screw shaft to pass through; and

a temporary screw having a longitudinal axis and a length measured along the axis and a width measured perpendicular to the axis, the temporary screw comprising:

a post with male threading, wherein the male threading profile does not essentially match the male threading profile of the definitive screw shaft, and wherein the coping aperture allows the post to pass through; and

a head with a temporary screw drive interface; and

wherein the temporary screw holds the coping in position on the implant abutment for pick-up processing by rotating the post threads into the implant abutment threads to a predetermined pick-up processing torque and wherein the post threads release from the implant abutment threads with a predetermined axial pick-up force in the proximal direction during pick-up processing.

27. The dental system for attachment of a coping to a threaded implant abutment of claim 26 wherein the width of the temporary screw post threading is smaller than the width of the definitive screw shaft threading.

28. The dental system for attachment of a coping to a threaded implant abutment of claim 26 wherein the proximal flank of the temporary screw post threading profile is at a smaller

angle relative to the longitudinal axis than the proximal flank of the definitive screw shaft threading profile.

29. The dental system for attachment of a coping to a threaded implant abutment of claim 26 wherein the definitive screw comprises a metallic material and the temporary screw comprises a polymeric material.

30. The dental system for attachment of a coping to a threaded implant abutment of claim 26 wherein a definitive screw that is rotated into the implant abutment and torqued to the pick-up processing torque does not release from the implant abutment threading with the application of the predetermined axial pick-up force.

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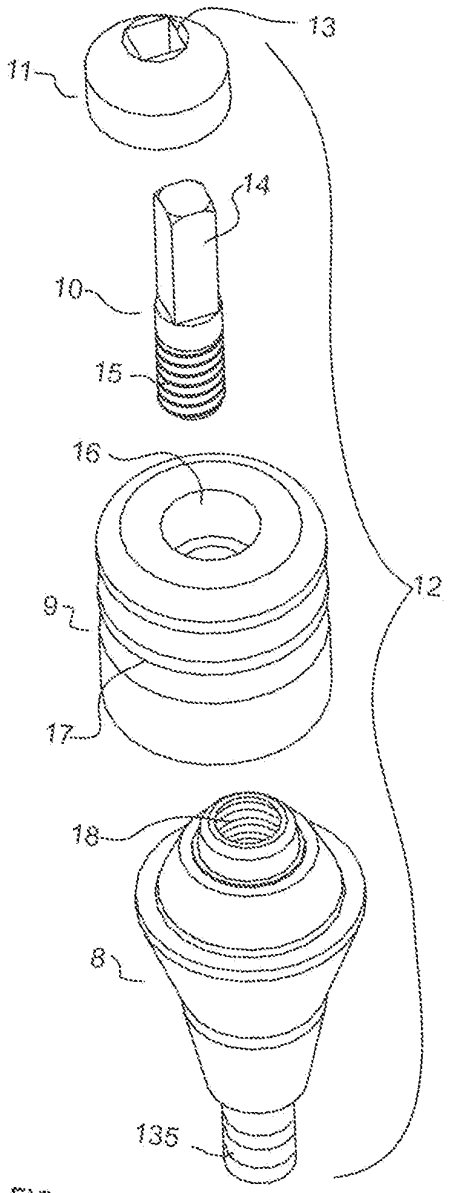


FIG. 1

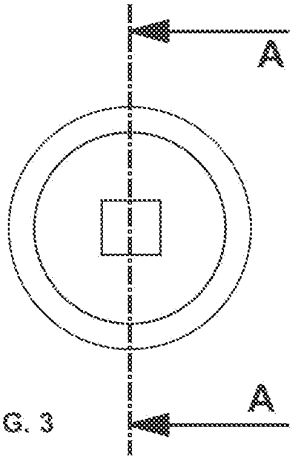


FIG. 3

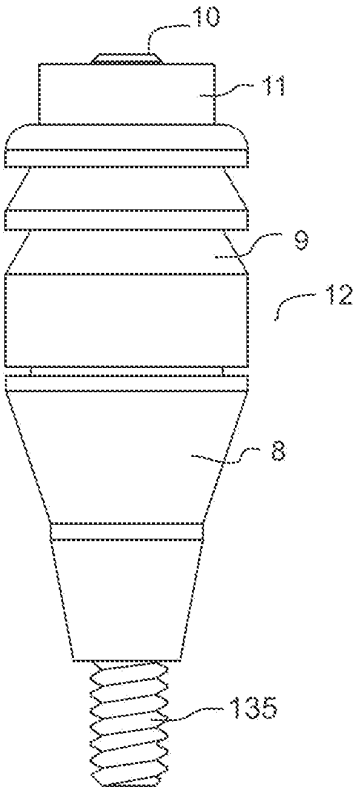


FIG. 2

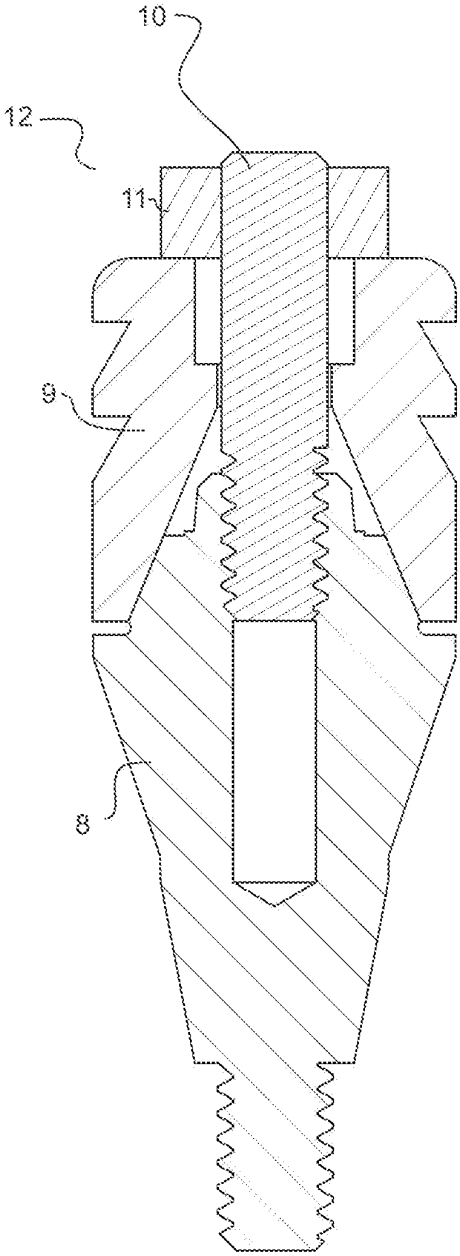


FIG. 4

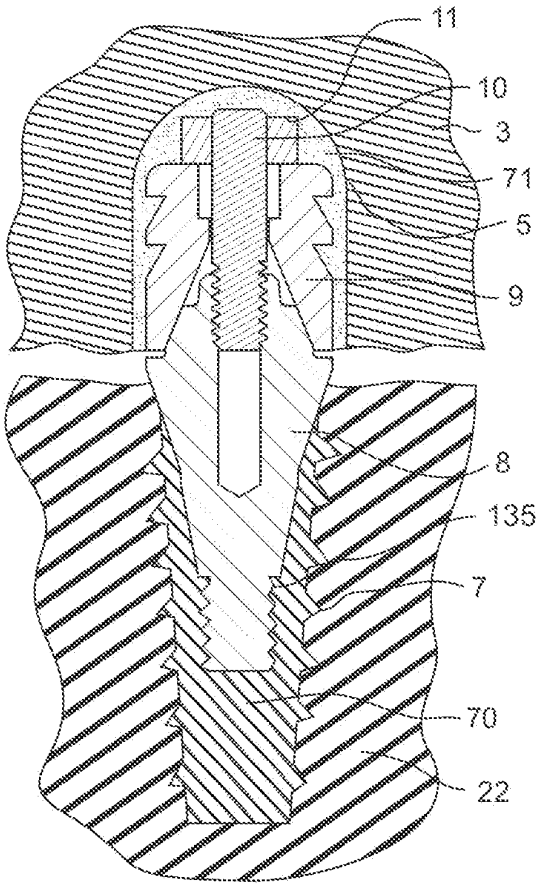


FIG. 5

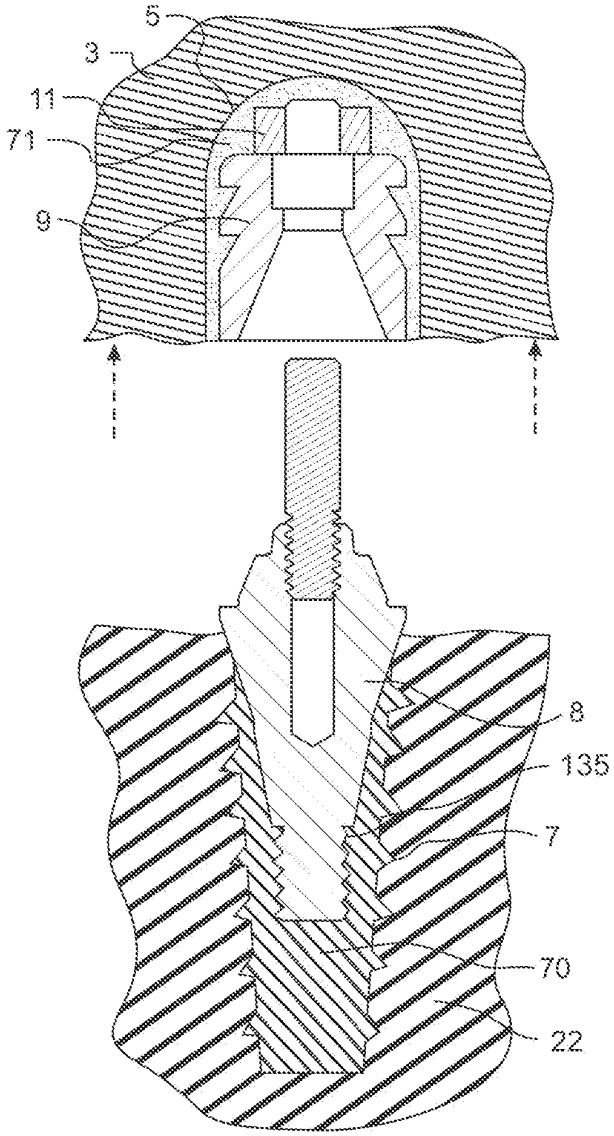


FIG. 6

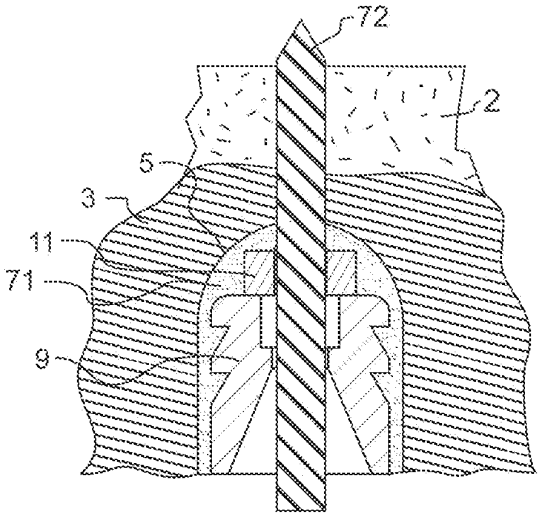


FIG. 7

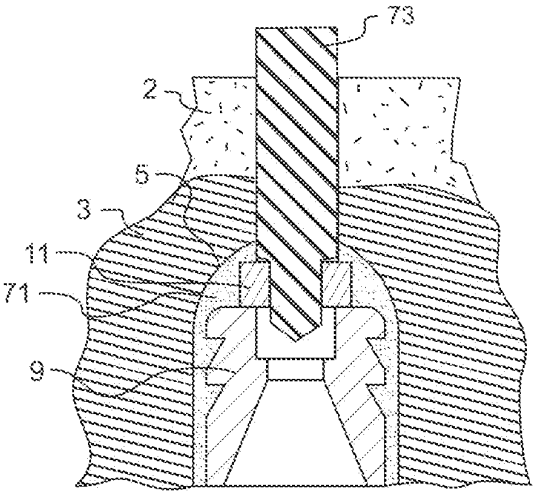


FIG. 8

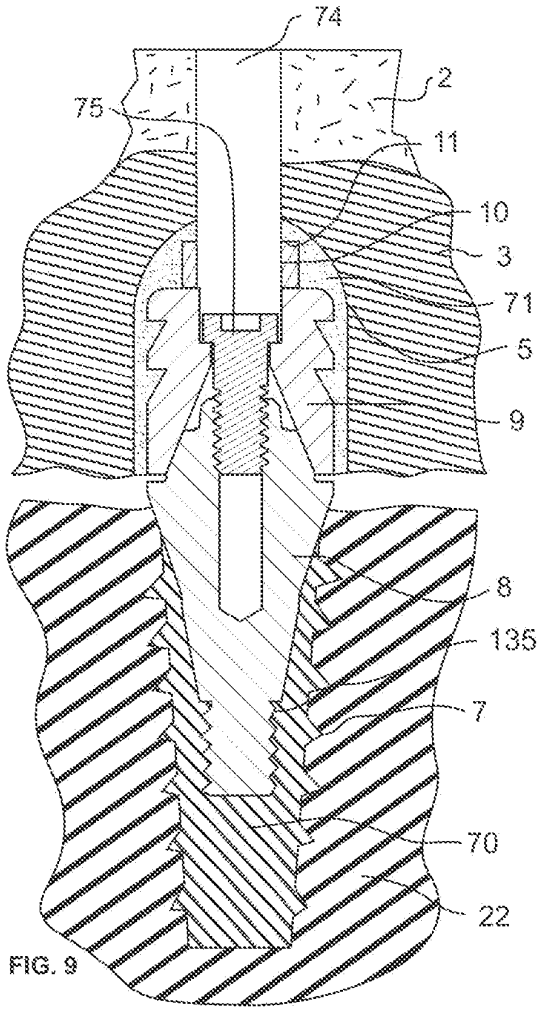


FIG. 9

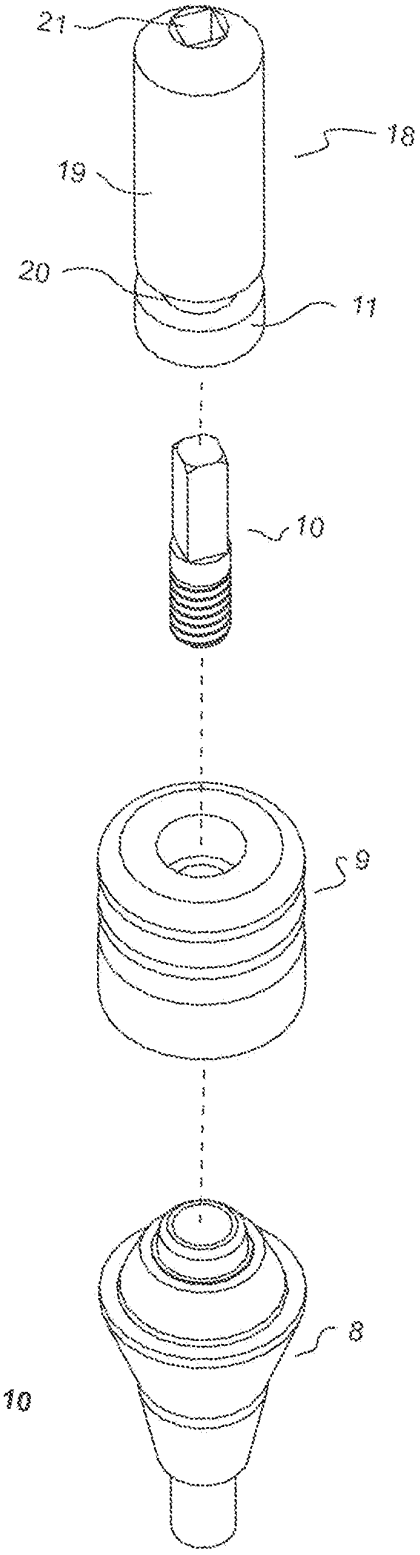


FIG. 10

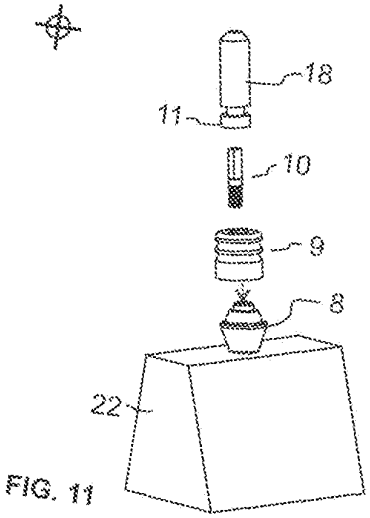


FIG. 11

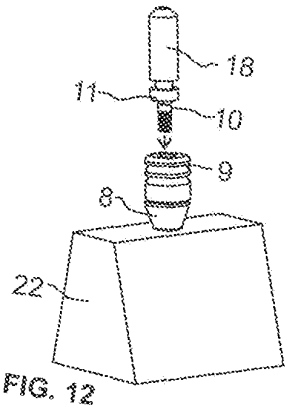


FIG. 12

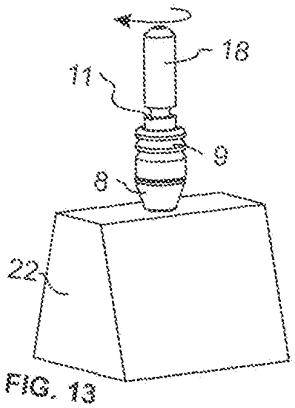


FIG. 13

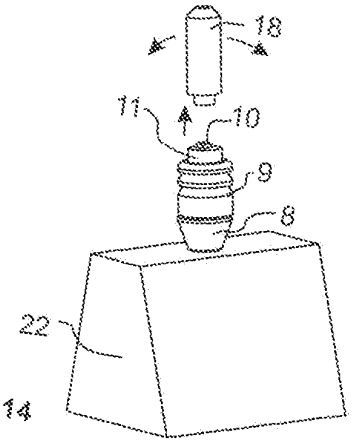


FIG. 14

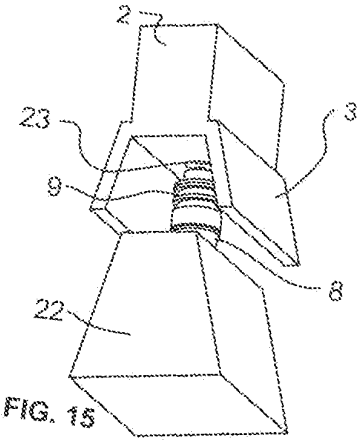


FIG. 15

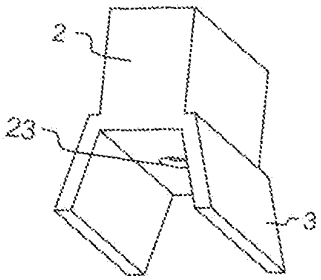


FIG. 16

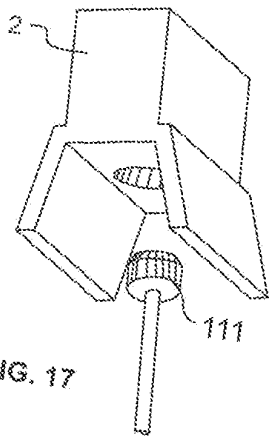


FIG. 17

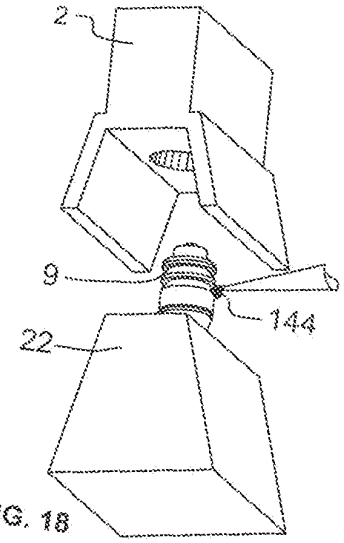


FIG. 18

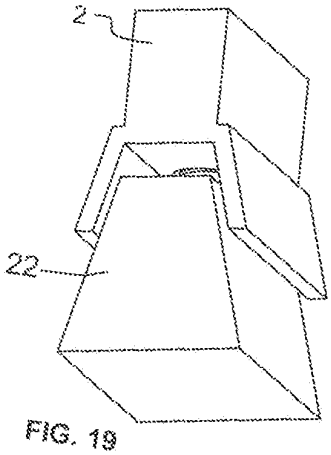


FIG. 19

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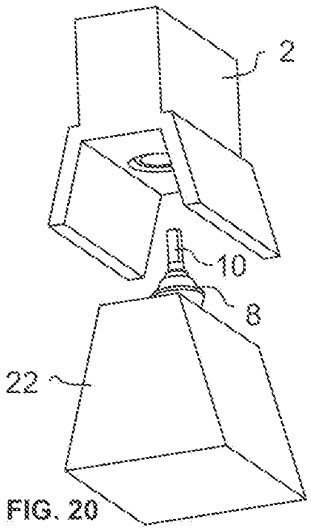


FIG. 20

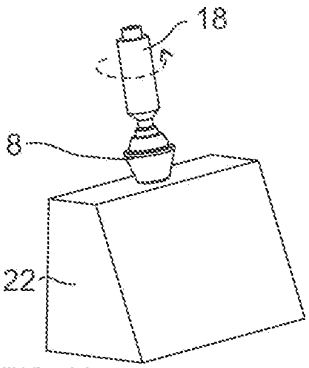


FIG. 21

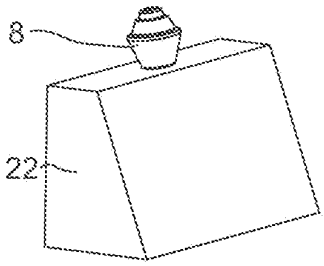


FIG. 22

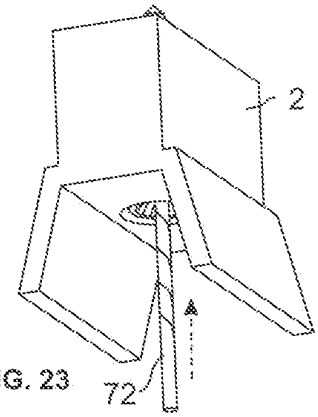


FIG. 23

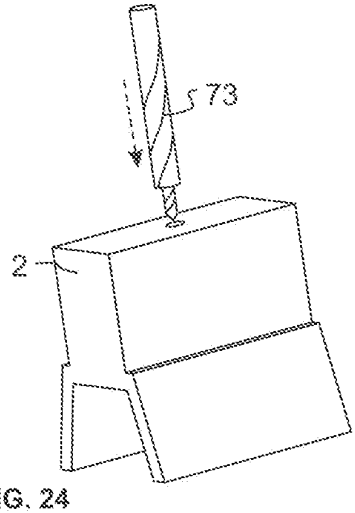


FIG. 24

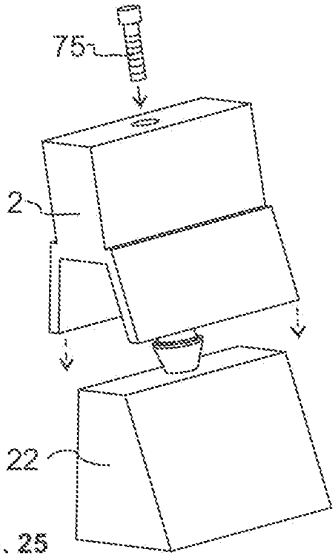


FIG. 25

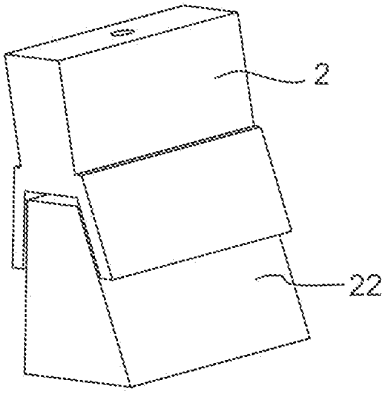


FIG. 26

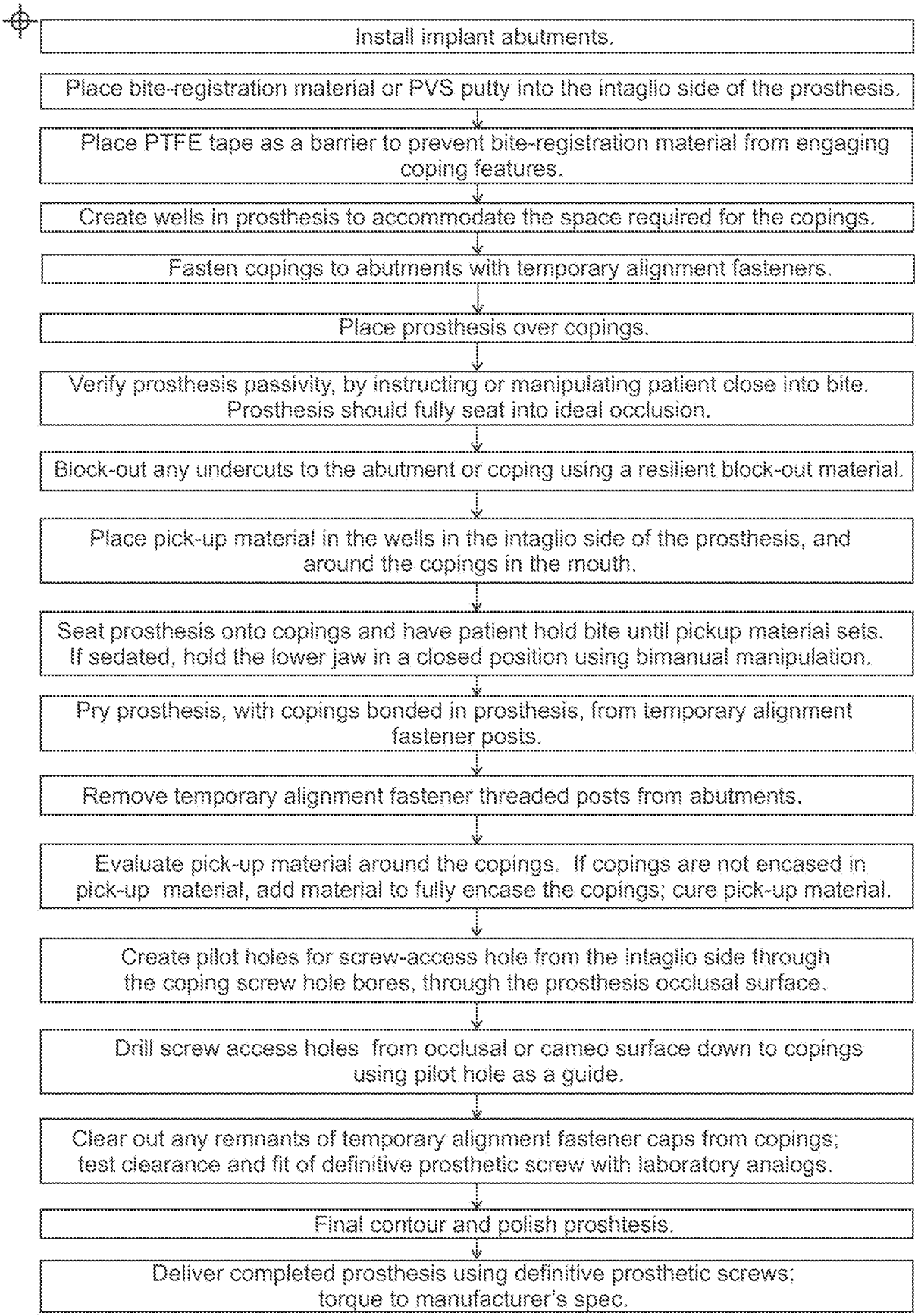

Install implant abutments.
Place bite-registration material or PVS putty into the intaglio side of the prosthesis.
Place PTFE tape as a barrier to prevent bite-registration material from engaging coping features.
Create wells in prosthesis to accommodate the space required for the copings.
Fasten copings to abutments with temporary alignment fasteners.
Place prosthesis over copings.
Verify prosthesis passivity, by instructing or manipulating patient close into bite. Prosthesis should fully seat into ideal occlusion.
Block-out any undercuts to the abutment or coping using a resilient block-out material.
Place pick-up material in the wells in the intaglio side of the prosthesis, and around the copings in the mouth.
Seat prosthesis onto copings and have patient hold bite until pickup material sets. If sedated, hold the lower jaw in a closed position using bimanual manipulation.
Pry prosthesis, with copings bonded in prosthesis, from temporary alignment fastener posts.
Remove temporary alignment fastener threaded posts from abutments.
Evaluate pick-up material around the copings. If copings are not encased in pick-up material, add material to fully encase the copings; cure pick-up material.
Create pilot holes for screw-access hole from the intaglio side through the coping screw hole bores, through the prosthesis occlusal surface.
Drill screw access holes from occlusal or cameo surface down to copings using pilot hole as a guide.
Clear out any remnants of temporary alignment fastener caps from copings; test clearance and fit of definitive prosthetic screw with laboratory analogs.
Final contour and polish proshtesis.
Deliver completed prosthesis using definitive prosthetic screws; torque to manufacturer's spec.

FIG. 27

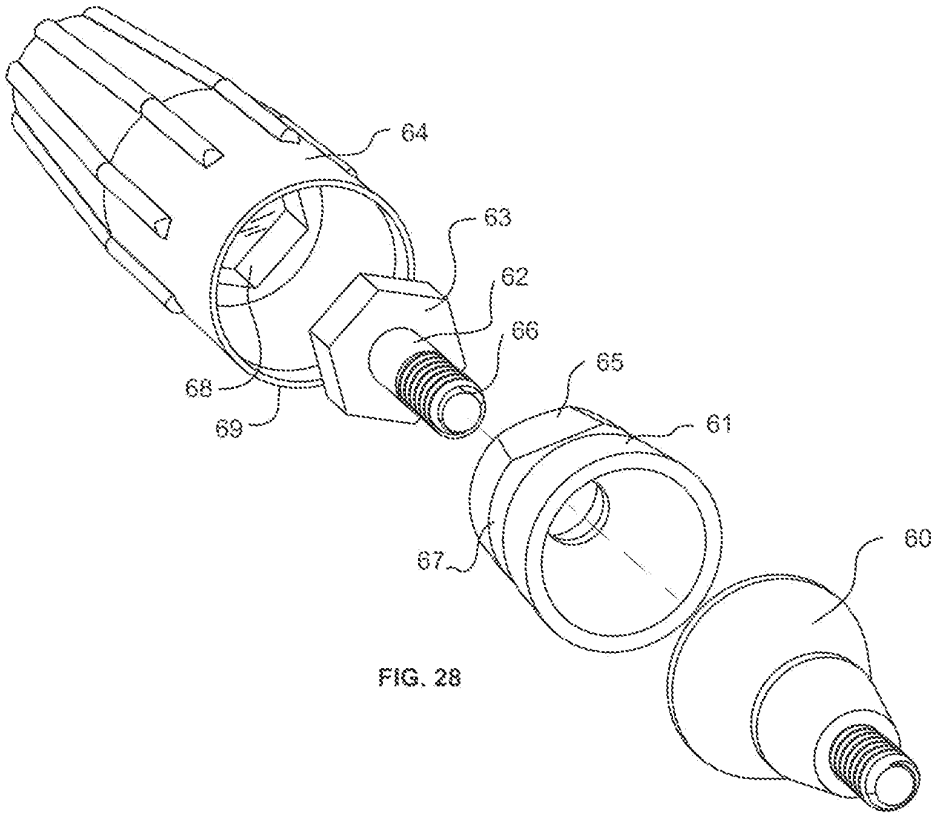


FIG. 28

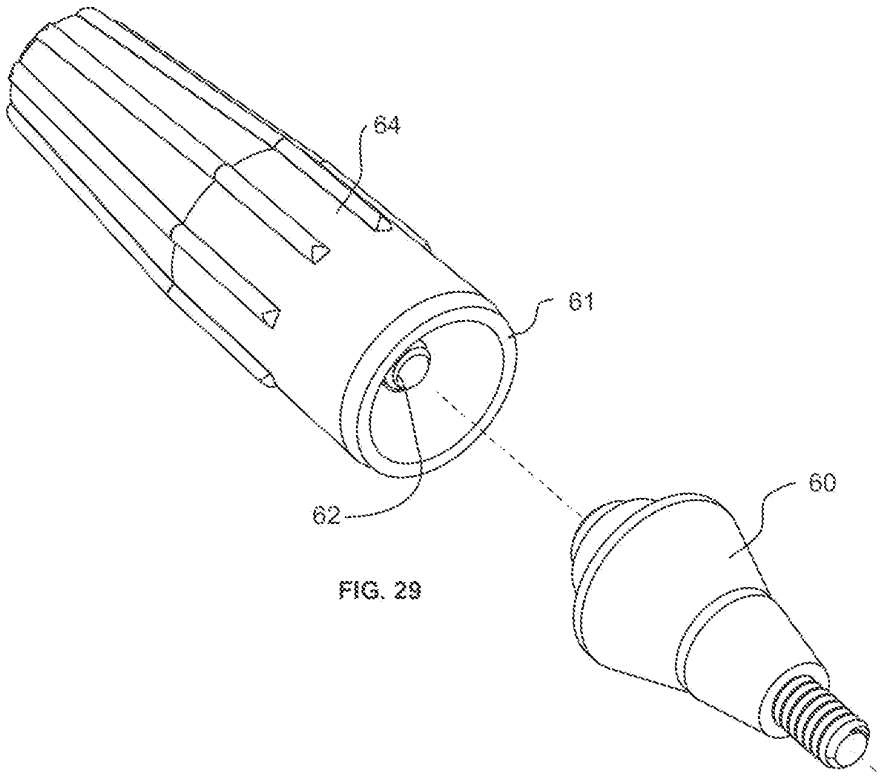


FIG. 29

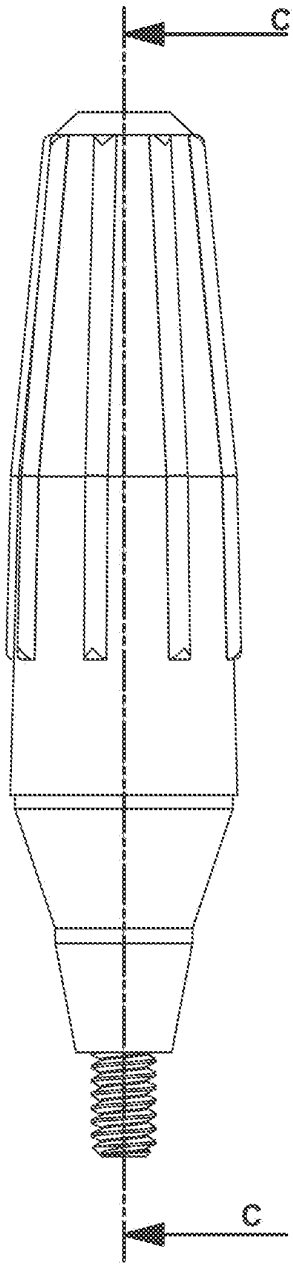


FIG. 30

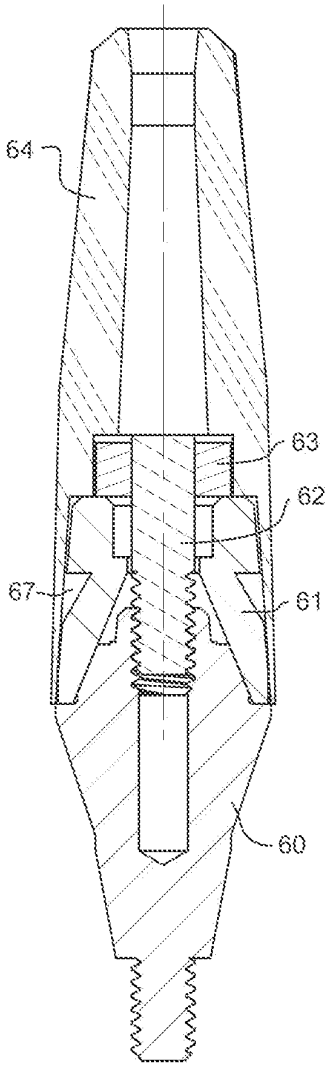


FIG. 31

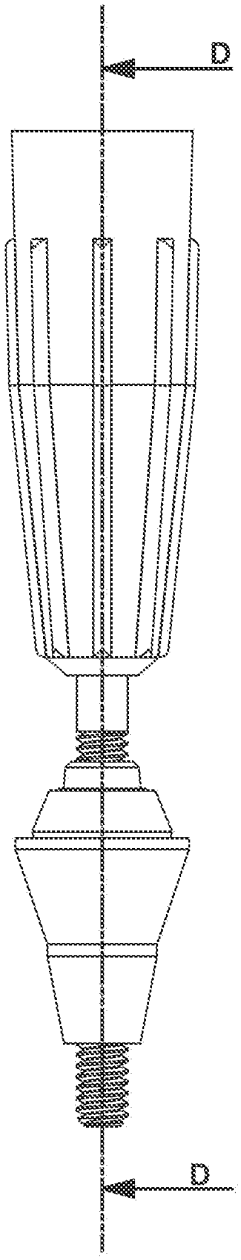


FIG. 32

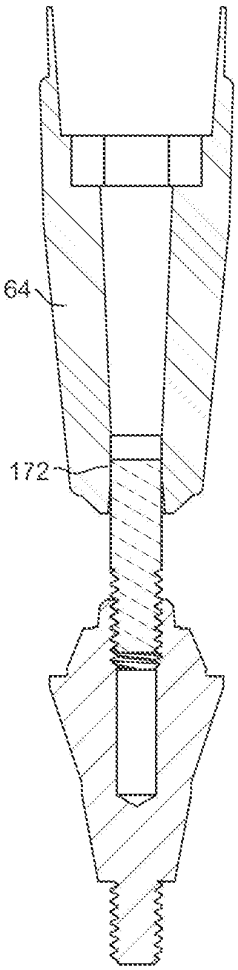


FIG. 33

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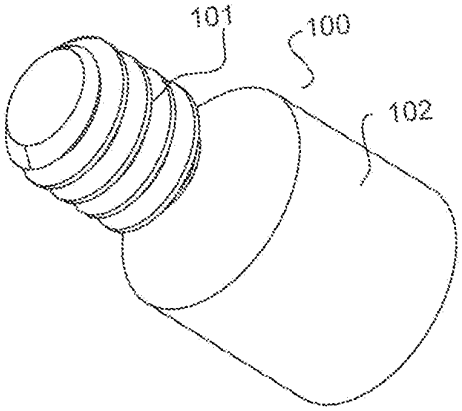


FIG. 35

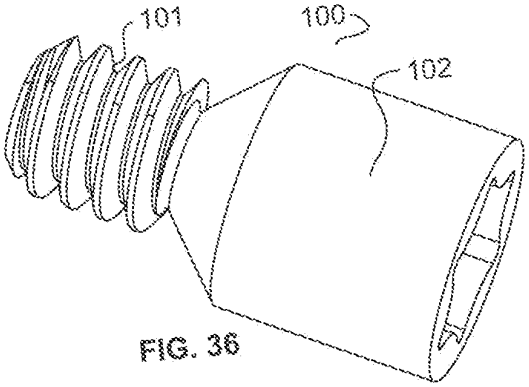


FIG. 36

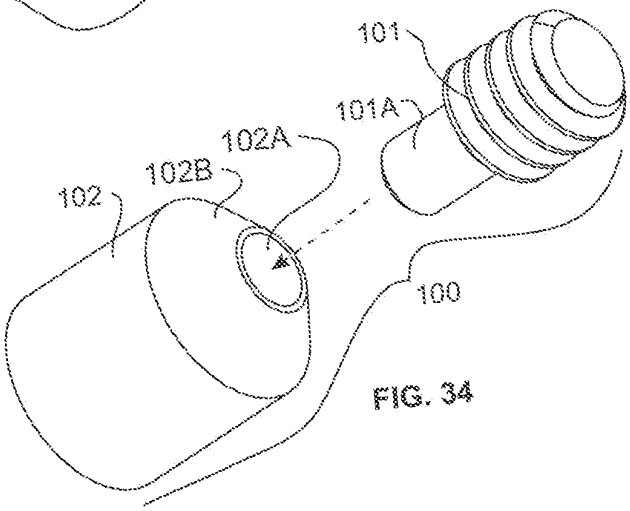


FIG. 34

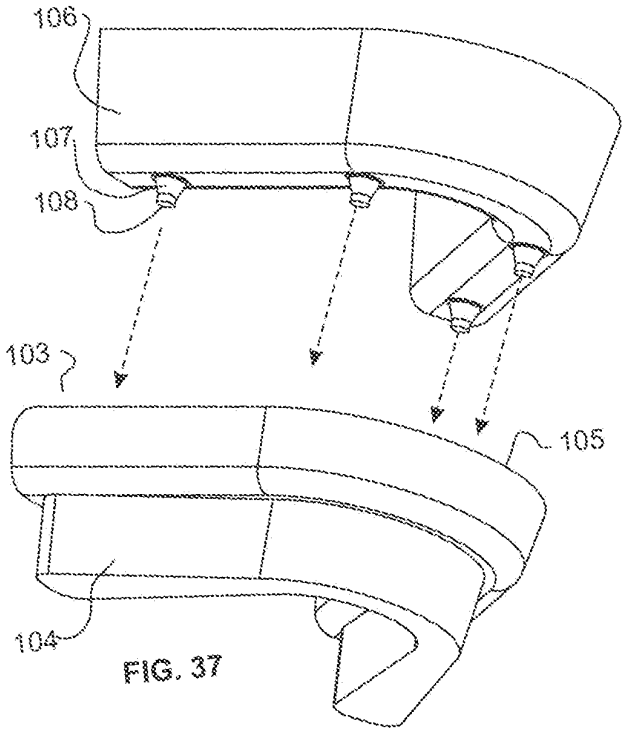


FIG. 37

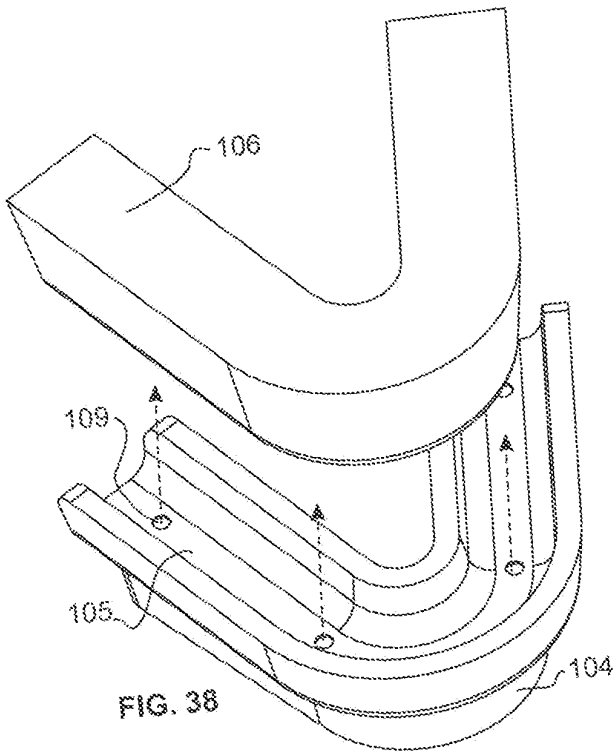


FIG. 38

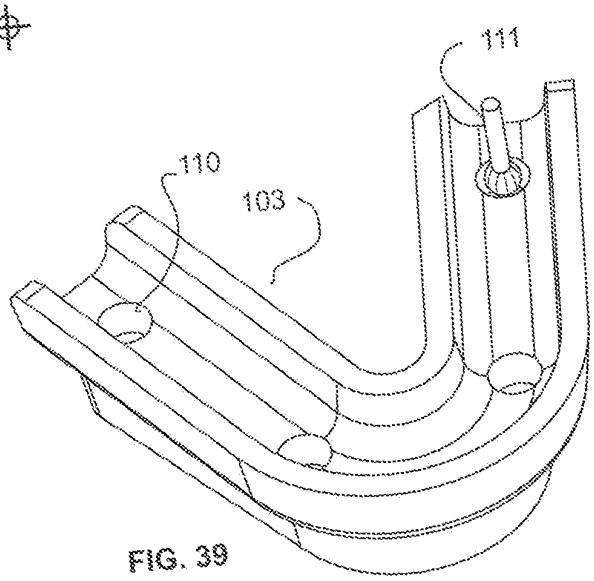


FIG. 39

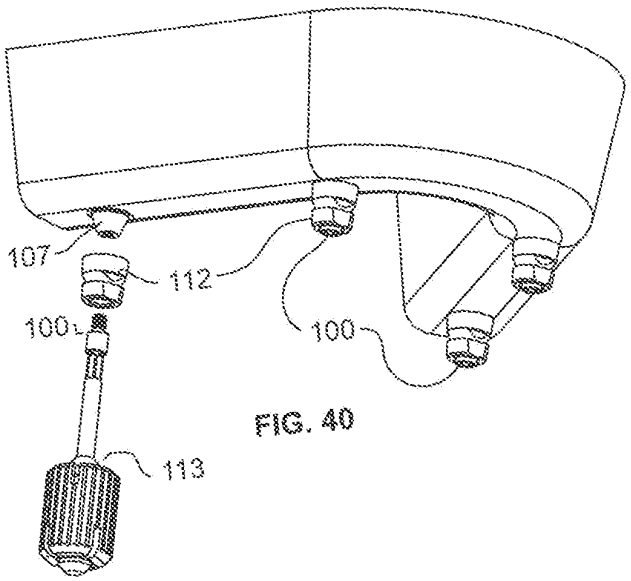


FIG. 40

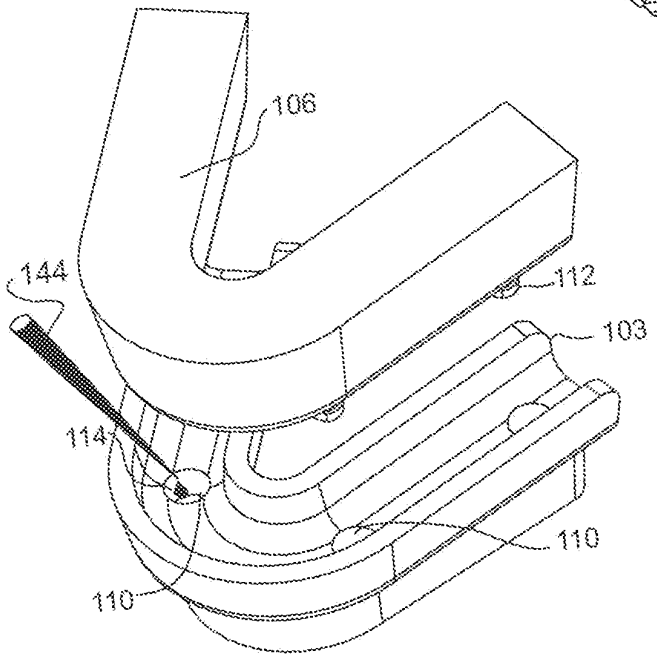


FIG. 41

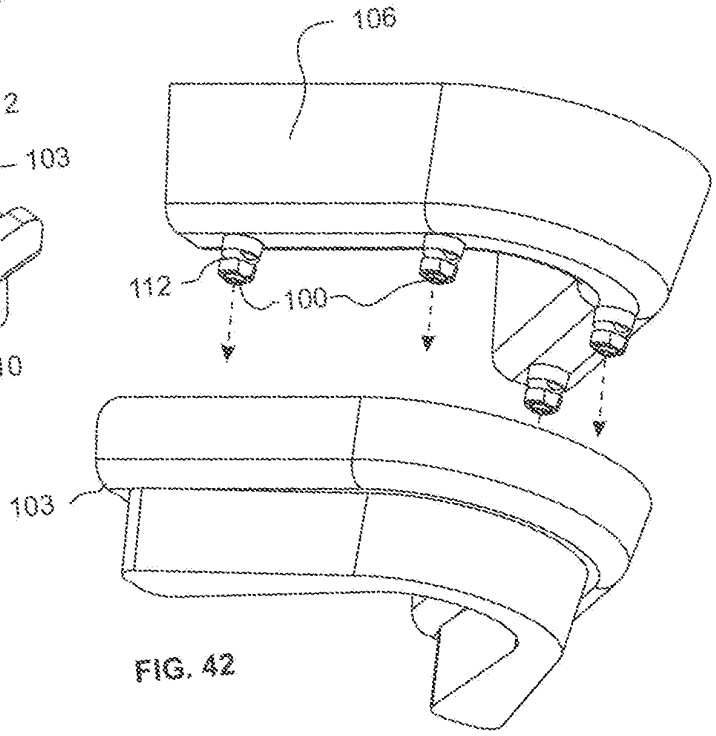


FIG. 42

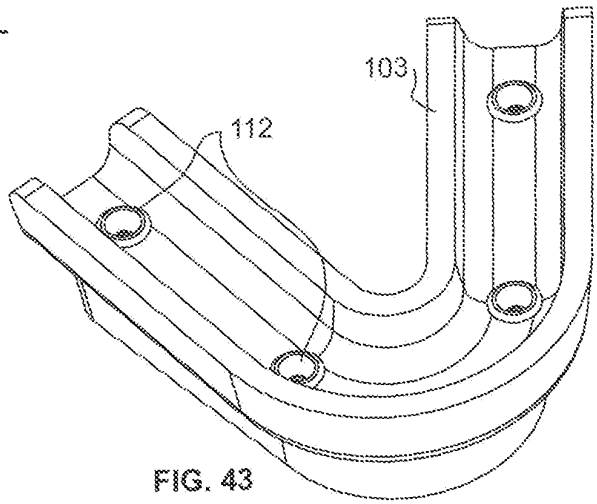


FIG. 43

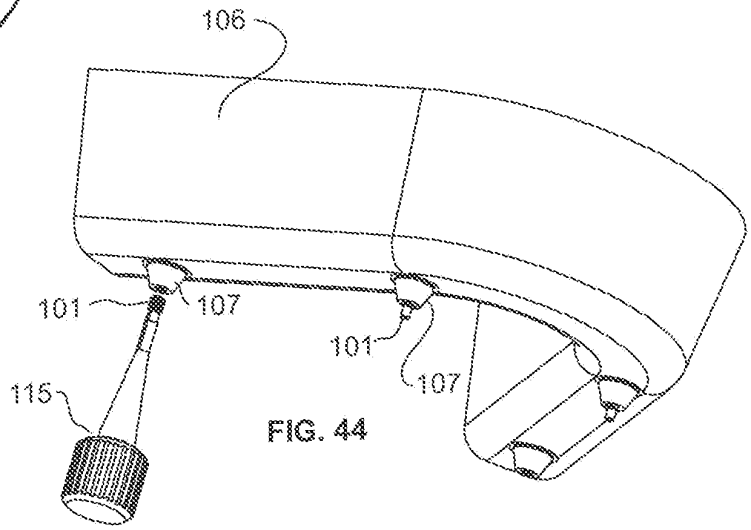


FIG. 44

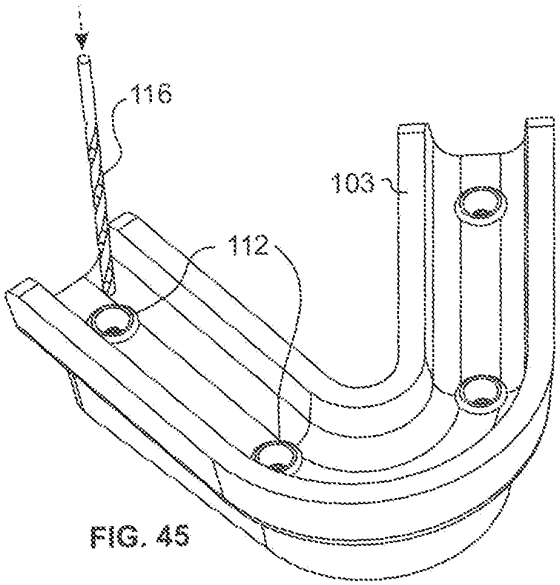


FIG. 45

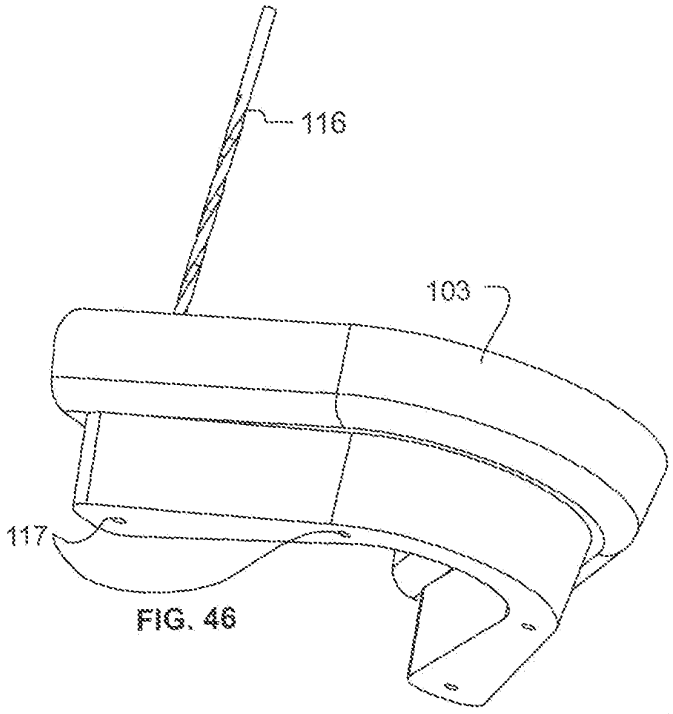


FIG. 46

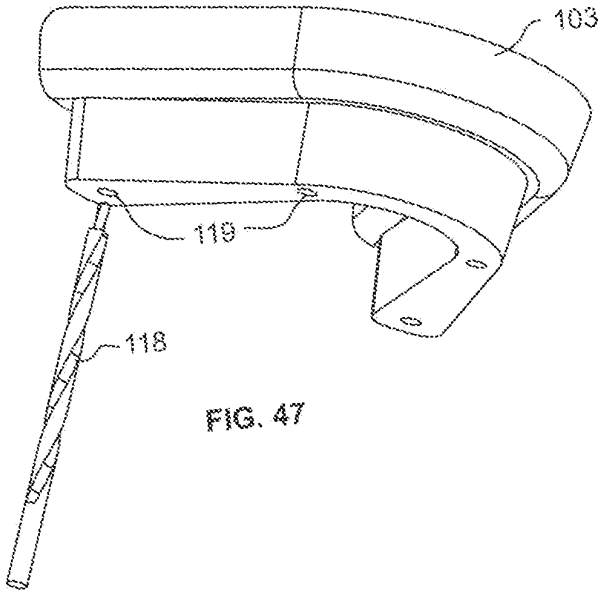


FIG. 47

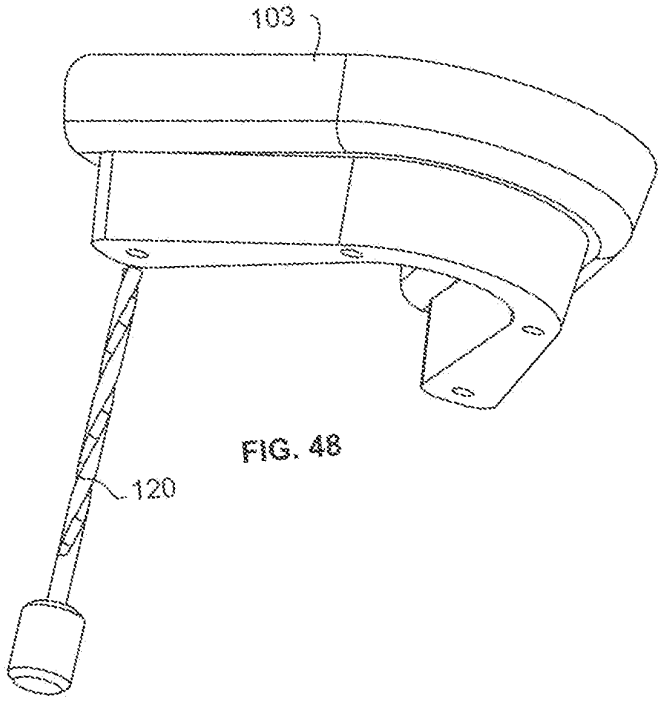


FIG. 48

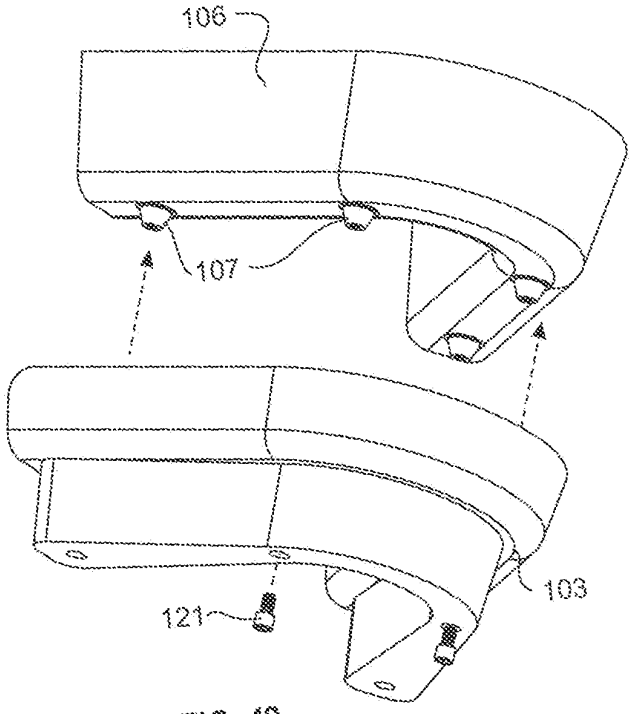


FIG. 49

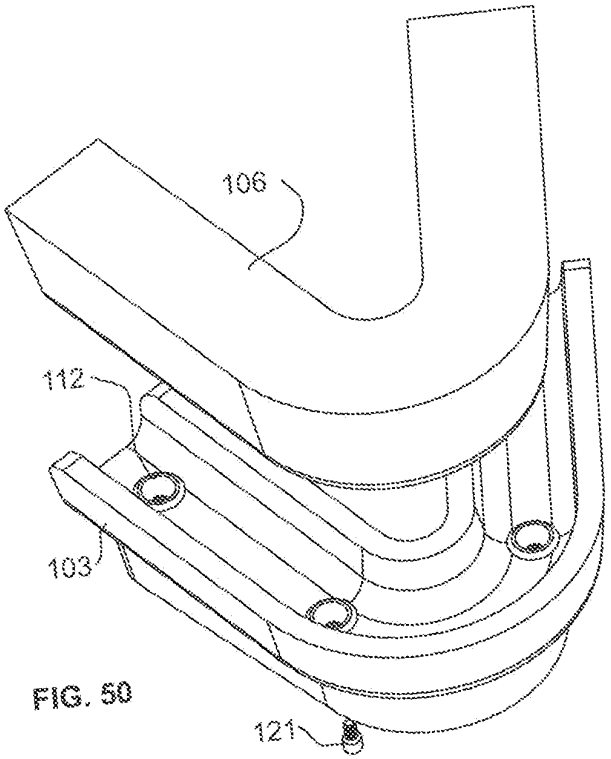


FIG. 50

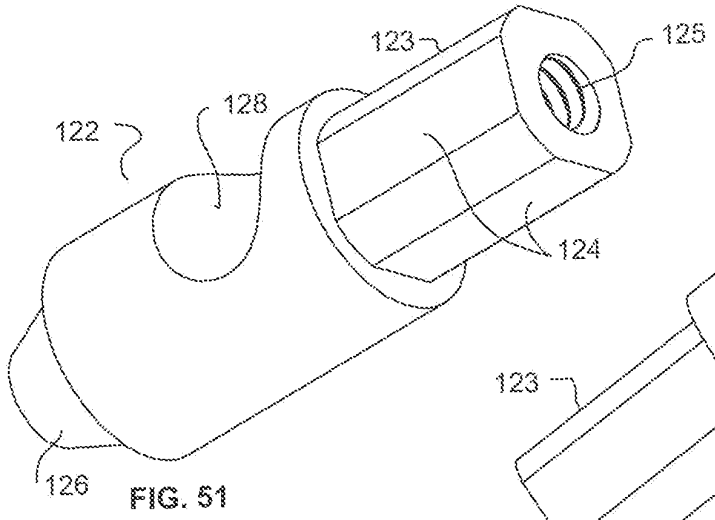


FIG. 51

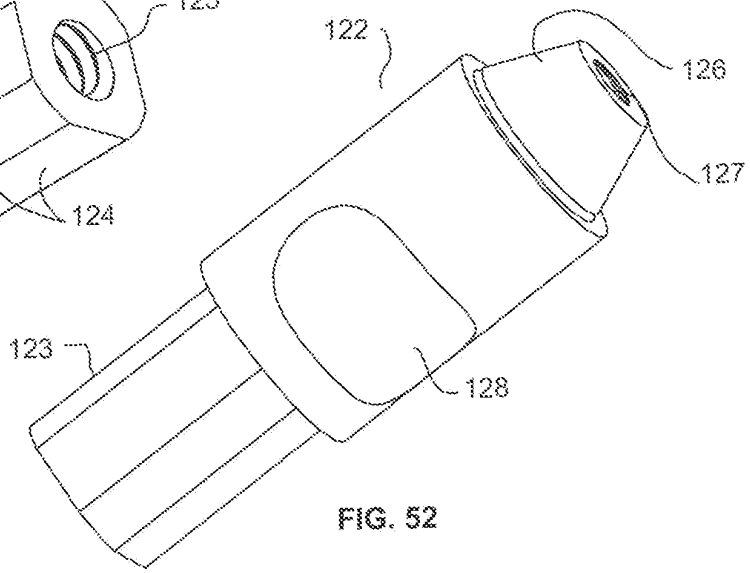


FIG. 52

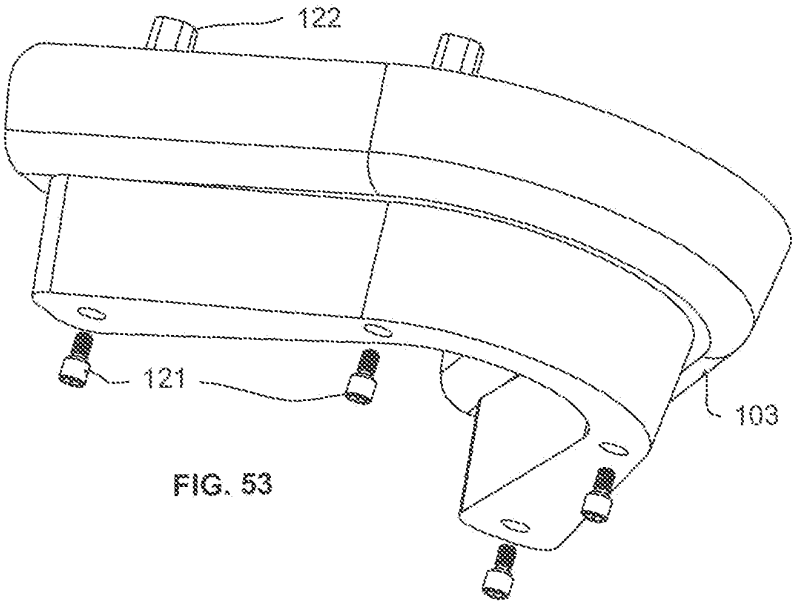


FIG. 53

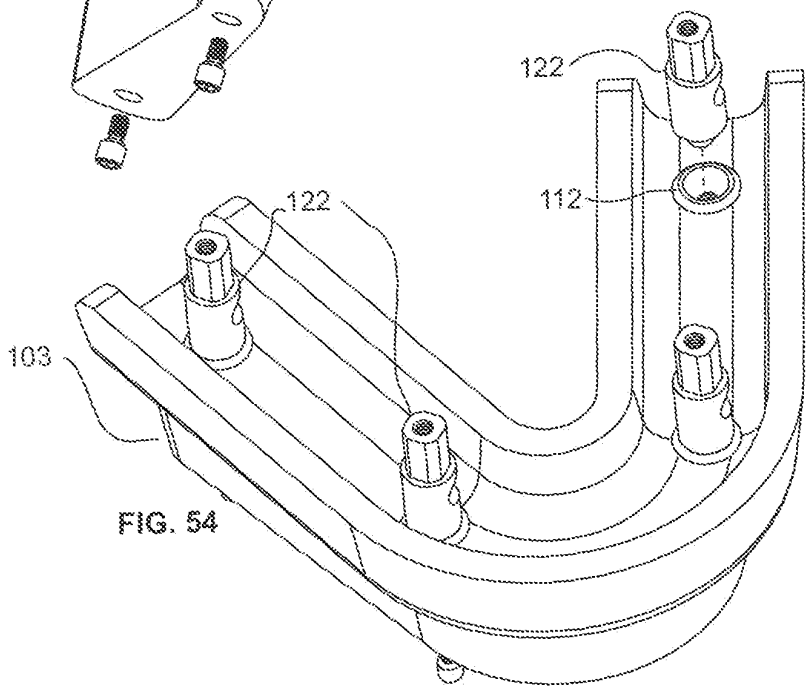


FIG. 54

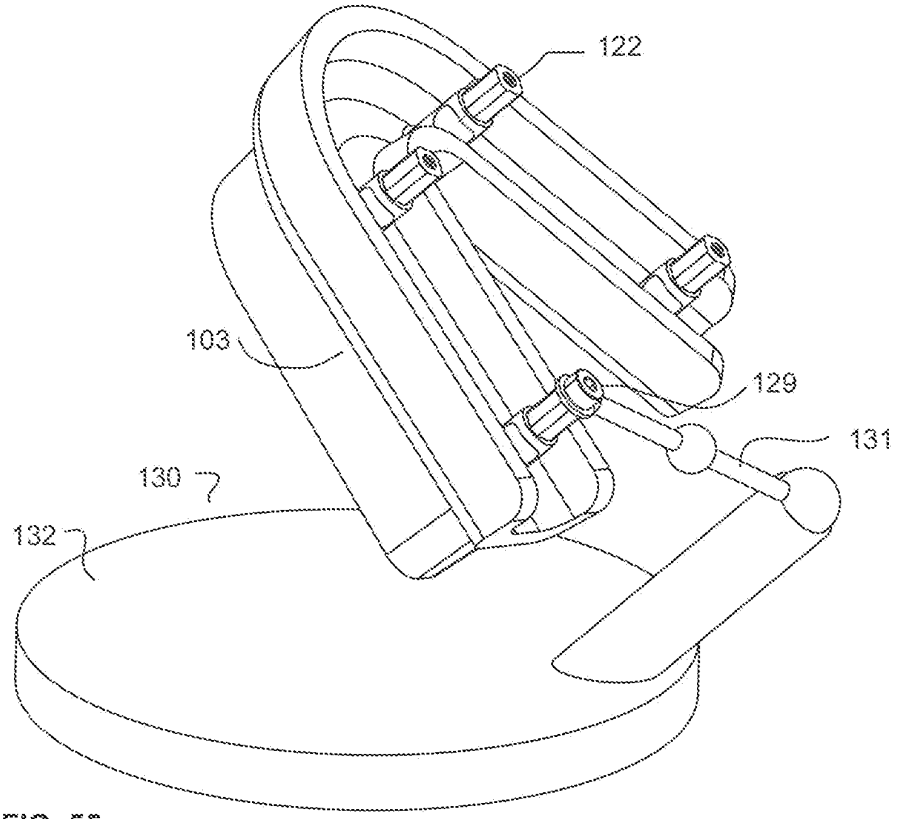


FIG. 55

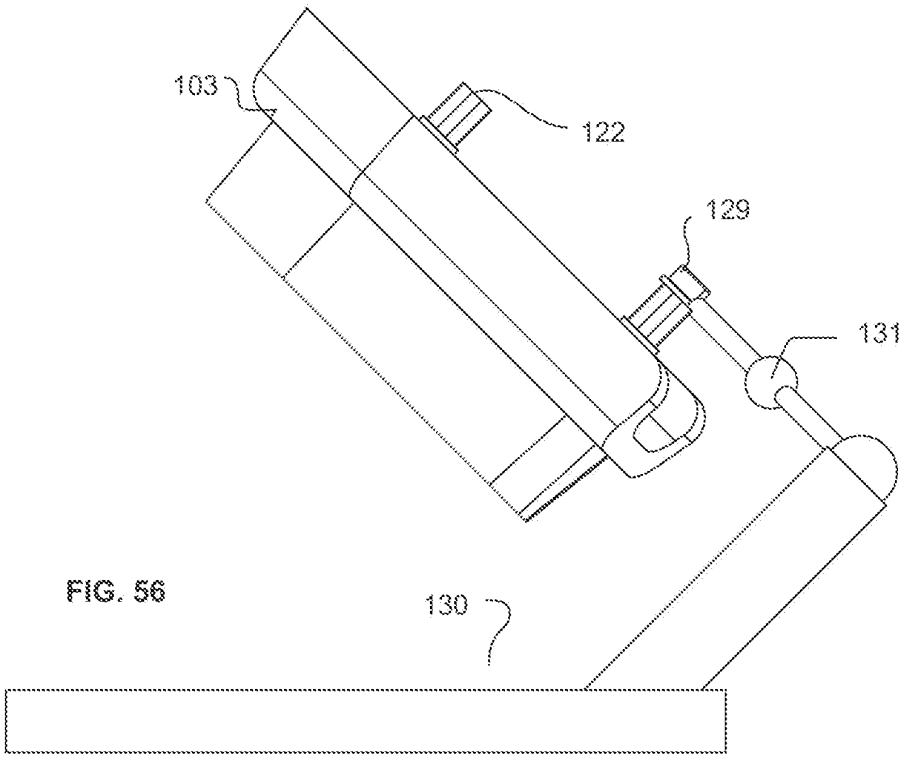


FIG. 56

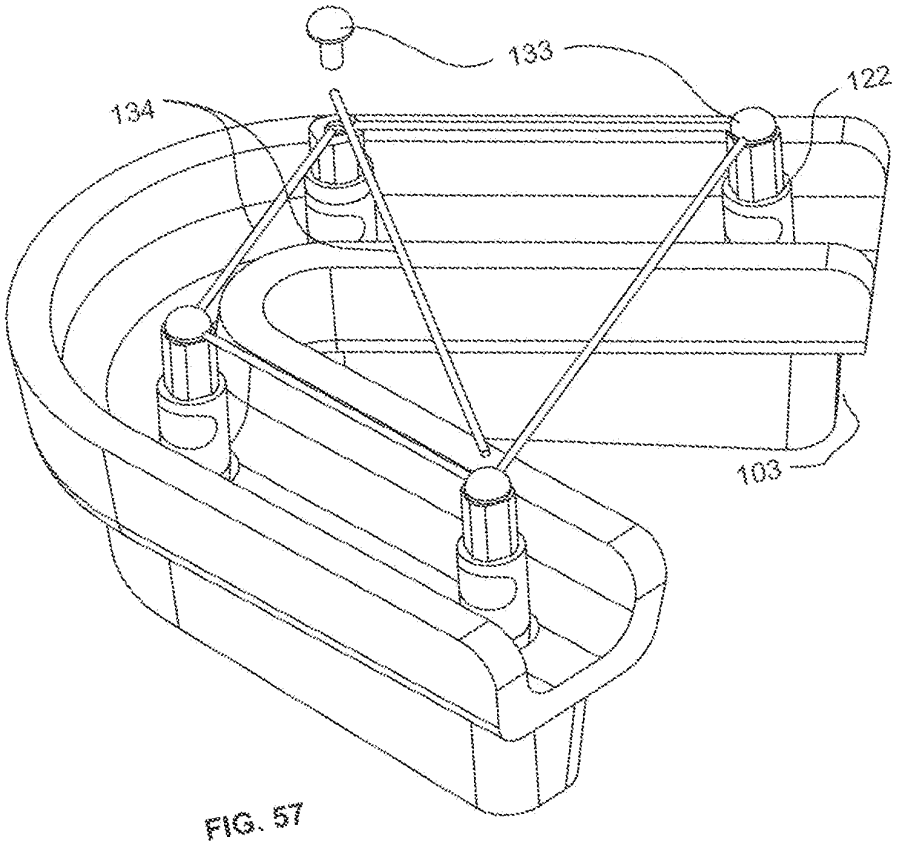


FIG. 57

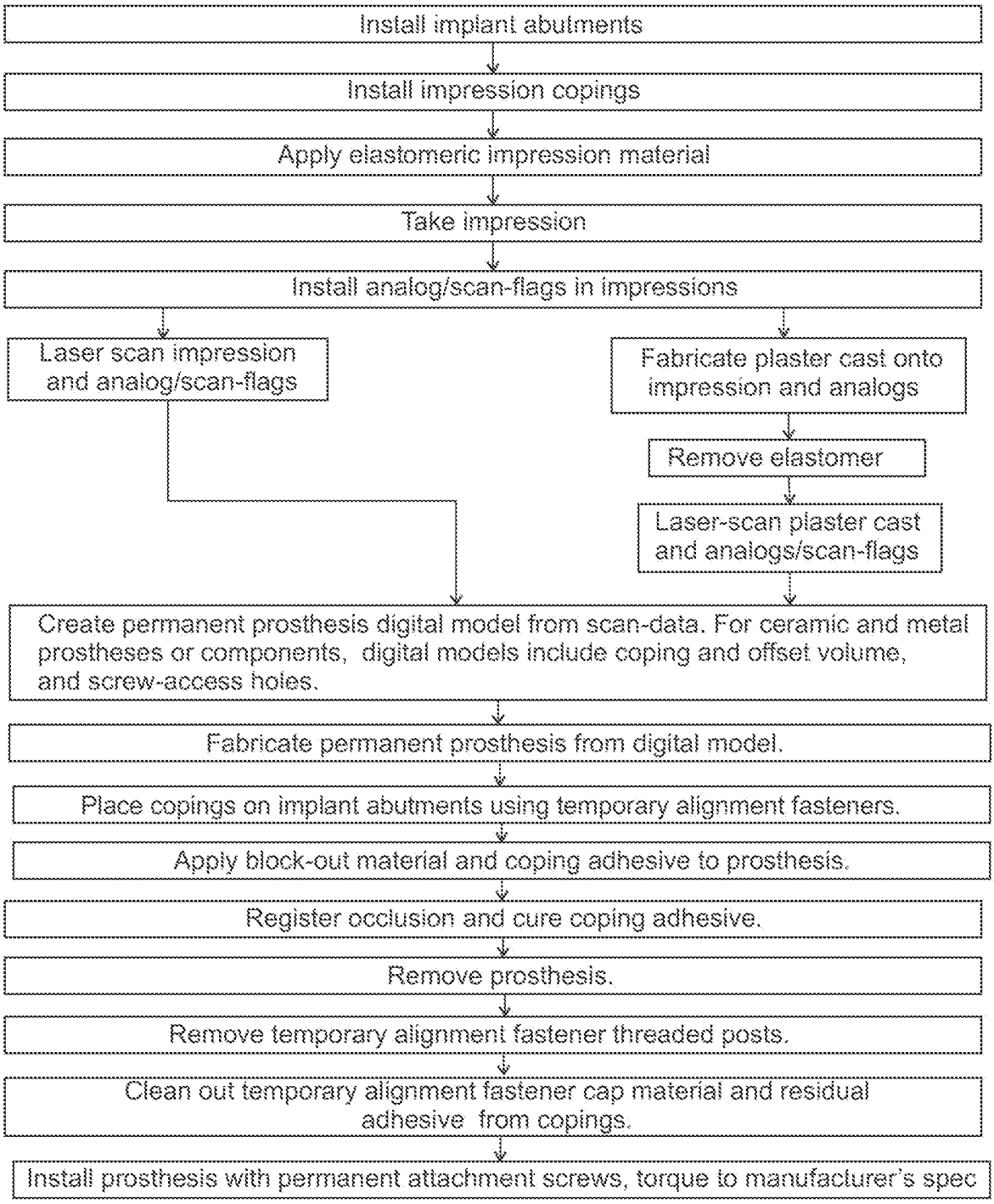

Install implant abutments
Install impression copings
Apply elastomeric impression material
Take impression
Install analog/scan-flags in impressions
Laser scan impression and analog/scan-flags
Fabricate plaster cast onto impression and analogs
Remove elastomer
Laser-scan plaster cast and analogs/scan-flags
Create permanent prosthesis digital model from scan-data. For ceramic and metal prostheses or components, digital models include coping and offset volume, and screw-access holes.
Fabricate permanent prosthesis from digital model.
Place copings on implant abutments using temporary alignment fasteners.
Apply block-out material and coping adhesive to prosthesis.
Register occlusion and cure coping adhesive.
Remove prosthesis.
Remove temporary alignment fastener threaded posts.
Clean out temporary alignment fastener cap material and residual adhesive from copings.
Install prosthesis with permanent attachment screws, torque to manufacturer's spec

FIG. 58

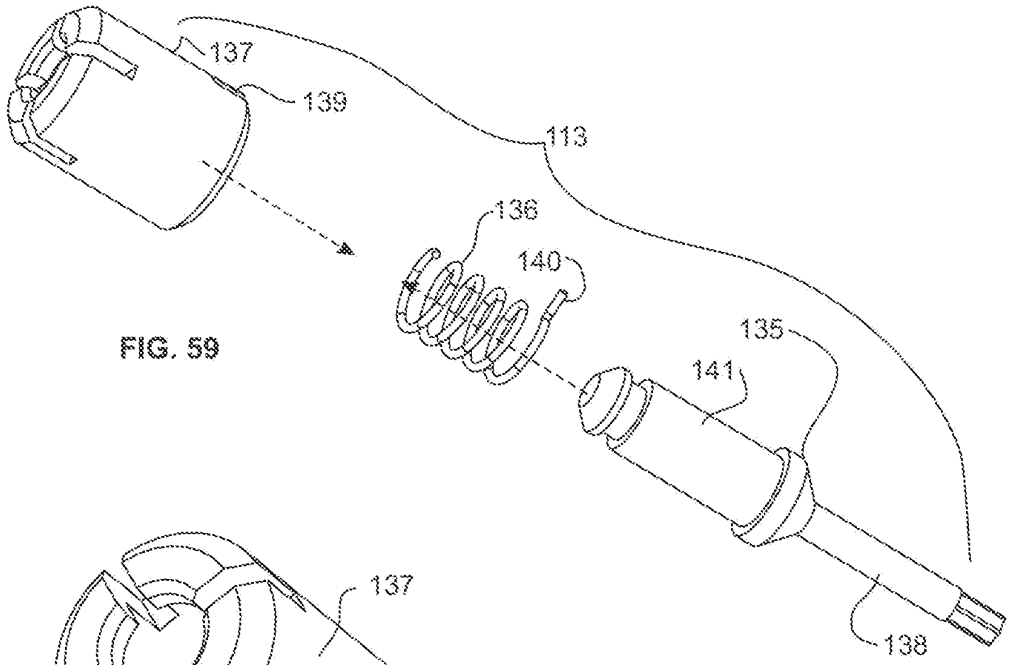


FIG. 59

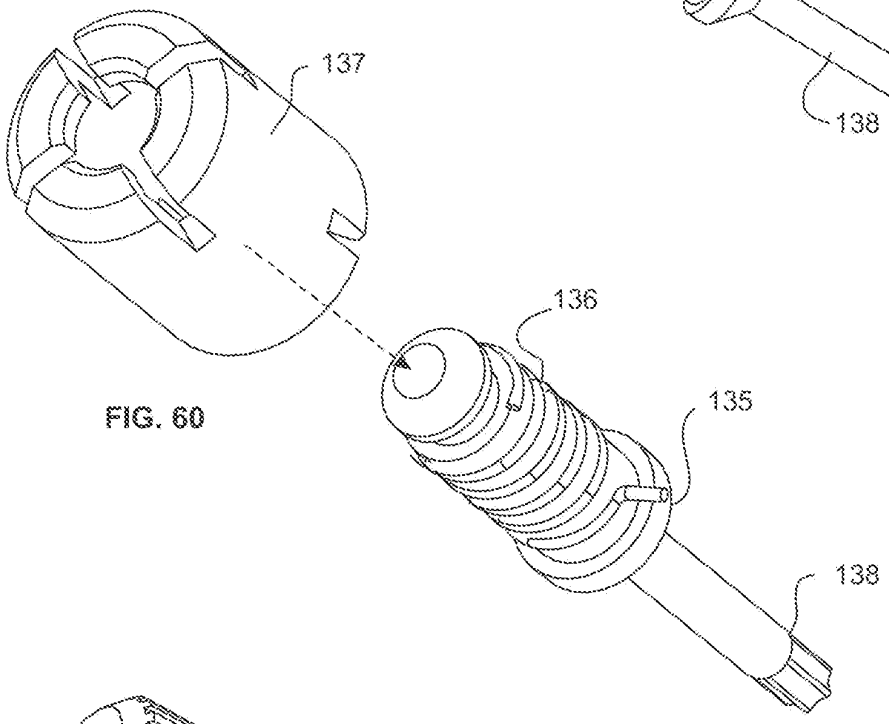


FIG. 60

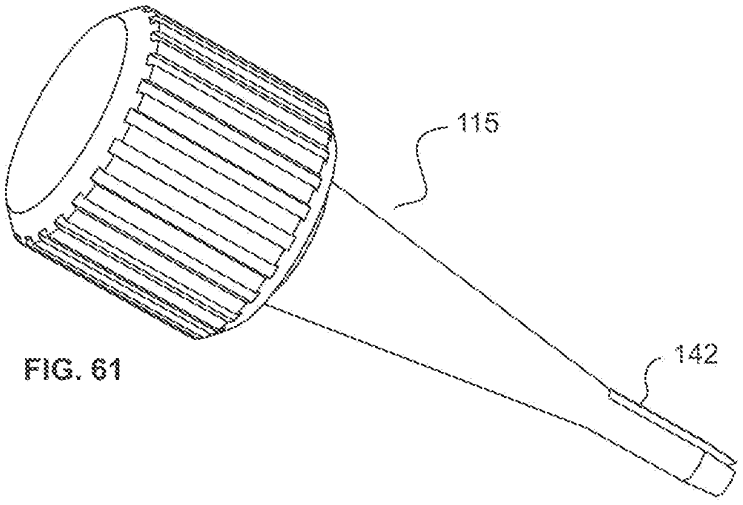


FIG. 61

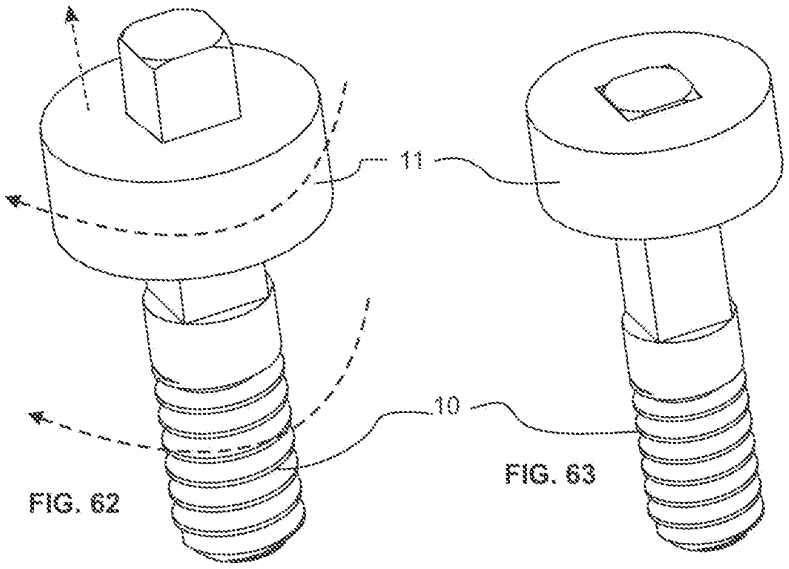


FIG. 62

FIG. 63

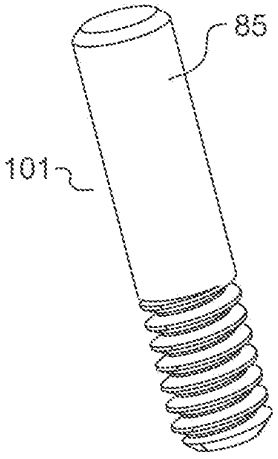


FIG. 64

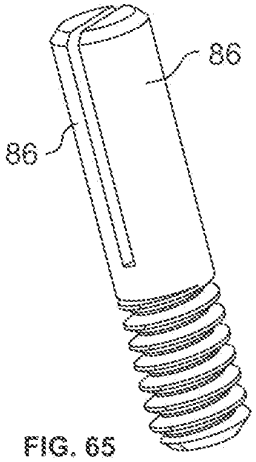


FIG. 65

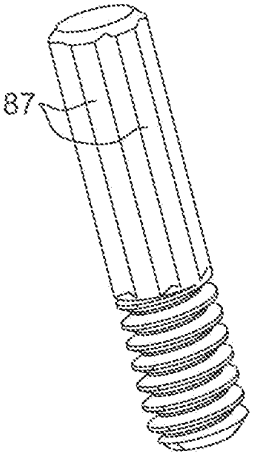


FIG. 66

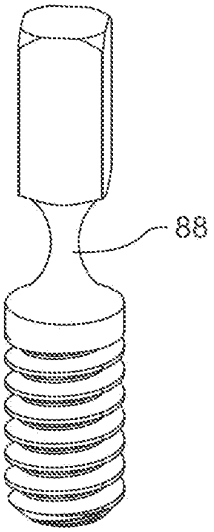


FIG. 67

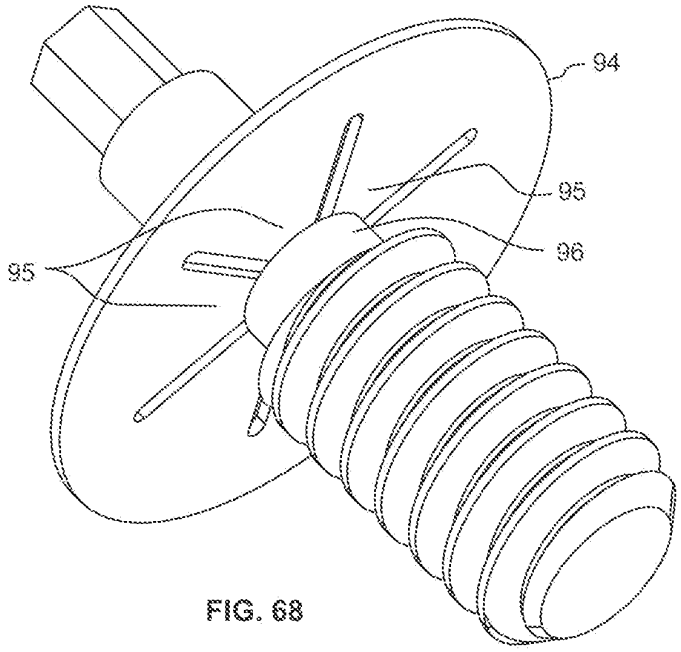


FIG. 68

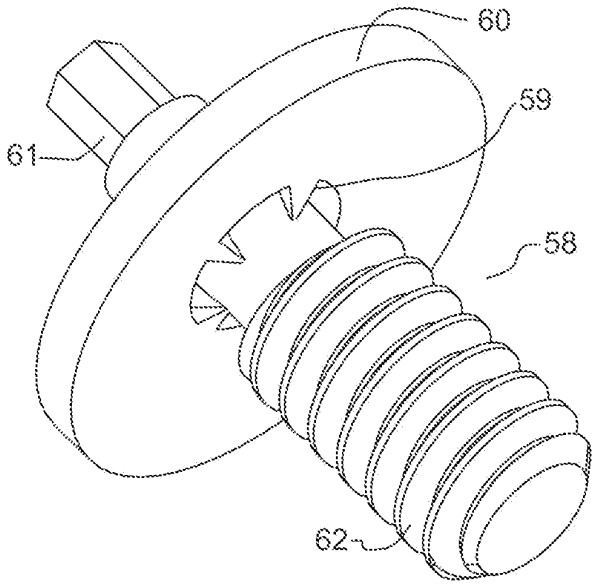


FIG. 69

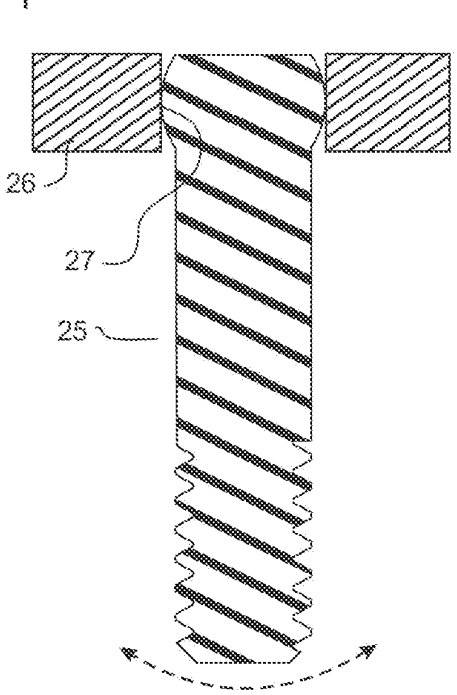


FIG. 70

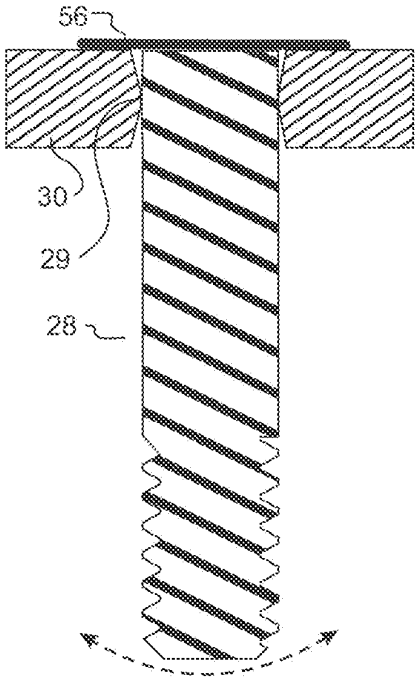


FIG. 71

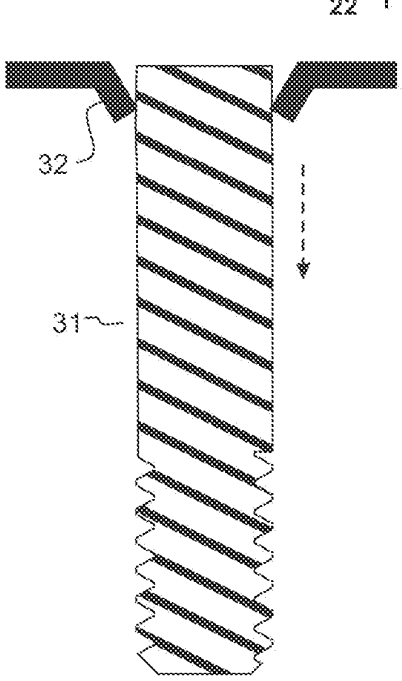


FIG. 72

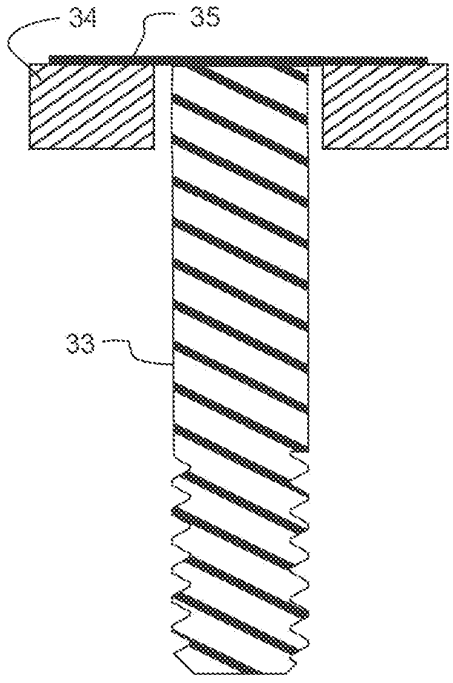


FIG. 73

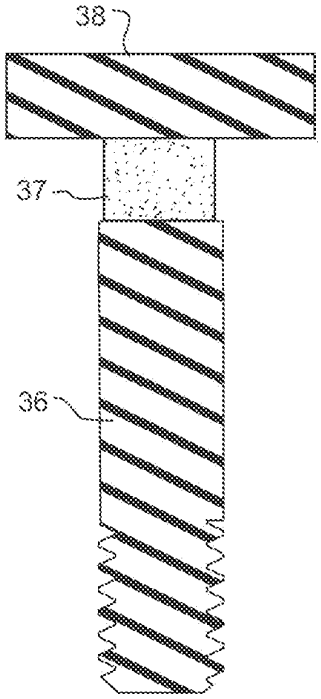


FIG. 74

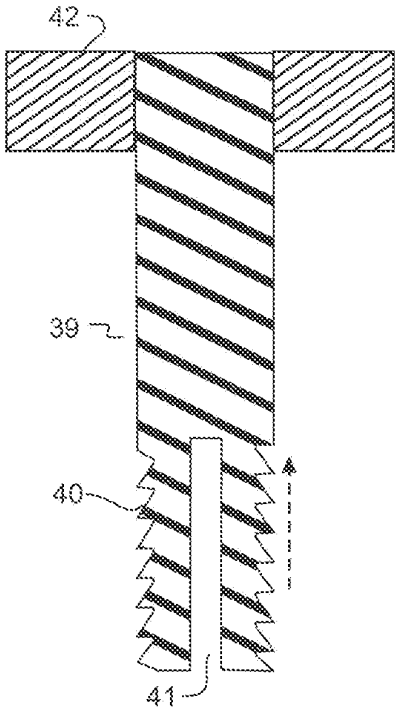


FIG. 75

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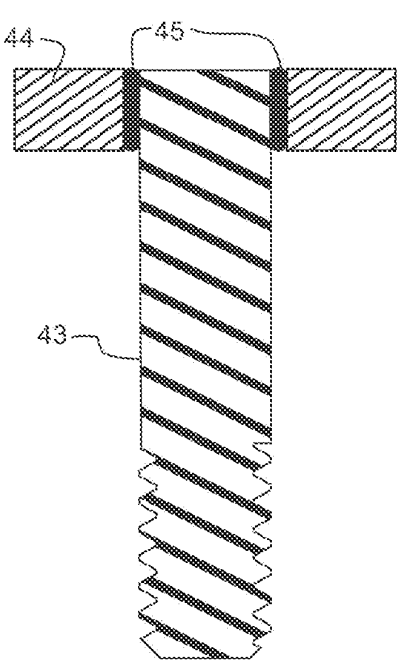


FIG. 76

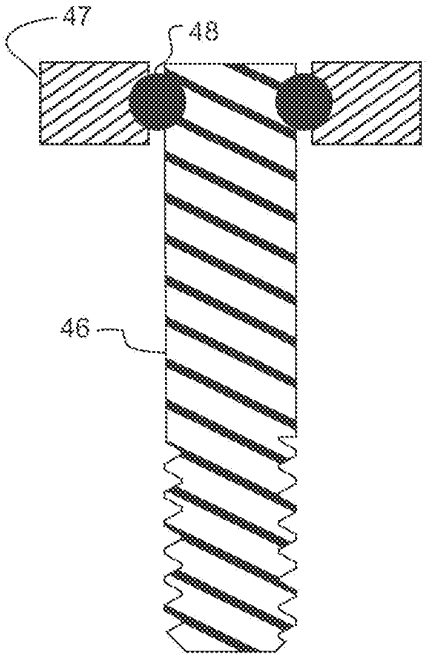


FIG. 77

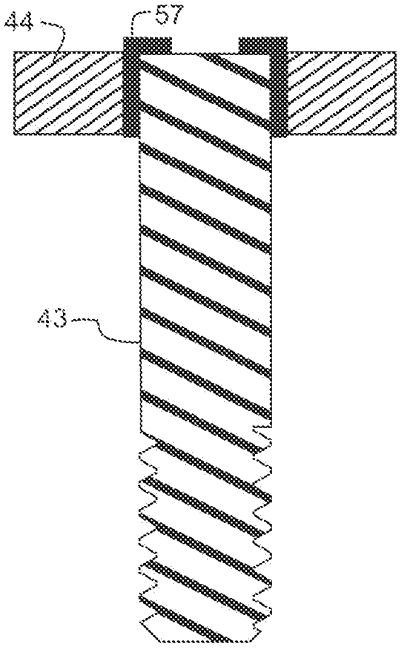


FIG. 78

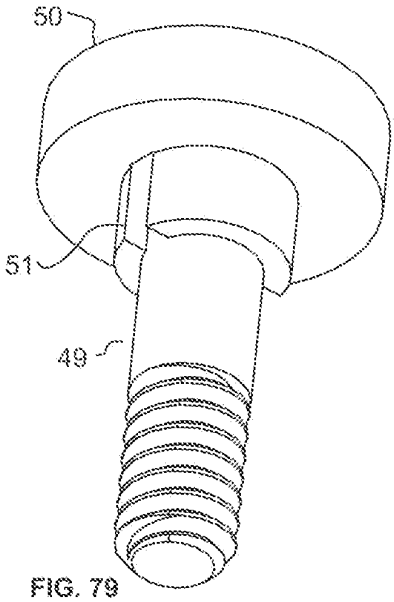


FIG. 79

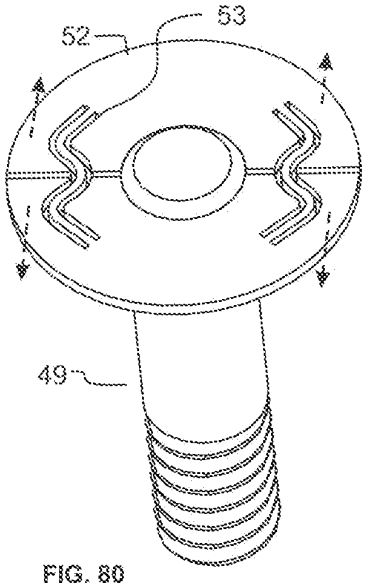


FIG. 80

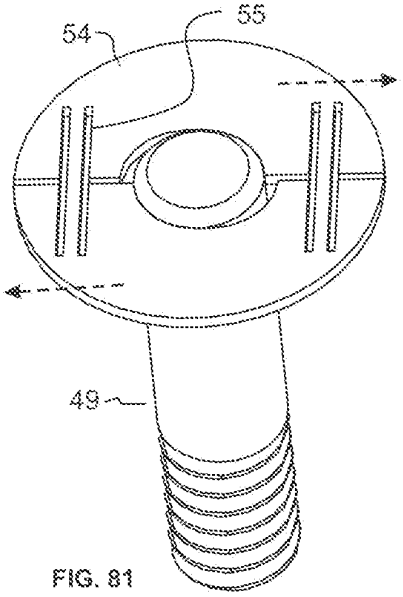


FIG. 81

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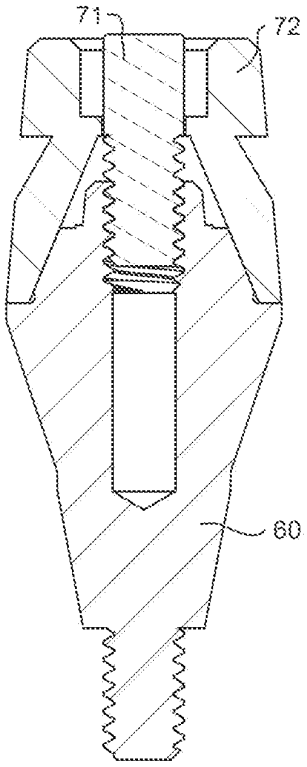


FIG. 82

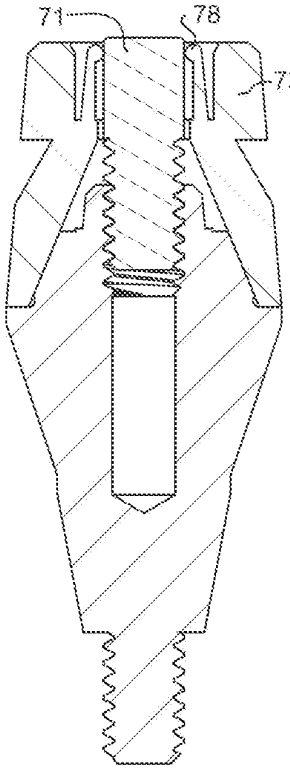


FIG. 83

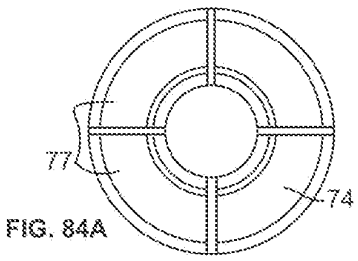


FIG. 84A

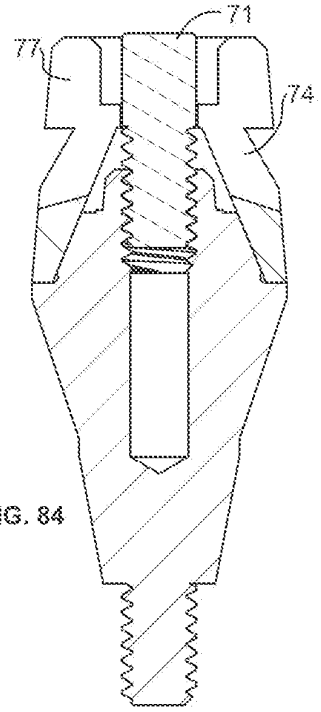


FIG. 84

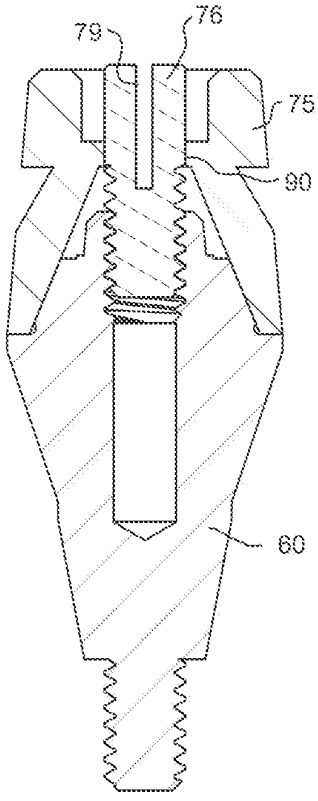


FIG. 85

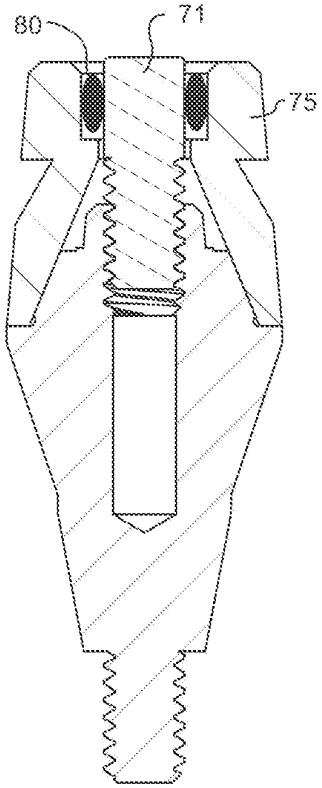


FIG. 86

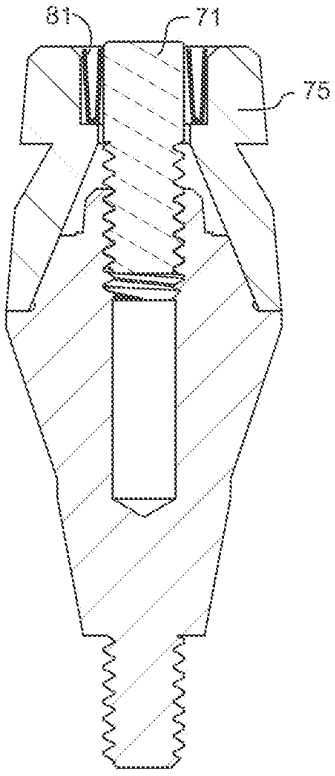


FIG. 87

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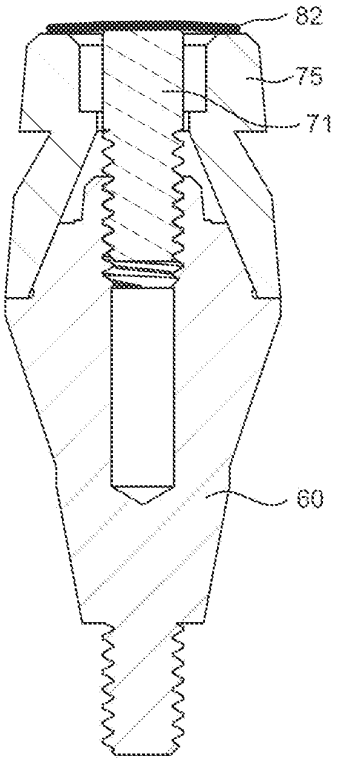


FIG. 88

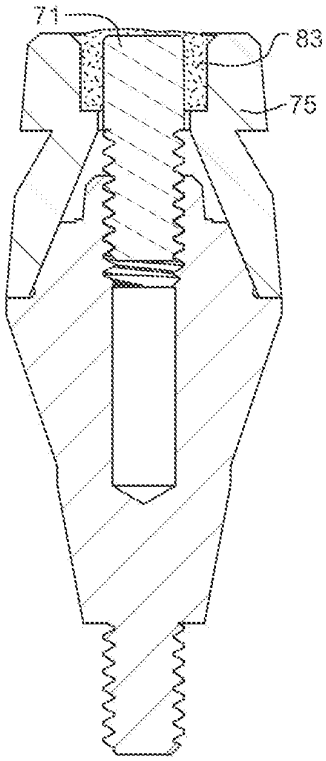


FIG. 89

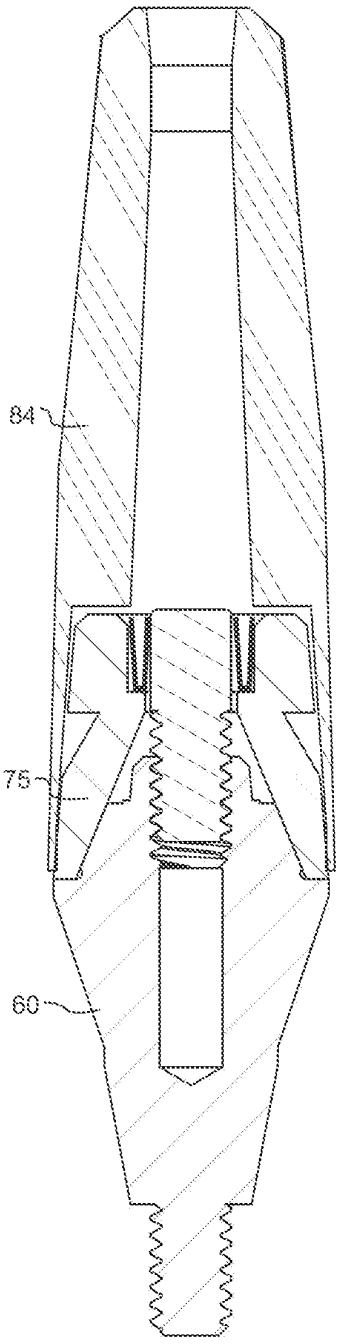


FIG. 90

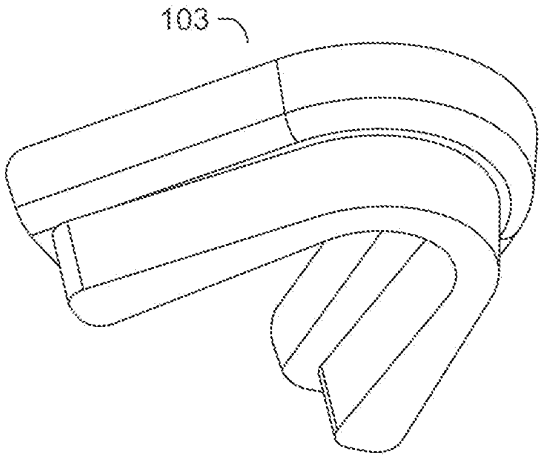


FIG. 91

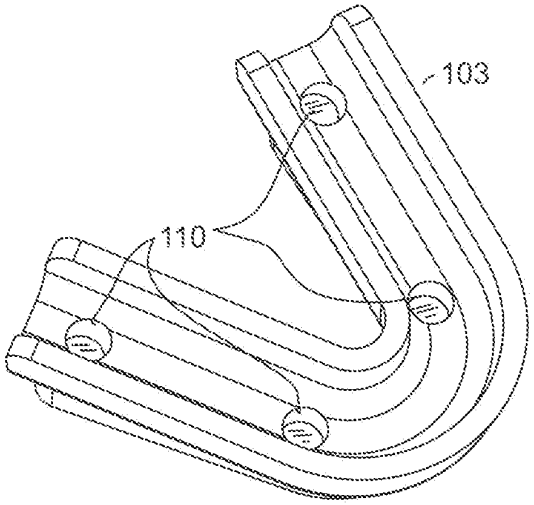


FIG. 92

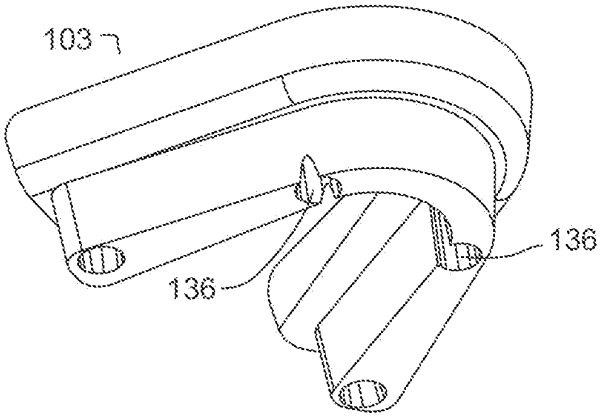


FIG. 93
(PRIOR ART)

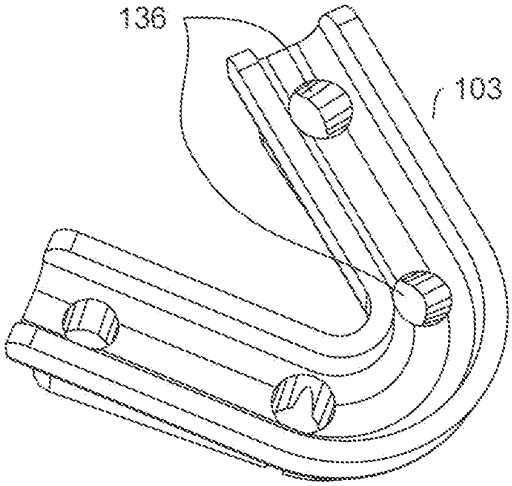


FIG. 94
(PRIOR ART)

SCREW-ATTACHED PICK-UP DENTAL COPING SYSTEMS AND METHODS

ABSTRACT

[0001] A temporary alignment system and method for holding a dental coping to an implant abutment using the same threads in the abutment that are used for definitive attachment are disclosed. The disclosed temporary fasteners initially orient and hold a coping against an abutment with a force along the same axis as the semi-definitive screw. The aligned coping can be picked-up in a closed-tray impression process without unscrewing the temporary fastener. Embodiments include threaded posts that release copings from the abutment through axial forces. Some embodiments include a threaded post with separable cap that is picked-up with the coping. Methods for converting an existing prosthesis for screw attachment to implants in a single visit and digital capture of the converted prosthesis are described.

CROSS-REFERENCE TO RELATED APPLICATIONS

[0003] This application is a continuation of US Patent Application 17/691,108, filed on March 9, 2022, which is a continuation of US Patent Application 16/596,361, filed on October 8, 2019, and issued as US Patent 11,311,354 on April 26, 2022. This disclosure claims priority of US provisional patent application number 62/742,942, filed on October 9, 2018, and US provisional patent application number 62/774,402, filed on December 3, 2018, and US provisional patent application number 62/818,082, filed on March 13, 2019. All of the above non-provisional and provisional applications are incorporated herein by reference in their entirety.

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BACKGROUND OF THE INVENTION

[0005] Different systems have been introduced for attaching dental prostheses to dental implants to replace one or more natural teeth. In order to simplify future modification or replacement needs, it is desirable to have reversable attachment between the implants and prostheses using mechanical systems as opposed to directly bonding these components together. These systems require features to provide both proper alignment and retention for acceptable use by the patient. Intermediate components such as copings and separable abutments having different lengths or orientations are often employed to provide proper registration between a dental prosthesis, one or more implants embedded in the patient's

jawbone, and the soft-tissue and any remaining natural teeth. These intermediate elements may be mutually attached with screws or with ball-and-socket or other forms of snap-on mounts. In the case of a single-tooth crown attachment, the coping and abutment surfaces preferably include features to remove rotational symmetry in the mating of the abutment and coping surfaces. Rotational locking features may also be included in these single mount systems. When the prosthesis contains multiple copings for attachment to multiple abutments, this rotational fixation is not generally required. For example, 30-degree tapered mating surfaces for multiple interface locations are sufficient to provide complete registration.

[0006] It is common to attach a complete upper or lower denture to four or more implants. The multi-unit abutment system interfaces with mating surfaces of the final prosthetic. In some cases, these dentures may be designed or fabricated from scratch following the pulling of undesirable teeth and mounting of implants. In other cases, no teeth are pulled, but it is desirable to convert an existing removable denture to definitive mounting to new implants. In some cases, it is preferable to convert these existing dentures shortly after the implants are placed. This chair-side processing decreases patient discomfort by providing at least temporary dentures more quickly.

[0007] Dental impressions are often used to provide information on the location of implants, soft tissue and existing teeth for designing new prostheses or mounting copings in existing dentures for implant attachment conversion. Generally, the copings are mounted to implant abutments and an impression is made to provide location information for the prosthesis through the copings. Impression material is introduced and cured around the copings to define their position. In the case of transfer copings, less rigid impression material is used to form a cavity for each coping; the coping remains attached to the abutment and the cured impression is removed. Subsequently, copings are inserted into the impression.

In the case of pick-up copings, the coping is directly retained in the impression material after curing. That is, the copings are picked-up when the impression is removed from the mouth. The resulting alignment of pick-up copings is generally superior to transfer copings as a result of the direct transfer of coping location information. Transfer copings introduce an indirect secondary alignment reference since the insertion of the coping into the impression may not accurately duplicate the original position, particularly in insertion depth.

[0008] Pick-up copings can be used with either an open tray or a closed tray protocol. For snap-on systems, a closed impression tray pick-up technique may be done. The tray can be closed because there is no need to access the copings in order to disconnect them after the impression material sets. However, it is desirable to ensure that the assembly of snap-on copings can be removed without patient discomfort. The amount of force required to remove the tray or converted prosthesis depends upon the total number of implant abutment/coping sets and their position and mutual alignment. Some snap-on systems provide features to provide different retention levels, but this complicates the installation process. Special tools have been introduced to help separate impression trays or prostheses with snap-on systems but may still result in patient discomfort. Since snap-on systems are generally physically larger than dental screws, converting an existing denture may require large clearance cavities to be bored into the existing denture before it can be used as an impression tray in a pick-up coping process. These large holes may significantly reduce the mechanical stability of the existing denture. The mechanical precision required of snap-on system elements generally makes them more expensive than screw-attached systems.

[0009] The simplicity of screw-attached systems provides some benefits over snap-on systems beyond fabrication cost. The mounting pressure between the coping and abutment is readily controlled through the torque applied to the screw

to tighten it. This axial tension control and the self-aligning characteristics of engaged screw threads provides more certainty in the engagement force and relative orientation of the components. Even if a screw breaks, techniques are known for removing the pieces without damage to surrounding components. Screws also have a benefit of independence for removal since each coping can be loosened individually. Tilting the prosthesis after screw removal to disengage one coping cannot cause reengagement of another coping.

[0010] A disadvantage with commercially available screw-attachment systems for pick-up copings is the requirement for using an open-tray impression in order to release the coping from the abutment after the impression material sets. By having an opening in the tray or existing denture, impression screws may be used. These impression screws extend through the tray beyond the impression material and can be unscrewed after the material sets. The impression screws use the same abutment threads as the semi-permanent screws used to attach the prosthesis later. As a result, the introduction of alignment uncertainty through a secondary reference may be avoided or minimized. The copings used with the impression screws are often relatively long and require modification for denture conversion. This customization may result in larger clearance holes in dentures and require additional process time by the dental practitioner. The length of the impression screws sticking through the tray can cause patient discomfort and a gag reflex. In the case of denture conversion, clearance for a set of impression screws at different angles may require additional material removal leading to a weakened denture. A schematic representation of the larger through-holes 136 required using conventional denture conversion processes for screw attachment are illustrated in FIGS. 93-94. The impression screws can also prevent the patient from applying bite pressure during the pick-up process to ensure proper registration of the modified denture and opposing teeth.

5 Specification

[0011] Prosthetic dentistry has rapidly moved into the realm of digital design and manufacturing. Typically, this requires that a digital model is created from a physical model or impression to allow digital design and manufacturing techniques to produce a physical prosthetic that can be delivered to a patient for restoration of dental and oral structures. When making a dental restoration with implants in this manner, an implant impression coping is often used in the mouth to reference the position of the implant geometry relative to surrounding structures such as gingiva, adjacent teeth, opposing teeth, etc. Once removed from the mouth, an implant analog is attached to the impression coping that was picked-up or transferred. With the lab implant analog attached to the impression coping in the elastomeric impression, dental stone is flowed into the impression and allowed to harden before separation from the impression with a resultant dental cast. A scan flag is attached to the lab analog on the dental stone model and is scanned in by laser or optical scanning technology. The scan flag is used for design software to reference and replicate the accurate positioning of the virtual implant relative to the adjacent teeth, gingiva and opposing tooth, as well as the timing of the implant and other pertinent implant geometries. Once the virtual implant is accurately brought into the design software, a prosthetic can be designed by following the workflow in the design software. A completed design is post-processed, and a CAD file is used in CAM software to direct either the 3-D printing or milling of the designed prosthesis. The manufactured prosthesis is verified on the physical model in a remote prosthetic manufacturing lab prior to delivery to the dentist or is verified directly on the dental patient if the prosthesis was manufactured in the local dental clinic. It is currently the standard of care to verify the fit, form, and function on a physical model.

[0012] Recently, an impression scan flag was introduced to the market for a few major implant systems and the most common multi-unit geometry. This scan flag allows for an impression to be digitized without the creation of a stone model. A digital model is created directly from the elastomeric impression, a prosthesis is

designed digitally and processed with CAM software and both a 3-D printed model and 3-D printed or milled prosthesis is finished and tested on the 3-D printed model. The disadvantage of the 3-D printed model for full arch implant prosthetics is the positioning of the implant lab analog within the 3-D printed model introduces a degree of inaccuracy. Additionally, an impression only captures the implant or multi-unit abutment relative to the tissues and requires cumbersome steps to incorporate a provisional prosthesis or wax-up into the design software relative to the scan of the impression.

[0013] A properly converted denture provides a valuable source of information of the relative location of the implant and its abutment surfaces, copings and soft tissue and any remaining teeth of the patient. It can be used as a model for digital scanning to produce a duplicate denture if needed in the future or as a starting digital model for manipulation to improve aesthetics or other characteristics. However, if the mechanical integrity of the converted denture is compromised, the scanned information may not faithfully represent the relative geometry of these elements and result in a poor fit.

[0014] Other alignment systems have been proposed which use silicone or melting screw threads to allow closed tray transfer for definitive screw attachment, but the practicality of providing adequate alignment and seating forces with a screw diameter in the range of existing systems or overcoming the lack of disengagement independence required in melting all threads simultaneously without patient discomfort has not been documented. Details on removing any residual material in the abutment threads or in the prosthesis after the pick-up process have not been disclosed. Other hybrid systems that use a snap-on engagement for the pick-up coping during transfer and subsequent screw-attachment have also been proposed, but detailed information on the tradeoffs in precision and associated complexity or size required for equivalent performance to open-tray impression screw techniques have not been disclosed.

A general need exists for systems that improve clinical efficiency, implant to prosthesis alignment accuracy, application to a wide range of coping designs and sources and patient comfort over existing systems.

[0015] The present disclosure includes systems and methods that address one or more of these issues in the prior art.

BRIEF SUMMARY OF THE INVENTION

[0016] Some embodiments of the invention include a screw-in fastener system used to temporarily retain a coping on an abutment during bonding of the coping into a blind hole located in the tissue-side of a removable dental element such as a removable complete denture. The temporary fastener system disclosed has features to allow easy removal of the dental prosthesis from the fastener post after pick-up of the coping into the dental prosthesis is complete, without the need for special tools or access to the fastener system to unscrew it.

[0017] Some embodiments include a temporary fastener with a male-threaded bottom portion that is installed into the screw threads of an abutment, and an axially separable top portion, or cap, that retains the coping onto the abutment. The separable portion allows removal of the coping picked-up in the dental prosthesis without requiring mechanical access to the fastener. The inventive concepts disclosed facilitate easier installation and removal on multiple abutments that may be oriented at different compound angles when compared to the conventional open-tray processes and long impression screws. The temporary fastener may engage the same screw threads of the abutment that are used to definitively attach the prosthesis. In this manner, the coping is held against the abutment for the pick-up process with a force oriented identically to that of the final screw mounting. The retention of the cap on the screw post can

be designed to provide a desired force holding the coping to the abutment through the applied torque on the temporary fastener. The cap can be attached to the post through a combination of known mechanical attachment means including but not limited to interference fits, adhesives, snap fits or other elastic and inelastically deforming retention elements. The cap may also be formed as an integral part of the screw post that has portions that fracture as a result of an applied axial force. In addition to applied axial forces, the cap may separate from the post as a result of retention changes resulting from chemical or thermal processes and or the application of electromagnetic energy during or subsequent to the pick-up process.

[0018] Other embodiments include a threaded post that has a temporary retention feature that engages the coping without a separable cap. These embodiments engage the abutment threads in mounting the coping but release the coping after bonding to the prosthesis.

[0019] The disclosed systems and methods can be applied to single tooth prostheses with copings and abutments with orientational features or for multiple tooth prostheses using copings and abutments with symmetrical mating surfaces such as 30-degree tapers.

[0020] In some embodiments, the temporary fastener is driven into the abutment threads by a tool that engages the post. In other embodiments, the temporary fastener is driven into the abutment threads by a tool that engages the cap. The drive torque can be designed to be sufficient for holding the coping to the abutment accurately, but less than the torque that would result in movement of the cap relative to the post.

[0021] In some embodiments, the threaded end of the post portion of the temporary fastener has a deflecting feature that allows the post to engage or disengage the abutment threads through axial motion instead of a rotary screw motion.

[0022] One embodiment describes a system for aligning a dental implant abutment, coping and separable dental element for definitive screw-attachment comprising:

a. a temporary alignment fastener comprising:

b. a post having an axis, a first post end and second post end, wherein the first post end is threaded for screw attachment to the implant abutment;

c. a cap, wherein the cap is attached to the second post end;

[0023] and wherein the temporary alignment screw is configured to hold the coping against the implant abutment when the first post end is screwed into the implant abutment and wherein the cap is separable from the post through a release force directed away from the first post end.

[0024] One embodiment describes a system for aligning a separable dental element for installation to a threaded implant abutment with a definitive screw having a head and threaded shaft portion comprising:

[0025] a coping having a distal end shaped to engage with the implant abutment and a proximal end with an aperture sized to allow the shaft portion of the definitive screw to pass through;

[0026] a temporary screw having a distal end portion adapted to engage the threads of the implant abutment and a proximal end portion having temporary engagement means for attachment adjacent to the proximal end of the coping wherein the temporary screw holds the distal end of the coping in alignment

against the implant abutment when the distal end portion of the temporary screw engages the implant abutment threads and wherein the temporary engagement means releases the coping without disengaging the post portion of the temporary screw upon the application of a predetermined axial force in the proximal direction.

[0027] In some embodiments, an existing removable denture is converted to a screw attached denture by milling pockets to allow copings to be bonded in a pick-up process. In this process, the denture acts in an equivalent manner to a closed impression tray. Proper registration can be confirmed by having the patient bite down on the denture during the pick-up process. After coping pick-up, clearance for the definitive screws can be drilled using the coping as a guide. The converted denture can be used with scan flags to provide a 3-dimensional digital capture. Thus a digital model can be used to make a duplicate prosthesis or as the starting point for a new custom prosthesis.

[0028] One embodiment describes an alignment system for converting an existing denture for screw attachment to threaded implant abutments designed to perform the process of:

a. mounting pick-up copings to the implant abutments with temporary fasteners,
b. adhering the copings to cavities formed in the existing denture,
c. pulling the denture with secured pick-up copings away from the implant abutments,
d. unscrewing the threaded portions of the temporary fasteners from the implant abutments,
e. forming definitive screw clearance holes in the denture,
f. mounting the denture to the implant abutments with definitive screws that engage the same implant abutment threads as the temporary fasteners,

wherein the unscrewing the threaded portions of the temporary fasteners and the forming definitive screw clearance holes in the denture may occur in either order.

[0029] For the purposes of this disclosure, a separable dental element is defined to be anything that incorporates one or more dental copings that can be mounted and removed from one or more implant abutments. Different coping designs are known in the dental industry, and the systems and methods disclosed here can be adapted to work with many commercially available types of copings including pick-up copings, temporary cylinders, inserts and impression copings. Implant abutments are known in the dental industry having compatible interfaces to these copings. Since the mechanical interface is the same, for the purposes of this disclosure, implant abutment is considered a generic term that includes abutment analogs. Description of alignment systems and process methods with copings and implant abutments that are installed in a patient's jaw should be considered to also describe equivalent inventive concepts that may be used with copings and implant abutment analogs in a dental lab. The inventive concepts disclosed herein can be used with different types of separable dental elements. The separable dental element can be any form of impression used in a dental lab to assist in creating and testing dental prostheses. A separable dental element can also be a dental prosthesis fabricated in the dental lab using a physical model made from the impression, a dental prosthesis newly fabricated, or an existing prosthesis being converted for screw attachment. A dental prosthesis is defined to include a single-tooth appliance such as a crown, or any multiple-tooth bridge or denture. These prostheses may incorporate copings to provide a separable interface to provide orientation with an appropriate abutment attached to a patient's jaw or gingiva. The abutments for use with the inventive concepts disclosed herein include screw threads to mount the prosthesis with copings onto the abutments. While the concepts describe female threads in the abutment mating with male threads on a mounting screw, this is for convenience in

disclosure. The inventive concepts could be applied with systems having male threads in the abutment engaging a screw with female threads for mounting the prosthesis. These are considered to be straightforward variations of the inventive concepts.

[0030] For the purposes of this disclosure, the abutments may be integral to the implants embedded into the patient's jaw or gingiva, or they may be separate units that are attached to the implants. The inventive concepts disclosed apply to both configurations.

[0031] For the purposes of this disclosure, an existing denture should be interpreted broadly to include any prosthesis that has been created prior to the use of the innovative systems and methods disclosed. An existing denture may be a loose denture that was worn by the patient prior to the installation of implants were installed, or it may be a new denture that is in the process of first fitting in the patient's mouth.

[0032] The systems and methods disclosed herein can be used with prostheses for attachment to both the upper and lower jaw. As a result, portions of the system that are oriented downward for the lower jaw will be oriented upward for the upper jaw and vice versa. For convenience, a disclosure of an embodiment of inventive concepts that is limited to a single jaw orientation, is considered to disclose an embodiment for the opposite jaw orientation. When referring to the perspective of a clinician, proximal portions are nearer to the clinician than distal portions. While a term such as top is the opposite of the term bottom, and proximal is the opposite of distal, their actual relative orientation will be determined by the context of their use. The term tissue-side is used interchangeably with intaglio to indicate the side of a prosthesis that is opposite the occlusal or cameo surface.

[0033] The inventive systems disclosed are beneficially applicable to screw-attached prostheses. Key benefits of screw-attachment are variable tightening torques and reversibility. The terms permanent, semi-permanent, definitive and final when referring to screw-attachment are used interchangeably in this disclosure. A conventional screw that is definitively attached can still be removed by accessing the screw and rotating it in the opposite direction that was used for attachment. For the purposes of screw-attached prostheses for this disclosure, the attachment is semi-permanent, permanent or definitive in the sense that frequent attachment and removal is not anticipated for normal use. In contrast, the temporary screw attachment is applied for a planned process duration or other anticipated interval. Removal of a semi-permanent or definitive screw is generally motivated by a problem or an opportunity for an improvement. Access to the screw to apply a tool for removal may require removal of material covering the screw for aesthetic reasons.

[0034] Other terms in the specification and claims of this application should be interpreted using generally accepted, common meanings qualified by any contextual language where they are used. The terms "a" or "an", as used herein, are defined as one or as more than one. The term "plurality", as used herein, is defined as two or as more than two. The term "another", as used herein, is defined as at least a second or more. The terms "including" and/or "having", as used herein, are defined as comprising (i.e., open language). The term "coupled", as used herein, is defined as connected, although not necessarily directly, and not necessarily mechanically. The terms “about” and “essentially” mean ±10 percent. Reference throughout this document to "one embodiment", "certain embodiments", and “an embodiment" or similar terms means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention.

Thus, the appearances of such phrases or in various places throughout this specification are not necessarily all referring to the same embodiment. Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner in one or more embodiments without limitation. The term "or" as used herein is to be interpreted as an inclusive or meaning any one or any combination. Therefore, "A, B or C" means any of the following: "A; B; C; A and B; A and C; B and C; A, B and C". An exception to this definition will occur only when a combination of elements, functions, steps or acts are in some way inherently mutually exclusive.

[0035] The drawings featured in the figures are for the purpose of illustrating certain convenient embodiments of the present invention and are not to be considered as limitation thereto. The term “means” preceding a present participle of an operation indicates a desired function for which there is one or more embodiments, i.e., one or more methods, devices, or apparatuses for achieving the desired function and that one skilled in the art could select from these or their equivalent in view of the disclosure herein and use of the term “means” is not intended to be limiting. Other objects, features, embodiments and/or advantages of the invention will be apparent from the following specification taken in conjunction with the following drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0036] FIG. 1 is a top exploded isometric view of a first embodiment of a system for aligning a dental implant abutment, coping and prosthesis for definitive screw-attachment.

[0037] FIG. 2 is a side plan view of a first embodiment of a system for aligning a dental implant abutment, coping and prothesis for definitive screw-attachment.

[0038] FIG. 3 is a top plan view of a first embodiment of a system for aligning a dental implant abutment, coping and prosthesis for definitive screw-attachment.

[0039] FIG. 4 is a side cross-sectional view of the system for aligning a dental implant abutment, coping and prosthesis for definitive screw-attachment along the line indicated in FIG. 3.

[0040] FIG. 5 is a side cross-sectional view of the embodiment of FIG. 4 attached to the jaw and prosthesis prior to the pick-up process.

[0041] FIG. 6 is a side cross-sectional view of the embodiment of FIG. 5 after the pick-up process.

[0042] FIG. 7 is a side cross-sectional view of the embodiment of FIG. 6 showing a drill bit creating a pilot hole for a definitive screw.

[0043] FIG. 8 is a side cross-sectional view of the embodiment of FIG. 7 showing a stepped drill bit creating a clearance for the head and shaft of a definitive screw.

[0044] FIG. 9 is side cross-sectional view of the embodiment of FIG. 8 showing the definitive screw holding the prosthesis to the implant.

[0045] FIG. 10 is an exploded top isometric view of a second embodiment of a system for aligning a dental implant abutment, coping and prothesis for definitive screw-attachment illustrating a single abutment and a temporary screw with breakaway tool.

[0046] FIG. 11 is an exploded side isometric view of the second embodiment of FIG. 10 prior to installation to the implant abutment.

[0047] FIG. 12 is an exploded side isometric view of the embodiment of FIG. 10 with the breakaway tool pushed onto the post and the coping placed on the implant abutment.

[0048] FIG. 13 is an exploded side isometric view of the embodiment of FIG. 10 schematically showing the tool being rotated to screw the post into the implant abutment.

[0049] FIG. 14 is an exploded side isometric view of the embodiment of FIG. 10 schematically showing the tool breaking away from the cap after the coping is secured on the abutment.

[0050] FIG. 15 is an exploded side isometric view of the embodiment of FIG. 10 schematically showing the prosthesis being marked for positioning a clearance hole.

[0051] FIG. 16 is a side isometric view of the marked prosthesis from FIG. 15.

[0052] FIG. 17 is a side isometric view of the marked prosthesis from FIG. 16 with blind clearance hole and boring tool.

[0053] FIG. 18 is an exploded side isometric view of the prepared embodiment of FIG. 17 as adhesive is schematically applied to the coping fixed to the abutment with the temporary screw.

[0054] FIG. 19 is a side view of the prosthesis in position for curing of the adhesive applied in FIG. 18.

[0055] FIG. 20 is a bottom side isometric exploded view of the coping incorporated in FIG. 19 being picked up as the prosthesis is removed from the implant abutment.

[0056] FIG. 21 is a top side isometric view schematically showing the post of the temporary screw being unscrewed from the implant abutment.

[0057] FIG. 22 is a top side isometric view of the implant abutment prepared for attachment of a prosthesis with a definitive screw.

[0058] FIG. 23 is a bottom isometric view of the prosthesis with picked-up coping from FIG. 20 being drilled from the bottom to provide clearance for the threaded shaft of a definitive screw following coping pick-up.

[0059] FIG. 24 is a top isometric view of the prosthesis with picked-up coping from FIG. 20 with a drill applied from the top to provide clearance for the definitive screw head.

[0060] FIG. 25 is top exploded isometric view of the prepared prosthesis from FIG. 24 with the definitive screw.

[0061] FIG. 26 is a top isometric view of the prepared prosthesis from FIG. 24 after attachment to the implant abutment with the definitive screw.

[0062] FIG. 27 is a schematic description of a process for aligning dental implant abutments, copings and a prosthesis for definitive screw-attachment.

[0063] FIG. 28 is an exploded bottom isometric view of a third embodiment of a system for aligning a dental implant abutment, coping and prosthesis for definitive screw-attachment with tool oriented for assembly.

[0064] FIG. 29 is an assembled bottom isometric view of the embodiment of FIG. 28 with temporary screw and coping inserted into tool.

[0065] FIG. 30 is a side view of the system of FIG. 29 after assembly with the implant abutment.

[0066] FIG. 31 is a cross-sectional view of the assembly of FIG. 30 along C-C.

[0067] FIG. 32 is a side view of the assembly of FIG. 28 after the pick-up process showing the removal end of the tool engaging the retained temporary screw post.

[0068] FIG. 33 is a cross-sectional of the assembly of FIG. 32 along D-D.

[0069] FIG. 34 is an exploded isometric view of another embodiment of a temporary screw of a system for aligning a dental implant abutment, coping and prosthesis for definitive screw-attachment.

[0070] FIG. 35 is an isometric view of the temporary screw of FIG. 34 from the screw thread end.

[0071] FIG. 36 is an isometric view of the temporary screw of FIG. 34 from the cap end.

[0072] FIG. 37 is a bottom isometric view of a jaw with multiple abutments in preparation of marking a prosthesis as part of the process for aligning a dental implant abutment, coping and prosthesis for definitive screw-attachment.

[0073] FIG. 38 is a top isometric view of the prosthesis of FIG. 37 showing abutment location markings.

[0074] FIG. 39 is a top isometric view of the prosthesis with clearances milled to receive copings for pick-up.

[0075] FIG. 40 is a bottom isometric view showing installed copings and the assembly of a coping to an implant abutment with a temporary screw and torque driver.

[0076] FIG. 41 is a top isometric view showing adhesive being dispensed in recesses of the prosthesis.

[0077] FIG. 42 is a bottom isometric view of the abutments with attached copings in the process of being positioned into the recesses of the prothesis after adhesive is dispensed.

[0078] FIG. 43 is a top isometric view of the copings attached to the prosthesis after adhesive curing and pick-up.

[0079] FIG. 44 is a bottom isometric view showing the removal of temporary screw posts from the implant abutments after the pick-up process.

[0080] FIG. 45 is a top view of a drill in position to create a pilot hole in the prosthesis of FIG. 43.

[0081] FIG. 46 is bottom view showing the pilot holes from the process of FIG. 45 extending through the prosthesis to exit on the occlusion side.

[0082] FIG. 47 is a bottom isometric view showing a counterbore positioned on the occlusion side of the prosthesis to provide clearance for the definitive screw.

[0083] FIG. 48 is a bottom isometric view illustrating a reamer positioned to clean residue from the bore.

[0084] FIG. 49 is a bottom isometric view of the prepared prosthesis with definitive mounting screws prior to fastening to the abutments.

[0085] FIG. 50 is a top isometric view corresponding to FIG. 49.

[0086] FIG. 51 is a top isometric view of an embodiment of a component suitable for use as a scan flag for digital capture and a laboratory analog for physical model creation.

[0087] FIG. 52 is a bottom isometric view of the component from FIG. 51.

[0088] FIG. 53 is a bottom isometric view showing the component of FIG. 51 positioned for screw attachment to the converted prosthesis of FIG. 49.

[0089] FIG. 54 is a top isometric view of FIG. 53.

[0090] FIG. 55 is a top isometric view showing the assembly of FIG. 54 mounted on a stand in preparation for scanning.

[0091] FIG. 56 is a side view of FIG. 55.

[0092] FIG. 57 is an isometric view of the assembly of FIG. 54 with reinforcing bars mounted prior to pouring of dental stone.

[0093] FIG. 58 is a schematic flow chart illustrating options for creating and attaching a permanent prosthesis.

[0094] FIG. 59 is an exploded isometric view of the torque driver shown in FIG. 40.

[0095] FIG. 60 is a top isometric view of the torque driver of FIG. 59 partially assembled.

[0096] FIG. 61 is a top isometric view of the post removal tool shown in FIG. 44.

[0097] FIG. 62 is a top isometric view of an embodiment of a temporary screw similar to FIG. 1 schematically illustrating axial motion of the cap away from the post threads from screwing after the coping contacts the abutment.

[0098] FIG. 63 is a top isometric view of the embodiment of FIG. 62 in which the temporary screw post end has become flush with the top of the cap.

[0099] FIG. 64 is a top isometric view of a temporary screw post embodiment having a cylindrical stem.

[0100] FIG. 65 is a top isometric view of a split temporary screw post embodiment having deflecting sections.

[0101] FIG. 66 is an isometric view of a temporary screw post embodiment having symmetric axial splines.

[0102] FIG. 67 is an isometric view of a temporary screw post embodiment having a weakened portion facilitating lateral movement during pick-up.

[0103] FIG. 68 is a bottom isometric view of a temporary screw embodiment having a spring cap.

[0104] FIG. 69 is a bottom isometric view of a one-piece temporary screw embodiment designed to fracture under axial loading.

[0105] FIG. 70 is a cross-sectional view of a temporary screw embodiment incorporating a rounded interface between cap and post facilitating pivotal movement as illustrated.

[0106] FIG. 71 is a cross-sectional view of a temporary screw embodiment incorporating a restricted interface between cap and post facilitating pivotal movement and protective film.

[0107] FIG. 72 is a cross-sectional view of a temporary screw embodiment incorporating a spring cap with preferential axial movement in the pick-up direction.

[0108] FIG. 73 is a cross-sectional view of a temporary screw embodiment incorporating a laminar cap fixed to the end of the post.

[0109] FIG. 74 is a cross-sectional view of a temporary screw embodiment incorporating a compliant interface between the cap and post.

[0110] FIG. 75 is a cross-sectional view of a temporary screw embodiment incorporating a split post that has deflecting sections with screw threads shaped to facilitate axial separation without unscrewing the post threads.

[0111] FIG. 76 is a cross-sectional view of a temporary screw embodiment incorporating an interface material between the cap and post.

[0112] FIG. 77 is a cross-sectional view of a temporary screw embodiment incorporating an O-ring interface between the cap and post.

[0113] FIG. 78 is a cross-sectional view of a temporary screw embodiment incorporating a cup-shaped interface material between the cap and post.

[0114] FIG. 79 is a bottom isometric view of a temporary screw embodiment incorporating a split collar cap.

[0115] FIG. 80 is a top isometric view of a temporary screw embodiment incorporating a planar spring that flexes when pulled perpendicular to the diameter indicated.

[0116] FIG. 81 is a top isometric view of a temporary screw embodiment incorporating a planar spring that flexes when pulled parallel perpendicular to the diameter indicated.

[0117] FIG. 82 is a cross-sectional view of an embodiment of a system for aligning a dental implant abutment, coping and prosthesis for semi-permanent screw-attachment in which the coping is held by mechanical interference to the proximal end of the threaded post.

[0118] FIG. 83 is a cross-sectional view of an embodiment of a system for aligning a dental implant abutment, coping and prosthesis for semi-permanent screw-attachment in which the coping has spring fingers holding the proximal end of the threaded post.

[0119] FIG. 84 is a cross-sectional view of an embodiment of a system for aligning a dental implant abutment, coping and prosthesis for semi-permanent

screw-attachment in which the coping has collet-type spring fingers holding the proximal end of the threaded post.

[0120] FIG. 84A is a top view of the embodiment of FIG. 84.

[0121] FIG. 85 is a cross-sectional view of an embodiment of a system for aligning a dental implant abutment, coping and prosthesis for semi-permanent screw-attachment in which the proximal end of threaded post has a slotted spring section holding the coping.

[0122] FIG. 86 is a cross-sectional view of an embodiment of a system for aligning a dental implant abutment, coping and prosthesis for semi-permanent screw-attachment in which a compressed ring holds the coping to the proximal end of the threaded post.

[0123] FIG. 87 is a cross-sectional view of an embodiment of a system for aligning a dental implant abutment, coping and prosthesis for semi-permanent screw-attachment in which a compressed ring with a u-shaped cross-section holds the coping to the proximal end of the threaded post.

[0124] FIG. 88 is a cross-sectional view of an embodiment of a system for aligning a dental implant abutment, coping and prosthesis for semi-permanent screw-attachment in which a thin cap fixes the coping to the proximal end of the threaded post.

[0125] FIG. 89 is a cross-sectional view of an embodiment of a system for aligning a dental implant abutment, coping and prosthesis for semi-permanent screw-attachment in which a filler material is placed in the bore of the coping at the proximal end of the threaded post.

[0126] FIG. 90 is a cross-sectional view of an embodiment of a system for aligning a dental implant abutment, coping and prosthesis for semi-permanent screw-attachment showing a tool engaging features of the coping to screw in the threaded portion of the post.

[0127] FIG. 91 is a bottom isometric view schematically illustrating the material removed from an existing denture necessary with inventive concepts disclosed in preparation for pick-up.

[0128] FIG. 92 is a top isometric view schematically illustrating the material removed from an existing denture necessary with inventive concepts disclosed in preparation for pick-up.

[0129] FIG. 93 is a bottom isometric view schematically illustrating the material removed from an existing denture necessary using prior art impression screw systems.

[0130] FIG. 94 is a top isometric view schematically illustrating the material removed from an existing denture necessary using prior art impression screw systems.

DETAILED DESCRIPTION OF THE INVENTION

[0131] FIG. 1 shows an exploded view of one embodiment of a temporary alignment system 12 for use in a direct coping pick-up process for screw attachment of a prosthesis. Implant abutment 8 has a distal end which may include attachment feature portion 135 illustrated as a screw thread for direct attachment to the patient's jaw and a proximal end with an abutment shaped to accommodate a coping 9. The abutment includes threaded section 18. The coping has a central bore 16 to accommodate screw fastening and may include ridges 17 or other structures or surface treatments to increase retention to the prosthesis with adhesive. The coping and abutment mating surfaces as shown in FIG. 1 are symmetrical. The inventive concepts of this disclosure may also be applied to abutment and coping systems that are keyed to restrict mating orientation. The coping may be mounted onto the abutment through rotation of a temporary adjustment screw comprising a threaded post 10 and cap 11. The cap

11 is mechanically attached to post 10 in a manner that allows relative axial motion with the application of a predetermined force. As illustrated in FIG. 1, cap 11 has a square central bore 13 that is press-fit onto a square portion 14 of post 10. The cap 11 temporarily retains coping 9 onto the implant abutment 8 during the pick-up process of the coping into the prosthesis with a force aligned directly along the same axis as the semi-permanent screw that will be used for definitive prosthesis mounting. The portion of the post engaging the abutment threads also prevents any pick-up material from contacting the abutment screw threads. After the coping is picked-up into the prosthesis, the cap and coping may be released from the abutment by applying an axial force. In the embodiment shown, the post threads 15 remain engaged with abutment threads 18 after the pick-up process. The post can then be removed from the abutment by unscrewing it. The prosthesis with embedded coping can be subsequently processed to accommodate semi-permanent screw attachment as will be described later.

[0132] FIGS. 2 and 3 show a side and top view of the assembled system of FIG. 1; FIG. 4 shows a cross-sectional view along the axis as indicated. As shown in FIG. 4, matching conical surfaces on the exterior of the implant abutment 8 and the interior of the coping 9 are engaged. The coping is pulled into alignment by an axial force from the lower surface of the cap 11 pushing against the upper surface of the coping from screwing the threads of post 10 into the implant abutment. The distal end of the abutment may be directly attached to the patient's jaw or attached to a separate implant attached to the jaw. The inventive concepts are not dependent upon the nature of the implant, so the distal end attachment feature 135 is represented schematically.

[0133] The capability for relative axial movement between the cap 11 and temporary attachment post 10 allows separation of the temporary attachment post from the cap without tools after retaining the coping onto the abutment during fitting and bonding of the coping into the prosthesis. These parts are

accurately aligned during the bonding process since the temporary post engages the abutment threads to provide an axial force holding the coping to the abutment just like the screw used for final attachment.

[0134] The cap may be sized to have an amount of press-fit mechanical interference to the temporary attachment post to provide an axial retention force of approximately 20 to 900 grams, this force being sufficient to retain coping 9 during assembly while allowing relatively easy pick-up removal of the coping and prosthesis from the temporary attachment post after assembly. The temporary attachment post 10 may include indicators (not shown) in the end by the cap 11 to provide intermediate visual and/or tactile feedback on the depth of threaded engagement of the post during screw attachment of the coping to the abutment.

[0135] In this embodiment, screw driving torque is provided by the square cross-section of the cap aperture and temporary attachment post. In the cross-sectional view of FIG. 4, the post 10 has been screwed in so that only a small beveled surface of the post extends above the top of the cap when the post threads bottom out in the abutment. During installation, this optional configuration provides feedback to the dental practitioner when the torque increases as the threads bottom. The square drive tool engagement can also be designed to disengage at a pre-designed minimum extension of the square post above the top of the cap. Alternatively, a tool with a specified maximum torque may be used to ensure engagement of the coping and abutment surfaces.

[0136] The screw driving torque function may be accomplished by engaging other features on the temporary attachment post such as hex or spline or asymmetric features. Alternately, the cap may be used to engage a screwdriver or other tool for torqueing. For example, in the case of a cylindrical temporary attachment post top portion, driving torque can be provided by the friction of the press-fit

between the cap and temporary attachment post. For example, a medium press-fit of a 3 mm diameter 1 mm thick nylon cap onto a 1.3 mm diameter stainless steel cylindrical rod may produce approximately 500 grams of axial retention force and 17 gram-cm driving torque. A typical screw thread size for appliances is m1.4 x 0.3. The retention/axial force of the cap to the temporary attachment post may be determined by the degree of press-fit and frictional properties between the cap and temporary attachment post, and/or spring features incorporated into the temporary attachment post and/or cap.

[0137] In actual trial installations, polymer caps of approximately 1.2 mm thickness press fit onto posts of approximately 1.4 mm diameter with cylindrical axial bores have been sufficient for installation and pick-up removal of a single prosthesis from multiple implant abutments in which the axes of the screw threads in the implant abutments are not mutually parallel.

[0138] The separable mechanical attachment means may include any combination of techniques, including frictional forces from interference, adhesives, waxes, chemical bonding, solders, elastically or inelastically deformable spring, snap or interlocking structures, thermally or electromagnetically fusible materials, fracturing structures, etc.

[0139] FIG. 5 through FIG. 9 show example cross-sectional views of some of the different stages of installation of the temporary fastener system into a denture. FIG. 5 shows a cross-sectional view of the assembly of the first embodiment during the initial phase of the coping pick-up process. As illustrated, the implant abutment 8 is attached to a schematic implant 70. The implant 70 has an interface 7 (shown schematically) that is attached to the patient's jawbone 22. The coping 9 is held against the implant abutment 8 through the temporary screw comprising the post 10 and cap 11. A blind clearance hole 5 in the prosthesis 3 is

sized to accommodate the coping and temporary screw. Pick-up material 71 is positioned in the clearance hole 5 to capture the coping in proper alignment within the prosthesis. After the pick-up material has set up, the prosthesis 3, coping 9 and temporary screw cap 10 assembly is pulled off the patient's jaw as shown by the arrows in FIG. 6. The coping 9 and cap 11 are released from the implant abutment 8 and post 10, while the threads of the post 10 keep it engaged in the implant abutment 8. The post 10 is subsequently removed to make the abutment threads 18 available for holding the prosthesis in proper alignment with a definitive screw.

[0140] The prosthesis/coping assembly must be processed after the pick-up process for screw attachment. A pilot hole is drilled with bit 72 from the bottom side of the assembly. As shown in FIG. 7, the diameter of the bit may be selected to use the interior bores of the coping and cap to act as guides for hand processing. Alternately, a drill guide may be employed that engages a portion of the interior of the coping may be used to align the pilot hole. The pilot hole provides guidance for a tool to provide clearance for the definitive screw shaft and head. FIG. 8 shows a stepped drill 73 that cuts both clearances in a single process. Alternatively, the shaft and head clearance may be drilled with two drills in two process steps. If desired, the cap 11 of the temporary screw can be fabricated of a material that is easier to drill than the coping material to provide feedback on the drill position. It has been found that it is possible to distinguish where the drill is positioned by feel at the interfaces between the pick-up adhesive and the top of the cap (as shown in FIG. 8) and the bottom of the cap and the top of the coping. Since pick-up material was blocked from entering the coping, drilling resistance decreases rapidly upon breaking through the bottom of the cap and entering the interior channel of the coping. Color differences in the materials can also be detected. Alternatively, a tool can be configured to fit within the bore of the coping to limit the depth of the drill.

[0141] Once clearance for the definitive screw has been made from the top of the prosthesis, the prosthesis is ready for mounting to the implant with definitive screw 75 as shown in FIG. 9. The screw clearance hole in the prosthesis may be filled with Teflon tape and color-matching composite materials for aesthetic purposes. In the illustrated embodiment, the coping bore has a shoulder to engage a flat surface on the underside of head of the screw. Alternate configurations are possible without deviating from the temporary screw system for coping pick-up disclosed.

[0142] FIG. 10 is another exploded isometric view of parts of an embodiment of the invention. In this example, cap 11 is integrated into a breakaway installation tool 18. The tool portion 19 may be used to install the temporary attachment post 10, and then section 19 broken away at mechanically weak separation feature 20, for example, when the post bottoms out in the abutment leaving the cap portion 11 in position. Alternatively, the tool can be designed to increase stress on the separation feature as the top of the post moves axially down relative to the weakened section. As illustrated, after the cap portion 11 breaks away from the tool portion 19, drive feature 21 in the tool portion may be used to remove the post 10 after the pick-up process. One or both ends of the tool may be shaped to subsequently engage and remove the temporary attachment post 10 after installation of coping 9 into the denture.

[0143] FIGS. 11-26 provide schematic isometric views of the process steps for using the elements of an exemplary embodiment introduced in FIG. 10 for a single implant system such as a crown. In FIG. 11, a schematic isometric view of a portion of the patient's jaw 22 is shown with an implant 70 (not shown) installed, and implant abutment 8 installed into the implant. The coping 9 is placed onto the implant abutment 8, the top portion of temporary attachment post 10 is assembled onto cap 11. The top portion of temporary attachment post 10 and cap 11 are configured such that there is a means to drive the temporary

attachment post into the abutment, while allowing axial movement of the cap 11 relative to the temporary attachment post axis, the cap/temporary attachment post interface having sufficient retention force to keep the coping in place on the abutment during subsequent installation steps, and the temporary attachment post being removable after picking up the coping into the prosthesis. Cap 11 may be attached to a break-away installation/removal tool 18.

[0144] FIG. 12 shows the coping 9 placed on the implant abutment 8 and the cap/tool 18 installed onto temporary attachment post 10. The coping-abutment surfaces may comprise a conical or spherical concave feature on the coping 9 that mates with a complementary feature on the top of the implant abutment 8, as illustrated. Alternatively, keying features may be employed to restrict relative rotational orientation, particularly in the case of single implants.

[0145] FIG. 13 shows the temporary attachment post being threaded into the implant abutment 8, through a clearance hole in the coping 9. The cap abuts the coping to secure the coping to the abutment. The cap 11 is free to move axially along the temporary attachment post with a frictional retaining force of the cap to the temporary attachment post. A known amount of retention force of the coping to abutment is provided by the design and materials used in the cap and temporary attachment post.

[0146] FIG. 14 shows the tool portion of the cap being removed after the cap has broken away; the tool may be used for removal of the temporary attachment post at a later step.

[0147] FIG. 15 shows marking of the position of the coping onto the appliance for drilling a recess for the coping in the prosthesis.

[0148] FIG. 16 shows the prosthesis with coping drilling location marking 23.

[0149] FIG. 17 shows the prosthesis after boring the cavity for the coping; the cavity for the coping may be accurately drilled slightly larger than the coping, without significant unwanted material removal from the prosthesis.

[0150] FIG. 18 shows pick-up material being applied to the coping and/or prosthesis after confirmation of freedom to provide proper occlusion during dry testing. Although not illustrated, the cavity of the prosthesis or the coping may optionally include features to provide venting of excess pick-up material if desired.

[0151] FIG. 19 shows the bonded coping being picked up into the prosthesis

[0152] FIG. 20 shows the prosthesis removed from the temporary attachment post; the temporary attachment post/cap design allows removal of the prosthesis from the temporary attachment post. The coping is now incorporated into the prosthesis.

[0153] FIG. 21 shows the temporary attachment post being removed with the tool portion of the cap.

[0154] FIG. 22 shows the abutment installed in the implant with the temporary attachment post removed.

[0155] FIG. 23 shows drilling a small guide-hole (for example 1-2 mm diameter), through the clearance hole of the coping, into and through the prosthesis. This guide hole provides a small reference hole for enlargement of the hole to accommodate the prosthesis retaining screw.

[0156] FIG. 24 shows enlarging the guide hole to a clearance hole for prosthesis retaining screw, approximately the diameter of the head of the retaining screw (e.g., 1.5-2.5 mm). The clearance hole would typically be drilled down to the top surface of the coping.

[0157] FIG. 25 shows the prosthesis being installed onto the implant abutment by placing the prosthesis coping onto the abutment and installing the prosthesis retaining screw.

[0158] FIG. 26 shows the assembled prosthesis on the implant.

[0159] FIG. 27 contains a summary of a generalized process extending the basic process described above for a prosthesis attached to multiple implant abutments.

[0160] Another embodiment of a prosthesis and implant alignment system and tool are shown in FIG. 28. In this case, the cap is in the form of a hex nut 63 that is press fit onto alignment post 62 to act as the temporary alignment screw. The drive tool 64 includes a concave hex socket 68 that fits temporary post nut 63, and coping retaining portion 69 that retains coping 61 with a slight interference fit. Thus, as shown in FIG. 29, the temporary screw comprising nut 63 with post 62 is engaged with the socket portion of the tool, and the coping 61 is retained in the tool. The coping is seated onto the abutment 60 by using the hex portion of the

driver to rotate the nut and engage the threads 66 on the temporary screw post 62. FIGS. 30 and 31 show an exterior and cross-sectional view of the mounting of the coping on the abutment with the tool. The tool may also have an integrated feature for removing the post as shown in FIG. 32. For example, FIG. 33 shows a tapering feature 170 on the narrow end of tool 64 which may be used to unscrew the post. FIG. 28 illustrates optional undercut 67 for stronger adhesive locking. Optional anti-rotation flat 65 is shown. Such an anti-rotation flat may be used on mating surfaces in circumstances in which there is a preferred orientation around the axis of the screw threads.

[0161] Another embodiment of the inventive concepts in which the cap of the temporary screw is shaped to engage the driving tool is shown in FIGS. 34-36. Cap 102 is mechanically attached to alignment post 101 at end portion 101A to form temporary alignment screw 100. This mechanical attachment may result from press-fitting a polymeric cap 102 onto a metal post 101 to provide adequate resistance to rotary slip to temporarily attach the coping to the implant abutment while still allowing relative axial movement during the pick-up process. The cap 102 may include a tapered surface 102B shaped to match the mating surface of an associated coping 112. A hexalobular internal (Torx) drive feature is shown in the end of the cap 102, although other bit socket shapes are possible. As previously discussed, other mechanical engagement means besides an interference fit are possible. The post may be made of different materials than these, or even be of unitary construction with weakened sections that fracture or otherwise breakaway under a desired pick-up axial force.

[0162] In a preferred embodiment the post 101 is made from stainless-steel or titanium, and the cap of polymer such as PEEK or acetal. The short length of the post and threaded fastener in this embodiment allows separation at high degrees of angularity of the assembled parts in use. This tolerance for off-axial removal has been found to be particularly advantageous when the prosthesis is to be definitively screw mounted to

multiple implant abutments. Testing has verified cap axial release forces of up to about 5 pounds and the application of torque to the cap of about 1.6 inch-ounces without slipping.

[0163] The general process for converting an existing removable denture for definitive screw attachment onto four implants with this embodiment is illustrated in FIGS. 37-50. This prosthesis may be, for example, a removable denture that was used prior to implant surgery or a duplicate of such an existing denture as described in US Provisional Patent Application 62/774,402 incorporated herein in its entirety.

[0164] FIG. 37 shows a schematic representation of a human jaw portion 106 with implant abutments 107 installed. It does not matter for this discussion if the abutments are separable from the implanted portion of the implant or not. Prosthesis 103 is shown with occlusion side 104 and intaglio side 105. Pick-up marking caps 108 are installed onto abutments 107. The location of implant abutments 107 is marked onto the prosthesis using customary methods by mating the prosthesis with the abutments. FIG. 38 shows the abutment positions 109 marked onto prosthesis 103. FIG. 39 shows the boring of blind holes 110 slightly larger than copings 112 in marked locations with burr tool 111.

[0165] FIG. 40 shows the installation of copings 112 onto abutments 107 using separable fastener assembly 100, and torque driver 113 (described in more detail later). The torque driver 113 prevents over-tightening of temporary screw 100 and possible separation of the cap 102 from the post 101 due to rotary motion. The cap 102 and/or post 101A of each separable fastener 100 may be mechanically captured or adhered to the coping 112, or may be designed to loosely fit into the bore of the coping as illustrated with axial force from tightening the separable fastener holding the copings to the abutments 107. The prosthesis is placed over the mounted copings to ensure proper fit.

[0166] FIG. 41 shows application of acrylic or other adhesive 144 into cavities 110 of prosthesis 103, which is subsequently fitted onto copings 112.

[0167] FIG. 42 shows prosthesis 103 being mated with copings 112. After the adhesive sets, the separable fasteners allow easy removal of the prosthesis from the abutments with the copings incorporated into the prosthesis. The angular tolerance for removing the prosthesis from multiple abutments allows applying pick-up forces sequentially around the edge of the prosthesis to work the caps 102 off the posts 101. The caps 102 remain in the prosthesis with the copings 112, while the posts 101 remain in the abutments.

[0168] FIG. 43 shows the prosthesis with incorporated copings 112 after the pick-up process.

[0169] FIG. 44 shows the removal of the threaded post 101 from the implant abutment with removal tool 115. This allows the implant abutment threads to be accessible for subsequent definitive screw attachment.

[0170] FIG. 45 shows the drilling of the small pilot hole 117 (e.g., using a drill bit 116 of approximately 1.4 mm diameter), from the intaglio side 105 of the prosthesis out through the occlusion side 104. It has been found that the bore of the coping 112 and the bore of the cap provide adequate guidance for this hole, although a tooling guide could readily be designed to mate with the particular coping used. The pilot hole is drilled completely through the prosthesis to the occlusion side 104 as shown in FIG. 46.

[0171] FIG. 47 shows enlarging of the pilot hole 117 to allow clearance for a prosthetic mounting screw 121. The clearance holes 119 are drilled down to the top of the coping using counterbore drill 118. This requires only a small diameter enlargement (for example, approximately 2.4 mm).

[0172] FIG. 48 shows a step of a final hand reaming with reamer 120 of the coping bore to clean out any debris or remaining material from the cap that would interfere with the definitive screw.

[0173] FIGS. 49 and 50 show the final installation of prosthesis 103 onto abutments 107 using definitive prosthetic screws 121. The screw holes may be subsequently filled to use the modified prosthesis depending upon the anticipated use as a short-term or more permanent prosthesis. This sequence of process steps essentially follows the material provided in FIG. 27.

[0174] Note that in the above procedure very little material is removed from the prosthesis during the coping pick-up installation process. The boring process in FIG. 39 need only be sufficient to provide clearance for the coping and temporary screw. Angular variation in the axes of the implant abutments does not appreciably increase the size of the cavity boring required in this closed tray process compared to the additional prosthesis material that must be removed with relatively long impression screws and sleeves in a conventional open tray conversion process for definitive screw attachment. FIGS. 91-92 provide a schematic comparison of the size of the recess borings required using the concepts disclosed compared to the prior art conversion process with larger through holes in FIGS. 93-94.

[0175] The converted prosthesis with copings and screw-access channels may also be used as an accurate digital scan model of abutment positioning for creating a new prosthesis. In this embodiment, dual purpose scan flag and lab analogs 122 shown in FIGS. 51-52 may be fastened to the provisional or duplicate prosthesis 103, for example, after the clearance hole cleaning shown in FIG. 48. Features that may be present on the scan-flag/analog include a scan-flag reference portion 123 near the top of the analog, reference scan-flag features such as flats 124, axial and radial retention feature 128, screw attachment 125 for scanning fixture and/or reinforcement wire attachment. The abutment features 126 are specific to various systems commercially available. The figures show a tapered abutment mating surface 126 and female thread 127.

[0176] FIGS. 53-54 show scan flag/analogs 122 attached to converted prosthesis 103 with copings 112 using definitive screws 121.

[0177] FIGS. 55-56 show converted prosthesis 103 with scan flags/analogs 122 mounted to fixture 130 by attaching one or more scan flags 122 to the base with adjustable means to orient the prosthesis properly for scanning. For illustration an approximate mounting angle of 45 degrees is shown. In this example, the converted prosthesis 103 is mounted to articulated arm 131 with screw 129 that fits into the threaded hole of scan-flag/analog 122. Base 132 is mounted onto the base of the scanning machine.

[0178] The provisional or duplicate prosthesis with attached scan flags/lab analogs is scanned into the design software. This process captures the accurate position of the implant multi-unit abutment relative to the soft tissues and it also captures the tested prosthetic contours to aid in the design of the definitive prosthesis. After the prosthesis has been scanned in, a physical model may optionally be created by creating a soft tissue moulage and pouring dental stone into the provisional or duplicate prosthetic utilizing the scan flags as the laboratory analogs.

[0179] FIG. 57 schematically shows the application of solder or brazing preforms 133 to attach reinforcement bars 134 prior to pouring dental stone. Preforms 133 may be inserted into holes in the scan-flag/analogs and heated to attach bars 134. Low-temperature solders, brazing compounds, and hot-melt or other adhesives may be utilized in a preform or dispensed method to increase the rigidity of the analog assembly prior to casting.

[0180] This method ensures a fast and efficient means of transferring all pertinent and relevant information from a converted denture required for designing a definitive prosthesis from digital scanning and creating the most accurate and precise physical

model that can be mounted in an articulator with the aid of a bite registration in preparation for post-processing of the machined prosthesis, for example to verify passivity of fit, occlusion, etc.

[0181] In addition to the screw attachment of the scan flags to the modified prosthesis, scan flags may be attached to the prosthesis with incorporated copings of FIG. 43 prior to the drilling operations shown in FIGS. 45-47. In this case, another embodiment of the scan flag (not shown) with a post feature equivalent to post feature 101A of separable screw would be inserted into copings 112 of the modified prosthesis and retained by the embedded cap 102. If the separable fastener uses a snap-fit feature to retain the cap to the post, drilling may not be required through the prosthesis to mount the scan flags or lab analogs to the prosthesis or to attach the modified prosthesis to the abutments after lab use. For example, US Provisional Patent Application 62/774,402 describes the use of spring fingers and O-rings for separable fastening of the coping to the abutment for lift-off, and the use of films to prevent adhesive from entering interior portions of the separable fastener. Scan flags and lab analogs may also be engaged with transferred copings using similar mounting features as the post used in the transfer pick-up process. The referenced patent application also includes separable systems in which the post attaches directly to the coping without a cap which may be applied for mounting scan flags or lab analogs as variations of the methods described above. Since the dimensions of the coping and its engagement with the abutment is precisely controlled, having snap-in scan flags engage with a cavity between the top of the coping and the separable cap or an internal groove or other feature of the coping may be desirable.

[0182] Variations of using the modified prosthesis as a digital scan model, or using the inventive concepts disclosed to create a permanent prosthesis will be recognized as possible to dental practitioners. For example, instead of using a dual-purpose scan flag and lab analog, single purpose scan flags can be mounted into the provisional prosthesis for scanning, and subsequently replaced with lab analogs prior to casting. In addition to the attachment of scan flags to a modified prosthesis for digitization, the separable fastener may be used to transfer a coping and cap to a new impression after implant surgery. A scan flag or lab analog may be attached and held to the impression

with transferred coping for digitization or casting by substituting the new impression for the modified prosthesis in any of the processes above. FIG. 58 describes a workflow for using the temporary alignment fasteners with a permanent prosthesis fabricated from a digital model based on an impression.

[0183] FIGS. 59-60 show an embodiment of a simple torque-driver 113 that can be used for the temporary coping attachment process discussed in reference to FIG. 40. Shaft assembly 135 contains a spring friction cylinder portion 141 and drive portion 138 designed to engage the temporary screw 100. Spring 136 has an interference fit with cylinder 141, and thus when spring 136 is rotated in the "unwind" direction of the spring, a designed amount of slip torque is present between the spring and cylinder. In the "wind" direction, the spring binds on the cylinder. This provides unequal drive torque capability in the two rotation directions. Slot 139 in drive cap 137 engages spring end 140, and snaps onto the end of the shaft assembly, thus when the cap is rotated in the clockwise direction, cylinder and drive slip at a known torque. When the cap is rotated in the counterclockwise direction, the spring binds on the shaft to provide a higher screw removal torque before slipping.

[0184] FIG. 61 shows an embodiment of a temporary screw post extractor 115 which may be used to remove post 101 after the pick-up process as shown in FIG. 44. The extractor utilizes a hollow metal tubular split-cylinder end portion 142 that deflects to grip the end of the temporary screw post 101, allowing removal of the separable fastener posts or other types of fasteners. FIG. 61 illustrates a hand-operated knurled end, but other torque tool systems known in the dental industry such as 3/32" friction and latch designs may be used.

[0185] FIGS. 62-63 schematically illustrate how the position of the temporary screw post 10 of the first embodiment relative to the implant abutment can be determined. As the temporary screw is rotated clockwise, the cap 11 will be pushed axially away from the screw threads of the post by the coping. The depth of threaded engagement and the

length of the temporary screw post 10 and cap can be designed to have the top of the post 10 coincide with the top of the cap 11 as shown in FIG. 63 when the temporary screw is properly positioned. At this point, a drive tool with a square socket cavity (not illustrated) would disengage from the temporary screw assembly since the post 10 would no longer extend into the tool socket cavity.

[0186] FIGS. 64-66 illustrate different embodiments of the end of the temporary screw post that engages the cap. FIG. 64 shows a modified version of the cylindrical post 101 designed for frictional engagement on cylindrical portion 85 with a cap having a circular bore similar to that shown in FIG. 34. In FIG. 65, the cylindrical post is slotted, and the resulting beam portions 86 sprung open to provide additional frictional retention of a cap through spring action with the deflecting beams. Various features such as symmetric axial splines 87 (FIG. 66), asymmetric splines or grooves, and textures may also be used to tailor driving torque and axial retention force of the cap to the temporary attachment post. Non-symmetric features may also be utilized to tailor different installation torque and extraction forces. Surface finish and coefficients of friction of the mating materials may also be used to control the driving and retention properties. Temporary attachment posts and caps may be made from metal and polymer materials such as titanium, stainless steels, nylon and PEEK and other non-corrosive biocompatible materials.

[0187] If additional off-axis accommodation is desired when extracting the temporary attachment post from the coping after pick-up, some flexibility may be incorporated into the temporary attachment post, such as the necked down portion 88 of the temporary attachment post shown in FIG. 67, which allows the temporary attachment post to flex slightly off-axis during the pick-up process. Under tension, the alignment of the temporary screw axis with this necked-down portion can be designed to align the axis of the implant abutment threads with the coping threads but allow some bending when the tension is released. Note that this alignment flexibility will generally not be required during the final screw attachment process. The final attachment process is more accommodating of axial misalignment of multiple abutments than the coping pick-up process. During pick-up, the prosthesis with copings incorporated must be removed

from all abutments simultaneously. For final attachment, each definitive screw is attached individually after the copings of the prosthesis are positioned on the implant abutments.

[0188] FIG. 68 shows an embodiment of a temporary screw cap 94 that includes spring features 95 that engage the outer diameter 96 of the temporary post. If desired the portion of the temporary screw cap with the spring features may be made of a different material than the remainder of the cap.

[0189] Although the temporary screw of FIG. 69 has a similar appearance to that shown in FIG. 68, it has distinct functionality. FIG. 69 shows an embodiment of a temporary alignment screw 58 having threaded portion 62, breakaway flange 60 and hex drive portion 61. The flange 60 pushes down on the top of the coping as the temporary alignment screw threads 62 are rotated into the implant abutment. The flange portion may be molded onto a temporary attachment post with threaded portion 62 and drive portion 61 by insert molding if different materials are desired. Preferable, all portions of the alignment screw are molded integrally of a single material. The cap and post do not slide axially relative to one another. Instead, small break-away tabs 59 in the flange portion are designed to yield under axial force during the prosthesis and coping assembly removal after the bonding step. The breakaway portions are designed to fracture at an axial force exceeding the force applied to align the coping to the implant abutment for pick-up.

[0190] FIG. 67 employed a temporary alignment screw post with a waist that can bend during prosthesis removal in the pick-up process. It is also possible to provide additional off-axis accommodation during coping pick-up with temporary screws that do not bend. For example, in FIG. 70, a temporary alignment screw post 25 includes a rounded portion 27 that bears against the central straight bore of cap 26. FIG.71 shows a tapered profile 29 on cap 30 which engages a straight cylindrical portion of post 28. It is preferable to prevent the incursion of adhesive in the gaps between the post and cap

that allow the post to pivot. FIG. 71 includes a thin protective film 56 for this purpose. This film should be chosen to deform easily when the post is pivoted.

[0191] FIG. 72 shows a thin retaining ring 32 that engages temporary attachment post 31. The retaining ring 32 also provides a one-way insertion direction of temporary attachment post 31. This preferential insertion direction also corresponds to the relative motion of the post and retaining ring for release in the pick-up process.

[0192] FIG. 73 shows another embodiment of a temporary alignment screw that does not have relative axial sliding between the post and cap. In this embodiment a thin retainer 35 that may be comprised of a metallic or polymer sheet is attached to the top portion of temporary attachment post 33 and optional cap 34. The sheet 35 may be attached to temporary attachment post 33 using adhesives, plastic or metal welding, etc. After the adhesive has cured holding the coping to the implant abutment, the mechanical connection between the post and cap is overcome by axial force in the pick-up process. The mechanical connection can be designed to fail by adhesive failure or by fracture of the joint or the sheet 35.

[0193] FIG. 74 shows another embodiment of a temporary alignment screw without relative sliding between the cap portion and the post portion. In this embodiment, a compliant or frangible portion of the post 37 is used to attach a cap 38 to the post. Under tension, the cap portion 38 holds the coping in position against the abutment for pick-up into a prosthesis. Compliant portion 37 may be for example an elastomeric material to provide some angular motion during prosthesis removal after the pick-up material sets. The compliant portion 37 itself or one of its interfaces with the cap or post may provide a separable interface with controlled axial breakaway force. Other methods of separating a compliant portion may include exposure of compliant portion 37 made from a material easily affected by heat, any wavelength of electromagnetic energy, or a chemical reaction that may be applied externally or as part of the pick-up process.

[0194] The inventive concepts disclosed are not meant to be restricted to a temporary attachment post with standard screw threads that both engage and disengage the threads in the implant abutment through rotations. For example, alternate separable temporary attachment posts embodiments are possible providing features that allow the post to removably hold the coping to the abutment by other means than a separable cap. For example, as shown in FIG. 75 an alignment fastener 39 may contain a separable threaded or serrated portion 40 that engages the screw threads in the abutment for pick-up, but that will release with axial force after. FIG. 75 shows a temporary attachment post 39 having a slot 41 and asymmetric threads or serrations 40 that allow the temporary attachment post to be inserted through rotation for alignment for coping pick-up but may be subsequently extracted with a separation force in the axial direction. Although the threads could be designed to provide engagement with the implant abutment threads through axial motion in the opposite direction to the arrow shown in FIG. 75, rotation to a design torque on engagement is generally preferred. If the post 39 is designed to be pulled out of the abutment during the coping pick-up process, it will subsequently need to be removed from flange 42 and the prosthesis assembly. Since there is no processing impact on patient comfort, higher mechanical forces or a broader range of energy or chemical processing may be employed to remove the post from the prosthesis after coping pick-up.

[0195] Further permutations of the separable alignment screw features disclosed above are possible. FIG. 76 shows an embodiment where axial flexibility and/or controlled retention between cap 44 and temporary attachment post 43 is provided by an interface material 45 such as adhesives, silicones, and elastomeric materials contained in the space between the bore of the cap 44 and the post 43. FIG. 77 shows cap 47 retained with an O-ring 48 held in grooves in the cap 47 and temporary attachment post 46. FIG. 78 shows a cup-shaped interface material 57 located within the bore of the cap 44 and extending over a portion of the end of the post 43. FIG. 79 shows a split-collar feature 51 on cap 50 which presses onto the temporary attachment post 49. FIGS. 80 and 81 show alternate designs of flexure beam features in caps gripping a post. In FIG. 80, the pressure on the post 49 is reduced by pulling the cap 52 perpendicular to a diagonal of the cap as indicated by the arrows. In FIG. 81, the pressure on the post 49

is reduced by pulling in opposite directions with moment arms as shown to open the spring.

[0196] It is understood that the concept of the temporary attachment of the coping with the abutment with an axially separable temporary post is not dependent upon having a separate cap 11 or nut 63 on the post. If desired the cap or nut can be eliminated and the coping may be directly fixed and axially separable from the temporary attachment post. That is, the coping can be designed to have an equivalent mechanical interface to the post as the caps in the embodiments above. The mechanical interface between the coping and post may be tailored to provide equivalent rotational engagement and relative axial movement above a designed minimum axial force.

[0197] Example embodiments of the coping and post being the separable components include the following:

[0198] FIG. 82 shows temporary attachment post 71, engaging an interference fit of coping 72 at a position above the threaded portion. Metal, metal-reinforced, ceramic, and polymer copings, posts and fasteners may be included in this and other embodiments. Any of the parts may have surface treatments to control friction or adhesion.

[0199] FIG. 83 shows temporary attachment post 71 engaging integral spring-finger features 78 of coping 73.

[0200] FIG. 84 shows a temporary attachment post 71 engaging collet-type spring fingers 77 of coping 74, these collet-type features may be formed using slots in the coping 74 as shown in FIG. 84A.

[0201] FIG. 85 shows a slotted spring feature 79 formed in the temporary attachment post 76. The spring-features engage a smaller bore portion 90 of the coping 75. Such features may be of varied shapes including slots, eyelets, swaged portions, tubular swaged parts, etc. A film 56 (not shown) may be used to prevent the ingress of pick-up material into any voids at the top of the post/coping assembly similar to that shown in FIG. 71.

[0202] FIG. 86 shows temporary attachment post 71 and coping 75 engaged using an O-ring or washer 80. Such washers may be elastomers, polymers, metals, etc. and may be forms in varied shapes, such as the u-shaped retainer 81 of FIG. 87.

[0203] FIG. 88 shows temporary attachment post 71 retained to coping 75 using a sheet cap 82. Sheet cap 82 may be a tape, or other polymers or metals joined using adhesives, thermal and ultrasonic bonding, welding, and brazing, etc. This is similar to the embodiment shown in FIG. 73, except the sheet cap 82 does not have thicker cap element 34.

[0204] FIG. 89 shows temporary attachment post 71 retained using a filler material 83 in the counterbore of coping 75. Fillers may include a variety of polymer adhesives or fillers, such as silicones, acrylics, epoxies, and/or soft metallic materials. Since the coping 75 in this embodiment is fixed to the post 71, the mating surfaces of the coping 75 and implant abutment must allow relative rotational motion until the predetermined torque is achieved.

[0205] Installation of these embodiments may also be accomplished with simple polymer or metal tools 84, for example, as shown in FIG. 90 that engage the flats or other features of the coping 75, and/or of features on top of the threaded post 71.

[0206] Although the descriptions above use rotational engagement of the bottom of the post with internal threads of the abutment as a preferred approach, this is not meant to

be limiting. Alternate approaches for engaging a temporary attachment post with abutment threads through axial insertion without rotation are considered to be part of this disclosure. For example, the split post bottom structure shown in FIG. 75 which allows axial extraction can also be used for axial insertion. Similarly, an interference fit between the bottom of the post with the threads may also be designed to provide sufficient engagement to provide adequate alignment and fixing of the coping for the pick-up bonding process described earlier. For non-rotary extraction of the post, it is not necessary to have the extraction force of the post-abutment thread interface greater than the force required for relative movement of the coping or cap with the upper end of the post. That is, if the temporary attachment post remains fixed to the coping during the pick-up step, the post can be removed from the dental appliance after removal from the patient's mouth.

[0207] Although axially symmetric interfaces between coping and abutment have been described for most embodiments, the inventive concepts may also be applied to asymmetric abutments and copings as long as the coping doesn't need to rotate on the implant abutment as noted, for example, with the embodiment of FIG. 89 .

[0208] Various embodiments have been described to illustrate the disclosed inventive concepts, not to limit the invention. Combining inventive elements of one or more of the embodiments with known materials, components and techniques in dental science to create further embodiments using the inventive concepts is considered to be part of this disclosure.

[0209] Any of the embodiments may contain a film or deposited material on top of the cap and temporary attachment post to prevent adhesion to the temporary attachment post of materials used for pick-up, as shown in the film 56 of FIG. 71.

[0210] Temporary attachment posts may be rotationally driven into the abutment threads using either the cap, coping or the temporary attachment post itself. Temporary attachment posts and caps may have varied drive features such as male or female

knurls, hex, spines, spanner notches/holes. These design alternatives are driven by functional requirements of a particular implementation.

[0211] Other means of attaching/joining a secondary separable portion include insert-molding, use of adhesives, waxes, solders or other metallic materials, heat-staking, and ultrasonic bonding.

[0212] Break-away portions may also be formed by two-shot molding, dispensing or otherwise placing a secondary mechanically, thermally, or electromagnetically fusible material on a portion of the fastener to provide the break-away function.

Thin-film or thick-film metallic and polymer coatings may be applied to portions of the fastener to tailor friction and insertion and extraction forces, enhance adhesion of pick-up materials, and other properties such as corrosion-resistance.

Claims

We claim:

1. A dental system for attachment of a coping to a threaded implant abutment comprising:

    a coping having a proximal end with an aperture sized to allow a shaft portion of a definitive screw to pass through ; and

    an implant abutment having helical threading for securing the coping with a definitive screw; and

    a definitive screw having a proximal head end having a tool interface and a distal post portion having threads for securing the coping to the implant abutment after processing; and

    a temporary screw having an axis with a length measured along the axis and a width measured perpendicular to the axis, the temporary screw comprising:

        a proximal head portion with a width larger than the coping aperture; and

        a distal shaft portion shaped for rotary engagement with the implant abutment threads;

    wherein rotating the temporary screw to engage the shaft portion of the temporary screw with the implant abutment threads through an engagement depth and to a predetermined torque causes the head portion of the screw to hold the coping into alignment with the implant abutment for processing, and wherein an axial force in the proximal direction releases the coping from the implant abutment, and wherein the shaft portion does not contact the implant abutment threads continuously above the most distal engagement position.

2. The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the temporary screw shaft includes a narrower region having a width that is less than the width of the temporary screw shaft threaded region, and wherein the narrower region is located between the distal end of the temporary screw head and the proximal end of the temporary screw shaft threading.

3. The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the temporary screw shaft comprises asymmetric threading.

4. The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the axial release force is applied through a pick-up process in which the coping is adhered to a separable dental element.

5. The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the axial release force is less than about 5 pounds.

6. The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the temporary screw shaft threading is not a continuous helical structure over the engagement depth.

7. The dental system for attachment of a coping to a threaded implant abutment of Claim 6 wherein the definitive screw post threading comprises a continuous symmetrical helical form.

8. The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the temporary screw shaft threading deforms under the axial force to release the coping.

9. The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein only mechanical energy is applied to release the coping.

10. The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the temporary screw shaft comprises an open space located toward the axis from the threading.

11. The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the temporary screw shaft threading makes contact with the implant abutment threading over a temporary screw threading contact area when holding the coping against the implant abutment and the definitive screw post makes contact with the implant abutment threading over a definitive screw threading contact area when holding the coping against the implant abutment, and wherein the temporary screw threading contact area is less than the definitive screw threading contact area.

12. The dental system for attachment of a coping to a threaded implant abutment of Claim 11 wherein the volume of the definitive screw post material located distally of the

proximal end of the implant abutment threading when holding the coping against the implant abutment is greater than the volume of the temporary screw shaft material holding the coping against the implant abutment when holding the coping against the implant abutment.

13. A dental system for attachment of a coping to a threaded implant abutment for pick-up processing comprising:

a threaded implant abutment, and

a coping having a proximal end with a central aperture, and

a temporary screw having a longitudinal axis with a length measured along the axis and a width measured perpendicular to the axis comprising:

a head with a proximal end having a drive tool interface for rotating the temporary screw to a predetermined torque and wherein the head portion does not fit through the central aperture of the coping, and

a shaft having an axis with a length measured along the axis and a width measured perpendicular to the axis comprising:

a distal portion having shaft threading with a shaft threading width that fits within the central aperture, and

a proximal portion having a width smaller than the shaft threading width, and

wherein inserting the shaft of the temporary screw into the coping central aperture and rotating the temporary screw to a predetermined torque aligns and seats the coping with the implant abutment for pick-up processing, and wherein applying an axial force above a predetermined value in the proximal direction releases the coping and temporary screw from the implant abutment.

14. The dental system for attachment of a coping to a threaded implant abutment for pick-up processing of Claim 13 wherein the shaft threading is asymmetrical.

15. The dental system for attachment of a coping to a threaded implant abutment for pick-up processing of Claim 14 wherein the asymmetrical threading allows axial movement of the shaft in the proximal and distal directions relative to the implant abutment threading

when an axial force is applied above a threshold force for movement in each direction and wherein the axial force threshold for movement is smaller in the proximal direction than in the distal direction.

16. The dental system for attachment of a coping to a threaded implant abutment for pick-up processing of Claim 13 wherein the distal portion of the shaft deforms during the axial release.

17. The dental system for attachment of a coping to a threaded implant abutment for pick-up processing of Claim 16 wherein the distal portion of the shaft includes an open space for shaft deformation towards the axis.

18. A dental system for attachment of a coping to a threaded implant abutment comprising:

an implant abutment having symmetric helical threading for a definitive screw; and

a definitive screw having an axis with a length measured along the axis and a width measured perpendicular to the axis, the definitive screw having a proximal head end having a tool interface and a distal post portion having threading matching the implant abutment threading; and

a coping having a proximal end with an aperture, wherein the aperture is larger than the definitive screw post and smaller than the definitive screw head; and

a temporary screw having an axis with a length measured along the axis and a width measured perpendicular to the axis, the temporary screw comprising:

a proximal head portion with a width larger than the coping aperture; and

a distal shaft portion with threading that is shaped differently from the definitive screw threading;

wherein rotating the temporary screw to engage the shaft portion of the temporary screw with the implant abutment threads to a predetermined torque causes the head portion of the temporary screw to hold the coping into alignment with the implant abutment, and wherein an axial force in the proximal direction from pick-up processing releases the coping and temporary screw from the implant abutment.

19. The dental system for attachment of a coping to a threaded implant abutment of Claim 18 further comprising a temporary screw torque driver, wherein the temporary screw torque driver comprises:

    a spring friction cylinder, and

    a drive cap, and

    a coil spring,

    wherein the torque driver limits the torque applied to the temporary screw to the predetermined torque.

20. The dental system for attachment of a coping to a threaded implant abutment of Claim 18 wherein the temporary screw threading is asymmetric.

21. The dental system for attachment of a coping to a threaded implant abutment of Claim 18 wherein the temporary screw can be inserted into the implant abutment threading with an axial force in the distal direction, and wherein the axial force in the distal direction needed for insertion is higher than the axial force in the proximal direction needed for release.

22. The dental system for attachment of a coping to a threaded implant abutment of Claim 18 wherein the width of the threaded region of the temporary screw shaft is smaller than the width of the threaded region of the definitive screw post.

23. The dental system for attachment of a coping to a threaded implant abutment of Claim 18 wherein the shaft of the temporary screw has a portion with a smaller width than the threaded region of the shaft of the temporary screw and wherein the smaller width portion is located between the head and the threaded region.

24. The dental system for attachment of a coping to a threaded implant abutment of Claim 18 wherein the threading of the temporary screw deforms during the release of the temporary screw from the implant abutment threading.

25. The dental system for attachment of a coping to a threaded implant abutment of Claim 18 wherein the temporary screw shaft has a hollow portion and wherein a portion of the temporary screw shaft deflects into the hollow portion when the axial force in the proximal direction is applied.

26. A dental system for attachment of a coping to a threaded implant abutment comprising:

an implant abutment having female threading having an implant abutment thread profile; and

a definitive screw having a longitudinal axis and a length measured along the axis and a width measured perpendicular to the axis, the definitive screw comprising:

a shaft with male threading, wherein the male threading profile matches the implant abutment thread profile; and

a head with a definitive screw drive interface; and

a coping having a proximal end with an aperture sized to allow the definitive screw shaft to pass through; and

a temporary screw having a longitudinal axis and a length measured along the axis and a width measured perpendicular to the axis, the temporary screw comprising:

a post with male threading, wherein the male threading profile does not essentially match the male threading profile of the definitive screw shaft, and wherein the coping aperture allows the post to pass through; and

a head with a temporary screw drive interface; and

wherein the temporary screw holds the coping in position on the implant abutment for pick-up processing by rotating the post threads into the implant abutment threads to a predetermined pick-up processing torque and wherein the post threads release from the implant abutment threads with a predetermined axial pick-up force in the proximal direction during pick-up processing.

27. The dental system for attachment of a coping to a threaded implant abutment of claim 26 wherein the width of the temporary screw post threading is smaller than the width of the definitive screw shaft threading.

28. The dental system for attachment of a coping to a threaded implant abutment of claim 26 wherein the proximal flank of the temporary screw post threading profile is at a smaller

angle relative to the longitudinal axis than the proximal flank of the definitive screw shaft threading profile.

29. The dental system for attachment of a coping to a threaded implant abutment of claim 26 wherein the definitive screw comprises a metallic material and the temporary screw comprises a polymeric material.

30. The dental system for attachment of a coping to a threaded implant abutment of claim 26 wherein a definitive screw that is rotated into the implant abutment and torqued to the pick-up processing torque does not release from the implant abutment threading with the application of the predetermined axial pick-up force.

Straumann USA Exhibit 1015

Doc Code: PA..
Document Description: Power of Attorney

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NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	
Filing Date	2023-06-03
First Named Inventor	Brandon D Kofford
Title	SCREW-ATTACHED PICK-UP DENTAL COPING SYSTEMS AND METHODS
Art Unit	
Examiner Name	
Attorney Docket Number	SDC010

SIGNATURE of Applicant or Patent Practitioner

Signature	/Daniel John Whittle, #54,537/	Date (Optional)	
Name	Daniel John Whittle	Registration Number	54,537
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ *Total of 2 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 000112823

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

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OR

Firm or Individual Name					
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Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

☑ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☐ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature	/Charles Rudisill/	Date (Optional)	
Name	Charles Albert Rudisill		
Title	president		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

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No more than ten (10) patent practitioners total may be appointed as set forth below by name and registration number. This page need not be submitted if appointing the Patent Practitioner(s) associated with a Customer Number (see form PTO/AIA/82B):

Name	Registration Number

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The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	SCREW-ATTACHED PICK-UP DENTAL COPING SYSTEMS AND METHODS

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [■] The attached application, or
- [ ] United States application or PCT international application number _____

  filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

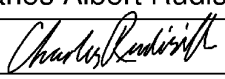
I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Charles Albert Rudisill Date (Optional) :_____

Signature: 

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Doc Code: TRACK1.REQ
Document Description: TrackOne Request

PTO/AIA/424 (04-14)

CERTIFICATION AND REQUEST FOR PRIORITIZED EXAMINATION UNDER 37 CFR 1.102(e) (Page 1 of 1)

First Named Inventor:	Kofford, Brandon Dale	Nonprovisional Application Number (if known):	
Title of Invention:	SCREW-ATTACHED PICK-UP DENTAL COPING SYSTEMS AND METHODS		

APPLICANT HEREBY CERTIFIES THE FOLLOWING AND REQUESTS PRIORITIZED EXAMINATION FOR THE ABOVE-IDENTIFIED APPLICATION.

1. The processing fee set forth in 37 CFR 1.17(i)(1) and the prioritized examination fee set forth in 37 CFR 1.17(c) have been filed with the request. The publication fee requirement is met because that fee, set forth in 37 CFR 1.18(d), is currently $0. The basic filing fee, search fee, and examination fee are filed with the request or have been already been paid. I understand that any required excess claims fees or application size fee must be paid for the application.
2. I understand that the application may not contain, or be amended to contain, more than four independent claims, more than thirty total claims, or any multiple dependent claims, and that any request for an extension of time will cause an outstanding Track I request to be dismissed.
3. The applicable box is checked below:

I. ☑ Original Application (Track One) - Prioritized Examination under § 1.102(e)(1)

i. (a) The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a). This certification and request is being filed with the utility application via EFS-Web.

---OR---

(b) The application is an original nonprovisional plant application filed under 35 U.S.C. 111(a). This certification and request is being filed with the plant application in paper.

ii. An executed inventor's oath or declaration under 37 CFR 1.63 or 37 CFR 1.64 for each inventor, **or** the application data sheet meeting the conditions specified in 37 CFR 1.53(f)(3)(i) is filed with the application.

II. ☐ Request for Continued Examination - Prioritized Examination under § 1.102(e)(2)

i. A request for continued examination has been filed with, or prior to, this form.
ii. If the application is a utility application, this certification and request is being filed via EFS-Web.
iii. The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a), or is a national stage entry under 35 U.S.C. 371.
iv. This certification and request is being filed prior to the mailing of a first Office action responsive to the request for continued examination.
v. No prior request for continued examination has been granted prioritized examination status under 37 CFR 1.102(e)(2).

Signature /Daniel John Whittle/	Date June 1, 2023
Name (Print/Typed) Daniel John Whittle	Practitioner Registration Number 54,537

Note: *This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. Submit multiple forms if more than one signature is required.**

☑ *Total of 1 forms are submitted.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Straumann USA Exhibit 1015

PTO/AIA/01 (06-12)
Approved for use through 01/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	SCREW-ATTACHED PICK-UP DENTAL COPING SYSTEMS AND METHODS

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [■] The attached application, or
- [ ] United States application or PCT international application number _____

  filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

LEGAL NAME OF INVENTOR

Inventor: Brandon Dale Kofford Date (Optional): 2023-05-31

Signature: /Brandon Dale Kofford/

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

This collection of information is required by 35 U.S.C. 115 and 37 CFR 1.63. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 1 minute to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Privacy Act Statement

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4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
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7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
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UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
18/328,730	06/03/2023		1256	SDC010	30	4

CONFIRMATION NO. 2867

112823
Patent Leverage LLC
1229 Modoc Drive
Bellingham, WA 98229

FILING RECEIPT

OC00000058592894

Date Mailed: 06/22/2023

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Brandon Dale Kofford, Apex, NC;
Charles Albert Rudisill, Apex, NC;

Applicant(s)

Brandon Dale Kofford, Apex, NC;
Charles Albert Rudisill, Apex, NC;

Power of Attorney: The patent practitioners associated with Customer Number 000112823

Domestic Priority data as claimed by applicant

This application is a CON of 17/691,108 03/09/2022
and is a CON of 16/596,361 10/08/2019 PAT 11,311,354
and claims benefit of 62/742,942 10/09/2018
and claims benefit of 62/774,402 12/03/2018
and claims benefit of 62/818,082 03/13/2019

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: No

Permission to Access Search Results: No

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 06/22/2023
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 18/328,730**
Projected Publication Date: Request for Non-Publication Acknowledged
Non-Publication Request: Yes
Early Publication Request: No
**** SMALL ENTITY ****
Title

Screw-attached Pick-up Dental Coping System and Methods

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific

countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

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The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop

technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 18/328,730

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	64		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	280		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	320		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	30 minus 20 =	* 10	x 40 =	400	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	4 minus 3 =	* 1	x 192 =	192			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			0			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	856		TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)	OR	RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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United States Patent and Trademark Office
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/328,730	06/03/2023	Brandon Dale Kofford	SDC010	2867

112823 7590 07/19/2023

Patent Leverage LLC
1229 Modoc Drive
Bellingham, WA 98229

EXAMINER	
CENTRAL, DOCKET	

ART UNIT	PAPER NUMBER
OPAP	

MAIL DATE	DELIVERY MODE
07/19/2023	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Decision Granting Request for Prioritized Examination (Track I)	**Application No.** 18/328,730	**Applicant(s)** Kofford et al.	
	Examiner FIKIRTE A GEREMEW	**Art Unit** OMBL	**AIA (FITF) Status** Yes

1. THE REQUEST FILED 03 June 2023 IS **GRANTED** .

The above-identified application has met the requirements for prioritized examination

A. ☑ for an original nonprovisional application (Track I).
B. ☐ for an application undergoing continued examination (RCE).

2. **The above-identified application will undergo prioritized examination**. The application will be accorded special status throughout its entire course of prosecution until one of the following occurs:

A. filing a **petition for extension of time** to extend the time period for filing a reply;

B. filing an **amendment to amend the application to contain more than four independent claims, more than thirty total claims** , or a multiple dependent claim;

C. filing a **request for continued examination** ;

D. filing a notice of appeal;

E. filing a request for suspension of action;

F. mailing of a notice of allowance;

G. mailing of a final Office action;

H. completion of examination as defined in 37 CFR 41.102; or

I. abandonment of the application.

Telephone inquiries with regard to this decision should be directed to FIKIRTE GEREMEW at (703) 756-1930. In his/her absence, calls may be directed to Petition Help Desk at (571) 272-3282.

/FIKIRTE A GEREMEW/ PROGRAM SUPPORT ASSISTANT, OMBL	

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/328,730	**08/01/2023 01:49:14 PM ET**	**SDC010**

Title of Invention

Screw-attached Pick-up Dental Coping System and Methods

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	2867	FILED BY	Daniel Whittle
PATENT CENTER #	62540405	FILING DATE	06/03/2023
CUSTOMER #	112823	FIRST NAMED INVENTOR	Brandon Dale Kofford
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	-

Documents

TOTAL DOCUMENTS: 1

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
sb0439.pdf	2	Internet Communications Authorization	208 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
sb0439.pdf	4E13C528F8FB1294FDCB63065200196A3BC8BA974A724E1A92C3B5FA25F29ED3B20073D04474260BA9E60A7C26F17F6443168A6EC5040BDB4CC526DB0FFE3669

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized

by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Doc Code: ECOMM.AUTH/ECOMM.WTDW
Doc Description: Internet Communications Authorization/Internet Communications Authorization Withdrawal

PTO/SB/439 (11-15)

AUTHORIZATION FOR INTERNET COMMUNICATIONS IN A PATENT APPLICATION OR REQUEST TO WITHDRAW AUTHORIZATION FOR INTERNET COMMUNICATIONS

Application No.	18/328,730
Filing Date	06/03/2023
First Named Inventor	Kofford, Brandon Dale
Art Unit	3772
Examiner Name	Courtney Huynh
Practitioner Docket No.	SDC010

To: Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

I. To authorize permission for Internet Communications.

☒ Recognizing that Internet communications are not secure, I hereby authorize the USPTO to communicate with the undersigned and practitioners in accordance with 37 CFR 1.33 and 37 CFR 1.34 concerning any subject matter of this application via video conferencing, instant messaging, or electronic mail. I understand that a copy of these communications will be made of record in the application file. (MPEP 502.03)

II. To withdraw authorization for Internet Communications.

☐ The authorization given on _____, to the USPTO to communicate with the undersigned and any practitioner in accordance with 37 CFR 1.33 and 37 CFR 1.34 concerning any subject matter of this application via Internet communications such as video conferencing, instant messaging, or electronic mail is hereby withdrawn. I understand that the withdrawal is effective when approved rather than when received.

I am the

☐ applicant.

☒ attorney or agent of record. Registration number 54,537.

☐ attorney or agent acting under 37 CFR 1.34. Registration number _____.

/Daniel John Whittle/ — Signature

08/01/2023 — Date

Daniel John Whittle — Typed or printed name

360-714-0777 — Telephone Number

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Juristic entities must be represented by a patent practitioner (see 37 CFR 1.31, which is applicable to any paper filed on or after September 16, 2012, that is presented on behalf of a juristic entity, regardless of application filing date). Submit multiple forms if more than one signature is required, see below*.

☐ * Total of 1 forms are submitted.

Straumann USA Exhibit 1015

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The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Straumann USA Exhibit 1015

UNITED STATES PATENT AND TRADEMARK OFFICE

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United States Patent and Trademark Office
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/328,730	06/03/2023	Brandon Dale Kofford	SDC010	2867

112823 7590 08/07/2023

Patent Leverage LLC
1229 Modoc Drive
Bellingham, WA 98229

EXAMINER	
HUYNH, COURTNEY NGUYEN	
ART UNIT	PAPER NUMBER
3772	
MAIL DATE	DELIVERY MODE
08/07/2023	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

PTOL-90A (Rev. 04/07)

Office Action Summary	Application No. 18/328,730	Applicant(s) Kofford et al.	
	Examiner COURTNEY N HUYNH	Art Unit 3772	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 2 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 03 June 2023.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-30 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☐ Claim(s) _____ is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☑ Claim(s) 1-30 are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Election/Restriction

1. This application contains claims directed to the following patentably distinct species:

A. Figs. 1-9
B. Figs. 10-26
C. Figs. 28-33
D. Figs. 34-36
E. Figs. 62-63
F. Fig. 64
G. Fig. 65
H. Fig. 66
I. Fig. 67
J. Fig. 68
K. Fig. 69
L. Fig. 70
M. Fig. 71
N. Fig. 72
O. Fig. 73
P. Fig. 74
Q. Fig. 75
R. Fig. 76
S. Fig. 77
T. Fig. 78
U. Fig. 79
V. Fig. 80
W. Fig. 81
X. Fig. 82
Y. Fig. 83
Z. Fig. 84-84A
AA. Fig. 85
BB. Fig. 86
CC. Fig. 87
DD. Fig. 88

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EE. Fig. 89

FF. Fig. 90

The species are independent or distinct because as disclosed the different species have mutually exclusive characteristics for each identified species. In addition, these species are not obvious variants of each other based on the current record.

Applicant is required under 35 U.S.C. 121 to elect a single disclosed species, or a single grouping of patentably indistinct species, for prosecution on the merits to which the claims shall be restricted if no generic claim is finally held to be allowable. Currently, no claims are generic.

There is a serious search and/or examination burden for the patentably distinct species as set forth above because at least the following reason(s) apply: The disclosed species require a different field of search (e.g. searching different classes/subclasses or electronic resources, or employing different search queries).

Applicant is advised that the reply to this requirement to be complete must include (i) an election of a species to be examined even though the requirement may be traversed (37 CFR 1.143) **and (ii) identification of the claims encompassing the elected species or grouping of patentably indistinct species**, including any claims subsequently added. An argument that a claim is allowable or that all claims are generic is considered nonresponsive unless accompanied by an election.

The election may be made with or without traverse. To preserve a right to petition, the election must be made with traverse. If the reply does not distinctly and specifically point out supposed errors in the election of species requirement, the election shall be treated as an election without traverse. Traversal must be presented at the time of election in order to be considered timely. Failure to timely traverse the requirement will result in the loss of right to petition under 37 CFR 1.144. If claims are added after the election, applicant must indicate

which of these claims are readable on the elected species or grouping of patentably indistinct species.

Should applicant traverse on the ground that the species, or groupings of patentably indistinct species from which election is required, are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing them to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the species unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103 or pre-AIA 35 U.S.C. 103(a) of the other species.

2. Upon the allowance of a generic claim, applicant will be entitled to consideration of claims to additional species which depend from or otherwise require all the limitations of an allowable generic claim as provided by 37 CFR 1.141.

3. A telephone call was made to Attorney Daniel Whittle on 01 August 2023 to request an oral election to the above restriction requirement, but did not result in an election being made.

4. Applicant is reminded that upon the cancelation of claims to a non-elected invention, the inventorship must be corrected in compliance with 37 CFR 1.48(a) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. A request to correct inventorship under 37 CFR 1.48(a) must be accompanied by an application data sheet in accordance with 37 CFR 1.76 that identifies each inventor by his or her legal name and by the processing fee required under 37 CFR 1.17(i).

Conclusion

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to COURTNEY N HUYNH whose telephone number is (571)272-7219. The examiner can normally be reached M-F 7:30AM-5:00PM (EST) flex, 2nd Friday off.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is

encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Cris Rodriguez can be reached on (571) 272-4964. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/C.N.H./
Examiner, Art Unit 3772

/AMY R SIPP/
Primary Examiner, Art Unit 3775

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/328,730	Kofford et al.
	Examiner	Art Unit
	COURTNEY N HUYNH	3772

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS										
☐ Claims renumbered in the same order as presented by applicant						☐ CPA		☐ T.D.		☐ R.1.47
CLAIM		DATE								
Final	Original	08/02/2023								
	1	÷								
	2	÷								
	3	÷								
	4	÷								
	5	÷								
	6	÷								
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	30	÷								

REMARKS

Claims

Claims 1-30 were pending in the application. With this response, Claim 13 has been amended. Claims 2 and 23 are withdrawn. As a result of this amendment, there remain 4 independent and 30 total claims pending.

Election/Restrictions

The Official Action dated August 7, 2023 required an election of Species under 35 U.S.C 121. Applicants elect to prosecute in this application the Species Q (Fig. 75). Applicants are making this election without traverse to advance examination under the Track 1 Prioritized Examination Program.

Claims 1, 3-22, and 24-30 read on the elected species Q.

Applicants note that Dependent Claims 4, 5, 9, 19, 29 and 30 include generic restrictions that could read on multiple species were it not for the Species Q restrictions found in associated Independent Claims 1, 18 and 26. Withdrawn Claims 2 and 23 include restrictions that read on Species L associated with FIG. 67. However, these restrictions also have utility in combination with the elected species and others. Paragraphs 0034 and 0208 of the Specification express the benefit of combining different embodiment features. Consideration of rejoinder of these withdrawn claims after allowance of claims for the elected Species Q would be appreciated.

Applicants appreciate the advance telephone notification by Examiner Huynh of the Restriction Requirement. If there are any questions on this response, another call or e-mail notification would be most welcome.

Respectfully submitted,

By /Daniel John Whittle/
Daniel John Whittle
Reg. No. 54,537
Tel.: (360) 714-0777

UNITED STATES
PATENT AND TRADEMARK OFFICE

P.O. Box 1450
Alexandria, VA 22313 - 1450
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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/328,730	**08/08/2023 11:33:39 PM ET**	**SDC010**

Title of Invention

Screw-attached Pick-up Dental Coping System and Methods

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	2867	FILED BY	Daniel Whittle
PATENT CENTER #	62584033	FILING DATE	06/03/2023
CUSTOMER #	112823	FIRST NAMED INVENTOR	Brandon Dale Kofford
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	-

Documents

TOTAL DOCUMENTS: 1

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
RESPONSE_Aug2023_SDC 010-APP.TEXT.docx	10	Application body structured text document	23 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
RESPONSE_Aug2023_SDC010-APP.TEXT.docx	9CAC30FCD779D76A1A58F19EDDB475E81ECC3D080EC48B4031AF9BA6850B741222EFF951FE418D2444306A95949AAB27B91BC1DF019E84EBBD1B592BDF03F03A

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized

by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	
	Filing Date	
	First Named Inventor	
	Art Unit	
	Examiner Name	
	Attorney Docket Number	

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	
	Filing Date	
	First Named Inventor	
	Art Unit	
	Examiner Name	
	Attorney Docket Number	

	1		☐

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	
	Filing Date	
	First Named Inventor	
	Art Unit	
	Examiner Name	
	Attorney Docket Number	

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☐ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature		Date (YYYY-MM-DD)	
Name/Print		Registration Number	

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/328,730	**08/08/2023 11:53:39 PM ET**	**SDC010**

Title of Invention

Screw-attached Pick-up Dental Coping System and Methods

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	2867	FILED BY	Daniel Whittle
PATENT CENTER #	62584064	FILING DATE	06/03/2023
CUSTOMER #	112823	FIRST NAMED INVENTOR	Brandon Dale Kofford
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	-

Documents

TOTAL DOCUMENTS: 1

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
IDSAug2023SDC010.pdf	4	Information Disclosure Statement (IDS) Form (SB08)	637 KB

Warning: The PDF file contains multiple layers and must be flattened prior to submission. Documents submitted with multiple layers will be flattened by the USPTO when converted to an image. Layers marked as "invisible" will be lost during conversion.

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
IDSAug2023SDC010.pdf	4261B61747DB893A90BACF6406F0979BFA3E679764A19FB2E0

C7F51234F3556B5CCA9077CA821541B59FD80B01451581AE96
16940FE95CCAD105442F935E24D0

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If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Appl. No.	:	18/328,730	Confirmation No. 2867
Applicant	:	Kofford, Brandon Dale and Rudisill, Charles Albert	
Filed	:	06-03-2023	
TC/A.U.	:	3772	
Examiner	:	HUYNH, COURTNEY NGUYEN	
Docket No.	:	SDC010	
Customer No.	:	112823	

Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

RESPONSE TO OFFICE ACTION DATED 08-08-2023

Amendments to the Listing of Claims begin on page 2 of this paper.

Remarks begin on page 9 of this paper.

Straumann USA Exhibit 1015

AMENDED CLAIMS

What is claimed is:

1. (Original) A dental system for attachment of a coping to a threaded implant abutment comprising:

    a coping having a proximal end with an aperture sized to allow a shaft portion of a definitive screw to pass through ; and

    an implant abutment having helical threading for securing the coping with a definitive screw; and

    a definitive screw having a proximal head end having a tool interface and a distal post portion having threads for securing the coping to the implant abutment after processing; and

    a temporary screw having an axis with a length measured along the axis and a width measured perpendicular to the axis, the temporary screw comprising:

        a proximal head portion with a width larger than the coping aperture; and

        a distal shaft portion shaped for rotary engagement with the implant abutment threads;

    wherein rotating the temporary screw to engage the shaft portion of the temporary screw with the implant abutment threads through an engagement depth and to a predetermined torque causes the head portion of the screw to hold the coping into alignment with the implant abutment for processing, and wherein an axial force in the proximal direction releases the coping from the implant abutment, and wherein the shaft portion does not contact the implant abutment threads continuously above the most distal engagement position.

2. (Withdrawn) The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the temporary screw shaft includes a narrower region having a width that is less than the width of the temporary screw shaft threaded region, and wherein the narrower region is located between the distal end of the temporary screw head and the proximal end of the temporary screw shaft threading.

3. (Original) The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the temporary screw shaft comprises asymmetric threading.

4. (Original) The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the axial release force is applied through a pick-up process in which the coping is adhered to a separable dental element.

5. (Original) The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the axial release force is less than about 5 pounds.

6. (Original) The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the temporary screw shaft threading is not a continuous helical structure over the engagement depth.

7. (Original) The dental system for attachment of a coping to a threaded implant abutment of Claim 6 wherein the definitive screw post threading comprises a continuous symmetrical helical form.

8. (Original) The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the temporary screw shaft threading deforms under the axial force to release the coping.

9. (Original) The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein only mechanical energy is applied to release the coping.

10. (Original) The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the temporary screw shaft comprises an open space located toward the axis from the threading.

11. (Original) The dental system for attachment of a coping to a threaded implant abutment of Claim 1 wherein the temporary screw shaft threading makes contact with the implant abutment threading over a temporary screw threading contact area when holding the coping against the implant abutment and the definitive screw post makes contact with the implant abutment threading over a definitive screw threading contact area when holding the coping against the implant abutment, and wherein the temporary screw threading contact area is less than the definitive screw threading contact area.

12. (Original) The dental system for attachment of a coping to a threaded implant abutment of Claim 11 wherein the volume of the definitive screw post material located distally of

the proximal end of the implant abutment threading when holding the coping against the implant abutment is greater than the volume of the temporary screw shaft material holding the coping against the implant abutment when holding the coping against the implant abutment.

13. (Currently Amended) A dental system for attachment of a coping to a threaded implant abutment for pick-up processing comprising:

a threaded implant abutment having an implant abutment longitudinal axis, and

a coping having a proximal end with a central aperture, and

a temporary screw having a temporary screw longitudinal axis with a length measured along the axis and a width measured perpendicular to the axis comprising:

a head with a proximal end having a drive tool interface for rotating the temporary screw to a predetermined torque and wherein the head portion does not fit through the central aperture of the coping, and

a shaft having an axis with a length measured along the axis and a width measured perpendicular to the axis that fits within the central aperture; the shaft comprising:

a distal portion having a shaft thread, and ~~threading with a shaft threading width that fits within the central aperture~~, and

a proximal portion without a shaft thread, and ~~having a width smaller than the shaft threading width, and~~

wherein inserting the shaft of the temporary screw into the coping central aperture and rotating the temporary screw to a predetermined torque engages the shaft thread with the implant abutment threading to provide an axial overlap of the temporary screw shaft axis and the implant abutment axis to pull the coping into position ~~aligns and seats the coping~~ with the implant abutment for pick-up processing, wherein the axial overlap comprises threaded and unthreaded shaft portions, and wherein applying an axial force above a predetermined value in the proximal direction releases the coping and temporary screw from the implant abutment.

14. (Original) The dental system for attachment of a coping to a threaded implant abutment for pick-up processing of Claim 13 wherein the shaft threading is asymmetrical.

15. (Original) The dental system for attachment of a coping to a threaded implant abutment for pick-up processing of Claim 14 wherein the asymmetrical threading allows axial movement of the shaft in the proximal and distal directions relative to the implant abutment threading when an axial force is applied above a threshold force for movement in each direction and wherein the axial force threshold for movement is smaller in the proximal direction than in the distal direction.

16. (Original) The dental system for attachment of a coping to a threaded implant abutment for pick-up processing of Claim 13 wherein the distal portion of the shaft deforms during the axial release.

17. (Original) The dental system for attachment of a coping to a threaded implant abutment for pick-up processing of Claim 16 wherein the distal portion of the shaft includes an open space for shaft deformation towards the axis.

18. (Original) A dental system for attachment of a coping to a threaded implant abutment comprising:

an implant abutment having symmetric helical threading for a definitive screw; and

a definitive screw having an axis with a length measured along the axis and a width measured perpendicular to the axis, the definitive screw having a proximal head end having a tool interface and a distal post portion having threading matching the implant abutment threading; and

a coping having a proximal end with an aperture, wherein the aperture is larger than the definitive screw post and smaller than the definitive screw head; and

a temporary screw having an axis with a length measured along the axis and a width measured perpendicular to the axis, the temporary screw comprising:

a proximal head portion with a width larger than the coping aperture; and

a distal shaft portion with threading that is shaped differently from the definitive screw threading;

wherein rotating the temporary screw to engage the shaft portion of the temporary screw with the implant abutment threads to a predetermined torque causes the head portion of the temporary screw to hold the coping into alignment with the implant abutment, and wherein an axial force in the proximal direction from pick-up processing releases the coping and temporary screw from the implant abutment.

19. (Original) The dental system for attachment of a coping to a threaded implant abutment of Claim 18 further comprising a temporary screw torque driver, wherein the temporary screw torque driver comprises:

    a spring friction cylinder, and

    a drive cap, and

    a coil spring,

    wherein the torque driver limits the torque applied to the temporary screw to the predetermined torque.

20. (Original) The dental system for attachment of a coping to a threaded implant abutment of Claim 18 wherein the temporary screw threading is asymmetric.

21. (Original) The dental system for attachment of a coping to a threaded implant abutment of Claim 18 wherein the temporary screw can be inserted into the implant abutment threading with an axial force in the distal direction, and wherein the axial force in the distal direction needed for insertion is higher than the axial force in the proximal direction needed for release.

22. (Original) The dental system for attachment of a coping to a threaded implant abutment of Claim 18 wherein the width of the threaded region of the temporary screw shaft is smaller than the width of the threaded region of the definitive screw post.

23. (Withdrawn) The dental system for attachment of a coping to a threaded implant abutment of Claim 18 wherein the shaft of the temporary screw has a portion with a smaller width than the threaded region of the shaft of the temporary screw and wherein the smaller width portion is located between the head and the threaded region.

24. (Original) The dental system for attachment of a coping to a threaded implant abutment of Claim 18 wherein the threading of the temporary screw deforms during the release of the temporary screw from the implant abutment threading.

25. (Original) The dental system for attachment of a coping to a threaded implant abutment of Claim 18 wherein the temporary screw shaft has a hollow portion and wherein a portion of the temporary screw shaft deflects into the hollow portion when the axial force in the proximal direction is applied.

26. (Original) A dental system for attachment of a coping to a threaded implant abutment comprising:

an implant abutment having female threading having an implant abutment thread profile; and

a definitive screw having a longitudinal axis and a length measured along the axis and a width measured perpendicular to the axis, the definitive screw comprising:

a shaft with male threading, wherein the male threading profile matches the implant abutment thread profile; and

a head with a definitive screw drive interface; and

a coping having a proximal end with an aperture sized to allow the definitive screw shaft to pass through; and

a temporary screw having a longitudinal axis and a length measured along the axis and a width measured perpendicular to the axis, the temporary screw comprising:

a post with male threading, wherein the male threading profile does not essentially match the male threading profile of the definitive screw shaft, and wherein the coping aperture allows the post to pass through; and

a head with a temporary screw drive interface; and

wherein the temporary screw holds the coping in position on the implant abutment for pick-up processing by rotating the post threads into the implant abutment threads to a predetermined pick-up processing torque and wherein the

post threads release from the implant abutment threads with a predetermined axial pick-up force in the proximal direction during pick-up processing.

27. (Original) The dental system for attachment of a coping to a threaded implant abutment of claim 26 wherein the width of the temporary screw post threading is smaller than the width of the definitive screw shaft threading.

28. (Original) The dental system for attachment of a coping to a threaded implant abutment of claim 26 wherein the proximal flank of the temporary screw post threading profile is at a smaller angle relative to the longitudinal axis than the proximal flank of the definitive screw shaft threading profile.

29. (Original) The dental system for attachment of a coping to a threaded implant abutment of claim 26 wherein the definitive screw comprises a metallic material and the temporary screw comprises a polymeric material.

30. (Original) The dental system for attachment of a coping to a threaded implant abutment of claim 26 wherein a definitive screw that is rotated into the implant abutment and torqued to the pick-up processing torque does not release from the implant abutment threading with the application of the predetermined axial pick-up force.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/328,730	06/03/2023	Brandon Dale Kofford	SDC010	2867

112823 7590 09/07/2023

Patent Leverage LLC
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EXAMINER	
HUYNH, COURTNEY NGUYEN	
ART UNIT	PAPER NUMBER
3772	
MAIL DATE	DELIVERY MODE
09/07/2023	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

PTOL-90A (Rev. 04/07)

Office Action Summary	Application No. 18/328,730	Applicant(s) Kofford et al.	
	Examiner COURTNEY N HUYNH	Art Unit 3772	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 08 August 2023.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-30 is/are pending in the application.

5a) Of the above claim(s) 2,5,19 and 23 is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1,3-4,6-18,20-22 and 24-30 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☑ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 03 June 2023 is/are: a)☐ accepted or b)☑ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date 08 Aug 2023.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Election/Restrictions

2. Applicant's election without traverse of Species Q (Fig. 75) in the reply filed on 08 August 2023 is acknowledged.

3. Applicant has indicated the dependent claims 4, 5, 9, 19, and 13 include "generic restrictions" that could read on multiple species were it not for "Species Q restrictions" found in independent claims 1, 18, and 26, that claims 2 and 23 "include restrictions" that read on species L of Fig. 67, and paragraphs 34 and 208 express the benefit of combining different embodiment features. Examiner notes that it is unclear what is meant by the assertion that claims include "restrictions" as such appears to be an mis-use of the term with no other indication as to the intent of the meaning. Further, Examiner notes that paragraph 34 does not provide the asserted benefit of combining different embodiment features and instead discloses that Fig. 1 is a top exploded isometric view, etc. Paragraph 208 also does not provide the asserted benefit of combining different embodiment features but instead discloses that temporary attachment posts may be rotationally driven, have various drive features, etc. Nonetheless, as provided by MPEP 2163.05(II) "introducing elements or limitations which are not supported by the as-filed disclosure is a violation of the written description requirement of 35 U.S.C. 112(a) or pre-AIA 35 U.S.C. 112, first paragraph. See, e.g., Fujikawa v. Wattanasin, 93 F.3d 1559, 1571, 39 USPQ2d 1895, 1905 (Fed. Cir. 1996) (a "laundry list" disclosure of every possible moiety does not constitute a written description of every species in a genus because it would not "reasonably lead" those skilled in the art to any particular species)" (https://mpep.uspto.gov/RDMS/MPEP/current#/result/d0e214820.html?q=laundry%20and%20list&ccb=on&ncb=off&icb=off&fcb=off&ver=current&syn=adj&results=compact&sort=relevance&cn

t=25&index=1) and MPEP 2163(I)(A) “Written description issues may also arise if the knowledge and level of skill in the art would not have permitted the ordinary artisan to immediately envisage the claimed product arising from the disclosed process. See, e.g., Fujikawa v. Wattanasin, 93 F.3d 1559, 1571, 39 USPQ2d 1895, 1905 (Fed. Cir. 1996) (a "laundry list" disclosure of every possible moiety does not necessarily constitute a written description of every species in a genus because it would not "reasonably lead" those skilled in the art to any particular species);” (https://mpep.uspto.gov/RDMS/MPEP/current#/result/d0e213583.html?q=laundry%20and%20list&ccb=on&ncb=off&icb=off&fcb=off&ver=current&syn=adj&results=compact&sort=relevance&cnt=25&index=2). Thus, a disclosure of there being a benefit of combining different embodiment features does not constitute a disclosure of an embodiment or a species.

4. Claims 2 and 23 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected species, there being no allowable generic or linking claim. Election was made **without** traverse in the reply filed on 08 August 2023.

5. As to claim 5, the limitation of the axial release force being less than about 5 pounds does not read on the elected species as an axial release force less than about 5 pounds has not been disclosed or shown for the elected species of Fig. 75. Further, an axial release force less than about 5 pounds is disclosed only in paragraph 0160 in regard to “a preferred embodiment” which appears to be intended to further describe the embodiment of the paragraph 0159, i.e. post 101 of Species D, Figs. 34-36, which includes a short post length and a cap with a hexaglobular (Torx) drive feature, which is not shown in the elected species of Fig. 75. Therefore, claim 5 does not read on the elected species.

6. As to claim 19, the limitation of a temporary screw torque driver comprising a spring friction cylinder, drive cap, and coil spring does not read on the elected species as a temporary screw torque driver comprising a spring friction cylinder, drive cap, and coil spring has not been disclosed or shown for the elected species of Fig. 75. Further, a temporary screw torque driver

(113) comprising a spring friction cylinder (141), drive cap (137), and coil spring (136) is shown only in Figs. 59-60 as described in paragraph 0181 as a torque driver which can be used for the temporary coping attachment process of Fig. 40, which uses separable fastener assembly 100 of Species D, Figs. 34-36, which includes a cap with a hexaglobular (Torx) drive feature, which is not shown in the elected species of Fig. 75. Therefore, claim 19 does not read on the elected species.

7. Accordingly, claims 5 and 19 are withdrawn from further consideration pursuant to 37 CFR 1.142(b) as being drawn to a nonelected species, there being no allowable generic or linking claim. Election was made **without** traverse in the reply filed on 08 August 2023.

Information Disclosure Statement

8. The information disclosure statement filed 08 August 2023 fails to comply with the provisions of 37 CFR 1.97, 1.98 and MPEP § 609 because is blank and lacks citations of prior art. It has been placed in the application file, but the information referred to therein has not been considered as to the merits. Applicant is advised that the date of any re-submission of any item of information contained in this information disclosure statement or the submission of any missing element(s) will be the date of submission for purposes of determining compliance with the requirements based on the time of filing the statement, including all certification requirements for statements under 37 CFR 1.97(e). See MPEP § 609.05(a).

Drawings

9. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore:

- The definitive screw post threading comprising a continuous symmetrical helical form of claim 7 lines 2-3;

- The use of only mechanical energy applied to release the coping of claim 9 line 2;
- The head portion which does not fit thought the central aperture of the coping of claim 13 lines 2-3;
- The axial overlap comprising threaded and unthreaded shaft portions of claim 13 lines 23-24;
- The axial force threshold for movement which is smaller in the proximal direction than in the distal direction of claim 14 lines 5-6;
- The implant abutment having symmetric helical threading of claim 18 line 3;
- The axial force in the distal direction needed for insertion which is higher than the axial force in the proximal direction needed for release of claim 21 lines 3-5;
- The width of the threaded region of the temporary screw shaft which is smaller than the width of the threaded region of the definitive screw post of claim 22 lines 2-3;
- The male threading profile which does not essentially match the male threading profile of the definitive screw shaft of claim 26 lines 16-17;
- The width of the temporary screw post threading which is smaller than the width of the definitive screw shaft threading of claim 27 lines 2-3;
- The proximal flank of the temporary screw post threading profile which is at a smaller angle relative to the longitudinal axis that the proximal flank of the definitive screw shaft threading profile of claim 28 lines 2-4; and
- The definitive screw comprising a metallic material of claim 29 line 2

must be shown or the features canceled from the claims. No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet,

even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

10. The specification is objected to as failing to provide proper antecedent basis for the claimed subject matter. See 37 CFR 1.75(d)(1) and MPEP § 608.01(o). Correction of the following is required:

11. In regard to claim 1 lines 20-21, the specification appears to lack proper antecedent basis for "wherein the shaft portion does not contact the implant abutment threads continuously above the most distal engagement portion". The specification does not appear to provide such a description, and elected Fig. 75 does not appear to show the shaft portion which does not contact the implant abutment threads continuously above the most distal engagement portion. Thus, the specification fails to provide proper antecedent basis for "wherein the shaft portion does not contact the implant abutment threads continuously above the most distal engagement portion".

12. In regard to claim 7, the specification appears to lack proper antecedent basis for "wherein the definitive screw post threading comprises a continuous symmetrical helical form" in lines 2-3. The specification does not appear to provide such a description, and elected Fig. 75 does not appear to show the a definitive screw post threading which comprises a continuous

symmetrical helical form. Thus, the specification fails to provide proper antecedent basis for "wherein the definitive screw post threading comprises a continuous symmetrical helical form".

13. In regard to claim 9, the specification appears to lack proper antecedent basis for "wherein only mechanical energy is applied to release the coping" in line 2. The specification does not appear to provide such a description, and elected Fig. 75 does not appear to show only mechanical energy applied to release the coping. Thus, the specification fails to provide proper antecedent basis for "wherein only mechanical energy is applied to release the coping".

14. In regard to claim 11, the specification appears to lack proper antecedent basis for "wherein the temporary screw shaft threading makes contact with the implant abutment threading over a temporary screw threading contact area when holding the coping against the implant abutment and the definitive screw post makes contact with the implant abutment threading over a definitive screw threading contact area when holding the coping against the implant abutment, and wherein the temporary screw threading contact area is less than the definitive screw threading contact area" in line 2. The specification does not appear to provide such a description, and elected Fig. 75 does not appear to show the temporary screw shaft threading making contact with the implant abutment threading over a temporary screw threading contact area when holding the coping against the implant abutment, and the definitive screw post making contact with the implant abutment threading over a definitive screw threading contact area when holding the coping against the implant abutment, and wherein the temporary screw threading contact area is less than the definitive screw threading contact area. Thus, the specification fails to provide proper antecedent basis for "wherein the temporary screw shaft threading makes contact with the implant abutment threading over a temporary screw threading contact area when holding the coping against the implant abutment and the definitive screw post makes contact with the implant abutment threading over a definitive screw threading contact area when holding the coping against the implant abutment, and wherein the temporary screw threading contact area is less than the definitive screw threading contact area".

15. In regard to claim 12, the specification appears to lack proper antecedent basis for "wherein the volume of the definitive screw post material located distally of the proximal end of the implant abutment threading when holding the coping against the implant abutment is greater than the volume of the temporary screw shaft material holding the coping against the implant abutment when holding the coping against the implant abutment" in lines 2-6. The specification does not appear to provide such a description, and elected Fig. 75 does not appear to show a volume of the definitive screw post material located distally of the proximal end of the implant abutment threading when holding the coping against the implant abutment which is greater than the volume of the temporary screw shaft material holding the coping against the implant abutment when holding the coping against the implant abutment. Thus, the specification fails to provide proper antecedent basis for "the volume of the definitive screw post material located distally of the proximal end of the implant abutment threading when holding the coping against the implant abutment is greater than the volume of the temporary screw shaft material holding the coping against the implant abutment when holding the coping against the implant abutment".

16. In regard to claim 13, the specification appears to lack proper antecedent basis for "wherein the head portion does not fit thought the central aperture of the coping" in lines 2-3. The specification does not appear to provide such a description, and elected Fig. 75 does not appear to show the head portion of a temporary screw which does not fit though the central aperture of a coping. Thus, the specification fails to provide proper antecedent basis for "wherein the head portion does not fit thought the central aperture of the coping".

17. In regard to claim 13, the specification appears to lack proper antecedent basis for "wherein the axial overlap comprising threaded and unthreaded shaft portions" in lines 23-24. The specification does not appear to provide such a description, and elected Fig. 75 does not appear to show the axial overlap comprising threaded and unthreaded shaft portions. Thus, the specification fails to provide proper antecedent basis for "wherein the axial overlap comprising threaded and unthreaded shaft portions".

18. As to claim 14, the specification appears to lack proper antecedent basis for “wherein the axial force threshold for movement is smaller in the proximal direction than in the distal direction” in lines 5-6. The specification describes how the embodiment of Fig. 75 can be extracted with a force in the axial direction or engaged by axial motion in the opposite direction of the arrow of Fig. 75, the specification does not appear to provide a description of, and elected Fig. 75 does not appear to show, an axial force threshold for movement which is smaller in the proximal direction than in the distal direction. Thus, the specification fails to provide proper antecedent basis for “wherein the axial force threshold for movement is smaller in the proximal direction than in the distal direction” in lines 5-6.

19. As to claim 18, the specification appears to lack proper antecedent basis for “an implant abutment having symmetric helical threading” in line 3. The specification does not appear to provide such a description, and elected Fig. 75 does not appear to show an implant abutment having symmetric helical threading. Thus, the specification fails to provide proper antecedent basis for “an implant abutment having symmetric helical threading” in line 3.

20. As to claim 21, the specification appears to lack proper antecedent basis for “wherein an axial force in the distal direction needed for insertion is higher than the axial force in the proximal direction needed for release” in lines 3-5. The specification does not appear to provide such a description, and elected Fig. 75 does not appear to show an axial force in the distal direction needed for insertion which is higher than the axial force in the proximal direction needed for release. Thus, the specification fails to provide proper antecedent basis for “wherein an axial force in the distal direction needed for insertion is higher than the axial force in the proximal direction needed for release” in lines 3-5.

21. As to claim 22, the specification appears to lack proper antecedent basis for “wherein the width of the threaded region of the temporary screw shaft is smaller than the width of the threaded region of the definitive screw post” in lines 2-3. The specification does not appear to provide such a description, and elected Fig. 75 does not appear to show the width of the

threaded region of the temporary screw shaft is smaller than the width of the threaded region of the definitive screw post. Thus, the specification fails to provide proper antecedent basis for "wherein the width of the threaded region of the temporary screw shaft is smaller than the width of the threaded region of the definitive screw post" in lines 2-3.

22. As to claim 26, the specification appears to lack proper antecedent basis for "wherein the male threading profile does not essentially match the male threading profile of the definitive screw shaft" in lines 16-17. The specification does not appear to provide such a description, and elected Fig. 75 does not appear to show a male threading profile which does not essentially match the male threading profile of the definitive screw shaft. Thus, the specification fails to provide proper antecedent basis for "wherein the male threading profile does not essentially match the male threading profile of the definitive screw shaft" in lines 16-17.

23. As to claim 27, the specification appears to lack proper antecedent basis for "wherein the width of the temporary screw post threading is smaller than the width of the definitive screw shaft threading" in lines 2-3. The specification does not appear to provide such a description, and elected Fig. 75 does not appear to show a width of the temporary screw post threading which is smaller than a width of the definitive screw shaft threading. Thus, the specification fails to provide proper antecedent basis for "wherein the width of the temporary screw post threading is smaller than the width of the definitive screw shaft threading" in lines 2-3.

24. As to claim 28, the specification appears to lack proper antecedent basis for "wherein the proximal flank of the temporary screw post threading profile is at a smaller angle relative to the longitudinal axis than the proximal flank of the definitive screw shaft threading profile" in lines 2-4. The specification does not appear to provide such a description, and elected Fig. 75 does not appear to show a proximal flank of the temporary screw post threading profile which is at a smaller angle relative to the longitudinal axis than the proximal flank of a definitive screw shaft threading profile. Thus, the specification fails to provide proper antecedent basis for "wherein the proximal flank of the temporary screw post threading profile is at a smaller angle

relative to the longitudinal axis than the proximal flank of the definitive screw shaft threading profile" in lines 2-4.

25. As to claim 29, the specification appears to lack proper antecedent basis for "wherein the definitive screw comprises a metallic material" in line 2. The specification does not appear to provide such a description, and elected Fig. 75 does not appear to show a definitive screw comprising a metallic material. Thus, the specification fails to provide proper antecedent basis for "wherein the definitive screw comprises a metallic material" in line 2.

26. As to claim 30, the specification appears to lack proper antecedent basis for "wherein a definitive screw that is rotated into the implant abutment and torqued to the pick-up processing torque does not release from the implant abutment threading with the application of the predetermined axial pick-up force" in lines 2-4. The specification does not appear to provide such a description, and elected Fig. 75 does not appear to show a definitive screw that is rotated into the implant abutment and torqued to the pick-up processing torque which does not release from the implant abutment threading with the application of the predetermined axial pick-up force. Thus, the specification fails to provide proper antecedent basis for "wherein a definitive screw that is rotated into the implant abutment and torqued to the pick-up processing torque does not release from the implant abutment threading with the application of the predetermined axial pick-up force" in lines 2-4.

Claim Objections

27. Claims 3-12, 14-22, and 24-29 are objected to because of the following informalities:

- Examiner suggests claim 3-6 and 8-12 lines 1-2 be amended to "The dental system f~~or attachment of a coping to a threaded implant abutment~~ of Claim 1, wherein".
- Examiner suggests claim 7 lines 1-2 be amended to "The dental system f~~or attachment of a coping to a threaded implant abutment~~ of Claim 6, wherein".

- Examiner suggests claim 11 lines 2-6 be amended to “wherein the temporary screw shaft threading makes contact with the implant abutment threading over a temporary screw threading contact area when holding the coping against the implant abutment, and the definitive screw post makes contact with the implant abutment threading over a definitive screw threading contact area when holding the coping against the implant abutment,”.
- Examiner suggests claims 14 and 16 lines 1-2 be amended to “The dental system ~~for attachment of a coping to a threaded implant abutment for pick-up processing~~ of Claim 13, wherein”.
- Examiner suggests claim 15 lines 1-2 be amended to “The dental system ~~for attachment of a coping to a threaded implant abutment for pick-up processing~~ of Claim 14, wherein”.
- Examiner suggests claim 17 lines 1-2 be amended to “The dental system ~~for attachment of a coping to a threaded implant abutment for pick-up processing~~ of Claim 16, wherein”.
- Examiner suggests claim 18 lines 20-21 be amended to “the coping and the temporary screw”.
- Examiner suggests claims 19-22 and 24-25 lines 1-2 be amended to “The dental system ~~for attachment of a coping to a threaded implant abutment~~ of Claim 18, wherein”.
- Examiner suggests claim 26 lines 8-10 be indented.
- Examiner suggests claims 27-30 lines 1-2 be amended to “The dental system ~~for attachment of a coping to a threaded implant abutment~~ of claim 26, wherein”.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

28. The following is a quotation of the first paragraph of 35 U.S.C. 112(a):

> (a) IN GENERAL.—The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor or joint inventor of carrying out the invention.

The following is a quotation of the first paragraph of pre-AIA 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

29. Claims 13-17 are rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor or a joint inventor, or for applications subject to pre-AIA 35 U.S.C. 112, the inventor(s), at the time the application was filed, had possession of the claimed invention.

30. In regard to claims 13-17, claim 13 lines 23-24 recites the limitation “wherein the axial overlap comprising threaded and unthreaded shaft portions”. The specification does not appear to provide such a description, and elected Fig. 75 does not appear to show the axial overlap comprising threaded and unthreaded shaft portions. Finally, such was not originally claimed. Thus, “wherein the axial overlap comprising threaded and unthreaded shaft portions” in lines 23-24 constitutes new matter. Examiner suggests cancelling claims 13-17.

31. Claims 14-17 are rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, for their dependence on one or more rejected base and/or intervening claims.

The following is a quotation of 35 U.S.C. 112(b):

> (b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

> The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

32. Claims 1, 3, 4, 6-18, 20-22, and 24-30 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor (or for applications subject to pre-AIA 35 U.S.C. 112, the applicant), regards as the invention.

33. Claim 1 is unclear with regards to “an implant abutment for securing the coping with a definitive screw” in lines 5-6 and if “the coping” is intended to refer to the positively recited “a coping” of line 3 or the functionally recited “a coping” of line 1. Further, it is unclear if the coping of line 3 is capable of the attachment recited in line 1, and it is unclear if the implant abutment of line 5 is capable of the attachment of the coping to the threaded implant abutment of line 1. For purposes of examination, Examiner will interpret claim 1 lines 1-2 as, and suggests amending as, “A dental system ~~for attachment of a coping to a threaded implant abutment~~ comprising:”.

34. Claim 1 recites the limitation "the implant abutment threads" in lines 13-14. There is insufficient antecedent basis for this limitation in the claim as claim 1 does not recite the limitation “implant abutment threads” prior to lines 13-14, though claim 1 does recite the limitation “an implant abutment having helical threading” in line 5. For purposes of examination, Examiner will interpret claim 1 lines 13-14 as, and suggests amending to, “the implant abutment threading ~~threads~~”.

35. Claim 1 recites the limitation “the head portion of the screw” in line 17. This limitation is unclear because claim 1 recites the limitations “a definitive screw” in line 7 and “a temporary screw” in line 10. For purposes of examination, Examiner will interpret claim 1 line 17 as, and suggests amending to, “the head portion of the temporary screw”.

36. Claim 1 recites the limitation "the proximal direction" in line 18. There is insufficient antecedent basis for this limitation in the claim as claim 1 does not recite the limitation “a proximal direction” prior to line 18. For purposes of examination, Examiner will interpret claim 1 line 18 as, and suggests amending to, “[[the]]a proximal direction”.

37. Claim 1 recites the limitation "the most distal engagement position" in line 21. There is insufficient antecedent basis for this limitation in the claim as claim 1 does not recite the limitation “a most distal engagement position” prior to line 21. For purposes of examination, Examiner will interpret claim 1 line 21 as, and suggests amending to, “[[the]]a most distal engagement position”.

38. Claim 3 recites the limitation “the temporary screw shaft” in line 2. There is insufficient antecedent basis for this limitation in the claim as claim 1 does not recite the limitation “a temporary screw shaft”, though claim 1 recites the limitation “a distal shaft portion” in line 12. For purposes of examination, Examiner will interpret claim 3 line 2 as, and suggests amending to, “the temporary screw distal shaft portion”.

39. Claim 4 recites the limitation “the axial release force” in line 2. There is insufficient antecedent basis for this limitation in the claim as claim 1 does not recite the limitation “an axial release force”, though claim 1 recites the limitation “an axial force” in line 18. For purposes of examination, Examiner will interpret claim 4 line 2 as, and suggests amending to, “the axial ~~release~~ force”.

40. Claim 6 recites the limitation “the temporary screw shaft threading” in line 2. There is insufficient antecedent basis for this limitation in the claim as claim 1 does not recite the limitation “temporary screw shaft threading”. For purposes of examination, Examiner will interpret claim 6 line 2 as, and suggests amending to, “wherein the temporary screw distal shaft portion comprises threading which is not a continuous helical structure over the engagement depth”.

41. Claim 7 recites the limitation "the definitive screw post threading" in line 2. There is insufficient antecedent basis for this limitation in the claim as claims 1 and 6 do not recite the limitation "definitive screw post threading", though claim 1 recites the limitation "a definitive screw having...a distal post portion having threads" in lines 7-8. For purposes of examination, Examiner will interpret claim 7 line 2 as, and suggests amending to, "the definitive screw post ~~threading~~ threads ".

42. Claim 8 recites the limitation "the temporary screw shaft threading" in line 2. There is insufficient antecedent basis for this limitation in the claim as claim 1 does not recite the limitation "temporary screw shaft threading". For purposes of examination, Examiner will interpret claim 8 line 2 as, and suggests amending to, "wherein the temporary screw distal shaft portion comprises threading which deforms under the axial force to release the coping".

43. Claim 10 recites the limitation "the temporary screw shaft" in line 2. There is insufficient antecedent basis for this limitation in the claim as claim 1 does not recite the limitation "a temporary screw shaft", though claim 1 does recite the limitation "a temporary screw having...a distal shaft portion" in lines 10-13. For purposes of examination, Examiner will interpret claim 10 line 2 as, and suggests amending to, "the temporary screw distal shaft portion".

44. Claim 10 recites the limitation "the threading" in line 3. This limitation is unclear as claim 1 recites the limitations "an implant abutment having helical threading" in line 5 and "a definitive screw having...a distal post portion having threads" in lines 7-8. In light of Fig. 75 and the specification, it appears that "the threading" of claim 10 is referring to threading on the temporary screw distal shaft portion, which is not recited in claim 1. For purposes of examination, Examiner will interpret claim 10 line 3 as, and suggests amending to, "~~the~~ threading of the temporary screw distal shaft portion".

45. Claim 11 recites the limitation "the temporary screw shaft threading" in line 2. There is insufficient antecedent basis for this limitation in the claim as claim 1 does not recite the limitation "temporary screw shaft threading". For purposes of examination, Examiner will

interpret claim 11 line 2 as, and suggests amending to, "the temporary screw distal shaft portion comprises threading which makes contact with the implant abutment threading".

46. Claim 12 recites the limitation "the volume of the definitive screw post material" in line 2. There is insufficient antecedent basis for this limitation in the claim as claims 1 and 11 do not recite the limitation "a volume of definitive screw post material". For purposes of examination, Examiner will interpret claim 12 line 2 as, and suggests amending to, "[[the]]a volume of ~~the~~ definitive screw post material".

47. Claim 12 recites the limitation "the proximal end of the implant abutment threading" in line 3. There is insufficient antecedent basis for this limitation in the claim as claims 1 and 11 do not recite the limitation "a proximal end of the implant abutment threading". For purposes of examination, Examiner will interpret claim 12 line 3 as, and suggests amending to, "[[the]]a proximal end of the implant abutment threading".

48. Claim 12 recites the limitation "the volume of the temporary screw shaft material" in line 2. There is insufficient antecedent basis for this limitation in the claim as claims 1 and 11 do not recite the limitation "a volume of temporary screw shaft material". For purposes of examination, Examiner will interpret claim 12 line 4 as, and suggests amending to, "[[the]]a volume of ~~the~~ temporary screw shaft material".

49. Claim 13 lines 1-2 recites the limitation "A dental system for attachment of a coping to a threaded implant abutment for pick-up processing comprising", which comprises a threaded implant abutment in line 3, and a coping in line 4. Claim 13 lines 25-26 recites the limitations "releases the coping and temporary screw from the implant abutment. It is unclear whether the limitation "the coping" of claim 13 line 25 refers to the positively recited coping of line 4, or refers to the functionally recited coping of line 1, and it is unclear if the implant abutment of line 26 is referring to the positively recited threaded implant abutment of line 3, or the functionally recited threaded implant abutment of lines 1-2. For purposes of examination, Examiner will interpret

claim 13 lines 1-2 as, and suggests amending to, “A dental system ~~for attachment of a coping to a threaded implant abutment for pick-up processing~~ comprising:”.

50. Claim 13 recites the limitation "along the axis and a width measured perpendicular to the axis" in line 6. This limitation is unclear as it is unclear what axes are being referred to, as claim 13 recites the limitation “an implant abutment longitudinal axis” in line 3, and “a temporary screw longitudinal axis” in line 5. For purposes of examination, Examiner will interpret claim 13 line 6 as, and suggests amending to, “along the temporary screw longitudinal axis and a width measured perpendicular to the temporary screw longitudinal axis”.

51. Claim 13 recites the limitation "the head portion" in line 9. There is insufficient antecedent basis for this limitation in the claim as claim 13 does not recite the limitation “a head portion” prior to line 9, but does recite the limitation “a head” in line 8. For purposes of examination, Examiner will interpret claim 13 line 9 as, and suggests amending to, “the head ~~portion~~”.

52. Claim 13 recites the limitation "a length measured along the axis and a width measured perpendicular to the axis" in lines 11-12. This limitation is unclear as it is unclear what axes are being referred to, as claim 13 recites the limitation “an implant abutment longitudinal axis” in line 3, and “a temporary screw longitudinal axis” in line 5. For purposes of examination, Examiner will interpret claim 13 lines 11-12 as, and suggests amending to, “a length measured along the temporary screw longitudinal axis and a width measured perpendicular to the temporary screw longitudinal axis”.

53. Claim 13 recites the limitation "the temporary screw shaft axis" in line 21. This limitation lacks antecedent basis, as claim 13 recites the limitation “a temporary screw longitudinal axis” in line 5. For purposes of examination, Examiner will interpret claim 13 lines 21 as, and suggests amending to, “the temporary screw ~~shaft~~ longitudinal axis”.

54. Claim 13 recites the limitation "the proximal direction" in line 25. There is insufficient antecedent basis for this limitation in the claim as claim 13 does not recite the limitation “a

proximal direction" prior to line 25. For purposes of examination, Examiner will interpret claim 13 line 25 as, and suggests amending to, "[[the]]a proximal direction".

55. Claim 14 recites the limitation "the shaft threading" in line 2. There is insufficient antecedent basis for this limitation in the claim as claim 13 does not recite the limitation "shaft threading", but claim 13 does recite the limitation "a shaft thread" in line 14. For purposes of examination, Examiner will interpret claim 14 line 2 as, and suggests amending to, "the shaft ~~threading~~ thread ".

56. Claim 15 recites the limitation "the axial force threshold" in line 5. There is insufficient antecedent basis for this limitation in the claim as claims 13 and 14 do not recite the limitation "an axial force threshold". For purposes of examination, Examiner will interpret claim 15 line 5 as, and suggests amending to, "[[the]]an axial force threshold".

57. Claim 15 recites the limitation "the proximal and distal directions" in line 3. There is insufficient antecedent basis for "the distal direction" limitation in the claim as claim 13 does not recite the limitation "a distal direction". For purposes of examination, Examiner will interpret claim 15 line 3 as, and suggests amending to, "the proximal direction and a distal direction[[s]]".

58. Claim 16 recites the limitation "the axial release" in line 3. There is insufficient antecedent basis for this limitation in the claim as claim 13 does not recite the limitation "an axial release". For purposes of examination, Examiner will interpret claim 16 line 3 as, and suggests amending to, "[[the]]an axial release".

59. Claim 17 recites the limitation "the shaft includes an open space for shaft deformation towards the axis" in lines 2-3. This limitation is unclear as it is unclear what axes are being referred to, as claim 13 recites the limitation "an implant abutment longitudinal axis" in line 3, "a temporary screw longitudinal axis" in line 5, and "a shaft having an axis" in line 11. For purposes of examination, Examiner will interpret claim 17 lines 2-3 as, and suggests amending to, "the shaft includes an open space for shaft deformation towards the axis of the shaft".

60. Claim 18 recites “A dental system for attachment of a coping to a threaded implant abutment comprising”, which comprises an implant abutment in line 3, and a coping in line 7. Claim 18 lines 18-19 recite the limitation “to hold the coping into alignment with the implant abutment, and wherein an axial force in the proximal direction from pick-up processing releases the coping and temporary screw from the implant abutment”. It is unclear whether the limitations “the coping” of claim 18 line 18 and line 20 refer to the positively recited coping of line 7, or refers to the functionally recited coping of line 1, and it is unclear whether the limitations “the implant abutment” of claim 18 line 19 and lines 20-21 refer to the positively recited implant abutment of line 3, or the functionally recited implant abutment of line 1. For purposes of examination, Examiner will interpret claim 18 lines 1-2 as, and suggests amending to, “A dental system ~~for attachment of a coping to a threaded implant abutment~~ comprising:”.

61. Claim 18 recites the limitation "the definitive screw post" in line 10. There is insufficient antecedent basis for this limitation in the claim as claim 18 does not recites the limitation “a definitive screw post” prior to line 10, though claim 18 does recite the limitation “the definitive screw having…a distal post portion” in lines 6-7. For purposes of examination, Examiner will interpret claim 18 line 10 as, and suggests amending to, “the definitive screw distal post portion”.

62. Claim 18 recites the limitation "the definitive screw head" in line 10. There is insufficient antecedent basis for this limitation in the claim as claim 18 does not recites the limitation “a definitive screw head” prior to line 10, though claim 18 does recite the limitation “the definitive screw having a proximal head end” in lines 6-7. For purposes of examination, Examiner will interpret claim 18 line 10 as, and suggests amending to, “the definitive screw proximal head end”.

63. Claim 18 recites the limitation "the implant abutment threads" in line 17. There is insufficient antecedent basis for this limitation in the claim as claim 18 does not recite the limitation “implant abutment threads” prior to line 17, though claim 1 does recite the limitation

"an implant abutment having symmetric helical threading" in line 3. For purposes of examination, Examiner will interpret claim 18 line 17 as, and suggests amending to, "the implant abutment threading ~~threads~~".

64. Claim 18 recites the limitation "the proximal direction" in line 19. There is insufficient antecedent basis for this limitation in the claim as claim 18 does not recite the limitation "a proximal direction" prior to line 19. For purposes of examination, Examiner will interpret claim 18 line 19 as, and suggests amending to, "[[the]]a proximal direction".

65. Claim 21 recites the limitation "the distal direction" in line 3. There is insufficient antecedent basis for this limitation in the claim as claim 18 does not recite the limitation "a distal direction". For purposes of examination, Examiner will interpret claim 21 line 3 as, and suggests amending to, "[[the]]a distal direction".

66. Claim 22 recites the limitation "the width of the threaded region of the temporary screw shaft" in line 2. There is insufficient antecedent basis for this limitation in the claim as claim 18 does not recite the limitation "a width of the threaded region of the temporary screw shaft", though claim 18 does recite the limitations "a temporary screw having…a distal shaft portion with threading" in lines 11-14. For purposes of examination, Examiner will interpret claim 22 line 2 as, and suggests amending to, "[[the]]a width of the ~~threaded region~~ threading of the temporary screw distal shaft portion".

67. Claim 22 recites the limitation "the width of the threaded region of the definitive screw post" in line 3. There is insufficient antecedent basis for this limitation in the claim as claim 18 does not recite the limitation "a width of the threaded region of the definitive screw post", though claim 18 does recite the limitations "the definitive screw having…a distal post portion having threading" in lines 6-7. For purposes of examination, Examiner will interpret claim 22 line 3 as, and suggests amending to, "[[the]]a width of the ~~threaded region~~ threading of the definitive screw distal post portion".

68. Claim 25 recites the limitation "the temporary screw shaft has a hollow portion and wherein a portion of the temporary screw shaft deflects into the hollow portion" in lines 2-3. There is insufficient antecedent basis for this limitation in the claim as claim 18 does not recite the limitation “a temporary screw shaft”, though claim 18 does recite the limitations “the temporary screw comprising: …a distal shaft portion” in lines 12-14. For purposes of examination, Examiner will interpret claim 25 lines 2-3 as, and suggests amending to, “the temporary screw distal shaft portion has a hollow portion and wherein a portion of the temporary screw distal shaft portion deflects into the hollow portion”.

69. Claim 26 recites “A dental system for attachment of a coping to a threaded implant abutment comprising”, which comprises an implant abutment in line 3, and a coping in line 11. Claim 26 lines 20-21 recite the limitation “holds the coping in position on the implant abutment for pick-up processing”. It is unclear whether the limitations “the coping” of claim 26 line 20 refers to the positively recited coping of line 11, or refers to the functionally recited coping of line 1, and it is unclear whether the limitations “the implant abutment” of claim 26 lines 20-21 refer to the positively recited implant abutment of line 3, or the functionally recited implant abutment of line 1. For purposes of examination, Examiner will interpret claim 26 lines 1-2 as, and suggests amending to, “A dental system ~~for attachment of a coping to a threaded implant abutment~~ comprising:”.

70. Claim 26 recites the limitation “the male threading profile” in line 8. There is insufficient antecedent basis for this limitation in the claim as claim 26 does not recite the limitation “a male threading profile” prior to line 8. For purposes of examination, Examiner will interpret claim 26 line 8 as, and suggests amending to, “the male threading of the shaft has a male threading profile which matches the implant abutment thread profile”.

71. Claim 26 recites the limitation “a post with male threading, wherein the male threading profile” in line 16. There is insufficient antecedent basis for this limitation in the claim as claim 26 does not recite the limitation “a male threading profile” of the temporary screw post prior to

line 16. For purposes of examination, Examiner will interpret claim 26 lines 16-17 as, and suggests amending to, “a post with male threading having a male threading profile, wherein the male threading profile of the post does not essentially match the male threading profile of the definitive screw shaft”.

72. Claim 26 recites the limitation “rotating the post threads into the implant abutment threads to a predetermined pick-up processing torque and wherein the post threads release from the implant abutment threads” in lines 21-23. There is insufficient antecedent basis for this limitation in the claim as claim 26 does not recite the limitation “post threads” or “implant abutment threads” prior to lines 21-23, though claims 26 does recite “a post with male threading” in line 16 and “an implant abutment having female threading” in line 3. For purposes of examination, Examiner will interpret claim 26 lines 21-23 as, and suggests amending to, “rotating the post male threading ~~threads~~ into the implant abutment female threading ~~threads~~ to a predetermined pick-up processing torque and wherein the post male threading ~~threads~~ release from the implant abutment female threading ~~threads~~”.

73. Claim 26 recites the limitation "the proximal direction" in line 24. There is insufficient antecedent basis for this limitation in the claim as claim 18 does not recite the limitation “a proximal direction” prior to line 24. For purposes of examination, Examiner will interpret claim 26 line 24 as, and suggests amending to, “[[the]]a proximal direction”.

74. Claim 27 recites the limitation "the width of the temporary screw post threading" in line 2. There is insufficient antecedent basis for this limitation in the claim as claim 26 does not recite the limitation “a width of the temporary screw post threading”, though claim 26 does recite the limitations “the temporary screw comprising: …a post with male threading” in lines 14-16. For purposes of examination, Examiner will interpret claim 27 line 2 as, and suggests amending to, “[[the]]a width of the temporary screw post male threading”.

75. Claim 27 recites the limitation "the width of the definitive screw shaft threading" in lines 2-3. There is insufficient antecedent basis for this limitation in the claim as claim 26 does not

recite the limitation “a width of the definitive screw shaft threading”, though claim 26 does recite the limitations “the definitive screw comprising: …a shaft with male threading” in lines 6-8. For purposes of examination, Examiner will interpret claim 27 lines 2-3 as, and suggests amending to, “[[the]]a width of the definitive screw shaft male threading”.

76. Claim 28 recites the limitation "the proximal flank of the temporary screw post threading profile" in line 2. There is insufficient antecedent basis for this limitation in the claim as claim 26 does not recite the limitation “a proximal flank of the temporary screw post threading profile”. For purposes of examination, Examiner will interpret claim 28 line 2 as, and suggests amending to, “[[the]]a proximal flank”.

77. Claim 28 recites the limitation “relative to the longitudinal axis” in line 3. This limitation is unclear because claim 26 recites the limitations “a definitive screw having a longitudinal axis” in line 5 and “a temporary screw having a longitudinal axis” in line 13. For purposes of examination, Examiner will interpret claim 28 line 3 broadly, and suggests amending clarify.

78. Claim 28 recites the limitation "the proximal flank of the definitive screw shaft threading profile" in lines 3-4. There is insufficient antecedent basis for this limitation in the claim as claim 26 does not recite the limitation “a proximal flank of the definitive screw shaft threading profile”. For purposes of examination, Examiner will interpret claim 28 lines 23-4 as, and suggests amending to, “[[the]]a proximal flank”.

79. Claim 30 recites the limitation "the application of the predetermined axial pick-up force" in line 4. There is insufficient antecedent basis for this limitation in the claim as claim 26 does not recite the limitation “an application”. For purposes of examination, Examiner will interpret claim 30 line 4 as, and suggests amending to, “[[the]]an application of the predetermined axial pick-up force”.

80. Claim 30 recites the limitation “wherein a definitive screw that is rotated into the implant abutment” in line 2. Claim 26 recites the limitation “a definitive screw” in line 5. In light of the specification, there does not appear to be a second definitive screw in the dental system. For

purposes of examination, Examiner will interpret claim 30 line 2 as, and suggests amending to, "wherein [[a]]the definitive screw that is rotated into the implant abutment".

81. Claim 30 recites the limitation "the pick-up processing torque" in line 3. Claim 26 does not recite the limitation "a pick-up processing torque", though claim 26 does recite the limitation "a predetermined pick-up processing torque". For purposes of examination, Examiner will interpret claim 30 line 3 as, suggests amending to, "and torqued to the predetermined pick-up processing torque".

82. Claims 9, 20, 24, and 29 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, for their dependence on one or more rejected base and/or intervening claims.

Claim Rejections - 35 USC § 103

83. The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

84. **Claims 1, 4 and 9 are rejected under 35 U.S.C. 103 as being unpatentable over Lannan** (U.S. Patent No. 2008/0206709 A1) **in view of Lazzara et al** (U.S. 4,850,870 A).

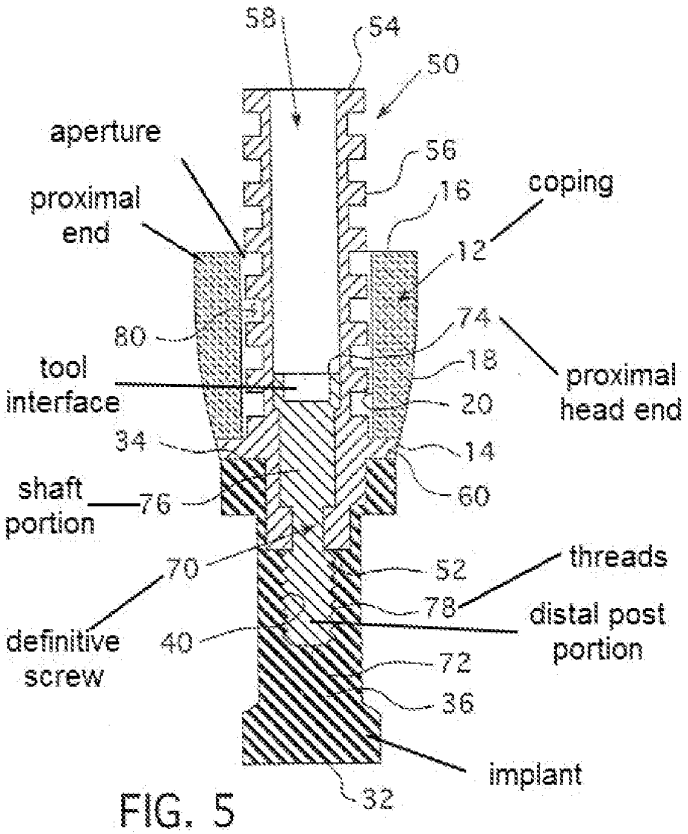


FIG. 5
(Lannan, annotated)

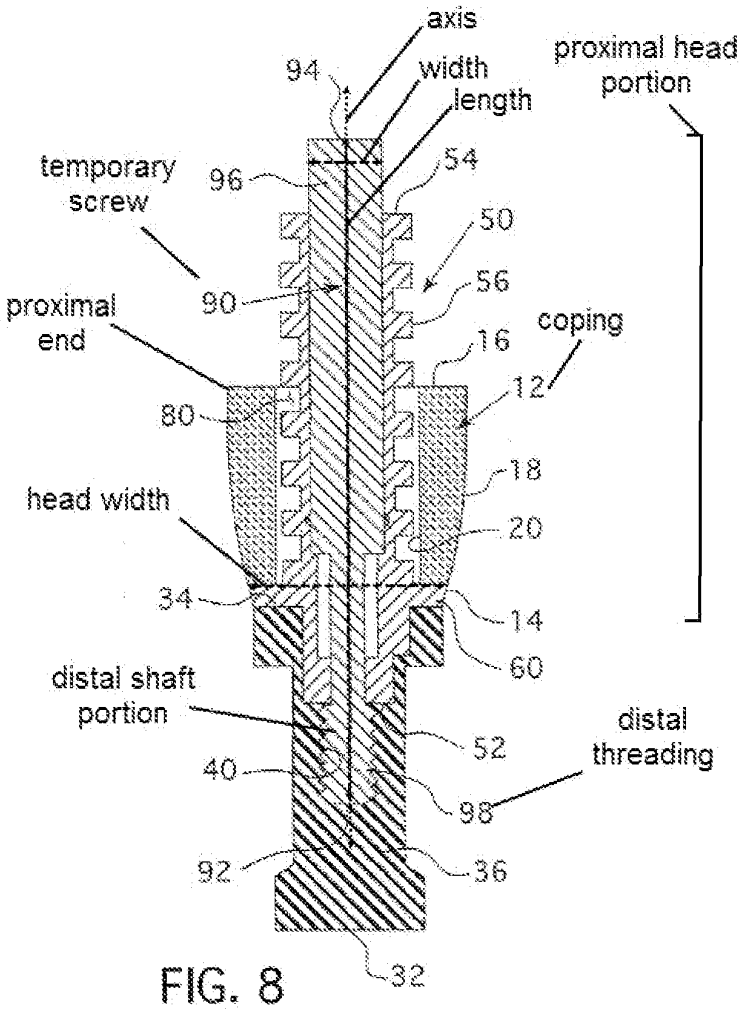


FIG. 8
(Lannan, annotated)

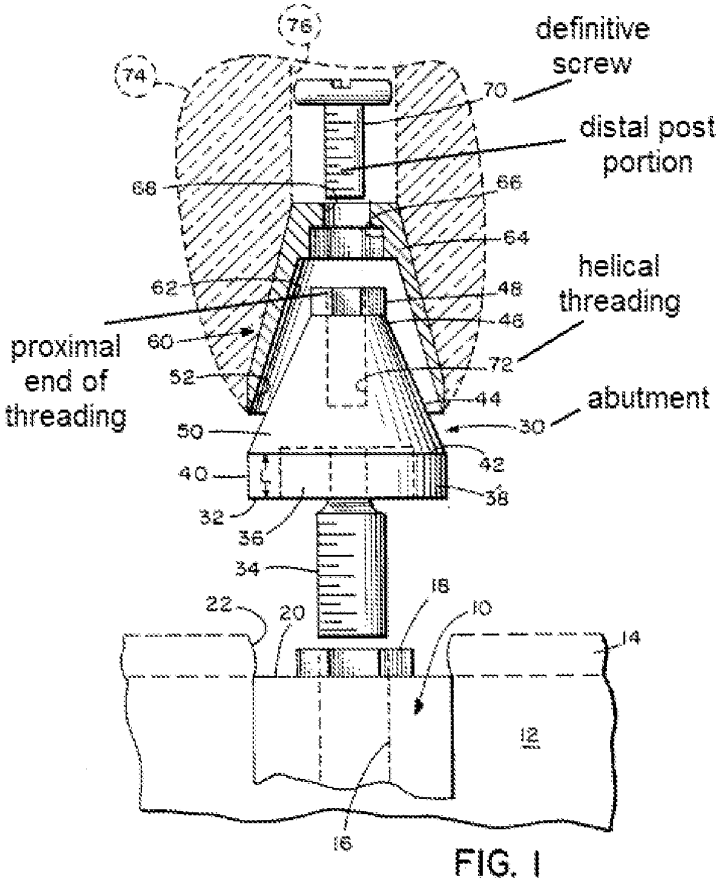


FIG. 1

85. In regard to claim 1, Lannan discloses a dental system (Figs. 1-8, 11-16, Abstract) comprising: a coping (12, Fig. 5) having a proximal end (proximal end in annotated Fig. 5, Fig. 5) with an aperture (aperture in annotated Fig. 5, Fig. 5) sized to allow a shaft portion (76, Fig. 5) of a definitive screw to pass through (Fig. 5); and an implant (implant in annotated in Fig. 5, Fig. 5) having helical threading (40 in Figs. 4 and 5, paras. 0050-0051) for securing the coping with a definitive screw (Fig. 16, para. 0058); and a definitive screw (70, Fig. 5) having a proximal head end (74, Fig. 5) having a tool interface (tool interface in annotated Fig. 5, Fig. 5) and a distal post portion (distal post portion in annotated Fig. 5, Fig. 5) having threads (78 in Fig. 5, para. 0050) for securing the coping to the implant after processing (Fig. 16, para. 0058); and a

temporary screw (90 in Fig. 8) having an axis (axis in annotated Fig. 8, Fig. 8) with a length (length in annotated Fig. 8, Fig. 8) measured along the axis (annotated Fig. 8, Fig. 8) and a width (width in annotated Fig. 8, Fig. 8) measured perpendicular to the axis (annotated Fig. 8, Fig. 8), the temporary screw comprising: a proximal head portion (proximal head portion in annotated Fig. 8, Fig. 8) with a width (head width in annotated Fig. 8, Fig. 8) larger than the coping aperture (Fig. 8); and a distal shaft portion (distal shaft portion in annotated Fig. 8, Fig. 8) shaped for rotary engagement with the implant threading (para. 0052); wherein rotating the temporary screw to engage the shaft portion of the temporary screw with the implant threads through an engagement depth and to a predetermined torque (Fig. 8, Fig. 13, paras. 0052-0053) causes the head portion of the temporary screw to hold the coping into alignment with the implant abutment for processing (Fig. 8, Fig. 13, paras. 0052-0053, para. 0057), and wherein an axial force in a proximal direction releases the coping from the implant abutment (Fig. 15, para. 0058), and wherein the shaft portion does not contact the implant threads continuously above a most distal engagement position (Fig. 8).

Lannan does not disclose a threaded implant abutment having helical threading.

Lazzara teaches an apparatus (Fig. 1) comprising an implant abutment (30, Fig. 1) having helical threading (72 in Fig. 1, col. 3 lines 7-10) for a definitive screw (col. 3 lines 7-10) and a definitive screw (70 in Fig. 1) having a distal post portion having threads (Fig. 1).

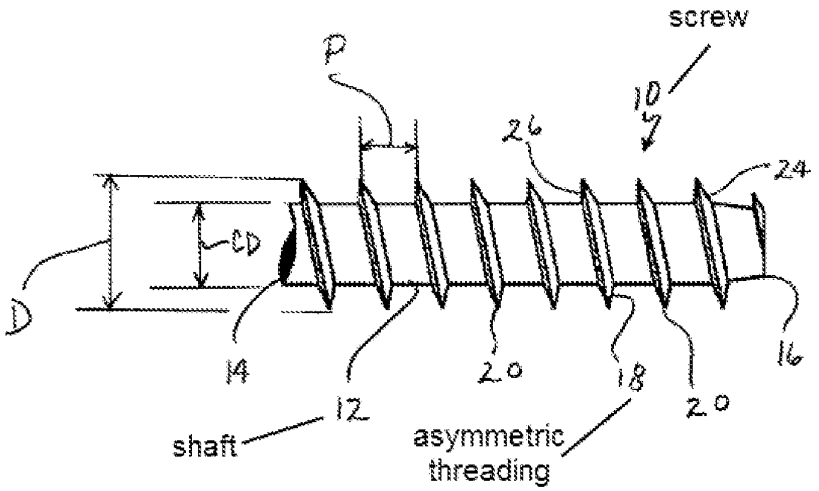
The references and the claimed invention are considered to be analogous to the claimed invention because they are in the same field of dental implant fastening systems. It would have been obvious to someone of ordinary skill in the art before the effective filing date of the claimed invention to have modified the dental system of Lannan by adding a threaded implant abutment having helical threading as taught by Lazzara in order to allow for accommodation of differences in gum thickness between different parts of the mouth of patients and between different patients (Lazzara Fig. 1, col. 2 lines 49-60).

86. In regard to claim 4, the combination of Lannan and Lazzara discloses the invention of claim 1; wherein the axial force is applied through a pick-up process (Lannan Fig. 14-15, paras. 0058) in which the coping (Lannan 12, Fig. 5) is adhered to a separable dental element (Lannan 122, para. 0058).

87. In regard to claim 9, the combination of Lannan and Lazzara discloses the invention of claim 1; wherein only mechanical energy is applied to release the coping (Lannan Fig. 14-15, paras. 0058).

88. **Claim 3 is rejected under 35 U.S.C. 103 as being unpatentable over the combination of Lannan and Lazzara in view of Neuhengen** (U.S. 2002/0094255 A1).

(Neuhengen, annotated) FIG.1



89. In regard to claim 3, the combination of Lannan and Lazzara discloses the invention of claim 1. The combination of Lannan and Lazzara does not disclose wherein the temporary screw distal shaft portion comprises asymmetric threading.

Neuhengen teaches an apparatus (Figs. 1, 2) comprising a screw (10, Fig. 1) with a shaft portion (12, Fig. 1) comprising asymmetric threading (18 in Figs. 1, 2, para. 0015).

The references and the claimed invention are considered to be analogous to the claimed invention because they are in the same field of threaded fasteners. It would have been obvious to someone of ordinary skill in the art before the effective filing date of the claimed invention to have modified the threading of the temporary screw distal shaft portion and the helical threading of the implant abutment of the combination of Lannan and Lazzara to be asymmetrical as taught by Neuhengen in order to reduce the tendency of the threads to crack the material it is screwed into (para. 0009).

90. **Claims 6, 8, and 10-12 are rejected under 35 U.S.C. 103 as being unpatentable over the combination of Lannan and Lazzara in view of Berrevoets et al** (U.S. Patent No. 6,517,543 B1, hereinafter "Berrevoets").

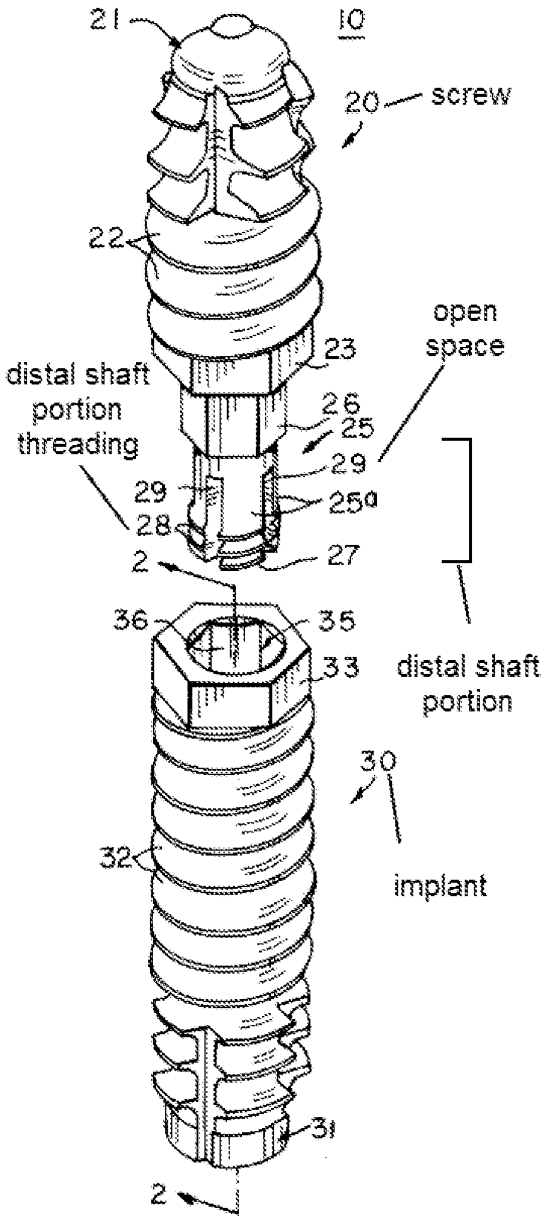


FIG. 1

91. In regard to claim 6, the combination of Lannan and Lazzara discloses the invention of claim 1. The combination of Lannan and Lazzara does not disclose wherein the temporary

screw distal shaft portion comprises threading which is not a continuous helical structure over the engagement depth.

Berrevoets teaches an apparatus (Figs. 1-3) comprising an implant (30 in Fig. 1) having helical threading (38 in Fig. 3) and a screw (20 in Fig. 1) having a distal shaft portion (distal shaft portion in annotated Fig. 1) shaped for engagement with the implant threading (col. 3 lines 26-31), wherein the screw distal shaft portion comprises an open space (29, Fig. 1) located toward the axis from the threading (28, Fig. 1), wherein the threading (28 in Fig. 1) is not a continuous helical structure over the engagement depth (Figs. 1, 3, col. 3 lines 4-8).

The references and the claimed invention are considered to be analogous to the claimed invention because they are in the same field of threaded fasteners. It would have been obvious to someone of ordinary skill in the art before the effective filing date of the claimed invention to have modified the temporary screw distal shaft portion of the combination of Lannan and Lazzara by specifying the threading is not a continuous helical structure over the engagement depth as taught by Berrevoets in order to allow the distal shaft portion of the temporary screw to have enough flexibility to be able to be deflected inwardly so that the insertion of the distal shaft portion can be accomplished without relative rotation of the parts (Berrevoets col. 3 lines 36-45), and allow for the distal shaft portion to be inserted at a variety of different depths, so that the overall length of the system is adjustable (Berrevoets col. 3 lines 52-57) to different patients and mouth locations.

92. In regard to claim 8, the combination of Lannan and Lazzara discloses the invention of claim 1. The combination of Lannan and Lazzara dose not disclose wherein the temporary screw distal shaft portion comprises threading which deforms under the axial force to release the coping.

Berrevoets teaches an apparatus (Figs. 1-3) comprising an implant (30 in Fig. 1) having helical threading (38 in Fig. 3) and a screw (20 in Fig. 1) having a distal shaft portion (distal shaft portion in annotated Fig. 1) shaped for engagement with the implant threading (col. 3 lines

26-31), wherein the screw distal shaft portion comprises an open space (29, Fig. 1) located toward the axis from the threading (28, Fig. 1), wherein the threading deforms under axial force (col. 3 lines 36-45).

The references and the claimed invention are considered to be analogous to the claimed invention because they are in the same field of threaded fasteners. It would have been obvious to someone of ordinary skill in the art before the effective filing date of the claimed invention to have modified the temporary screw distal shaft portion of the combination of Lannan and Lazzara by specifying the threading deforms under an axial force as taught by Berrevoets in order to allow the distal shaft portion of the temporary screw to have enough flexibility to be able to be deflected inwardly so that the insertion of the distal shaft portion can be accomplished without relative rotation of the parts (Berrevoets col. 3 lines 36-45), and allow for the distal shaft portion to be inserted at a variety of different depths, so that the overall length of the system is adjustable (Berrevoets col. 3 lines 52-57) to different patients and mouth locations.

93. In regard to claim 10, the combination of Lannan and Lazzara discloses the invention of claim 1. The combination of Lannan and Lazzara does not disclose that the temporary screw distal shaft portion comprises an open space located toward the axis from the threading of the temporary screw distal shaft portion.

Berrevoets teaches an apparatus (Figs. 1-3) comprising an implant (30 in Fig. 1) having helical threading (38 in Fig. 3) and a screw (20 in Fig. 1) having a distal shaft portion (distal shaft portion in annotated Fig. 1) shaped for engagement with the implant threading (col. 3 lines 26-31), wherein the screw distal shaft portion comprises an open space (29, Fig. 1) located toward the axis from the threading (28, Fig. 1) of the screw distal shaft portion (col. 3 lines 3-8).

The references and the claimed invention are considered to be analogous to the claimed invention because they are in the same field of threaded fasteners. It would have been obvious to someone of ordinary skill in the art before the effective filing date of the claimed invention to have modified the temporary screw distal shaft portion of the combination of Lannan and

Lazzara by specifying the distal shaft portion comprises an open space located toward the axis from the threading as taught by Berrevoets in order to allow the distal shaft portion of the temporary screw to have flexibility to be able to be deflected inwardly so that the insertion of the distal shaft portion can be accomplished without relative rotation of the parts (Berrevoets col. 3 lines 36-45), and allow for the distal shaft portion to be inserted at a variety of different depths, so that the overall length of the system is adjustable (Berrevoets col. 3 lines 52-57) to different patients and mouth locations.

94. In regard to claim 11, the combination of Lannan and Lazzara discloses the invention of claim 1; wherein the temporary screw distal shaft portion (Lannan distal shaft portion in annotated Fig. 8, Fig. 8) comprises threading (Lannan distal threading in annotated Fig. 8, Fig. 8) which makes contact with the implant abutment threading (Lazzara helical threading in annotated Fig. 1, Fig. 1) over a temporary screw threading contact area (Lannan Fig. 8, Lazzara Fig. 1) when holding the coping (Lannan 12 in Fig. 8) against the implant abutment (Lannan Fig. 8, Lazzara Fig. 1), and the definitive screw post (Lannan distal post portion in annotated Fig. 5, Fig. 5) makes contact with the implant abutment threading over a definitive screw threading contact area (Lannan Fig. 8, Lazzara Fig. 1) when holding the coping against the implant abutment (Lannan Fig. 5).

The combination of Lannan and Lazzara does not disclose wherein the temporary screw threading contact area is less than the definitive screw threading contact area.

Berrevoets teaches an apparatus (Figs. 1-3) comprising an implant (30 in Fig. 1) having helical threading (38 in Fig. 3) and a screw (20 in Fig. 1) having a distal shaft portion (distal shaft portion in annotated Fig. 1) shaped for engagement with the implant threading (col. 3 lines 26-31), wherein the screw distal shaft portion comprises an open space (29, Fig. 1) located toward an axis from a threading (28, Fig. 1) of the screw distal shaft portion (col. 3 lines 3-8); wherein the screw distal shaft portion threading makes contact with the implant abutment threading (Fig. 3) over a screw threading contact area (area shown including thread 28 in Fig. 1,

Fig. 1), wherein the screw threading contact area is less than an area that extends around an entire circumference of the screw distal shaft portion (due to the open spaces 29, Fig. 1).

The references and the claimed invention are considered to be analogous to the claimed invention because they are in the same field of threaded fasteners. It would have been obvious to someone of ordinary skill in the art before the effective filing date of the claimed invention to have modified the temporary screw distal shaft portion of the combination of Lannan and Lazzara by specifying the distal shaft portion comprises an open space located toward the axis from the threading as taught by Berrevoets in order to allow the distal shaft portion of the temporary screw to have flexibility to be able to be deflected inwardly so that the insertion of the distal shaft portion can be accomplished without relative rotation of the parts (Berrevoets col. 3 lines 36-45), and allow for the distal shaft portion to be inserted at a variety of different depths, so that the overall length of the system is adjustable (Berrevoets col. 3 lines 52-57) to different patients and mouth locations.

As a result of the combination, the temporary screw distal shaft portion of Lannan, Lazzara and Berrevoets discloses a temporary screw threading contact area (Lannan Fig. 8; Berrevoets area shown including thread 28 in Fig. 1, Fig. 1) which is less than the definitive screw threading contact area (Lannan Fig. 8, i.e. a screw with a distal shaft portion comprising open spaces has less threading contact area than a screw without open spaces).

95. In regard to claim 12 the combination of Lannan, Lazzara, and Berrevoets discloses the invention of claim 11; wherein a volume of the definitive screw post material (Lannan volume of distal post portion in annotated Fig. 5, Fig. 5) located distally of a proximal end of the implant abutment threading (Lazzara proximal end of threading in annotated Fig. 1, Fig. 1) when holding the coping (Lannan 12 in Fig. 5) against the implant abutment is greater than a volume of the temporary screw shaft material (Lannan volume of distal shaft portion in annotated Fig. 8, Fig. 8, modified to have openings 29 of Berrevoets) holding the coping (Lannan 12 in Fig. 8) against

the implant abutment when holding the coping against the implant abutment (Lannan Fig. 8, Lazzara Fig. 1).

96. **Claim 7 is rejected under 35 U.S.C. 103 as being unpatentable over the combination of Lannan, Lazzara, and Berrevoets in view of Otaki** (U.S. 4,040,327 A).

97. In regard to claim 7, the combination of Lannan, Lazzara, and Berrevoets discloses the invention of claim 6; wherein the definitive screw post threads (78 in Fig. 5, para. 0050) comprise a continuous helical form (Figs. 4 and 5, para. 0050). The combination of Lannan, Lazzara, and Berrevoets does not disclose wherein the definitive screw post threads are symmetrical.

Otaki teaches an apparatus (Fig. 1a) comprising screw threads which are symmetrical (Fig. 1a, col. 1 lines 26-31, col. 2 lines 7-23).

The references and the claimed invention are considered to be analogous to the claimed invention because they are in the same field of threaded fasteners. It would have been obvious to someone of ordinary skill in the art before the effective filing date of the claimed invention to have modified the definitive screw post threads of the combination of Lannan, Lazzara, and Berrevoets by specifying the threading is symmetrical as taught by Otaki in order to allow for improved load distribution and higher fatigue strength of the threads (Otaki col. 1 lines 26-31).

Allowable Subject Matter

98. Claims 18, 20-22, and 24-30 would be allowable if rewritten or amended to overcome the rejection(s) under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), 2nd paragraph, set forth in this Office action.

Conclusion

99. Any inquiry concerning this communication or earlier communications from the examiner should be directed to COURTNEY N HUYNH whose telephone number is (571)272-7219. The examiner can normally be reached M-F 7:30AM-5:00PM (EST) flex, 2nd Friday off.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Cris Rodriguez can be reached on (571) 272-4964. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of published or unpublished applications may be obtained from Patent Center. Unpublished application information in Patent Center is available to registered users. To file and manage patent submissions in Patent Center, visit: https://patentcenter.uspto.gov. Visit https://www.uspto.gov/patents/apply/patent-center for more information about Patent Center and https://www.uspto.gov/patents/docx for information about filing in DOCX format. For additional questions, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/C.N.H./
Examiner, Art Unit 3772

/AMY R SIPP/
Primary Examiner, Art Unit 3775

Notice of References Cited	Application/Control No. 18/328,730	Applicant(s)/Patent Under Reexamination Kofford et al.	
	Examiner COURTNEY N HUYNH	Art Unit 3772	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-4040327-A	08-1977	Otaki; Hideyuki	F16B33/02	411/423
*	B	US-4850870-A	07-1989	Lazzara; Richard J.	A61C8/005	433/201.1
*	C	US-20020094255-A1	07-2002	Neuhengen, Ken	F16B25/00	411/414
*	D	US-6517543-B1	02-2003	Berrevoets; Greg A.	A61B17/68	411/419
*	E	US-20080206709-A1	08-2008	Lannan; William G.	A61C8/005	433/172
	F					
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FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/328,730	Kofford et al.
	Examiner	Art Unit
	COURTNEY N HUYNH	3772

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	08/02/2023	08/22/2023							
	1	÷	✓							
	2	÷	N							
	3	÷	✓							
	4	÷	✓							
	5	÷	N							
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	28	÷	✓							
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	30	÷	✓							

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/328,730	Kofford et al.
	Examiner	Art Unit
	COURTNEY N HUYNH	3772

CPC - Searched*		
Symbol	**Date**	**Examiner**
A61C8/0001	08/16/2023	CNH
A61C8/0007	08/18/2023	CNH
A61C11/088	08/22/2023	CNH

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**
411	419, 414	08/23/2023	CNH

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

/COURTNEY N HUYNH/ Examiner, Art Unit 3772	/AMY R SIPP/ Primary Examiner, Art Unit 3775

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/328,730	Kofford et al.
	Examiner	Art Unit
	COURTNEY N HUYNH	3772

Search Notes		
Search Notes	**Date**	**Examiner**
Considered IDS	08/14/2023	CNH
Searched patent family on Global Dossier, Espacenet, Patentscope	08/14/2023	CNH
Inventor name search in PE2E and PDP	08/14/2023	CNH
PE2E Search -A61C8/0082,006 8,0087,0066,0074,0078, A61C2008 /0084, A61C13/225,2255,265, 2656,275, A61C2201/00, USPC 433/ 173 -with text, see attached search history	08/16/2023	CNH
Search in IP.com		CNH
Consulted Examiner Heidi Eide regarding search	08/17/2023	CNH
PE2E Search - A61C8/0007,0082,006 8,0087,0066,0074,0078, $ A61C2008/0084, A61C13/225,2255,265, 2656,275, A61C2201/00, USPC 433/173 -with text, see attached search history	08/18/2023	CNH
Search in IP.com	08/18/2023	CNH
Consulted Examiner Matthew Saunders regarding search	08/22/2023	CNH
PE2E Search - A61C11/088, F16B37/14 -with text, see attached search history	08/22/2023	CNH
Consulted Examiner Flemming Saether (AU 3677) regarding search	08/23/2023	CNH
PE2E Search - F16B35/06, F16B35/041, F16B33/02, USPC 411/ 396,397,411 -with text, see attached search history	08/23/2023	CNH
PE2E Search - A61C8/00,005,008, A61C2008/0084 -with text, see attached search history	09/06/2023	CNH
Consulted Examiner Ed Moran regarding allowability	09/06/2023	CNH

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**

/COURTNEY N HUYNH/ Examiner, Art Unit 3772	/AMY R SIPP/ Primary Examiner, Art Unit 3775

Bibliographic Data

Application No: 18/328,730

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☐ No ☐ Met After Allowance

Verified and Acknowledged: /COURTNEY N HUYNH/ Examiner's Signature | Initials

Title: Screw-attached Pick-up Dental Coping System and Methods

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
06/03/2023	433	3772	SDC010
RULE			

APPLICANTS

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CONTINUING DATA

This application is a CON of 17691108 03/09/2022

This application is a CON of 16596361 10/08/2019 PAT 11311354

This application has PRO of 62818082 03/13/2019

This application has PRO of 62774402 12/03/2018

This application has PRO of 62742942 10/09/2018

FOREIGN APPLICATIONS

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1	2023-08-18 14:09 UTC	286,099	3

Content: Patent Publications (169)

US Patents | US Designs | US Applications | EPO Patents | EPO Applications | China Patents | China Applications | Japan Patents | Japan Applications | Korea Patents | Korea Applications | WIPO Applications | Argentina Patents | Argentina Applications | Brazil Patents | Brazil Applications | Canada Patents | Canada Applications | Chile Patents | Chile Applications | Colombia Applications | Costa Rica Applications | Cuba Patents | Cuba Applications | Dominican Republic Applications | Ecuador Patents | Ecuador Applications | El Salvador Applications | Guatemala Applications | Honduras Applications | Mexico Patents | Mexico Applications | Nicaragua Patents | Panama Applications | Peru Applications | Trinidad & Tobago Patents | Uruguay Applications | Austria Patents | Austria Applications | Belarus Patents | Belgium Patents | Belgium Applications | Bosnia & Herzegovina Patents | Bosnia & Herzegovina Applications | Bulgaria Patents | Bulgaria Applications | Croatia Patents | Croatia Applications | Czech Republic Patents | Czech Republic Applications | Czechoslovakia Patents | Czechoslovakia Applications | Denmark Patents | Denmark Applications | Estonia Patents | Estonia Applications | EUIPO Patents | Finland Patents | Finland Applications | France Patents | France Applications | Germany Patents | Germany Applications | Great Britain Patents | Great Britain Applications | Greece Patents | Greece Applications | Hungary Patents | Hungary Applications | Iceland Patents | Iceland Applications | Ireland Patents | Ireland Applications | Italy Patents | Italy Applications | Latvia Patents | Latvia Applications | Lithuania Patents | Lithuania Applications | Luxembourg Patents | Luxembourg Applications | Malta Patents | Monaco Patents | Montenegro Patents | Montenegro Applications | Netherlands Patents | Netherlands Applications | Norway Patents | Norway Applications | Poland Patents | Poland Applications | Portugal Patents | Portugal Applications | Republic of Moldova Patents | Republic of Moldova Applications | Romania Patents | Romania Applications | San Marino Patents | San Marino Applications | Serbia Patents | Serbia Applications | Slovakia Patents | Slovakia Applications | Slovenia Patents | Spain Patents | Spain Applications | Sweden Patents | Sweden Applications | Switzerland Patents | Switzerland Applications | Ukraine Patents | Yugoslavia/Serbia and Montenegro Patents | Yugoslavia/Serbia and Montenegro Applications | Armenia Patents | Australia Patents | Australia Applications | Cyprus Patents | Gulf Cooperation Council Patents | Hong Kong Patents | India Patents | India Applications | Indonesia Patents | Indonesia Applications | Israel Patents | Israel Applications | Jordan Patents | Jordan Applications | Kyrgyzstan Patents | Macao Applications | Malaysia Patents | Mongolia Patents | New Zealand Patents | Philippines Patents | Philippines Applications | Saudi Arabia Patents | Saudi Arabia Applications | Singapore Patents | Singapore Applications | Taiwan Patents | Taiwan Applications | Tajikistan Patents | Tajikistan Applications | Thailand Patents | Thailand Applications | Uzbekistan Patents | Vietnam Patents | Algeria Patents | ARIPO Patents | ARIPO Applications | Egypt Patents | Kenya Patents | Malawi Patents | Morocco Patents | Morocco Applications | OAPI Patents | South Africa Patents | Tunisia Applications | Zambia Patents | Zimbabwe Patents | EAPO Patents | EAPO Applications | Georgia Patents | Georgia Applications | Kazakhstan Patents | Kazakhstan Applications | Russia Patents | Russia Applications | Turkey Patents | Turkey Applications

1 **2023-08-18 14:09 UTC | 286,099 results from**

De-Dup: None | **Relevance Cut-off:** None | **Sort:** Relevance

Main Concept: Text
pick up impression coping where coping used for both the impression and final prosthesis

Concept Modifiers: None

Filters: None

Straumann USA Exhibit 1015

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
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EXAMINER SIGNATURE

Examiner Signature	/COURTNEY N HUYNH/	Date Considered	08/14/2023

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**		
	Application Number	
	Filing Date	
	First Named Inventor	
	Art Unit	
	Examiner Name	
	Attorney Docket Number	

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☐ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature		Date (YYYY-MM-DD)	
Name/Print		Registration Number	

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

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PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L1	63	((("KOFFORD") near3 ("Brandon")) OR (("RUDISILL") near3 ("Charles"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2023/08/14 04:22 PM
L2	63	((("KOFFORD") near3 ("Brandon")) OR (("RUDISILL") near3 ("Charles"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2023/08/14 04:24 PM
L3	6479	(A61C8/0001).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/15 11:32 AM
L4	0	(15/543757).APP.	(USPAT; USOCR)	OR	ON	ON	2023/08/15 01:22 PM
L5	6479	(A61C8/0001).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/16 07:39 AM
L6	5	"6379148".pn.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO,	OR	ON	ON	2023/08/16 09:16 AM

			MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L7	574	(A61C8/0001).cpc. AND (asymmetric$5)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/16 09:17 AM
L8	6330	(A61C8/0066).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/16 09:34 AM
L9	0	(A61C8/00668).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/16 09:35 AM
L10	10503	(A61C8/0068).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT,	OR	ON	ON	2023/08/16 09:35 AM

			AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L11	30987	(A61C8/0001,0082,0068,0087,0066,0074,0078).cpc. OR (A61C2008/0084).cpc. OR (A61C13/225,2255,265,2656,275).cpc. OR (A61C2201/00).cpc. OR (433/173).ccls.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/16 04:22 PM
L12	9243	((A61C8/0001,0082,0068,0087,0066,0074,0078).cpc. OR (A61C2008/0084).cpc. OR (A61C13/225,2255,265,2656,275).cpc. OR (A61C2201/00).cpc. OR (433/173).ccls.) AND (cap OR head OR top OR washer OR cover OR disc OR cover) AND (post OR strut OR rod OR pillar OR shaft OR column OR stake)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/16 04:25 PM
L13	1534	((A61C8/0001,0082,0068,0087,0066,0074,0078).cpc. OR (A61C2008/0084).cpc. OR (A61C13/225,2255,265,2656,275).cpc. OR (A61C2201/00).cpc. OR (433/173).ccls.) AND (cap OR head OR top OR washer OR cover	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE,	OR	ON	ON	2023/08/16 04:49 PM

		OR disc OR cover) AND (post OR strut OR rod OR pillar OR shaft OR column OR stake) AND coping	SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L14	610	(A61C8/0007).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/18 09:27 AM
L15	587	((A61C8/0001,0082,0068,0087,0066,0074,0078).cpc. OR (A61C2008/0084).cpc. OR (A61C13/225,2255,265,2656,275).cpc. OR (A61C2201/00).cpc. OR (433/173).ccls.) AND (cap OR head OR top OR washer OR cover OR disc OR cover) AND (post OR strut OR rod OR pillar OR shaft OR column OR stake) AND ((pick near3 up) OR (open near3 tray))	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/18 11:06 AM
L16	0	(12/038552).APP.	(USPAT; USOCR)	OR	ON	ON	2023/08/18 01:27 PM
L17	8	("2008/0206709").urpn. AND (PGPB | USPT | USOC).dbnm.	(US-PGPUB; USPAT; USOCR)	OR	ON	ON	2023/08/18 01:27 PM
L18	35	(Artificial Intelligence) More like doc: US-20080206709-A1 Text: (US-20170215996-A1 OR US-9655697-B2 OR US-20180147031-A1 OR US-9901425-B2 OR US-20140272790-A1 OR ES-2860928-T3 OR EP-3236878-B1 OR EP-3236878-A1 OR WO-2016103270-A1	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA,	OR	ON	ON	2023/08/18 01:32 PM

		OR US-20160270886-A1 OR US-10123856-B2 OR KR-20170023890-A OR WO-2017156405-A1 OR EP-3426187-A1 OR KR-20220140717-A OR JP-2023511388-A OR US-10426711-B2 OR US-20180250102-A1 OR US-11173017-B2 OR CN-115003244-A).did.	VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L19	3777	(A61C8/$).cpc. AND (asymmetrical OR uneven OR different OR skew OR unsymmetrical OR skewed OR lopsided) WITH (threads OR threading OR threaded)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/18 03:40 PM
L20	1345	(A61C8/$).cpc. AND ((pick near3 up) OR (open near3 tray) OR (closed near3 tray))	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/18 04:02 PM
L21	7661	(A61C13/225,2255,265,2656,275).cpc. OR (A61C2201/00).cpc. OR (433/173).ccls. AND (cap OR head OR top OR washer OR cover OR disc OR cover) AND (post OR strut OR rod OR pillar OR shaft OR column OR stake) AND coping	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH,	OR	ON	ON	2023/08/18 04:20 PM

			TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L22	521	((A61C13/225,2255,265,2656,275).cpc. OR (A61C2201/00).cpc. OR (433/173).ccls.) AND (cap OR head OR top OR washer OR cover OR disc OR cover) AND (post OR strut OR rod OR pillar OR shaft OR column OR stake) AND coping	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/18 04:21 PM
L23	949	(A61C11/088).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/22 11:22 AM
L24	13	(A61C11/088).cpc. AND (torqu$6)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/22 02:15 PM
L25	366	(A61C11/088).cpc. AND (cap OR head OR top OR washer OR cover OR disc OR cover) AND (slid$6 OR	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA,	OR	ON	ON	2023/08/22 02:17 PM

		removv$5 OR movab$5 OR detach$5 OR separat$5)	EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L26	224	(A61C11/088).cpc. AND ((cap OR head OR top OR washer OR cover OR disc OR cover) WITH (slid$6 OR remov$5 OR movab$5 OR detach$5 OR separat$5))	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/22 02:17 PM
L27	10173	(F16B37/14).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/22 03:06 PM
L28	4875	(F16B37/14).cpc. AND (slid$6 OR remov$5 OR movab$5 OR detach$5 OR separat$5)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO;	OR	ON	ON	2023/08/22 03:06 PM

			JPO; DERWENT; IBM_TDB)				
L29	0	(411/396,397).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/23 07:47 AM
L30	0	(411/396).cpc. OR (411/397).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/23 07:48 AM
L31	717	(411/396).ccls. OR (411/397).ccls.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/23 07:48 AM
L32	12031	((411/396).ccls. OR (411/397).ccls. OR (F16B35/06).cpc.)	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS,	OR	ON	ON	2023/08/23 07:57 AM

			IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L33	5244	((411/396).ccls. OR (411/397).ccls. OR (F16B35/06).cpc.) AND (slid$6 OR remov$5 OR movab$5 OR detach$5 OR separat$5)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/23 07:57 AM
L34	335	(411/419).ccls. OR (411/414).ccls.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/23 08:01 AM
L35	15	"4040327".pn.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/23 08:08 AM

L36	1488	(411/419).ccls. OR (411/411,414).ccls.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/23 08:25 AM
L37	1188	(411/411).ccls.	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/23 08:28 AM
L38	15981	((411/411).ccls. OR (F16B35/041).cpc. OR (F16B33/02).cpc.)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/23 08:28 AM
L39	1866	((411/411).ccls. OR (F16B35/041).cpc. OR (F16B33/02).cpc.) AND (symmetric$5 OR asymmetric$5)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL,	OR	ON	ON	2023/08/23 08:37 AM

			NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L40	167	(411/419).ccls. OR (411/414).ccls. AND asymmetric	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/23 11:42 AM
L41	8	((411/419).ccls. OR (411/414).ccls.) AND asymmetric	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/23 11:43 AM
L42	111	((US-20230200950-A1 OR US-20220387144-A1 OR US-20210275279-A1 OR US-20200107914-A1 OR US-20200107913-A1 OR US-20200100876-A1 OR US-20180243053-A1 OR US-20180235734-A1 OR US-20180000566-A1 OR US-20170367803-A1 OR US-20170202649-A1 OR US-20160346066-A1 OR US-20160143711-A1 OR US-20160106523-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/23 01:53 PM

		A1 OR US-20150140514-A1 OR US-20150111175-A1 OR US-20070281279-A1 OR US-20110262884-A1 OR US-20060121416-A1 OR US-20060084033-A1 OR US-20030104336-A1 OR US-20030170587-A1 OR US-20020025505-A1 OR US-20100248180-A1 OR US-20070059121-A1 OR US-20030190586-A1 OR US-20030211445-A1 OR US-20080176186-A1 OR US-20100196855-A1 OR US-20020127515-A1 OR US-20110129798-A1 OR US-20100159417-A1 OR US-20140297232-A1 OR US-20030082498-A1 OR US-20080227057-A1 OR US-20210282901-A1 OR US-20200197134-A1 OR US-20190008614-A1 OR US-20040096804-A1 OR US-20080008981-A1 OR US-20080206709-A1 OR US-20150093718-A1 OR US-20130002758-A1 OR US-20020094255-A1).did. AND PGPB.dbnm.) OR ((EP-4151177-A1 OR KR-102502144-B1 OR CN-113940772-A OR KR-20200053276-A OR KR-101966407-B1 OR KR-20160105099-A OR KR-20150086699-A OR WO-2022023823-A1 OR WO-2022073088-A1 OR KR-100702487-B1 OR WO-2017131833-A1 OR WO-2008068338-A1 OR KR-20190136496-A).did. AND FTDB.dbnm.) OR ((US-					

		20220151751-A1 OR WO-2020075071-A1 OR KR-2062505-B1 OR WO-2018172270-A1 OR WO-2017002111-A1 OR US-20160106523-A1 OR WO-2016012581-A1 OR SE-9804235-A OR WO-2014049589-A1 OR WO-2010056330-A1 OR US-20100112527-A1 OR US-5759036-A OR WO-9852490-A1 OR US-5938443-A OR KR-948074-B1 OR US-20090053675-A1 OR WO-0002497-A1 OR US-20080176186-A1 OR US-6379148-B1 OR FR-2860421-A1 OR WO-9629019-A1 OR JP-2002078719-A OR US-20100143871-A1 OR WO-2012074717-A1).did. AND DWPI.dbnm.) OR ((DE-102018122064-A1 OR DE-102018001195-A1 OR WO-2015016629-A1 OR DE-102009024372-A1 OR WO-2009024838-A2 OR WO-2010075993-A1 OR KR-20110022876-A OR WO-9629019-A1).did. AND FPRS.dbnm.) OR ((US-5040983-A OR US-4850870-A OR US-6203323-B1 OR US-6213773-B1 OR US-3854371-A OR US-3832747-A OR US-5899697-A OR US-5350297-A OR US-5904483-A OR US-6142782-A OR US-5015186-A OR US-6379148-B1 OR US-6283752-B1 OR US-8920170-B2 OR US-6139236-A OR US-4907926-A OR US-3115804-A OR US-4040327-A OR US-0462752-A OR US-					

		6517543-B1 OR US-0771336-A OR US-1729670-A).did. AND USPT.dbnm.)					
L43	99	((US-20230200950-A1 OR US-20220387144-A1 OR US-20210275279-A1 OR US-20200107914-A1 OR US-20200107913-A1 OR US-20200100876-A1 OR US-20180243053-A1 OR US-20180235734-A1 OR US-20180000566-A1 OR US-20170367803-A1 OR US-20170202649-A1 OR US-20160346066-A1 OR US-20160143711-A1 OR US-20160106523-A1 OR US-20150140514-A1 OR US-20150111175-A1 OR US-20070281279-A1 OR US-20110262884-A1 OR US-20060121416-A1 OR US-20060084033-A1 OR US-20030104336-A1 OR US-20030170587-A1 OR US-20020025505-A1 OR US-20100248180-A1 OR US-20070059121-A1 OR US-20030190586-A1 OR US-20030211445-A1 OR US-20080176186-A1 OR US-20100196855-A1 OR US-20020127515-A1 OR US-20110129798-A1 OR US-20100159417-A1 OR US-20140297232-A1 OR US-20030082498-A1 OR US-20080227057-A1 OR US-20210282901-A1 OR US-20200197134-A1 OR US-20190008614-A1 OR US-20040096804-A1 OR US-20080008981-A1 OR US-20080206709-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/23 01:54 PM

		A1 OR US-20150093718-A1 OR US-20130002758-A1 OR US-20020094255-A1).did. AND PGPB.dbnm.) OR ((EP-4151177-A1 OR KR-102502144-B1 OR CN-113940772-A OR KR-20200053276-A OR KR-101966407-B1 OR KR-20160105099-A OR KR-20150086699-A OR WO-2022023823-A1 OR WO-2022073088-A1 OR KR-100702487-B1 OR WO-2017131833-A1 OR WO-2008068338-A1 OR KR-20190136496-A).did. AND FTDB.dbnm.) OR ((US-20220151751-A1 OR WO-2020075071-A1 OR KR-2062505-B1 OR WO-2018172270-A1 OR WO-2017002111-A1 OR US-20160106523-A1 OR WO-2016012581-A1 OR SE-9804235-A OR WO-2014049589-A1 OR WO-2010056330-A1 OR US-20100112527-A1 OR US-5759036-A OR WO-9852490-A1 OR US-5938443-A OR KR-948074-B1 OR US-20090053675-A1 OR WO-0002497-A1 OR US-20080176186-A1 OR US-6379148-B1 OR FR-2860421-A1 OR WO-9629019-A1 OR JP-2002078719-A OR US-20100143871-A1 OR WO-2012074717-A1).did. AND DWPI.dbnm.) OR ((DE-102018122064-A1 OR DE-102018001195-A1 OR WO-2015016629-A1 OR DE-102009024372-A1 OR WO-2009024838-A2 OR WO-2010075993-A1 OR KR-					

		20110022876-A OR WO-9629019-A1).did. AND FPRS.dbnm.) OR ((US-5040983-A OR US-4850870-A OR US-6203323-B1 OR US-6213773-B1 OR US-3854371-A OR US-3832747-A OR US-5899697-A OR US-5350297-A OR US-5904483-A OR US-6142782-A OR US-5015186-A OR US-6379148-B1 OR US-6283752-B1 OR US-8920170-B2 OR US-6139236-A OR US-4907926-A OR US-3115804-A OR US-4040327-A OR US-0462752-A OR US-6517543-B1 OR US-0771336-A OR US-1729670-A).did. AND USPT.dbnm.) AND abutment					
L44	97	((US-20230200950-A1 OR US-20220387144-A1 OR US-20210275279-A1 OR US-20200107914-A1 OR US-20200107913-A1 OR US-20200100876-A1 OR US-20180243053-A1 OR US-20180235734-A1 OR US-20180000566-A1 OR US-20170367803-A1 OR US-20170202649-A1 OR US-20160346066-A1 OR US-20160143711-A1 OR US-20160106523-A1 OR US-20150140514-A1 OR US-20150111175-A1 OR US-20070281279-A1 OR US-20110262884-A1 OR US-20060121416-A1 OR US-20060084033-A1 OR US-20030104336-A1 OR US-20030170587-A1 OR US-20020025505-A1 OR US-	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/08/23 01:58 PM

		20100248180-A1 OR US-20070059121-A1 OR US-20030190586-A1 OR US-20030211445-A1 OR US-20080176186-A1 OR US-20100196855-A1 OR US-20020127515-A1 OR US-20110129798-A1 OR US-20100159417-A1 OR US-20140297232-A1 OR US-20030082498-A1 OR US-20080227057-A1 OR US-20210282901-A1 OR US-20200197134-A1 OR US-20190008614-A1 OR US-20040096804-A1 OR US-20080008981-A1 OR US-20080206709-A1 OR US-20150093718-A1 OR US-20130002758-A1 OR US-20020094255-A1).did. AND PGPB.dbnm.) OR ((EP-4151177-A1 OR KR-102502144-B1 OR CN-113940772-A OR KR-20200053276-A OR KR-101966407-B1 OR KR-20160105099-A OR KR-20150086699-A OR WO-2022023823-A1 OR WO-2022073088-A1 OR KR-100702487-B1 OR WO-2017131833-A1 OR WO-2008068338-A1 OR KR-20190136496-A).did. AND FTDB.dbnm.) OR ((US-20220151751-A1 OR WO-2020075071-A1 OR KR-2062505-B1 OR WO-2018172270-A1 OR WO-2017002111-A1 OR US-20160106523-A1 OR WO-2016012581-A1 OR SE-9804235-A OR WO-2014049589-A1 OR WO-2010056330-A1 OR US-20100112527-A1 OR						

		US-5759036-A OR WO-9852490-A1 OR US-5938443-A OR KR-948074-B1 OR US-20090053675-A1 OR WO-0002497-A1 OR US-20080176186-A1 OR US-6379148-B1 OR FR-2860421-A1 OR WO-9629019-A1 OR JP-2002078719-A OR US-20100143871-A1 OR WO-2012074717-A1).did. AND DWPI.dbnm.) OR ((DE-102018122064-A1 OR DE-102018001195-A1 OR WO-2015016629-A1 OR DE-102009024372-A1 OR WO-2009024838-A2 OR WO-2010075993-A1 OR KR-20110022876-A OR WO-9629019-A1).did. AND FPRS.dbnm.) OR ((US-5040983-A OR US-4850870-A OR US-6203323-B1 OR US-6213773-B1 OR US-3854371-A OR US-3832747-A OR US-5899697-A OR US-5350297-A OR US-5904483-A OR US-6142782-A OR US-5015186-A OR US-6379148-B1 OR US-6283752-B1 OR US-8920170-B2 OR US-6139236-A OR US-4907926-A OR US-3115804-A OR US-4040327-A OR US-0462752-A OR US-6517543-B1 OR US-0771336-A OR US-1729670-A).did. AND USPT.dbnm.) AND ((thread$5 OR screw$5) WITH abutment)					
L45	25877	(A61C8/00,005,008).cpc. OR (A61C2008/0084).cpc.	(US-PGPUB; USPAT; USOCR; FIT (AU, AP, AT, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS,	OR	ON	ON	2023/09/06 09:00 AM

			IT, JP, KR, LT, LU, LV, MA, OA, RU, SU, WO, MC, MD, MY, NL, NO, NZ, PH, PL, PT, RO, RS, SE, SG, SI, SK, TH, TN, TR, TW, UA, VN); FPRS; EPO; JPO; DERWENT; IBM_TDB)				
L46	25634	(A61C8/00,005,008).cpc. OR (A61C2008/0084).cpc. AND (coping)	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/09/06 09:19 AM
L47	25656	(A61C8/00,005,008).cpc. OR (A61C2008/0084).cpc. AND ((cap OR head OR top OR washer OR cover OR disc OR cover) WITH (slid$6 OR remov$5 OR movab$5 OR detach$5 OR separat$5))	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/09/06 09:20 AM
L48	5024	((A61C8/00,005,008).cpc. OR (A61C2008/0084).cpc.) AND ((cap OR head OR top OR washer OR cover OR disc OR cover) WITH (slid$6 OR remov$5 OR movab$5 OR detach$5 OR separat$5))	(US-PGPUB; USPAT; USOCR; FIT (AP, AT, AU, BE, BG, BR, BY, CA, CH, CN, CS, CU, CZ, DD, DE, DK, EA, EE, EP, ES, FI, FR, GB, HR, HU, ID, IE, IL, IS, IT, JP, KR, LT, LU, LV, MA, MC, MD, MY, NL, NO, NZ, OA, PH, PL, PT, RO, RS, RU, SE, SG, SI, SK, SU, TH, TN, TR, TW, UA, VN, WO); FPRS; EPO; JPO; DERWENT; IBM_TDB)	OR	ON	ON	2023/09/06 09:20 AM

PE2E SEARCH - Search History (Interference)

There are no Interference searches to show.

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/328,730	**09/22/2023 01:54:11 AM ET**	**SDC010**

Title of Invention

Screw-attached Pick-up Dental Coping System and Methods

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	2867	FILED BY	Daniel Whittle
PATENT CENTER #	62845601	FILING DATE	06/03/2023
CUSTOMER #	112823	FIRST NAMED INVENTOR	Brandon Dale Kofford
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	-

Documents

TOTAL DOCUMENTS: 2

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
updated_IDS_p_SDC010.pdf	4	Information Disclosure Statement (IDS) Form (SB08)	569 KB
Warning: This is not a USPTO supplied IDS fillable form. Data in the form cannot be automatically loaded to other USPTO systems.			
sb0021_09212023.pdf	2	Transmittal Letter	343 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)

updated_IDS_p_SDC010.pdf	57D98DCBDEB3E1942EE4370C2895D4543927F9AF68A84A5C3 024191E2FC517C357B132717B1FD463C6E0AF93DFBB52EA55 78C3096E70EF89BE0F3C78E98C8B31
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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Doc Code: TRAN.LET

Document Description: Transmittal Letter

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TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Application Number	18328730
Filing Date	06/03/2023
First Named Inventor	Kofford, Brandon Dale
Art Unit	3772
Examiner Name	Huynh, Courtney Nguyen
Attorney Docket Number	SDC010

Total Number of Pages in This Submission

ENCLOSURES (*Check all that apply*)

- ☐ Fee Transmittal Form
  - ☐ Fee Attached
- ☐ Amendment/Reply
  - ☐ After Final
  - ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☑ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Reply to Missing Parts/ Incomplete Application
  - ☐ Reply to Missing Parts under 37 CFR 1.52 or 1.53
- ☐ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition
- ☐ Petition to Convert to a Provisional Application
- ☐ Power of Attorney, Revocation Change of Correspondence Address
- ☐ Terminal Disclaimer
- ☐ Request for Refund
- ☐ CD, Number of CD(s) _____
  - ☐ Landscape Table on CD
- ☐ After Allowance Communication to TC
- ☐ Appeal Communication to Board of Appeals and Interferences
- ☐ Appeal Communication to TC **(Appeal Notice, Brief, Reply Brief)**
- ☐ Proprietary Information
- ☐ Status Letter
- ☐ Other Enclosure(s) (please Identify below):

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SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	Patent Leverage LLC		
Signature	/Daniel John Whittle/		
Printed name	Daniel John Whittle		
Date	09/21/2023	Reg. No.	54,537

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PTO/SB/08a (01-10)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	18328730
Filing Date	06/03/2023
First Named Inventor	Kofford, Brandon Dale
Art Unit	3772
Examiner Name	Huynh, Courtney Nguyen
Attorney Docket Number	SDC010

U.S.PATENTS

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
		9568037	B2	02/14/2017	Staniszewski	

If you wish to add additional U.S. Patent citation information please click the Add button.

U.S.PATENT APPLICATION PUBLICATIONS

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear

If you wish to add additional U.S. Published Application citation information please click the Add button.

FOREIGN PATENT DOCUMENTS

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] ¡	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
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NON-PATENT LITERATURE DOCUMENTS

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	
	Art Unit	
	Examiner Name	
	Attorney Docket Number	

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Examiner Signature		Date Considered	
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[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	
	Art Unit	
	Examiner Name	
	Attorney Docket Number	

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Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☒ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

☐ See attached certification statement.

☐ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☐ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Daniel John Whittle/	Date (YYYY-MM-DD)	2023-09-21
Name/Print	Daniel John Whittle	Registration Number	54,037

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The information provided by you in this form will be subject to the following routine uses:

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

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8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

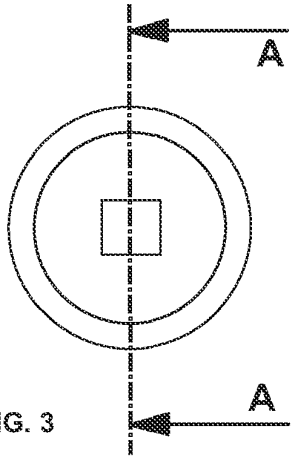


FIG. 3

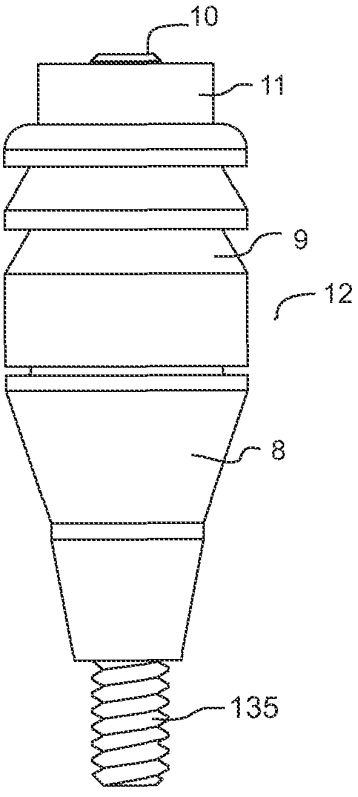


FIG. 2

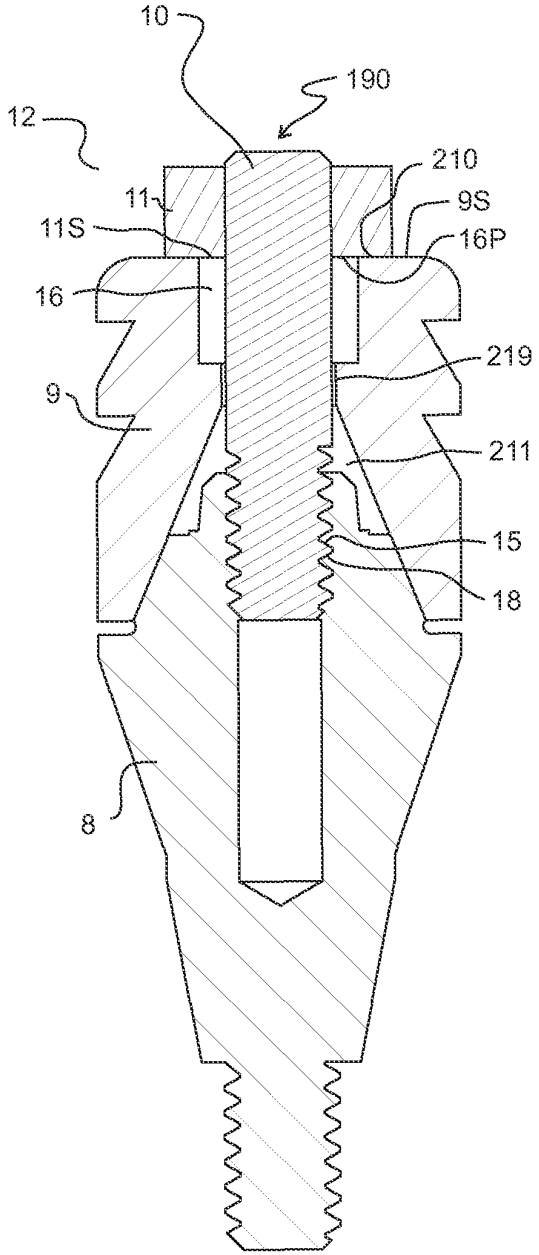


FIG. 4

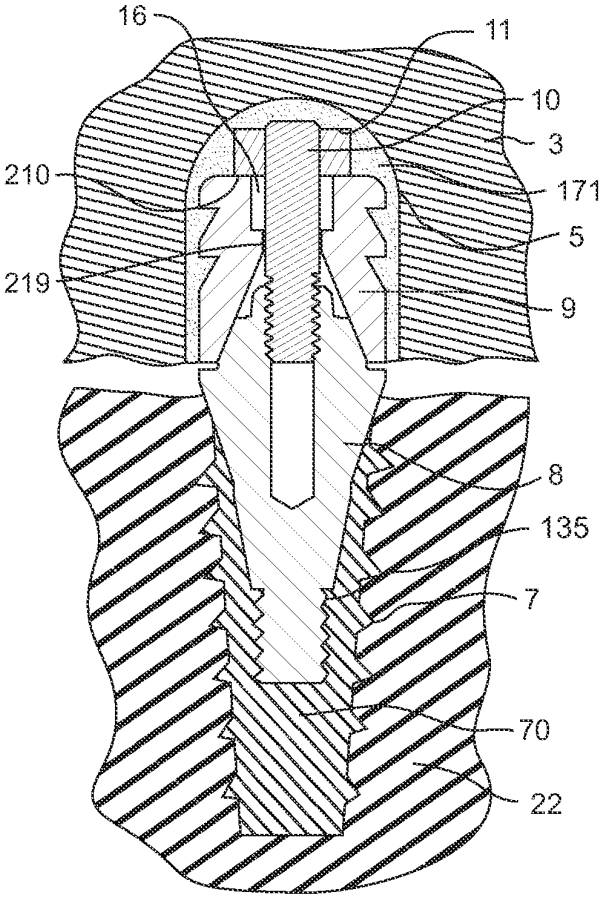


FIG. 5

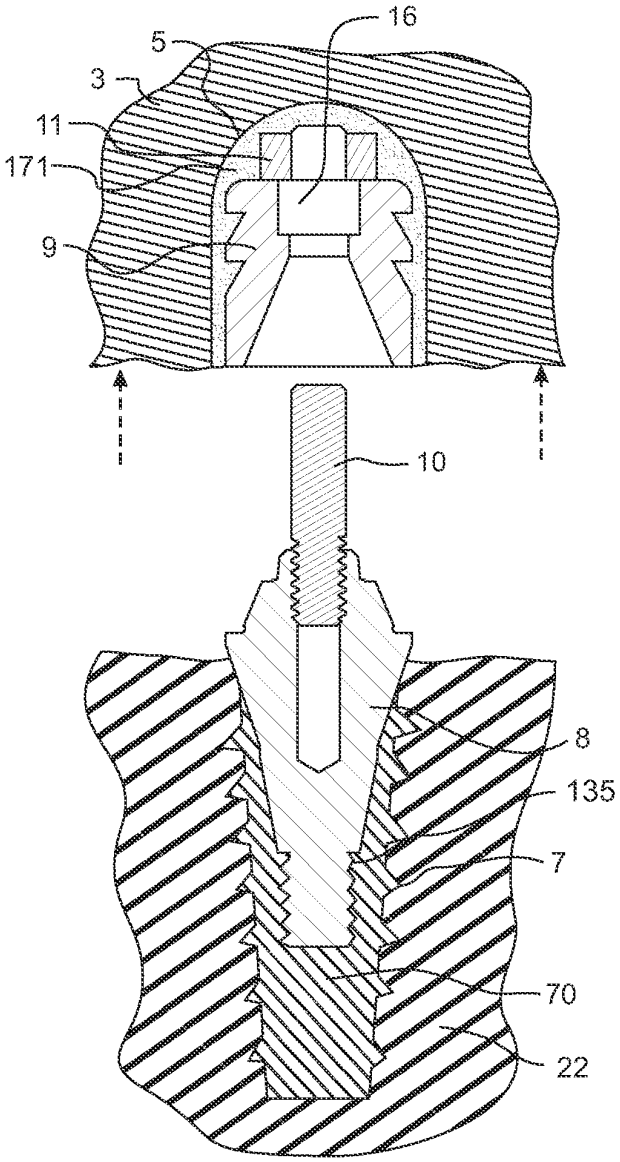


FIG. 6

Straumann USA Exhibit 1015

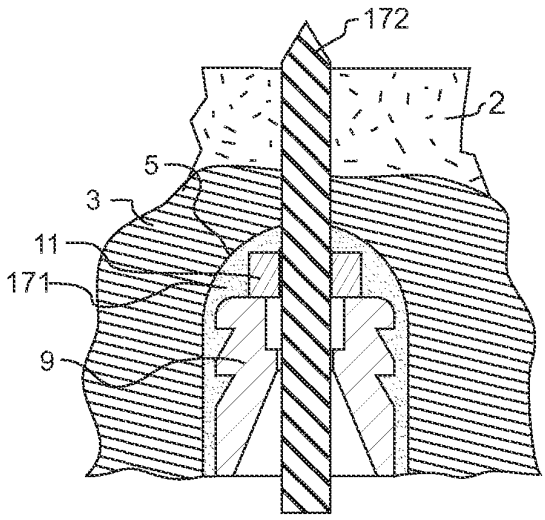


FIG. 7

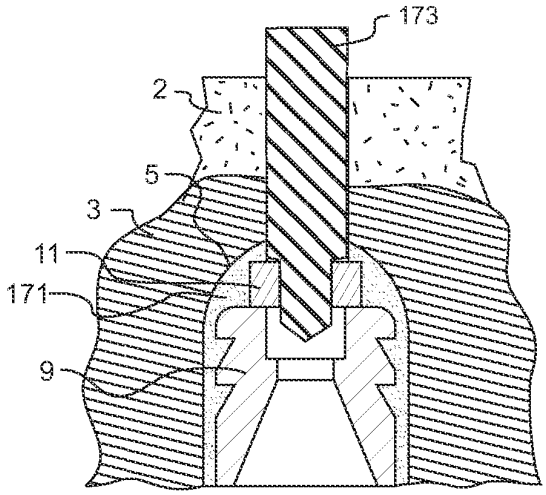


FIG. 8

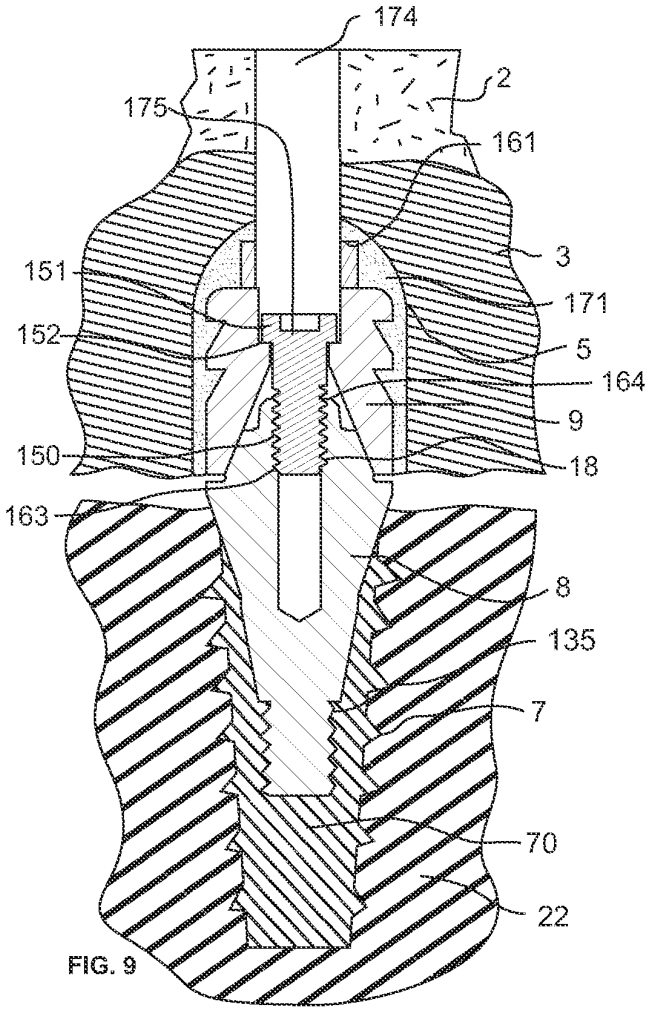


FIG. 9

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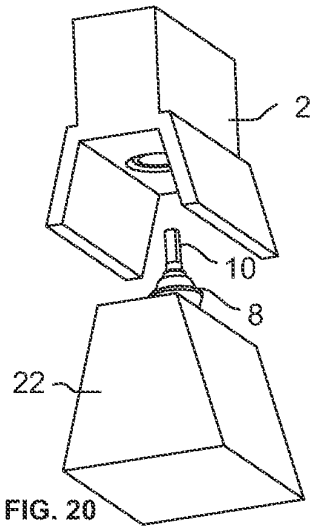


FIG. 20

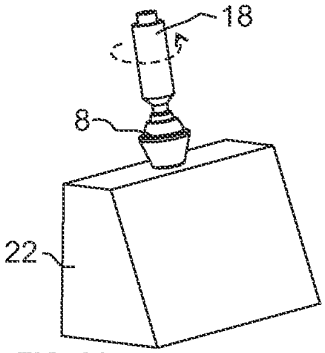


FIG. 21

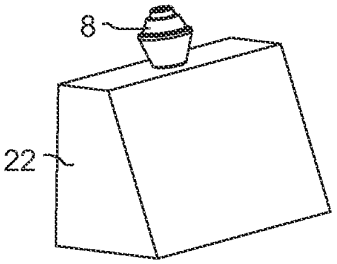


FIG. 22

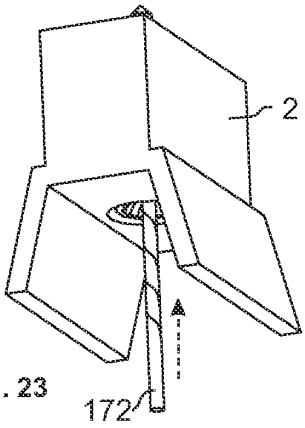


FIG. 23

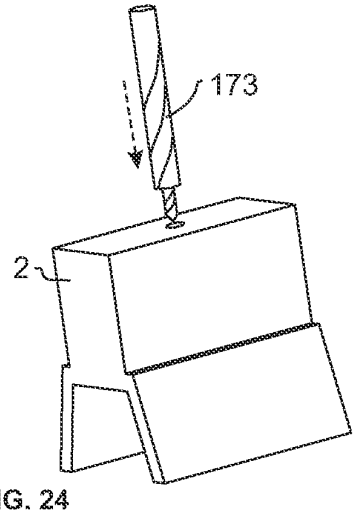


FIG. 24

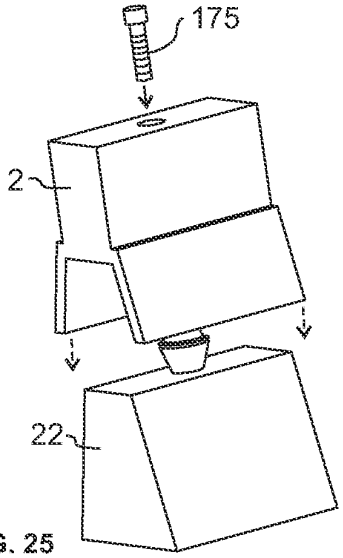


FIG. 25

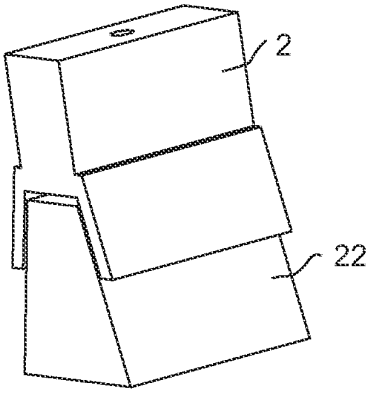


FIG. 26

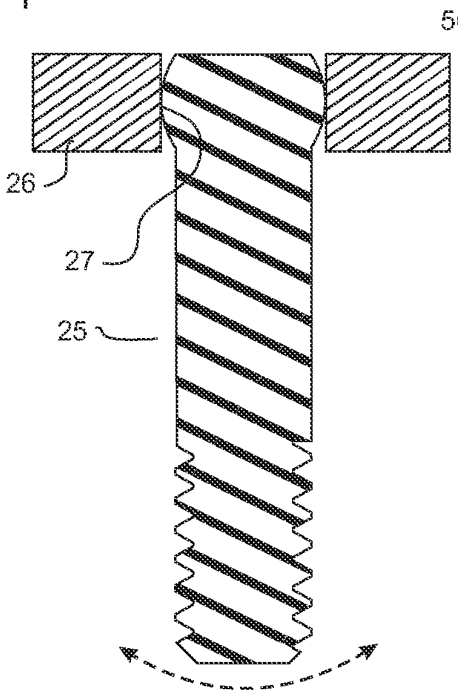


FIG. 70

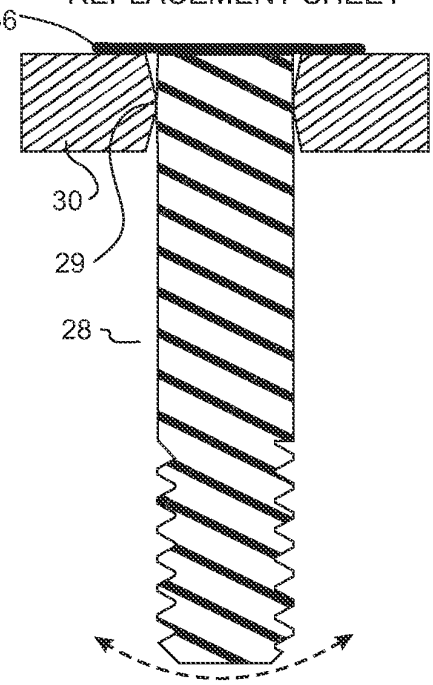


FIG. 71

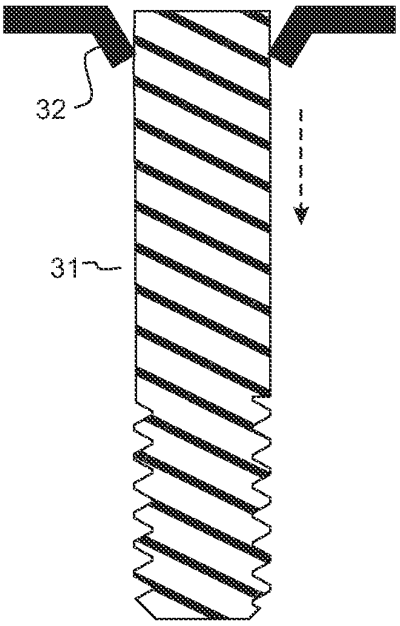


FIG. 72

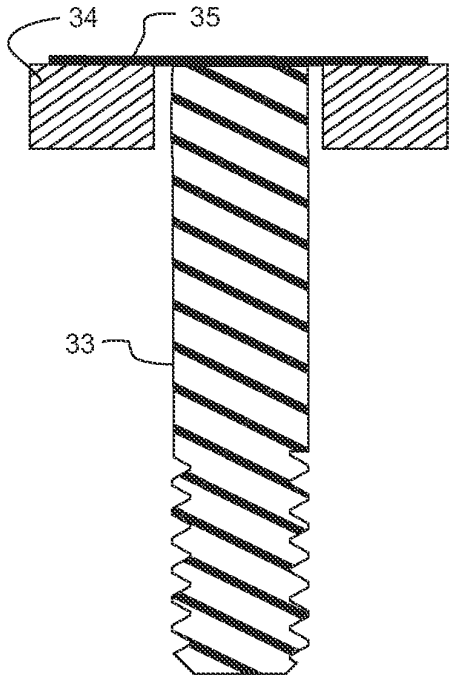


FIG. 73

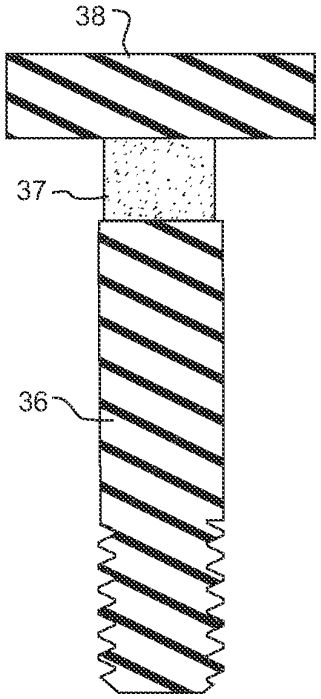


FIG. 74

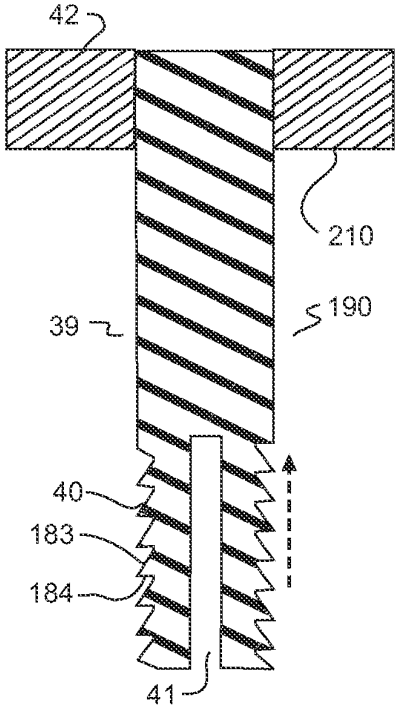


FIG. 75

Attorney Docket No. SDC010

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re: Kofford et al. Confirmation No.: 2867
Serial No.: 18/328,730 Group Art Unit: 3772
Filing Date: June 3, 2023 Examiner: HUYNH, COURTNEY NGUYEN
For: **SCREW-ATTACHED PICK-UP DENTAL COPING SYSTEM AND METHODS**

Date: December 5, 2023

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT

Commissioner:

This response is submitted in reply to the Office Action dated September 7, 2023 ("the Action").

If any extension of time for the accompanying response or submission is required, Applicant requests that this be considered a petition therefor.

Amendments to the Specification begin on page 2 of this document.

Amendments to the Claims are reflected in the Listing of Claims, which begins on page 6 of this document.

Amendments to the Drawings are reflected in Replacement Sheets 2, 3, 4, 7 and 22, adding to or amending callouts in **FIGS. 4-9**, **23-25** and **75.**

Remarks begin on page 10 of this document.

CERTIFICATION OF TRANSMISSION

I hereby certify that this correspondence is being transmitted via the Office electronic filing system in accordance with § 1.6(a)(4) to the U.S. Patent and Trademark Office on December 5, 2023.

Signature: /Daniel John Whittle #54,537/
Name: Daniel John Whittle

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Amendments to the Specification:

Please replace ¶ [0130] with the following amended paragraph:

FIGS. 2 and 3 show a side and top view of the assembled system of FIG. 1; FIG. 4 shows a cross-sectional view along the axis as indicated. As shown in FIG. 4, matching conical surfaces on the exterior of the implant abutment 8 and the interior of the coping 9 are engaged. In the orientation shown, ~~T~~the coping 9 is pulled into alignment by an axial force from the lower surface 11s of the cap 11 pushing against the upper surface 9s of the coping 9 from screwing the threads of post 10 into the implant abutment 8. As shown, there is a gap 219 between the temporary screw attachment post 10 and the coping 9. As also shown in FIG. 4, the width of the temporary screw cap 11 is greater than the width of the largest portion of the central aperture 16 of the coping 9. The temporary screw cap 11 holds the coping 9 in position on the implant abutment 8. As shown in FIG. 4, the cap-coping interface 210 is located at the proximal end 16p of the central aperture 16. As also shown in FIG. 4, due to the gap 219 and open space 211 between the coping 9 and the temporary screw attachment post 10 facing the implant abutment 8, the only contact between the temporary screw 190 and the coping 9 is between the temporary screw cap 11 and the proximal end of the coping 9 which provides an axial force by torquing the temporary screw 190 into the abutment 8 to hold the coping 9 on the implant abutment 8. The distal end of the abutment may be directly attached to the patient's jaw or attached to a separate implant attached to the jaw. The inventive concepts are not dependent upon the nature of the implant, so the distal end attachment feature 135 is represented schematically.

Please replace ¶ [0134] with the following amended paragraph:

The screw driving torque function may be accomplished by engaging other features on the temporary attachment post such as hex or spline or asymmetric features. Alternately, the cap may be used to engage a screwdriver or other tool for ~~torqueing~~ torquing. For example, in the case of a cylindrical temporary attachment post top portion, driving torque can be provided by the friction of the press-fit between the cap and temporary attachment post. For example, a medium press-fit of a 3 mm diameter 1 mm thick nylon cap onto a 1.3 mm diameter stainless steel cylindrical rod may produce approximately 500 grams of axial retention force and 17 gram-cm driving torque. A typical screw thread size for appliances is

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m1.4 x 0.3. Note that in FIG. 4, the temporary attachment post threads 181 are illustrated making contact with the abutment threads 182 when engaged. The retention/axial force of the cap to the temporary attachment post may be determined by the degree of press-fit and frictional properties between the cap and temporary attachment post, and/or spring features incorporated into the temporary attachment post and/or cap.

Please replace ¶¶ [0137-139] with the following amended paragraphs:

FIG. 5 through FIG. 9 show example cross-sectional views of some of the different stages of installation of the temporary fastener system into a denture. FIG. 5 shows a cross-sectional view of the assembly of the first embodiment during the initial phase of the coping pick-up process. As illustrated, the implant abutment 8 is attached to a schematic implant 70. The implant 70 has an interface 7 (shown schematically) that is attached to the patient's jawbone 22. The coping 9 is held against the implant abutment 8 through the temporary screw comprising the post 10 and cap 11. A blind clearance hole 5 in the prosthesis 3 is sized to accommodate the coping and temporary screw. Pick-up material 171 is positioned in the clearance hole 5 to capture the coping in proper alignment within the prosthesis. The cap-coping interface 210 is positioned at the proximal end 9p of the coping central bore or aperture 16 and, as shown in FIG. 5, blocks pick-up material 171 from entering the coping central aperture 16. After the pick-up material 171 has set up, the prosthesis 3, coping 9 and temporary screw cap 10 ~~is~~ are pulled off as an assembly off the patient's jaw as shown by the arrows in FIG. 6. The coping 9 and cap 11 are released from the implant abutment 8 and post 10, while the threads of the post 10 keep it engaged in the implant abutment 8. The post 10 is subsequently removed to make the abutment threads 18 available for holding the prosthesis in proper alignment with a definitive screw.

The prosthesis/coping assembly must be processed after the pick-up process for screw attachment. A pilot hole is drilled with bit 172 from the bottom side of the assembly. As shown in FIG. 7, the diameter of the bit may be selected to use the interior bores of the coping and cap to act as guides for hand processing. Alternately, a drill guide may be employed that engages a portion of the interior of the coping ~~may be used~~ to align the pilot hole. The pilot hole provides guidance for a tool to provide clearance for the definitive screw

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shaft and head. FIG. 8 shows a stepped drill 173 that cuts both clearances in a single process. Alternatively, the shaft and head clearance may be drilled with two drills in two process steps. If desired, the cap 11 of the temporary screw 190 can be fabricated of a material that is easier to drill than the coping material to provide feedback on the drill position. It has been found that it is possible to distinguish where the drill is positioned by feel at the interfaces between the pick-up adhesive and the top of the cap (as shown in FIG. 8) and the bottom of the cap and the top of the coping. Since pick-up material was blocked from entering the coping, drilling resistance decreases rapidly upon breaking through the bottom of the cap and entering the interior channel of the coping. Color differences in the materials can also be detected. Alternatively, a tool can be configured to fit within the bore of the coping to limit the depth of the drill.

Once clearance hole 174 for the definitive screw has been made from the top of the prosthesis, the prosthesis is ready for mounting to the implant with definitive screw 175 as shown in FIG. 9. The male threads of the definitive screw are shown filling the female threads of the abutment over an engagement depth extending from a first end of the thread engagement 163 to the second end of abutment thread engagement 164 of the implant abutment threading 18. Once the most distal thread of the definitive screw 175 is engaged in an abutment thread, the engagement depth will increase by a distance equal to the thread pitch for each complete revolution of the definitive screw 175. As shown in FIG. 4, a screw clearance hole 174 is large enough to accommodate the definitive screw head 151. A residual portion 161 of the cap 11 is shown in FIG. 9 for aligning the coping 9 to the prosthesis 3 in the closed tray pick-up process. After the definitive screw 175 is torqued into position, ~~T~~the screw clearance hole 174 in the prosthesis 3 may be filled with Teflon tape and color-matching composite materials for aesthetic purposes. In the illustrated embodiment, the coping bore 16 has a shoulder 152 to engage a flat surface on the underside of the definitive screw head 151 of the definitive screw 175 to pull the coping 9 into proper seating on the implant abutment 8. Alternate configurations are possible without deviating from the temporary screw system for coping pick-up disclosed.

Please replace ¶ [0192] with the following amended paragraph:
The inventive concepts disclosed are not meant to be restricted to a temporary attachment

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post with standard screw threads that both engage and disengage the threads in the implant abutment through rotations. For example, alternate separable temporary attachment posts embodiments are possible providing features that allow the post to removably hold the coping to the abutment by other means than a separable cap. For example, as shown in FIG. 75 an alignment fastener post 39 may contain a separable threaded or serrated portion 40 that engages the screw threads in the abutment for pick-up, but that will release with axial force after. FIG. 75 shows a temporary fastener 190 with a head 42 portion and an attachment post portion 39. The attachment post portion 39 is shown as having a slot 41 and asymmetric threads or serrations 40 that have proximal flank 183 and a distal flank 184. This asymmetric threading ~~that allow~~ still allows the temporary attachment post portion 39 to be inserted through rotation like other temporary screw embodiments for alignment for coping pick-up. The post 39 ~~but~~ may be subsequently extracted with a separation force in the axial direction. Although the threads could be designed to provide engagement with the implant abutment threads through axial motion in the opposite direction to the arrow shown in FIG. 75, rotation to a design torque on engagement is generally preferred. If the post 39 is designed to be pulled out of the abutment during the coping pick-up process, it will subsequently need to be removed from flange 42 and the prosthesis assembly. Since there is no processing impact on patient comfort, higher mechanical forces or a broader range of energy or chemical processing may be employed to remove the post 39 from the prosthesis 3 after coping 9 pick-up.

This Listing of Claims replaces all prior versions in the application.

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Listing of Claims:

1-17. (Canceled)

18. (Currently Amended) A dental system ~~for attachment of a coping to a threaded implant abutment~~ comprising:

an implant abutment having threads ~~symmetric helical threading for a definitive screw~~; ~~and~~

a definitive screw having an axis with a length measured along the axis and a width measured perpendicular to the axis, the definitive screw having a proximal head end having a tool interface and a distal post portion having threads configured to engage the threads of ~~threading matching~~ the implant abutment ~~threading~~; ~~and~~

a coping having a proximal end with an aperture, wherein the aperture is larger than the distal post portion of the definitive screw ~~post~~ and smaller than the proximal head end of the definitive screw ~~head~~; and

a temporary screw having an axis with a length measured along the axis and a width measured perpendicular to the axis, the temporary screw comprising:

a proximal head portion with a width larger than the aperture of the coping ~~aperture~~; and

a distal shaft portion with threads in a pattern ~~threading~~ that is shaped differently from a pattern of the threads of the definitive screw ~~threading;~~.

wherein ~~rotating~~ the temporary screw is rotatable in a distal direction whereby the distal ~~to engage the~~ shaft portion of the temporary screw engages ~~with~~ the threads of the implant abutment ~~threads~~ to a predetermined torque which causes the proximal head portion of the temporary screw to hold the coping in~~to~~ alignment with the implant abutment, and wherein an axial force in ~~the~~ a proximal direction from pick-up processing releases the coping and the temporary screw from the implant abutment.

19. (Withdrawn, Currently Amended) The dental system ~~for attachment of a coping to a threaded implant abutment~~ of Claim 18, further comprising a temporary screw torque driver, wherein the temporary screw torque driver comprises:

a spring friction cylinder, and

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a drive cap, and

a coil spring,

wherein the temporary screw torque driver is configured to limit[[s]] ~~the~~ torque applied to the temporary screw to the predetermined torque.

20. (Currently Amended) The dental system ~~for attachment of a coping to a threaded implant abutment~~ of Claim 18, wherein the pattern of the threads of the temporary screw ~~threading~~ is asymmetric.

21. (Currently Amended) The dental system ~~for attachment of a coping to a threaded implant abutment~~ of Claim 18, wherein the temporary screw is polymeric, and wherein the distal shaft portion is hollow, and wherein the temporary screw is rotatably insertable ~~can be~~ ~~inserted~~ into the implant abutment ~~threading with an axial force in the distal direction~~ to the predetermined torque~~, and wherein the axial force in the distal direction needed for insertion is higher than the axial force in the proximal direction needed for release~~.

22. (Currently Amended) The dental system ~~for attachment of a coping to a threaded implant abutment~~ of Claim 18, wherein ~~the width of the threaded region of the temporary screw shaft is smaller than[the width of the threaded region of the definitive screw post~~ the pattern of the threads of the temporary screw is configured to define an abutment threading contact area and/or volume with the threads of the implant abutment that is less than an abutment threading contact area and/or volume with the threads of the implant abutment defined by the pattern of the threads of the definitive screw.

23. (Withdrawn, Currently Amended) The dental system ~~for attachment of a coping to a threaded implant abutment~~ of Claim 18, wherein the distal shaft portion of the temporary screw has a first portion with a smaller width than a second portion of the distal shaft portion ~~the threaded region of the shaft~~ of the temporary screw comprising the threads, and wherein the first portion with the smaller width ~~portion~~ is located between the proximal head portion and the threads ~~threaded region~~.

24. (Currently Amended) The dental system ~~for attachment of a coping to a~~

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~~threaded implant abutment~~ of Claim 18, wherein the threads ~~threading~~ of the temporary screw deforms during the release of the temporary screw from the implant abutment ~~threading~~.

25. (Currently Amended) The dental system ~~for attachment of a coping to a threaded implant abutment~~ of Claim 18, wherein the distal shaft portion of the temporary screw ~~shaft~~ has a hollow portion, and wherein at least a portion of the distal shaft portion is configured to deflect inwardly ~~temporary screw shaft deflects~~ into the hollow portion in response to ~~when~~ the axial force in the proximal direction ~~is applied~~.

26. (Currently Amended) A dental system ~~for attachment of a coping to a threaded implant abutment~~ comprising:

an implant abutment having female threading having an implant abutment thread profile; ~~and~~

a definitive screw having a longitudinal axis and a length measured along the axis and a width measured perpendicular to the axis, the definitive screw comprising:

a shaft with male threading, wherein the male threading has a male threading profile that matably threadably engages and which matches the female threading of the implant abutment ~~thread profile~~; and

a head with a definitive screw drive interface; ~~and~~

a coping having a proximal end with an aperture sized to allow the definitive screw shaft to pass through; and

a temporary screw having a longitudinal axis and a length measured along the axis and a width measured perpendicular to the axis, the temporary screw comprising:

a post comprising ~~with~~ male threading, wherein the male threading has a male threading profile that is different from ~~does not essentially match~~ the male threading profile of the shaft of the definitive screw ~~shaft~~, and wherein the aperture of the coping is sized and configured to allow ~~aperture allows~~ the post to pass through; and

a head with a temporary screw drive interface, wherein the head is integral to or coupled to the post, ~~; and~~

wherein the temporary screw holds the coping in position ~~on~~ against the implant abutment for pick-up processing, wherein the male threading of the post of the temporary

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screw is configured to enter the implant abutment and rotatably engage ~~by rotating~~ the ~~post threads into~~ the female threading of the implant abutment ~~threads~~ to a predetermined pick-up processing torque, and wherein threads of the male threading of the post ~~threads~~ release from threads of the female threading of the implant abutment ~~threads~~ with a predetermined axial pick-up force in ~~the~~ a proximal direction in response to and/or during pick-up processing.

27. (Currently Amended) The dental system ~~for attachment of a coping to a threaded implant abutment~~ of claim 26, wherein ~~the width of~~ the male threading profile of the post of the temporary screw comprises at least some threads that have a pitch angle that is different than a pitch angle of threads of the female threading of the implant abutment and threads of ~~post threading is smaller than the width of~~ the male threading profile of the shaft of the definitive screw ~~shaft threading~~.

28. (Currently Amended) The dental system ~~for attachment of a coping to a threaded implant abutment~~ of claim 26, wherein a ~~the~~ proximal flank of the male threading profile of the post of the temporary screw ~~post threading profile~~ is at a smaller angle relative to the longitudinal axis thereof than a ~~the~~ proximal flank of the male threading profile of the shaft of the definitive screw relative to the longitudinal axis thereof ~~shaft threading profile~~.

29. (Currently Amended) The dental system ~~for attachment of a coping to a threaded implant abutment~~ of claim 26, wherein the ~~definitive screw comprises a metallic material and the~~ temporary screw comprises a polymeric material.

30. (Canceled)

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REMARKS

Applicant hereby requests further consideration of the application in view of the amendments above and the comments that follow. Claims 1-30 were pending in the application at the mailing of the Action, with Claims 2, 5, 9 and 23 withdrawn from consideration. Claims 1-17 and 30 have been canceled hereinabove.

Applicant acknowledges the thorough review of the claims and application. Applicant appreciates that the Examiner acknowledged the election without traverse of Species Q (FIG. 75).

The undersigned also apologizes for some wording used in the last response that may have caused some confusion and also an inadvertent offset in paragraph number referencing. Paragraph number references in the current response correspond to the original numbering of the USPTO specification from the initial uploading through Patent Center, not the source files.

I. The Allowable Subject Matter

Applicant acknowledges, with appreciation, the Action's statement that Claims 18, 20-22 and 24-30 would be allowable if rewritten or amended to overcome the rejections under 35 USC §112(b). Action, page 37.

To advance prosecution and reduce the issues for consideration in this response, but without acquiescing as to the rejections of Claims 1-17 and 30, Applicant has canceled those claims without prejudice for pursuit in a future continuation application.

II. The Drawing Objections

The Action states that the drawings are objected to under 37 CFR 1.83(a) for allegedly not showing every feature of the invention specified in the claims. Action, pages 4-6. Applicant respectfully disagrees.

Applicant has submitted Replacement Sheets that address the drawing objections, at least as far as the noted objections relate to the currently pending claims. Callouts (reference numbers) have been added to features in the original drawings which correspond to some of the features alleged not to be in the drawings.

With respect to (canceled) Claim 13, FIG. 4 clearly shows the head 11 of the temporary screw extends across and does not fit through the central aperture 16 of the coping.

Replacement Sheet 2 includes additional reference numbers 9s, 11s, 16p, 16, 181, 182, 190, 210, 211, and 219 for features shown in original FIG. 4.

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Replacement Sheet 3 includes corrected 171 and additional reference numbers 10, 16, 210 and 219 for features shown in original FIGS. 5-6.

Replacement Sheet 4 includes corrected 10, 161, 171, 172, 173, 174, and 175 reference numbers and additional reference numbers 18, 150, 151, 152, 163, 164 for features shown in original FIGS. 7-9.

Replacement Sheet 7 corrects reference numbers 172, 173, and 175 in FIGS. 23-25.

Replacement Sheet 22 includes additional reference numbers 183, 184, 190, and 210 for features shown in original FIG. 75.

Applicant respectfully submits that the amended drawings and corresponding updated text of the Specification provided hereinabove do not introduce new matter. The Replacement Sheets only add callouts or correct/change callouts for features in the original filed drawings. Applicant respectfully requests that the drawing objections be withdrawn.

II. The Specification Objections

The Action appears to object to the "combination" of features from different embodiments of the different Species with respect to Claims 19 and 23, for example. Action, page 3. Applicant continues to submit that the application as-filed does not exclude different combinations of features of the temporary screws for the coping and implant abutment systems and that there is sufficient written description for same.

The Action also objects to the specification as failing to allegedly provide "proper antecedent basis for the claimed subject matter, citing 37 CFR 1.75(d)(1) and MPEP 608.01(o). Action, pages 6-11. Applicant respectfully disagrees. Applicant submits that the claims are supported by the original disclosure.

35 USC §132 bars an applicant from presenting new matter once a patent application has been filed. The Federal Circuit has addressed the "related" new matter and written description issues and has stated that both issues turn on a single question: whether the amendment broadened the disclosure of what the inventors invented. *See, e.g.*, *Ex parte Dev Melepura*, Appeal No. 2020-003047 (PTAB December 30, 2021) (citing *Commonwealth Scientific and Indus. Research Organisation v. Buffalo Technology (USA), Inc.*, 542 F.3d 1363, 1380 (Fed. Cir., 2008)).

It is well accepted that "the invention claimed does not have to be described *in ipsis verbis* in order to satisfy the description requirement of § 112." *Regents of the Univ. of Minn. v. Gilead Scis.*, 2021-2168 (Fed. Cir. March 6, 2023) (citing *Fujikawa v. Wattanasin*, 93 F.3d

1559, 1570 (Fed. Cir. 1996)). Rather, the disclosure need only reasonably convey to persons skilled in the art that the Applicants had possession of the subject matter in question. *Novartis Pharm. Corp. v. Accord Healthcare, Inc.*, 38 F.4th 1013, 1016 (Fed. Cir. 2022) ("To satisfy the written description requirement, a patent's specification must "reasonably convey[ ] to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date. . . . Such possession must be 'shown in the disclosure.'") (quoting *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010) (en banc).

35 USC § 112, first paragraph, requires that an Applicant convey with reasonable clarity to those skilled in the art that, as of the effective filing date, the Applicant was in possession of the invention. *See Vas-Cath, Inc. v. Mahurkar*, 935 F.2d 1555, 1560, 19 USPQ2d 1111, 1117 (Fed. Cir., 1991). An Applicant shows possession of a claimed invention "by such descriptive means as words, **structures**, **figures**, diagrams, formulas, etc., that fully set forth the claimed invention." *Blue Calypso, LLC v. Groupon, Inc.*, 815 F.3d 1331, 1346 (Fed. Cir. 2016) (quoting *Lockwood v. American Airlines, Inc.*, 41 USPQ2d 1961, 1966 (Fed. Cir. 1997) (emphasis added).

"The written description requirement does not require the applicant 'to describe exactly the subject matter claimed, [instead] the description must clearly allow persons of ordinary skill in the art to recognize that [he or she] invented what is claimed.'" *Union Oil Co. of Cal. v. Atlantic Richfield Co.*, 208 F.3d 989,997, 54 USPQ2d 1227, 1232 (Fed. Cir. 2000); see also Novozymes v. DuPont Nutrition Biosciences APS, 723 F.3d 1336, 1346 (Fed. Cir. 2013) (internal citations omitted) ("We have consistently held that, to satisfy § 112, a patent's written description "must 'clearly allow persons of ordinary skill in the art to recognize that [the inventor] invented what is claimed.' A "mere wish or plan" to obtain the claimed invention is not sufficient.").

"In rejecting a claim under the first paragraph of 35 U.S.C. § 112 for lack of adequate descriptive support, it is incumbent upon the examiner to establish that the originally filed disclosure would not have reasonably conveyed to one having ordinary skill in the art that an appellant had possession of the now claimed subject matter." *Ex parte Parks*, 30 USPQ2d 1234, 1236 (BPAI 1994) (citing *Wang Laboratories, Inc. v. Toshiba Corp.*, 993 F.2d 858, 26 USPQ2d 1767 (Fed. Cir. 1993)).

A description as filed is presumed to be adequate, unless or until sufficient evidence or reasoning to the contrary has been presented by the Examiner to rebut the presumption. *Ex*

parte Ji Eun Kim, Appeal No. 2016-003176 (PTAB 2017) (citing *In re Marzocchi*, 439 F.2d 220, 224, 169 USPQ 367, 370 (CCPA 1971)); *see also* MPEP § 2163.04. The Examiner, therefore, must have a reasonable basis to challenge the adequacy of the written description.

The examiner has the initial burden of presenting by a preponderance of evidence why a person of ordinary skill in the art would not recognize in an **Applicant's disclosure** a description of the invention defined by the claims. *See In re Wertheim*, 541 F.2d 257, 263, 191 USPQ 90, 97 (CCPA 1976); *see also* MPEP § 2163.04 (emphasis added).

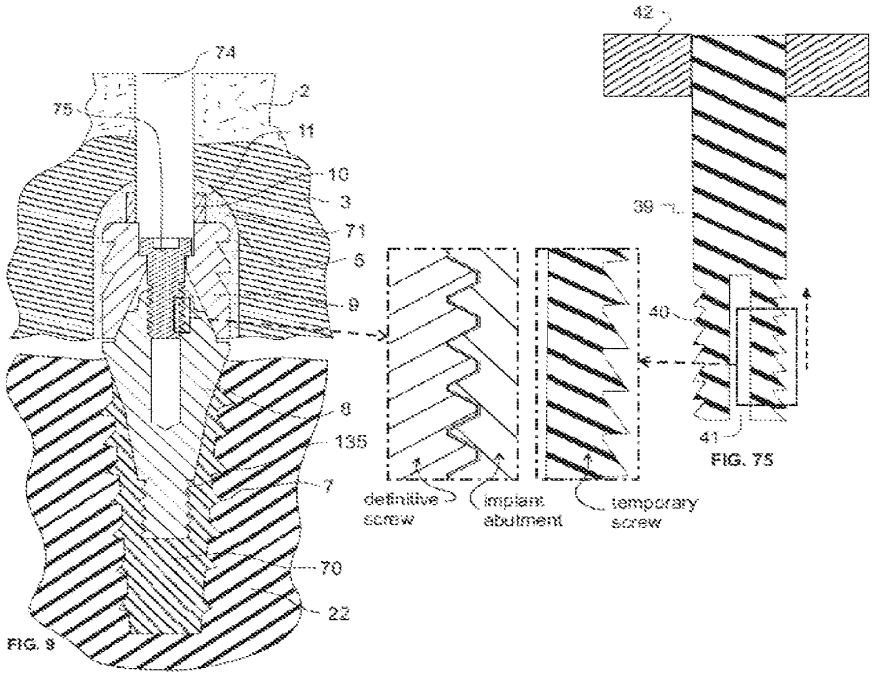
With respect to Claim 18, the Action states that the "symmetrical helical threading" of the implant abutment does not appear to be described in the specification. Applicant respectfully submits that FIGS. 4 and 9, for example show this configuration. However, without acquiescing as to this rejection, Claim 18 has been amended in a non-narrowing manner to remove this recitation.

With respect to Claim 21, Applicant has amended this claim to remove the recitation related to the difference in axial forces. Applicant has amended Claim 21 to recite that the temporary screw is polymeric, that the distal shaft portion is hollow, and that the temporary screw is rotatably insertable into the implant abutment to the predetermined torque.

With respect to Claims 22, 26, 27 and 28, the following discussion is provided in support of the features identified by the Action as apparently lacking written support.

Figures 9 and 75 are reproduced below with enlargements of the cross-sectional views of a few threads of the definitive screw engaging the implant abutment of FIG.9 and the temporary screw of FIG. 75.

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As shown in FIG. 9, the male definitive screw threads (callout 150 for these threads added to the replacement figure) essentially fill the female abutment threads (callout 18 for the female abutment threads added to FIG. 9 as well). When engaged, the profile of the temporary screw threading 40 fits within the profile of the abutment threading 18 to preserve the female threading geometry for the definitive screw after pick-up processing. The temporary fastener 190 of FIG. 75 engages the implant abutment 8. The male threading 40 of the temporary fastener 190 can engage the female abutment threads 18 without or with distortion. The temporary fastener 190 of FIG. 75 can be combined with various coping and implant abutments, such as the environment of the implant abutment 8 and coping 9 elements of FIG. 4 and FIG. 9.

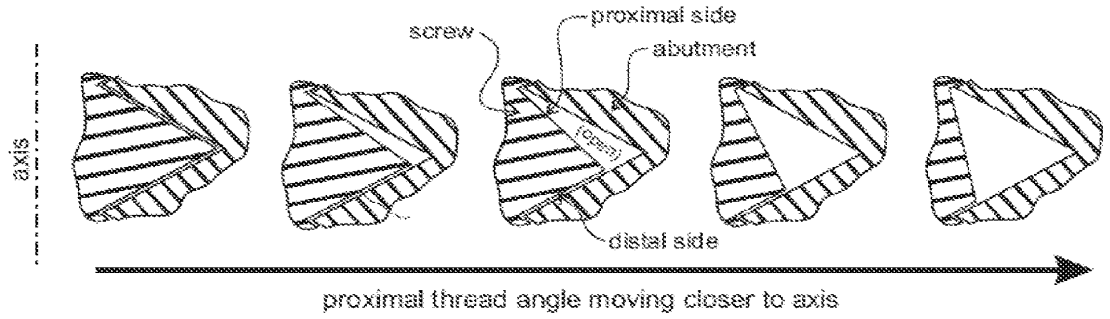
Typically, the standard definitive screw has a continuous symmetrical helical form as is well known to those of skill in the art. FIG. 9 (enlarged portion of the screw threading shown in the box adjacent FIG. 9) also shows that the implant abutment threading 18 matches and is filled with the definitive screw post threading 150. That is, the female implant abutment threading substantially matches, e.g., has substantially the same pitch as the

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definitive screw male threading 150. Thus, as shown in FIG. 9, the male definitive screw threads 150 matably, threadably engage, e.g., essentially fill the female abutment threads 18.

In contrast, the thread profile 40 of the temporary screw of FIG. 75 is not the same as the illustrated profile (enlarged from FIG. 9 shown above) of the definitive screw threading. As shown in FIG. 75, the proximal side or flank of at least some of the respective threads of the temporary screw/fastener (toward the head portion 42), labeled as feature 183 in the replacement drawing, lies at an angle that is at a smaller angle relative to the longitudinal axis than the angle of the proximal side of the threads of the definitive screw. The distal side of the temporary fastener thread illustrated in FIG. 75 (labeled as feature 184 in the replacement drawing) lies at a steeper angle relative to the longitudinal axis than the distal side of the threads of the definitive screw. Although the threading shape is different, when engaged, the profile of the temporary screw threading 40 fits within the same abutment threading 18 as the definitive screw.

For background information, it may be useful to look at how changing the proximal side thread angle of a male thread affects its fit into a fixed female thread shape. The following figure shows a sequence of a single male asymmetric thread in which the proximal side angle becomes progressively closer to the axis engaging a fixed symmetric female thread.



In this schematic sequence, the male thread of the fastener is to the left and the implant abutment thread is to the right. It is evident that as the male proximal side profile angle becomes closer to the axis, the male thread fills less of the female thread. An increasingly larger open space is created as the outer vertex of the male thread moves towards

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the axis with the increasingly smaller proximal angle. In the limit when the proximal angle nears the axis, there is a negligible filling of the female threads. That is, the remaining male thread essentially has no real engagement with the female thread. This follows directly from simple geometry and is a feature of FIG. 75, for example, having at least an inherent property of the asymmetric/serrated threads with the different thread angle. *See*, MPEP § 2163.07(a): *Yeda Research and Dev. Co. v. Abbott GMBH & Co.,* 837 F.3d 1341, 120 USPQ2d 1299 (Fed. Cir. 2016) ("Under the doctrine of inherent disclosure, when a specification describes an invention that has certain undisclosed yet inherent properties, that specification serves as adequate written description to support a subsequent patent application that explicitly recites the invention's inherent properties." (citing *Kennecott Corp. v. Kyocera Int'l, Inc.,* 835 F.2d 1419, 1423, 5 USPQ2d 1194, 1198 (Fed. Cir. 1987)); see also MPEP §2163.07(a).

The open space created on the proximal side of the male thread of temporary fastener 190 relative to the female thread(s) due to the angle lying closer to the axis represents a portion of the female abutment thread that is filled with the definitive screw when engaged as shown in FIG. 9. As a result of the open space from the different thread profile of the temporary screw compared to the definitive screw in FIG. 9, the temporary screw threading of FIG. 75 has less surface area contact with the female implant abutment threading, has less material volume within the engagement depth with the implant abutment and can have a smaller radial extent or width than the definitive screw.

Similarly, a steeper angle on the distal side thread profile of the temporary fastener may create additional open space to reduce relative implant abutment thread surface contact and volume. Thus, slot 41 and/or the thread profile of FIG. 75 can reduce relative implant abutment thread surface contact area and engaged volume.

With respect to Claim 22 , the Action states that the "wherein the width of the threaded region of the temporary screw shaft is smaller than the width of the threaded region of the definitive screw post" does not appear to be described in the specification. Applicant respectfully submits that this is inherent due to the relative geometry of FIGS. 9 and 75 discussed above. However, without acquiescing as to this rejection, Applicant has amended this claim to remove the recitation related to the difference in width. Applicant has amended Claim 22 to recite that the "pattern of the threads of the temporary screw is configured to define an abutment threading contact area and/or volume with the threads of the implant abutment that is less than an abutment threading contact area and/or volume with the threads

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of the implant abutment defined by the pattern of the threads of the definitive screw" . This is supported by the discussion of the inherent additional open space above.

With respect to Claim 26, without acquiescing to the rejection, Applicant has amended this claim to recite a male threading profile that is different from rather than "does not essentially match".

With respect to Claim 27 , the Action states that the "wherein the width of the temporary screw post threading is smaller than the width of the definitive screw shaft threading" does not appear to be described in the specification. Applicant maintains that this is supported as described for the similar limitation of Claim 22. Without acquiescing to the rejection, Applicant has amended this claim to recite wherein "the male threading profile of the post of the temporary screw comprises at least some threads that have a pitch angle that is different than a pitch angle of threads of the female threading of the implant abutment and threads of the male threading profile of the shaft of the definitive screw." Applicant respectfully submits that FIG. 75 clearly shows a temporary thread pitch angle that is different from a pitch angle of threads of the implant abutment and definitive screw in FIG. 9.

With respect to Claim 28, Applicant respectfully submits that FIG. 75 shows the temporary fastener with the flank angle of the thread(s) and FIG. 9 shows the definitive screw with its proximal flank angle. Comparing the respective flank angles, Referring to FIG. 75 showing the proximal flank angle(s) clearly being smaller.

With respect to Claim 29, Applicant has amended this claim in a non-narrowing manner to remove the definitive screw material.

With respect to Claim 30, Applicant has canceled this claim without prejudice thereto. However, Applicant notes that FIG. 75 only shows the temporary screw. FIG. 9, for example shows a definitive screw.

Applicant respectfully submits that pending application provides the requisite written description and support for the claimed recitations. Applicant also submits that the Examiner does not have a reasonable basis to challenge the adequacy of the written description in light of the disclosure and drawings.

As such, Applicant submits that the Action has failed to meet the initial burden of establishing an adequate basis for the rejection of the claims. Applicant submits that the claims are sufficiently supported by the application.

III. The Claim Objections

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The Action objects to the preamble of the claims and the preamble has been amended as suggested by the Examiner. Action, pages 11, 12.

With respect to Claim 26, the suggested indentation of lines 8-10 have been added.

With respect to Claim 18, lines 20-21, the Action suggests amendment to "the coping and the temporary screw."

Other amendments have been made to the pending claims to address the claim objections and/or restate the recitations in a consistent manner.

III. The 35 USC §112(b) Rejections

The Action rejects the claims for certain claim language informalities/inconsistencies. The claims have been amended in a non-narrowing manner to address the noted issues.

IV. The Information Disclosure Statement

The Information Disclosure Statement filed August 8, 2023, is stated to fail to comply with 37 CFR 1.97, 1.98. Action, page 4. This IDS was resubmitted in September. A supplemental IDS is also being filed containing all references from the parent application and supplemental non-patent literature on the state of the art.

Return of an initialed copy of each IDS confirming consideration of same is respectfully considered.

V. Request for Rejoinder

Applicant respectfully requests the rejoinder of Claim 19 based on its dependency from allowable Claim 18.

The temporary torque driver may be discussed in the specification by way of example for certain figures of the application, the configuration of the temporary screw of FIG. 75 simply does not exclude the use of such a tool with that embodiment. The fact that the head of FIG. 75 does not show the Hex drive feature is in apposite (it is a sideview and a number of different shapes may be used for providing a drive interface). Indeed, throughout the specification it is discussed that a torque limit or predefined torque can be used to provide a suitable engagement depth of a temporary screw and several ways to achieve this are also described. There is simply no requirement that every combination of every feature of a respective temporary screw be explicitly shown together to provide the support (see discussion above regarding written description). Indeed, the temporary torque drive contemplated by embodiments of the pending application can be used for other screws.

The predetermined temporary screw torque used to properly align the coping with the

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implant abutment can generally be design specific. Applicant respectfully submits that a dental practitioner would recognize that the temporary screw torque driver of Claim 19 would be generally useful for limiting the torque applied to any species of temporary screw contemplated by embodiments of the invention, including the elected species and independent Claim 18.

With respect to Claim 23, this claim depends on Claim 18 and as Claim 18 is in condition for allowance, Claim 23 is also patentable, at least for depending from a patentable base claim, and should be rejoined. With respect to the Action's statement that the feature is shown in Species L (FIG. 67), it is also shown in FIG. 74, for example. ¶206 of the application also states that one or more inventive elements from one or more embodiments can be combined. Applicant respectfully submits that the originally filed disclosure reasonably conveys to one having ordinary skill in the art that applicant had possession of the subject matter of Claim 23, in combination with Claim 18.

CONCLUSION

Accordingly, Applicant submits that the present application is in condition for allowance and the same is earnestly solicited. The Examiner is encouraged to telephone the undersigned at 360-714-0777 for expeditious handling of any matters outstanding of resolution.

Respectfully submitted,

/Daniel John Whittle/

Daniel John Whittle
Registration No. 54,537

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Document Description: Transmittal Letter

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TRANSMITTAL FORM

(to be used for all correspondence after initial filing)

Total Number of Pages in This Submission	45

Application Number	18328730
Filing Date	06/03/2023
First Named Inventor	Kofford, Brandon Dale
Art Unit	3772
Examiner Name	Huynh, Courtney Nguyen
Attorney Docket Number	SDC010

ENCLOSURES *(Check all that apply)*

- ☐ Fee Transmittal Form
  - ☐ Fee Attached
- ☑ Amendment/Reply
  - ☐ After Final
  - ☐ Affidavits/declaration(s)
- ☐ Extension of Time Request
- ☐ Express Abandonment Request
- ☐ Information Disclosure Statement
- ☐ Certified Copy of Priority Document(s)
- ☐ Reply to Missing Parts/ Incomplete Application
  - ☐ Reply to Missing Parts under 37 CFR 1.52 or 1.53
- ☑ Drawing(s)
- ☐ Licensing-related Papers
- ☐ Petition
- ☐ Petition to Convert to a Provisional Application
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- ☐ CD, Number of CD(s) _____
  - ☐ Landscape Table on CD
- ☐ After Allowance Communication to TC
- ☐ Appeal Communication to Board of Appeals and Interferences
- ☐ Appeal Communication to TC **(Appeal Notice, Brief, Reply Brief)**
- ☐ Proprietary Information
- ☐ Status Letter
- ☐ Other Enclosure(s) (please Identify below):

Remarks

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT

Firm Name	Patent Leverage LLC		
Signature	/Daniel John Whittle/		
Printed name	Daniel John Whittle		
Date	2023-12-05	Reg. No.	54,537

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Attorney Docket No. SDC010

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re: Kofford et al. Confirmation No.: 2867
Serial No.: 18/328,730 Group Art Unit: 3772
Filing Date: June 3, 2023 Examiner: HUYNH, COURTNEY NGUYEN
For: **SCREW-ATTACHED PICK-UP DENTAL COPING SYSTEM AND METHODS**

Date: December 5, 2023

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT

Commissioner:

This response is submitted in reply to the Office Action dated September 7, 2023 ("the Action").

If any extension of time for the accompanying response or submission is required, Applicant requests that this be considered a petition therefor.

Amendments to the Specification begin on page 2 of this document.

Amendments to the Claims are reflected in the Listing of Claims, which begins on page 6 of this document.

Amendments to the Drawings are reflected in Replacement Sheets 2, 3, 4, 7 and 22, adding to or amending callouts in **FIGS. 4-9**, **23-25** and **75.**

Remarks begin on page 10 of this document.

CERTIFICATION OF TRANSMISSION

I hereby certify that this correspondence is being transmitted via the Office electronic filing system in accordance with § 1.6(a)(4) to the U.S. Patent and Trademark Office on December 5, 2023.

Signature: /Daniel John Whittle #54,537/
Name: Daniel John Whittle

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Amendments to the Specification:

Please replace ¶ [0130] with the following amended paragraph:

FIGS. 2 and 3 show a side and top view of the assembled system of FIG. 1; FIG. 4 shows a cross-sectional view along the axis as indicated. As shown in FIG. 4, matching conical surfaces on the exterior of the implant abutment 8 and the interior of the coping 9 are engaged. In the orientation shown, ~~T~~the coping 9 is pulled into alignment by an axial force from the lower surface 11s of the cap 11 pushing against the upper surface 9s of the coping 9 from screwing the threads of post 10 into the implant abutment 8. As shown, there is a gap 219 between the temporary screw attachment post 10 and the coping 9. As also shown in FIG. 4, the width of the temporary screw cap 11 is greater than the width of the largest portion of the central aperture 16 of the coping 9. The temporary screw cap 11 holds the coping 9 in position on the implant abutment 8. As shown in FIG. 4, the cap-coping interface 210 is located at the proximal end 16p of the central aperture 16. As also shown in FIG. 4, due to the gap 219 and open space 211 between the coping 9 and the temporary screw attachment post 10 facing the implant abutment 8, the only contact between the temporary screw 190 and the coping 9 is between the temporary screw cap 11 and the proximal end of the coping 9 which provides an axial force by torquing the temporary screw 190 into the abutment 8 to hold the coping 9 on the implant abutment 8. The distal end of the abutment may be directly attached to the patient's jaw or attached to a separate implant attached to the jaw. The inventive concepts are not dependent upon the nature of the implant, so the distal end attachment feature 135 is represented schematically.

Please replace ¶ [0134] with the following amended paragraph:

The screw driving torque function may be accomplished by engaging other features on the temporary attachment post such as hex or spline or asymmetric features. Alternately, the cap may be used to engage a screwdriver or other tool for ~~torqueing~~ torquing. For example, in the case of a cylindrical temporary attachment post top portion, driving torque can be provided by the friction of the press-fit between the cap and temporary attachment post. For example, a medium press-fit of a 3 mm diameter 1 mm thick nylon cap onto a 1.3 mm diameter stainless steel cylindrical rod may produce approximately 500 grams of axial retention force and 17 gram-cm driving torque. A typical screw thread size for appliances is

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m1.4 x 0.3. Note that in FIG. 4, the temporary attachment post threads 181 are illustrated making contact with the abutment threads 182 when engaged. The retention/axial force of the cap to the temporary attachment post may be determined by the degree of press-fit and frictional properties between the cap and temporary attachment post, and/or spring features incorporated into the temporary attachment post and/or cap.

Please replace ¶¶ [0137-139] with the following amended paragraphs:

FIG. 5 through FIG. 9 show example cross-sectional views of some of the different stages of installation of the temporary fastener system into a denture. FIG. 5 shows a cross-sectional view of the assembly of the first embodiment during the initial phase of the coping pick-up process. As illustrated, the implant abutment 8 is attached to a schematic implant 70. The implant 70 has an interface 7 (shown schematically) that is attached to the patient's jawbone 22. The coping 9 is held against the implant abutment 8 through the temporary screw comprising the post 10 and cap 11. A blind clearance hole 5 in the prosthesis 3 is sized to accommodate the coping and temporary screw. Pick-up material 171 is positioned in the clearance hole 5 to capture the coping in proper alignment within the prosthesis. The cap-coping interface 210 is positioned at the proximal end 9p of the coping central bore or aperture 16 and, as shown in FIG. 5, blocks pick-up material 171 from entering the coping central aperture 16. After the pick-up material 171 has set up, the prosthesis 3, coping 9 and temporary screw cap 10 ~~is~~ are pulled off as an assembly off the patient's jaw as shown by the arrows in FIG. 6. The coping 9 and cap 11 are released from the implant abutment 8 and post 10, while the threads of the post 10 keep it engaged in the implant abutment 8. The post 10 is subsequently removed to make the abutment threads 18 available for holding the prosthesis in proper alignment with a definitive screw.

The prosthesis/coping assembly must be processed after the pick-up process for screw attachment. A pilot hole is drilled with bit 172 from the bottom side of the assembly. As shown in FIG. 7, the diameter of the bit may be selected to use the interior bores of the coping and cap to act as guides for hand processing. Alternately, a drill guide may be employed that engages a portion of the interior of the coping ~~may be used~~ to align the pilot hole. The pilot hole provides guidance for a tool to provide clearance for the definitive screw

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shaft and head. FIG. 8 shows a stepped drill 173 that cuts both clearances in a single process. Alternatively, the shaft and head clearance may be drilled with two drills in two process steps. If desired, the cap 11 of the temporary screw 190 can be fabricated of a material that is easier to drill than the coping material to provide feedback on the drill position. It has been found that it is possible to distinguish where the drill is positioned by feel at the interfaces between the pick-up adhesive and the top of the cap (as shown in FIG. 8) and the bottom of the cap and the top of the coping. Since pick-up material was blocked from entering the coping, drilling resistance decreases rapidly upon breaking through the bottom of the cap and entering the interior channel of the coping. Color differences in the materials can also be detected. Alternatively, a tool can be configured to fit within the bore of the coping to limit the depth of the drill.

Once clearance hole 174 for the definitive screw has been made from the top of the prosthesis, the prosthesis is ready for mounting to the implant with definitive screw 175 as shown in FIG. 9. The male threads of the definitive screw are shown filling the female threads of the abutment over an engagement depth extending from a first end of the thread engagement 163 to the second end of abutment thread engagement 164 of the implant abutment threading 18. Once the most distal thread of the definitive screw 175 is engaged in an abutment thread, the engagement depth will increase by a distance equal to the thread pitch for each complete revolution of the definitive screw 175. As shown in FIG. 4, a screw clearance hole 174 is large enough to accommodate the definitive screw head 151. A residual portion 161 of the cap 11 is shown in FIG. 9 for aligning the coping 9 to the prosthesis 3 in the closed tray pick-up process. After the definitive screw 175 is torqued into position, ~~T~~the screw clearance hole 174 in the prosthesis 3 may be filled with Teflon tape and color-matching composite materials for aesthetic purposes. In the illustrated embodiment, the coping bore 16 has a shoulder 152 to engage a flat surface on the underside of the definitive screw head 151 of the definitive screw 175 to pull the coping 9 into proper seating on the implant abutment 8. Alternate configurations are possible without deviating from the temporary screw system for coping pick-up disclosed.

Please replace ¶ [0192] with the following amended paragraph:
The inventive concepts disclosed are not meant to be restricted to a temporary attachment

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post with standard screw threads that both engage and disengage the threads in the implant abutment through rotations. For example, alternate separable temporary attachment posts embodiments are possible providing features that allow the post to removably hold the coping to the abutment by other means than a separable cap. For example, as shown in FIG. 75 an alignment fastener post 39 may contain a separable threaded or serrated portion 40 that engages the screw threads in the abutment for pick-up, but that will release with axial force after. FIG. 75 shows a temporary fastener 190 with a head 42 portion and an attachment post portion 39. The attachment post portion 39 is shown as having a slot 41 and asymmetric threads or serrations 40 that have proximal flank 183 and a distal flank 184. This asymmetric threading ~~that allow~~ still allows the temporary attachment post portion 39 to be inserted through rotation like other temporary screw embodiments for alignment for coping pick-up. The post 39 ~~but~~ may be subsequently extracted with a separation force in the axial direction. Although the threads could be designed to provide engagement with the implant abutment threads through axial motion in the opposite direction to the arrow shown in FIG. 75, rotation to a design torque on engagement is generally preferred. If the post 39 is designed to be pulled out of the abutment during the coping pick-up process, it will subsequently need to be removed from flange 42 and the prosthesis assembly. Since there is no processing impact on patient comfort, higher mechanical forces or a broader range of energy or chemical processing may be employed to remove the post 39 from the prosthesis 3 after coping 9 pick-up.

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This Listing of Claims replaces all prior versions in the application.

Listing of Claims:

1-17. (Canceled)

18. (Currently Amended) A dental system ~~for attachment of a coping to a threaded implant abutment~~ comprising:

an implant abutment having threads ~~symmetric helical threading for a definitive screw~~; ~~and~~

a definitive screw having an axis with a length measured along the axis and a width measured perpendicular to the axis, the definitive screw having a proximal head end having a tool interface and a distal post portion having threads configured to engage the threads of ~~threading matching~~ the implant abutment ~~threading~~; ~~and~~

a coping having a proximal end with an aperture, wherein the aperture is larger than the distal post portion of the definitive screw ~~post~~ and smaller than the proximal head end of the definitive screw ~~head~~; and

a temporary screw having an axis with a length measured along the axis and a width measured perpendicular to the axis, the temporary screw comprising:

a proximal head portion with a width larger than the aperture of the coping ~~aperture~~; and

a distal shaft portion with threads in a pattern ~~threading~~ that is shaped differently from a pattern of the threads of the definitive screw ~~threading;~~,

wherein ~~rotating~~ the temporary screw is rotatable in a distal direction whereby the distal ~~to engage the~~ shaft portion of the temporary screw engages ~~with~~ the threads of the implant abutment ~~threads~~ to a predetermined torque which causes the proximal head portion of the temporary screw to hold the coping in~~to~~ alignment with the implant abutment, and wherein an axial force in ~~the~~ a proximal direction from pick-up processing releases the coping and the temporary screw from the implant abutment.

19. (Withdrawn, Currently Amended) The dental system ~~for attachment of a coping to a threaded implant abutment~~ of Claim 18, further comprising a temporary screw torque driver, wherein the temporary screw torque driver comprises:

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a spring friction cylinder, and

a drive cap, and

a coil spring,

wherein the temporary screw torque driver is configured to limit[[s]] ~~the~~ torque applied to the temporary screw to the predetermined torque.

20. (Currently Amended) The dental system ~~for attachment of a coping to a threaded implant abutment~~ of Claim 18, wherein the pattern of the threads of the temporary screw ~~threading~~ is asymmetric.

21. (Currently Amended) The dental system ~~for attachment of a coping to a threaded implant abutment~~ of Claim 18, wherein the temporary screw is polymeric, and wherein the distal shaft portion is hollow, and wherein the temporary screw is rotatably insertable ~~can be inserted~~ into the implant abutment ~~threading with an axial force in the distal direction~~ to the predetermined torque~~, and wherein the axial force in the distal direction needed for insertion is higher than the axial force in the proximal direction needed for release~~.

22. (Currently Amended) The dental system ~~for attachment of a coping to a threaded implant abutment~~ of Claim 18, wherein ~~the width of the threaded region of the temporary screw shaft is smaller than[the width of the threaded region of the definitive screw post~~ the pattern of the threads of the temporary screw is configured to define an abutment threading contact area and/or volume with the threads of the implant abutment that is less than an abutment threading contact area and/or volume with the threads of the implant abutment defined by the pattern of the threads of the definitive screw.

23. (Withdrawn, Currently Amended) The dental system ~~for attachment of a coping to a threaded implant abutment~~ of Claim 18, wherein the distal shaft portion of the temporary screw has a first portion with a smaller width than a second portion of the distal shaft portion ~~the threaded region of the shaft~~ of the temporary screw comprising the threads, and wherein the first portion with the smaller width ~~portion~~ is located between the proximal head portion and the threads ~~threaded region~~.

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24. (Currently Amended) The dental system ~~for attachment of a coping to a threaded implant abutment~~ of Claim 18, wherein the threads ~~threading~~ of the temporary screw deforms during the release of the temporary screw from the implant abutment ~~threading~~.

25. (Currently Amended) The dental system ~~for attachment of a coping to a threaded implant abutment~~ of Claim 18, wherein the distal shaft portion of the temporary screw ~~shaft~~ has a hollow portion, and wherein at least a portion of the distal shaft portion is configured to deflect inwardly ~~temporary screw shaft deflects~~ into the hollow portion in response to ~~when~~ the axial force in the proximal direction ~~is applied~~.

26. (Currently Amended) A dental system ~~for attachment of a coping to a threaded implant abutment~~ comprising:

an implant abutment having female threading having an implant abutment thread profile; ~~and~~

a definitive screw having a longitudinal axis and a length measured along the axis and a width measured perpendicular to the axis, the definitive screw comprising:

a shaft with male threading, wherein the male threading has a male threading profile that matably threadably engages and which matches the female threading of the implant abutment ~~thread profile~~; and

a head with a definitive screw drive interface; ~~and~~

a coping having a proximal end with an aperture sized to allow the definitive screw shaft to pass through; and

a temporary screw having a longitudinal axis and a length measured along the axis and a width measured perpendicular to the axis, the temporary screw comprising:

a post comprising ~~with~~ male threading, wherein the male threading has a male threading profile that is different from ~~does not essentially match~~ the male threading profile of the shaft of the definitive screw ~~shaft~~, and wherein the aperture of the coping is sized and configured to allow ~~aperture allows~~ the post to pass through; and

a head with a temporary screw drive interface, wherein the head is integral to or coupled to the post, ~~; and~~

wherein the temporary screw holds the coping in position ~~on~~ against the implant

abutment for pick-up processing, wherein the male threading of the post of the temporary screw is configured to enter the implant abutment and rotatably engage ~~by rotating~~ the ~~post threads into~~ the female threading of the implant abutment ~~threads~~ to a predetermined pick-up processing torque, and wherein threads of the male threading of the post ~~threads~~ release from threads of the female threading of the implant abutment ~~threads~~ with a predetermined axial pick-up force in ~~the~~ a proximal direction in response to and/or during pick-up processing.

27. (Currently Amended) The dental system ~~for attachment of a coping to a threaded implant abutment~~ of claim 26, wherein ~~the width of~~ the male threading profile of the post of the temporary screw comprises at least some threads that have a pitch angle that is different than a pitch angle of threads of the female threading of the implant abutment and threads of ~~post threading is smaller than the width of~~ the male threading profile of the shaft of the definitive screw ~~shaft threading~~.

28. (Currently Amended) The dental system ~~for attachment of a coping to a threaded implant abutment~~ of claim 26, wherein a ~~the~~ proximal flank of the male threading profile of the post of the temporary screw ~~post threading profile~~ is at a smaller angle relative to the longitudinal axis thereof than a ~~the~~ proximal flank of the male threading profile of the shaft of the definitive screw relative to the longitudinal axis thereof ~~shaft threading profile~~.

29. (Currently Amended) The dental system ~~for attachment of a coping to a threaded implant abutment~~ of claim 26, wherein the ~~definitive screw comprises a metallic material and the~~ temporary screw comprises a polymeric material.

30. (Canceled)

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REMARKS

Applicant hereby requests further consideration of the application in view of the amendments above and the comments that follow. Claims 1-30 were pending in the application at the mailing of the Action, with Claims 2, 5, 9 and 23 withdrawn from consideration. Claims 1-17 and 30 have been canceled hereinabove.

Applicant acknowledges the thorough review of the claims and application. Applicant appreciates that the Examiner acknowledged the election without traverse of Species Q (FIG. 75).

The undersigned also apologizes for some wording used in the last response that may have caused some confusion and also an inadvertent offset in paragraph number referencing. Paragraph number references in the current response correspond to the original numbering of the USPTO specification from the initial uploading through Patent Center, not the source files.

I. The Allowable Subject Matter

Applicant acknowledges, with appreciation, the Action's statement that Claims 18, 20-22 and 24-30 would be allowable if rewritten or amended to overcome the rejections under 35 USC §112(b). Action, page 37.

To advance prosecution and reduce the issues for consideration in this response, but without acquiescing as to the rejections of Claims 1-17 and 30, Applicant has canceled those claims without prejudice for pursuit in a future continuation application.

II. The Drawing Objections

The Action states that the drawings are objected to under 37 CFR 1.83(a) for allegedly not showing every feature of the invention specified in the claims. Action, pages 4-6. Applicant respectfully disagrees.

Applicant has submitted Replacement Sheets that address the drawing objections, at least as far as the noted objections relate to the currently pending claims. Callouts (reference numbers) have been added to features in the original drawings which correspond to some of the features alleged not to be in the drawings.

With respect to (canceled) Claim 13, FIG. 4 clearly shows the head 11 of the temporary screw extends across and does not fit through the central aperture 16 of the coping.

Replacement Sheet 2 includes additional reference numbers 9s, 11s, 16p, 16, 181, 182, 190, 210, 211, and 219 for features shown in original FIG. 4.

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Replacement Sheet 3 includes corrected 171 and additional reference numbers 10, 16, 210 and 219 for features shown in original FIGS. 5-6.

Replacement Sheet 4 includes corrected 10, 161, 171, 172, 173, 174, and 175 reference numbers and additional reference numbers 18, 150, 151, 152, 163, 164 for features shown in original FIGS. 7-9.

Replacement Sheet 7 corrects reference numbers 172, 173, and 175 in FIGS. 23-25.

Replacement Sheet 22 includes additional reference numbers 183, 184, 190, and 210 for features shown in original FIG. 75.

Applicant respectfully submits that the amended drawings and corresponding updated text of the Specification provided hereinabove do not introduce new matter. The Replacement Sheets only add callouts or correct/change callouts for features in the original filed drawings. Applicant respectfully requests that the drawing objections be withdrawn.

II. The Specification Objections

The Action appears to object to the "combination" of features from different embodiments of the different Species with respect to Claims 19 and 23, for example. Action, page 3. Applicant continues to submit that the application as-filed does not exclude different combinations of features of the temporary screws for the coping and implant abutment systems and that there is sufficient written description for same.

The Action also objects to the specification as failing to allegedly provide "proper antecedent basis for the claimed subject matter, citing 37 CFR 1.75(d)(1) and MPEP 608.01(o). Action, pages 6-11. Applicant respectfully disagrees. Applicant submits that the claims are supported by the original disclosure.

35 USC §132 bars an applicant from presenting new matter once a patent application has been filed. The Federal Circuit has addressed the "related" new matter and written description issues and has stated that both issues turn on a single question: whether the amendment broadened the disclosure of what the inventors invented. *See, e.g.*, *Ex parte Dev Melepura*, Appeal No. 2020-003047 (PTAB December 30, 2021) (citing *Commonwealth Scientific and Indus. Research Organisation v. Buffalo Technology (USA), Inc.*, 542 F.3d 1363, 1380 (Fed. Cir., 2008)).

It is well accepted that "the invention claimed does not have to be described *in ipsis verbis* in order to satisfy the description requirement of § 112." *Regents of the Univ. of Minn. v. Gilead Scis.*, 2021-2168 (Fed. Cir. March 6, 2023) (citing *Fujikawa v. Wattanasin*, 93 F.3d

1559, 1570 (Fed. Cir. 1996)). Rather, the disclosure need only reasonably convey to persons skilled in the art that the Applicants had possession of the subject matter in question. *Novartis Pharm. Corp. v. Accord Healthcare, Inc.*, 38 F.4th 1013, 1016 (Fed. Cir. 2022) ("To satisfy the written description requirement, a patent's specification must "reasonably convey[ ] to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date. . . . Such possession must be 'shown in the disclosure.'") (quoting *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010) (en banc).

35 USC § 112, first paragraph, requires that an Applicant convey with reasonable clarity to those skilled in the art that, as of the effective filing date, the Applicant was in possession of the invention. *See Vas-Cath, Inc. v. Mahurkar*, 935 F.2d 1555, 1560, 19 USPQ2d 1111, 1117 (Fed. Cir., 1991). An Applicant shows possession of a claimed invention "by such descriptive means as words, **structures**, **figures**, diagrams, formulas, etc., that fully set forth the claimed invention." *Blue Calypso, LLC v. Groupon, Inc.*, 815 F.3d 1331, 1346 (Fed. Cir. 2016) (quoting *Lockwood v. American Airlines, Inc.*, 41 USPQ2d 1961, 1966 (Fed. Cir. 1997) (emphasis added).

"The written description requirement does not require the applicant 'to describe exactly the subject matter claimed, [instead] the description must clearly allow persons of ordinary skill in the art to recognize that [he or she] invented what is claimed.'" *Union Oil Co. of Cal. v. Atlantic Richfield Co.*, 208 F.3d 989,997, 54 USPQ2d 1227, 1232 (Fed. Cir. 2000); see also Novozymes v. DuPont Nutrition Biosciences APS, 723 F.3d 1336, 1346 (Fed. Cir. 2013) (internal citations omitted) ("We have consistently held that, to satisfy § 112, a patent's written description "must 'clearly allow persons of ordinary skill in the art to recognize that [the inventor] invented what is claimed.' A "mere wish or plan" to obtain the claimed invention is not sufficient.").

"In rejecting a claim under the first paragraph of 35 U.S.C. § 112 for lack of adequate descriptive support, it is incumbent upon the examiner to establish that the originally filed disclosure would not have reasonably conveyed to one having ordinary skill in the art that an appellant had possession of the now claimed subject matter." *Ex parte Parks*, 30 USPQ2d 1234, 1236 (BPAI 1994) (citing *Wang Laboratories, Inc. v. Toshiba Corp.*, 993 F.2d 858, 26 USPQ2d 1767 (Fed. Cir. 1993)).

A description as filed is presumed to be adequate, unless or until sufficient evidence or reasoning to the contrary has been presented by the Examiner to rebut the presumption. *Ex*

parte Ji Eun Kim, Appeal No. 2016-003176 (PTAB 2017) (citing *In re Marzocchi*, 439 F.2d 220, 224, 169 USPQ 367, 370 (CCPA 1971)); *see also* MPEP § 2163.04. The Examiner, therefore, must have a reasonable basis to challenge the adequacy of the written description.

The examiner has the initial burden of presenting by a preponderance of evidence why a person of ordinary skill in the art would not recognize in an **Applicant's disclosure** a description of the invention defined by the claims. *See In re Wertheim*, 541 F.2d 257, 263, 191 USPQ 90, 97 (CCPA 1976); *see also* MPEP § 2163.04 (emphasis added).

With respect to Claim 18, the Action states that the "symmetrical helical threading" of the implant abutment does not appear to be described in the specification. Applicant respectfully submits that FIGS. 4 and 9, for example show this configuration. However, without acquiescing as to this rejection, Claim 18 has been amended in a non-narrowing manner to remove this recitation.

With respect to Claim 21, Applicant has amended this claim to remove the recitation related to the difference in axial forces. Applicant has amended Claim 21 to recite that the temporary screw is polymeric, that the distal shaft portion is hollow, and that the temporary screw is rotatably insertable into the implant abutment to the predetermined torque.

With respect to Claims 22, 26, 27 and 28, the following discussion is provided in support of the features identified by the Action as apparently lacking written support.

Figures 9 and 75 are reproduced below with enlargements of the cross-sectional views of a few threads of the definitive screw engaging the implant abutment of FIG.9 and the temporary screw of FIG. 75.

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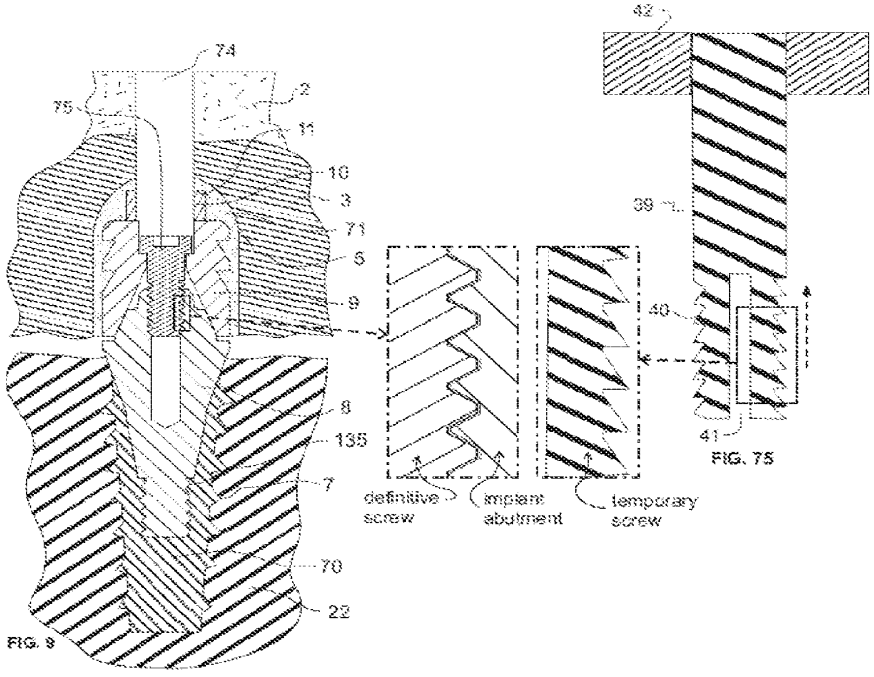


FIG. 9

FIG. 75

As shown in FIG. 9, the male definitive screw threads (callout 150 for these threads added to the replacement figure) essentially fill the female abutment threads (callout 18 for the female abutment threads added to FIG. 9 as well). When engaged, the profile of the temporary screw threading 40 fits within the profile of the abutment threading 18 to preserve the female threading geometry for the definitive screw after pick-up processing. The temporary fastener 190 of FIG. 75 engages the implant abutment 8. The male threading 40 of the temporary fastener 190 can engage the female abutment threads 18 without or with distortion. The temporary fastener 190 of FIG. 75 can be combined with various coping and implant abutments, such as the environment of the implant abutment 8 and coping 9 elements of FIG. 4 and FIG. 9.

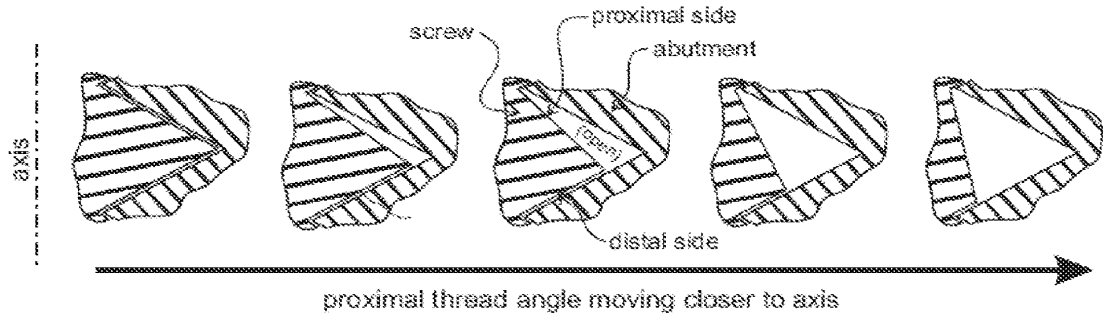
Typically, the standard definitive screw has a continuous symmetrical helical form as is well known to those of skill in the art. FIG. 9 (enlarged portion of the screw threading shown in the box adjacent FIG. 9) also shows that the implant abutment threading 18 matches and is filled with the definitive screw post threading 150. That is, the female implant abutment threading substantially matches, e.g., has substantially the same pitch as the

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definitive screw male threading 150. Thus, as shown in FIG. 9, the male definitive screw threads 150 matably, threadably engage, e.g., essentially fill the female abutment threads 18.

In contrast, the thread profile 40 of the temporary screw of FIG. 75 is not the same as the illustrated profile (enlarged from FIG. 9 shown above) of the definitive screw threading. As shown in FIG. 75, the proximal side or flank of at least some of the respective threads of the temporary screw/fastener (toward the head portion 42), labeled as feature 183 in the replacement drawing, lies at an angle that is at a smaller angle relative to the longitudinal axis than the angle of the proximal side of the threads of the definitive screw. The distal side of the temporary fastener thread illustrated in FIG. 75 (labeled as feature 184 in the replacement drawing) lies at a steeper angle relative to the longitudinal axis than the distal side of the threads of the definitive screw. Although the threading shape is different, when engaged, the profile of the temporary screw threading 40 fits within the same abutment threading 18 as the definitive screw.

For background information, it may be useful to look at how changing the proximal side thread angle of a male thread affects its fit into a fixed female thread shape. The following figure shows a sequence of a single male asymmetric thread in which the proximal side angle becomes progressively closer to the axis engaging a fixed symmetric female thread.



In this schematic sequence, the male thread of the fastener is to the left and the implant abutment thread is to the right. It is evident that as the male proximal side profile angle becomes closer to the axis, the male thread fills less of the female thread. An increasingly larger open space is created as the outer vertex of the male thread moves towards

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the axis with the increasingly smaller proximal angle. In the limit when the proximal angle nears the axis, there is a negligible filling of the female threads. That is, the remaining male thread essentially has no real engagement with the female thread. This follows directly from simple geometry and is a feature of FIG. 75, for example, having at least an inherent property of the asymmetric/serrated threads with the different thread angle. *See*, MPEP § 2163.07(a): *Yeda Research and Dev. Co. v. Abbott GMBH & Co.,* 837 F.3d 1341, 120 USPQ2d 1299 (Fed. Cir. 2016) ("Under the doctrine of inherent disclosure, when a specification describes an invention that has certain undisclosed yet inherent properties, that specification serves as adequate written description to support a subsequent patent application that explicitly recites the invention's inherent properties." (citing *Kennecott Corp. v. Kyocera Int'l, Inc.,* 835 F.2d 1419, 1423, 5 USPQ2d 1194, 1198 (Fed. Cir. 1987)); see also MPEP §2163.07(a).

The open space created on the proximal side of the male thread of temporary fastener 190 relative to the female thread(s) due to the angle lying closer to the axis represents a portion of the female abutment thread that is filled with the definitive screw when engaged as shown in FIG. 9. As a result of the open space from the different thread profile of the temporary screw compared to the definitive screw in FIG. 9, the temporary screw threading of FIG. 75 has less surface area contact with the female implant abutment threading, has less material volume within the engagement depth with the implant abutment and can have a smaller radial extent or width than the definitive screw.

Similarly, a steeper angle on the distal side thread profile of the temporary fastener may create additional open space to reduce relative implant abutment thread surface contact and volume. Thus, slot 41 and/or the thread profile of FIG. 75 can reduce relative implant abutment thread surface contact area and engaged volume.

With respect to Claim 22 , the Action states that the "wherein the width of the threaded region of the temporary screw shaft is smaller than the width of the threaded region of the definitive screw post" does not appear to be described in the specification. Applicant respectfully submits that this is inherent due to the relative geometry of FIGS. 9 and 75 discussed above. However, without acquiescing as to this rejection, Applicant has amended this claim to remove the recitation related to the difference in width. Applicant has amended Claim 22 to recite that the "pattern of the threads of the temporary screw is configured to define an abutment threading contact area and/or volume with the threads of the implant abutment that is less than an abutment threading contact area and/or volume with the threads

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of the implant abutment defined by the pattern of the threads of the definitive screw" . This is supported by the discussion of the inherent additional open space above.

With respect to Claim 26, without acquiescing to the rejection, Applicant has amended this claim to recite a male threading profile that is different from rather than "does not essentially match".

With respect to Claim 27 , the Action states that the "wherein the width of the temporary screw post threading is smaller than the width of the definitive screw shaft threading" does not appear to be described in the specification. Applicant maintains that this is supported as described for the similar limitation of Claim 22. Without acquiescing to the rejection, Applicant has amended this claim to recite wherein "the male threading profile of the post of the temporary screw comprises at least some threads that have a pitch angle that is different than a pitch angle of threads of the female threading of the implant abutment and threads of the male threading profile of the shaft of the definitive screw." Applicant respectfully submits that FIG. 75 clearly shows a temporary thread pitch angle that is different from a pitch angle of threads of the implant abutment and definitive screw in FIG. 9.

With respect to Claim 28, Applicant respectfully submits that FIG. 75 shows the temporary fastener with the flank angle of the thread(s) and FIG. 9 shows the definitive screw with its proximal flank angle. Comparing the respective flank angles, Referring to FIG. 75 showing the proximal flank angle(s) clearly being smaller.

With respect to Claim 29, Applicant has amended this claim in a non-narrowing manner to remove the definitive screw material.

With respect to Claim 30, Applicant has canceled this claim without prejudice thereto. However, Applicant notes that FIG. 75 only shows the temporary screw. FIG. 9, for example shows a definitive screw.

Applicant respectfully submits that pending application provides the requisite written description and support for the claimed recitations. Applicant also submits that the Examiner does not have a reasonable basis to challenge the adequacy of the written description in light of the disclosure and drawings.

As such, Applicant submits that the Action has failed to meet the initial burden of establishing an adequate basis for the rejection of the claims. Applicant submits that the claims are sufficiently supported by the application.

III. The Claim Objections

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The Action objects to the preamble of the claims and the preamble has been amended as suggested by the Examiner. Action, pages 11, 12.

With respect to Claim 26, the suggested indentation of lines 8-10 have been added.

With respect to Claim 18, lines 20-21, the Action suggests amendment to "the coping and the temporary screw."

Other amendments have been made to the pending claims to address the claim objections and/or restate the recitations in a consistent manner.

III. The 35 USC §112(b) Rejections

The Action rejects the claims for certain claim language informalities/inconsistencies. The claims have been amended in a non-narrowing manner to address the noted issues.

IV. The Information Disclosure Statement

The Information Disclosure Statement filed August 8, 2023, is stated to fail to comply with 37 CFR 1.97, 1.98. Action, page 4. This IDS was resubmitted in September. A supplemental IDS is also being filed containing all references from the parent application and supplemental non-patent literature on the state of the art.

Return of an initialed copy of each IDS confirming consideration of same is respectfully considered.

V. Request for Rejoinder

Applicant respectfully requests the rejoinder of Claim 19 based on its dependency from allowable Claim 18.

The temporary torque driver may be discussed in the specification by way of example for certain figures of the application, the configuration of the temporary screw of FIG. 75 simply does not exclude the use of such a tool with that embodiment. The fact that the head of FIG. 75 does not show the Hex drive feature is in apposite (it is a sideview and a number of different shapes may be used for providing a drive interface). Indeed, throughout the specification it is discussed that a torque limit or predefined torque can be used to provide a suitable engagement depth of a temporary screw and several ways to achieve this are also described. There is simply no requirement that every combination of every feature of a respective temporary screw be explicitly shown together to provide the support (see discussion above regarding written description). Indeed, the temporary torque drive contemplated by embodiments of the pending application can be used for other screws.

The predetermined temporary screw torque used to properly align the coping with the

implant abutment can generally be design specific. Applicant respectfully submits that a dental practitioner would recognize that the temporary screw torque driver of Claim 19 would be generally useful for limiting the torque applied to any species of temporary screw contemplated by embodiments of the invention, including the elected species and independent Claim 18.

With respect to Claim 23, this claim depends on Claim 18 and as Claim 18 is in condition for allowance, Claim 23 is also patentable, at least for depending from a patentable base claim, and should be rejoined. With respect to the Action's statement that the feature is shown in Species L (FIG. 67), it is also shown in FIG. 74, for example. ¶206 of the application also states that one or more inventive elements from one or more embodiments can be combined. Applicant respectfully submits that the originally filed disclosure reasonably conveys to one having ordinary skill in the art that applicant had possession of the subject matter of Claim 23, in combination with Claim 18.

CONCLUSION

Accordingly, Applicant submits that the present application is in condition for allowance and the same is earnestly solicited. The Examiner is encouraged to telephone the undersigned at 360-714-0777 for expeditious handling of any matters outstanding of resolution.

Respectfully submitted,

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APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/328,730	**12/05/2023 08:28:24 PM Z ET**	**SDC010**

Title of Invention

Screw-attached Pick-up Dental Coping System and Methods

Application Information

APPLICATION TYPE	Utility - Nonprovisional Application under 35 USC 111(a)	PATENT #	-
CONFIRMATION #	2867	FILED BY	Daniel Whittle
PATENT CENTER #	63500659	FILING DATE	06/03/2023
CUSTOMER #	112823	FIRST NAMED INVENTOR	Brandon Dale Kofford
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	-

Documents

TOTAL DOCUMENTS: 4

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
SDC010_Response_9-7-23_NFOA-APP.TEXT.docx	19	Application body structured text document	215 KB
Warning: The automatic document description has been replaced. Document contains text marked for both insertion and deletion. Please review and revise if necessary. Bookmarks were found and have been removed. Document contains text marked for both insertion and deletion. Please review and revise if necessary. Bookmarks were found and have been removed.			
replacements-2-3-4-7-22-1dec2023.pdf	5	Drawings-only black and white line drawings	116 KB
SDC010_Response_9-7-23_NFOA.pdf	19	Auxiliary PDF of Application	431 KB

sb0021.pdf	2	Transmittal Letter	265 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
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If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

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If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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ABSTRACT KR101745575B1

[0001a]

14 The present invention relates to an impression cap having a function of a scan body for implants, comprising: a body having a tool coupling groove formed in the upper center and an abutment coupling groove formed in the lower center; An upper plate formed in a plate shape on the outer surface of the body and having a string coupling hole formed therein so that a safety line can be coupled to one or both sides of the inner side; may be integrally formed. According to the present invention, it is possible to prevent the loss of the impression cap and the abutment combination into the patient's body during the operation of the impression cap and the abutment assembly by coupling the safety line to the string coupling hole constituting the plate. It has the effect of reducing economic loss and operation time.

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DESCRIPTION KR101745575B1

11 Impression cap with scan body function for implants {IMPRESSION CAP FOR IMPLANT}

[0001]

16 The present invention relates to an impression cap having a function of a scan body for an implant, and more particularly, an implant capable of being accurately inserted and operated at a designated location while preventing the loss of an impression cap and abutment assembly during implant treatment. It relates to an impression cap having a function of a scan body for use.

[0002]

24 In general, the implant refers to fixing the denture by using a screw to the fixture after installing the fixture in the periodontal bone.

[0003]

29 And, in the implant procedure, after determining the condition of periodontal bone through CT, the position of the tooth to be operated is selected, the tooth with abnormality is extracted, and the fixture is installed in the periodontal bone area where the missing tooth is located.

[0004]

36 At this time, since the denture cannot be installed immediately after the fixture is installed, treatment is performed to eliminate the inflammation that occurred during

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the procedure on the periodontal bone and gums.

[0005]

42 In addition, an abutment made of a material harmless to the human body, such as titanium, is installed on the fixture in order to prevent the upper part of the fixture from being partially covered by the skin of the gum while treating the position and gums of the fixture.

[0006]

49 Next, when the inflammation in the gums and periodontal bone disappears after the fixture construction, the pattern inside the oral cavity is made and dentures are manufactured according to the pattern. By making a tight bite, the shape of the mouth is created as a pattern, and then dentures are manufactured according to the pattern.

[0007]

56 T he abutment coupled to the fixture is manufactured in 4mm, 6mm, 8mm, etc., and although it is selectively installed depending on the depth of the fixture installed on the periodontal bone, it does not protrude significantly above the gums, so it was difficult to identify and measure it.

[0008]

63 In addition, in order to overcome the above problems, an impression cap is used to more accurately measure the position of the abutment, but the conventional abutment and impression cap are too small in size and move and work in a small mouth. , there was a problem in that the doctor missed it and dropped it into the patient's mouth.

[0009]

70 And, recently, the technology of photographing a patient's gums with a 3D scanner has been developed, and the patient's gums are simply photographed as a three-dimensional image through the 3D scanner without cutting a pattern as in the prior art.

[0010]

76 However, even when shooting with a three- dimensional scanner, the conventional impression cap can only check the depth of the fixture, and it is difficult to check the angle at which the fixture is installed.

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[0011]

82 More supplementary explanation of this, the fixture is manufactured by accurately calculating the lead- in portion of the screw, and is manufactured so that the position of the denture can be more accurately identified when the installed angle is accurately identified, and is usually made to be measured in 6 directions.

[0012]

89 T herefore, when the fixture and the abutment are completely combined, the direction and position of the fixture can be accurately measured with the direction mark displayed on the top of the abutment. It was difficult to figure this out.

[0013]

95 T he problem with this is that when the length of the abutment, which is the most important for checking the position of the fixture in the process of making the pattern of the gums, is wrongly checked and delivered to the dental laboratory, the dentures manufactured by the dental laboratory cannot be operated on the patient. A problem occurred, which led to the problem of having to redo all the work everywhere, and there was a problem that the patient had to endure as much inconvenience as the time to re- manufacture the denture.

[0014]

105 Republic of K orea Patent Publication No. 10- 1108280 Republic of K orea Patent Publication No. 10- 1038068

[0015]

110 T he present invention has been devised to solve the above problems, and the impression cap and the abutment combination are inserted into the patient's body during the operation of the impression cap and the abutment assembly by coupling the safety line to the string coupling hole constituting the plate. T he purpose is to prevent it from being lost.

[0016]

118 In addition, the purpose is to prevent damage to the mouth while accurately inserting the impression cap and the abutment assembly at a designated position through the position guide grooves and cutouts formed on the diagonal of the plate.

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[0017]

124 In addition, the purpose of this is to enable accurate measurement of the size and position increase of the abutment with the shape of the impression cap in the process of making the pattern of the gum.

[0018]

130 In order to achieve the above object, the impression cap having a function of the scan body for implants according to the present invention includes a body in which a tool coupling groove is formed in the upper center and an abutment coupling groove is formed in the lower center; An upper plate formed in a plate shape on the outer surface of the body and having a string coupling hole formed thereon so that a safety line can be coupled to one or both sides of the inner side; may be integrally formed.

[0019]

139 In addition, a lower plate having the same shape as the upper plate may be further formed on the outer surface of the body located under the upper plate.

[0020]

144 In addition, a position guide groove may be formed on the diagonal of the outer surface of the plate for coordinate recognition.

[0021]

149 Here, a cutout may be formed in an inclined or curved shape at an interval at the outer edge of the plate.

[0022]

154 In addition, an abutment depth guide formed by combining an annular projection or a straight surface or an annular projection and a straight surface may be formed on the inner surface of the abutment coupling groove constituting the body.

[0023]

160 According to the present invention, it is possible to prevent the loss of the impression cap and the abutment combination into the patient's body during the operation of the impression cap and the abutment combination by coupling the safety line to the string coupling hole constituting the plate. It has the effect of reducing

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economic loss and operation time.

[0024]

168 In addition, it is possible to prevent damage to the mouth while accurately inserting the impression cap and abutment assembly at the designated position through the position guide groove and incision formed on the diagonal of the plate, as well as improving the reliability of the operator there is

[0025]

175 In addition, there is an effect of accurately checking the length of the abutment, the overlapping position, etc. just by checking the position of the impression cap in the process of knitting the gum pattern.

[0026]

181 1 is a perspective view showing an impression cap having a function of a scan body for implants according to the present invention. 2 and 3 are a plan view and a front view showing an impression cap having a function of a scan body for implants according to the present invention. 4 and 5 are bottom views showing an embodiment of a plate abutment coupling groove constituting an impression cap having a function of a scan body for implants according to the present invention. 6 is a view showing the use state of the impression cap having a function of the scan body for implants according to the present invention.

[0027]

192 Hereinafter, embodiments of the present invention will be described in detail with reference to the accompanying drawings so that those of ordinary skill in the art can easily carry out the present invention.

195 However, the present invention may be implemented in several different forms and is not limited to the embodiments described herein. T hroughout the specification, like reference numerals are assigned to similar parts.

[0028]

201 Hereinafter, the configuration of the present invention will be described with reference to the accompanying drawings, in which FIG. 1 is a perspective view showing an impression cap having a function of a scan body for an implant according to the present invention, and FIGS. 2 and 3 are for an implant according to the present invention It is a plan view and a front view showing an impression cap

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having a function of a scan body, and FIGS. 4 and 5 show an embodiment of a plate abutment coupling groove constituting an impression cap having a function of a scan body for an implant according to the present invention It is a bottom view, and FIG. 6 is a view showing the use state of the impression cap having the function of the scan body for implants according to the present invention.

[0029]

214 Impression cap 10 for implants according to the present invention includes a body 20 , an upper plate 30 , and a lower plate 40 .

[0030]

219 The body 20 has a predetermined size and height depending on the environment and purpose, and is formed in various shapes.

[0031]

224 And in the present invention, the body 20 has a cylindrical shape having a predetermined diameter and height, and a tool coupling groove 22 is formed in the upper center, and an abutment coupling groove 24 is formed in the lower center.

[0032]

230 That is, the body 20 forms a tool coupling groove 22 in the upper center so as to be coupled with a tool used during surgery, and an abutment coupling groove in the lower center to be coupled with the abutment 5 (24) was formed.

[0033]

236 Here, the shape of the tool coupling groove 22 may be formed in various shapes depending on the shape of the tool, and the shape of the abutment coupling groove 24 is also formed in various shapes depending on the abutment 5 . reveal that it can be

[0034]

243 And on the inner surface of the abutment coupling groove 24, an annular protrusion or a straight surface or an abutment depth guide 26 formed by combining an annular protrusion and a straight surface is formed.

[0035]

249 That is, at least one abutment depth guide part 26 is formed in the shape of an annular projection or a straight surface on the inner surface of the abutment coupling groove 24 so that the depth of the abutment 5 can be checked. .

[0036]

255 For example, if the length of the abutment is 4 mm, one annular projection is formed and a straight surface is formed on the other two surfaces, and when the abutment length is 6 mm, two annular projections are formed, A straight surface is formed on the other side, and when the length of the abutment is 8 mm, annular protrusions are formed on all three sides so that the length of the abutment can be checked in the dental laboratory without separate explanation. will be.

[0037]

264 At this time, it is revealed that a shape corresponding to the abutment depth guide 26 may be selectively formed on the upper portion of the abutment 5 .

[0038]

269 In a more supplementary explanation, the abutment depth guide unit 26 includes the abutment depth guide unit 26 to prevent a misalignment of the size of the abutment 5 due to a doctor's or nurse's mistake during the procedure.) and the upper shape of the abutment 5, the length of the abutment 5 is 4mm, 6mm, or 8mm.

[0039]

276 Therefore, an annular protrusion or an engraved annular groove or a straight groove is formed on the upper portion of the abutment 5 to match the straight surface, and the abutment 5 and the impression cam 10 are only those that coincide with each other. It is a feature of the present invention to manufacture to be combined.

[0040]

283 The upper plate 30 is formed in a plate shape on the outer surface of the body 20, a string coupling hole 32 is formed on one or both sides of the inner surface, and a position guide groove 34 is formed on the outer surface diagonally, and the outer surface On the opposite side of the diagonal, an inclined or curved cutout portion 36 is formed.

[0041]

291 And in the present invention, the upper plate 30 is formed in an oval or rectangular shape, and a string coupling hole 32 is formed so that it can be coupled with the safety line 50 on both sides, and an "L" shape position guide is provided on the diagonal line. The groove 34 is formed, and an example in which the cutout 36 is formed to be inclined or curved on the opposite side will be described as an example.

[0042]

300 That is, the upper plate 30 is formed in a plate shape at the top of the body 20 and symmetrically forms the string coupling holes 32 on both sides, and the position guide grooves 34 in the "L" shape are formed diagonally on both sides and The incision 36 is formed to be inclined or curved.

[0043]

307 Looking at this in more detail, the impression cap 10 for implant is the impression cap 10 for implantation during implant operation through the safety line 50 coupled to the string coupling hole 32 after the abutment 5 is coupled.) and the abutment 5 can be prevented from entering the patient's body.

[0044]

314 In addition, the "L"- shaped position guide groove 34 formed on the diagonal of the upper plate 30 allows the coordinates to be recognized during a three- dimensional scan through a 3D scanner.

[0045]

320 That is, the impression cap 10 for implants can not only find one straight line in three dimensions through the coordinates of the position guide grooves 34 and the coordinates of the tool engaging grooves 32 formed on both diagonals, but also the tool engaging grooves (32) so that the position and size of the fixture and the abutment 5 can be checked on a straight line.

[0046]

328 Next, the cutout 36 formed on the diagonal opposite side of the upper plate 30 is inclined or curved.

[0047]

333 That is, the impression cap for implant 10 is a corner portion during rotation operation of the impression cap 10 for implant through a cutout 36 that is inclined or curved on the opposite side diagonally separately from the position guide groove 34 . This will prevent damage to the patient's mouth.

[0048]

340 The lower plate 40 is formed on the outer surface of the body 20 located below the upper plate 30 .

[0049]

345 And the lower plate 40 is formed in a plate shape on the outer surface of the body 20 in the same way as the upper plate 30, and a string coupling hole (42) is formed, a position guide groove 44 is formed for coordinate recognition on the diagonal of the outer surface, and an inclined or curved cutout 46 is formed on the diagonal opposite to the outer surface.

[0050]

353 Here, the string coupling hole 42 and the position guide groove 44 and the cutout 46 constituting the lower plate 40 are the string coupling hole 32 and the location guide groove 34 of the upper plate 30 . And since it corresponds to the cutout 36, it will be briefly described.

[0051]

360 That is, the lower plate 40 is formed in an oval or rectangular shape in the same way as the upper plate 30, and a string coupling hole 42 is formed so that it can be coupled with the safety line 50 on both sides, and the diagonal "L" A ruler- shaped position guide groove 44 is formed, and an inclined or curved cutout 46 is formed on the opposite side diagonally.

[0052]

368 To further explain this, the lower plate 40 is formed in a shape corresponding to the upper plate 30 and is formed in the body 20 with an interval therebetween, and a string coupling hole 42 is formed on both sides, and both sides A diagonally "L"-shaped position guide groove 44 and an inclined or curved cutout 46 are formed.

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[0053]

375 An embodiment of an impression cap having a function of a scan body for implants configured as described above will be described with reference to the following.

377 At this time, it is preferable that the impression cap 10 for implants is formed integrally at a time, and here, for convenience of description, an example in which the implant is formed in stages will be described.

[0054]

383 First, the body 20 is formed in a cylindrical shape having a predetermined diameter and height, in which the tool coupling groove 22 is formed in the upper center and the abutment coupling groove 24 is formed in the lower center.

[0055]

389 And the upper end of the body 20 is formed in a plate shape, the inner one side or both sides of the string coupling hole 32 is formed, the position guide groove 34 is formed on the diagonal of the outer surface, the diagonal opposite to the outer surface is inclined Alternatively, the upper plate 30 in which the cutout 36 is formed is formed to be curved.

[0056]

397 Next, it is formed in a plate shape at a distance from the upper plate 30, and on one or both sides of the inside, a string coupling hole 42 is formed so that the safety line 50 can be coupled, and coordinate recognition is performed on the outer surface diagonally. In order to achieve this, the impression cap 10 for implantation is completed when a position guide groove 44 is formed, and a lower plate 40 in which an inclined or curved incision 46 is formed is formed on the diagonal opposite to the outer surface.

[0057]

407 And after coupling the abutment 5 to the abutment coupling groove 24 of the body 20 constituting the impression cap 10 for implant, the string coupling hole 32 constituting the plates 30 and 40 , 42) is coupled to the safety line (50).

[0058]

413 Next, after the combination in which the impression cap 10 and the abutment 5 are combined is mounted on the fixture, the procedure is performed.

[0059]

418 In the above description of the impression cap having the function of the scan body for implants according to the present invention with reference to the accompanying drawings, a specific shape and direction have been mainly described, but the present invention is capable of various modifications and changes by those skilled in the art, and such modifications and changes should be construed as being included in the scope of the present invention.

[0060]

427 5 : abutment, 10: impression cap for implant, 20: body, 22: tool coupling groove, 24: abutment coupling groove, 26: abutment depth guide, 30: upper plate, 32: file coupling hole, 34: location guide groove, 36: cutout, 40: lower plate, 42: string coupling hole, 44: location guide groove, 46: cutout, 50: safety line.

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CLAIMS KR101745575B1

1.

14 a body in which a tool coupling groove is formed in the upper center and an abutment coupling groove is formed in the lower center; and an upper plate formed in a plate shape on the outer surface of the body and having a string coupling hole formed on one or both sides of the inner side so that a safety line can be coupled; is integrally formed, and a position guide for coordinate recognition on the outer surface of the plate diagonally Impression cap having a function of a scan body for implants, characterized in that a groove is formed.

2.

24 [2] The impression cap according to claim 1, wherein a lower plate having the same shape as the upper plate is further formed on the outer surface of the body located under the upper plate.

3.

30 delete

4.

34 [Claim 3] The impression cap according to claim 1 or 2, wherein an inclined or curved incision is formed at the outer edge of the plate at intervals.

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5.

39 The scan body for implant according to claim 1, wherein an abutment depth guide formed by combining an annular projection or a straight surface or an annular projection and a straight surface is formed on the inner surface of the abutment coupling groove constituting the body. Impression cap with the function of

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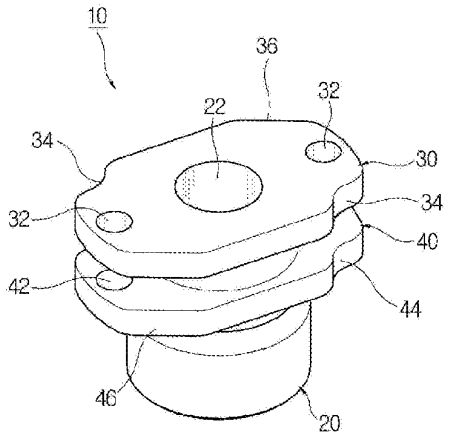
(54) 발명의 명칭 **임플란트용 스캔바디의 기능을 구비한 임프레션 캡**

(57) 요 약

본 발명은 임플란트용 스캔바디의 기능을 구비한 임프레션 캡에 관한 것으로서, 상부 중앙에 공구 결합홈이 형성되고 하부 중앙에는 어버트먼트 결합홈이 형성되는 몸체; 상기 몸체의 외면에 판 형상으로 형성되고 내부 일 측 또는 양측에는 안전줄이 결합될 수 있도록 줄 결합공이 형성되는 상부 플레이트;가 일체로 형성될 수 있다.

본 발명에 따르면, 플레이트를 구성하는 줄 결합공에 안전줄을 결합하여 임프레션 캡과 어버트먼트 결합체의 시술시 환자의 몸속으로 임프레션 캡과 어버트먼트 결합체가 유실되는 것을 방지할 수 있을 뿐만 아니라 그에 따른 경제적 손실 및 시술시간을 절감할 수 있는 효과가 있다.

대 표 도 - 도1



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명 세 서

청구범위

청구항 1

상부 중앙에 공구 결합홈이 형성되고 하부 중앙에는 어버트먼트 결합홈이 형성되는 몸체; 및

상기 몸체의 외면에 판 형상으로 형성되고 내부 일 측 또는 양측에는 안전줄이 결합될 수 있도록 줄 결합공이 형성되는 상부 플레이트;가 일체로 형성되고,

상기 플레이트의 외면 대각선상에는 좌표 인식을 위하여 위치 안내홈이 형성되는 것을 특징으로 하는 임플란트용 스캔바디의 기능을 구비한 임프레션 캡.

청구항 2

제 1항에 있어서,

상기 상부 플레이트의 하부에 위치한 몸체의 외면에는 상기 상부 플레이트와 동일한 형상의 하부 플레이트가 더 형성되는 것을 특징으로 하는 임플란트용 스캔바디의 기능을 구비한 임프레션 캡.

청구항 3

삭제

청구항 4

제 1항 또는 2항에 있어서,

상기 플레이트의 외면 가장자리 부분에는 간격을 두고 경사 또는 곡면지게 절개부가 형성되는 것을 특징으로 하는 임플란트용 스캔바디의 기능을 구비한 임프레션 캡.

청구항 5

제 1항에 있어서,

상기 몸체를 구성하는 어버트먼트 결합홈의 내면에는 환형돌기 또는 직선면 또는 환형돌기와 직선면을 조합하여 형성되는 어버트먼트 깊이 안내부가 형성되는 것을 특징으로 하는 임플란트용 스캔바디의 기능을 구비한 임프레션 캡.

발명의 설명

기 술 분 야

[0001] 본 발명은 임플란트용 스캔바디의 기능을 구비한 임프레션 캡에 관한 것으로서, 더욱 상세하게는 임플란트 치료 시 임프레션 캡과 어버트먼트 결합체의 유실사고를 방지하면서도 지정된 위치에 정확하게 삽입 및 시술할 수 있도록 한 임플란트용 스캔바디의 기능을 구비한 임프레션 캡에 관한 것이다.

배 경 기 술

[0002] 일반적으로 임플란트란 치주골에 픽스처를 설치한 후 상기 픽스처에 나사를 이용하여 의치를 고정하는 것을 말한다.

[0003] 그리고 상기 임플란트 시술절차는 CT를 통해 치주골의 상태를 파악한 후, 시술할 치아의 위치를 선정한 다음,

이상이 있는 치아를 발치한 후, 빠진 치아가 위치한 치주골 부위에 픽스처를 시공하게 된다.

[0004] 이때 상기 픽스처가 시공된 뒤 바로 의치를 설치할 수 없기 때문에 치주골과 잇몸에 시술시 발생한 염증을 없애는 치료를 하게 된다.

[0005] 더불어 상기 픽스처의 위치와 잇몸을 치료하면서 픽스처 상부가 잇몸의 피부에 의해 일부 덮히는 것을 방지하기 위해 상기 픽스처에는 티타늄 등의 인체에 무해한 소재로 만들어진 어버트먼트를 설치하게 된다.

[0006] 다음으로 상기 픽스처 시공 후 잇몸과 치주골에 염증이 사라지면, 구강 내부의 본을 뜨고 상기 본에 따라 의치를 제작하게 되고, 이 과정에서 종래에는 합성수지재질의 본을 뜨는 물질을 입 안에 넣고 환자가 이로 꽉 물고 있도록 하여, 상기 입안의 형상을 본으로 뜬 후 상기 본에 따라 의치를 제작하게 된다.

[0007] 픽스처에 결합되는 어버트먼트는 4㎜, 6㎜, 8㎜ 등으로 제작되고, 치주골에 시공된 픽스처의 깊이에 따라 선택적으로 설치되기는 하나, 잇몸 위로 크게 돌출되지 않아 이를 식별 및 측정하는데 어려움이 있었다.

[0008] 또한 상기와 같은 문제점을 극복하고자 어버트먼트의 위치를 더욱 정확하게 측정하기 위한 임프레션 캡을 사용하고 있으나, 종래의 어버트먼트와 임프레션 캡은 크기가 너무 작고 공간이 좁은 입안에서 이동 및 작업을 하다보면, 의사가 이를 놓쳐 환자의 입속으로 떨어트리는 문제점이 있었다.

[0009] 그리고 최근에는 환자의 잇몸을 3D 스캐너로 촬영하는 기술이 발달하여 종래와 같이 본을 뜨지 않고 상기 3D 스캐너를 통해 환자의 잇몸을 3차원 이미지로 간단하게 촬영하고 있다.

[0010] 그러나 3차원 스캐너로 촬영을 하여도 종래의 임프레션 캡은 픽스처의 깊이만을 확인할 수 있을 뿐 상기 픽스처가 설치된 각도까지는 확인하기 곤란한 문제점이 있었다.

[0011] 이를 좀더 보충설명하면, 상기 픽스처는 나사의 인입부가 정확히 계산되어 제작된 것으로서, 설치된 각도를 정확히 파악하면 의치의 위치를 더욱 정확히 알 수 있도록 제작된 것으로서, 통상 6방향으로 측정이 가능하도록 제작된다.

[0012] 따라서 픽스처와 어버트먼트가 완전히 결합되는 경우에는 어버트먼트 상부에 표시된 방향표시로 픽스처의 설치된 방향과 위치까지도 정확히 측정할 수 있는데, 임프레션 캡에 어버터먼트의 위치를 식별할 수 있는 수단이 없어 이를 파악하는데 어려움이 있었다.

[0013] 이에 대한 문제점으로는 잇몸의 본을 뜨는 과정에서 픽스처의 위치를 확인하는데 가장 중요한 어버트먼트의 길이를 잘 못 확인하여 치기공소로 전달된 경우, 치기공소에서 제작한 의치는 환자에게 시술할 수 없는 문제가 발생하고, 이는 곳 모든 작업을 다시해야하는 문제로 이어져 환자는 의치를 다시 제작하는 시간만큼 불편함을 감수해야 하는 문제가 있었다.

선행기술문헌

특허문헌

[0014] (특허문헌 0001) 대한민국 등록특허공보 제10-1108280호

(특허문헌 0002) 대한민국 등록특허공보 제10-1038068호

발명의 내용

해결하려는 과제

[0015] 본 발명은 상기와 같은 문제점을 해결하기 위하여 안출된 것으로서, 플레이트를 구성하는 줄 결합공에 안전줄을 결합하여 임프레션 캡과 어버트먼트 결합체의 시술 시 환자의 몸속으로 임프레션 캡과 어버트먼트 결합체가 유실되는 것을 방지하는데 그 목적이 있다.

[0016] 또한 플레이트의 대각선상에 형성되는 위치 안내홈과 절개부를 통해 임프레션 캡과 어버트먼트 결합체를 지정된 위치에 정확하게 삽입하면서 입안이 손상되는 것을 방지하는데 그 목적이 있다.

[0017] 또한, 잇몸의 본을 뜨는 과정에서 임프레션 캡의 형상으로 어버트먼트의 크기와 위치 중을 정확히 측정할 수 있도록 하는데 그 목적이 있다.

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과제의 해결 수단

[0018] 상기와 같은 목적을 달성하기 위하여, 본 발명인 임플란트용 스캔바디의 기능을 구비한 임프레션 캡은 상부 중앙에 공구 결합홈이 형성되고 하부 중앙에는 어버트먼트 결합홈이 형성되는 몸체; 상기 몸체의 외면에 판 형상으로 형성되고 내부 일 측 또는 양측에는 안전줄이 걸합될 수 있도록 줄 걸합공이 형성되는 상부 플레이트;가 일체로 형성될 수 있다.

[0019] 그리고 상기 상부 플레이트의 하부에 위치한 몸체의 외면에는 상기 상부 플레이트와 동일한 형상의 하부 플레이트가 더 형성될 수 있다.

[0020] 또한, 상기 플레이트의 외면 대각선상에는 좌표 인식을 위하여 위치 안내홈이 형성될 수 있다.

[0021] 여기서 상기 플레이트의 외면 가장자리 부분에는 간격을 두고 경사 또는 곡면지게 절개부가 형성될 수 있다.

[0022] 또한, 상기 몸체를 구성하는 어버트먼트 결합홈의 내면에는 환형돌기 또는 직선면 또는 환형돌기와 직선면을 조합하여 형성되는 어버트먼트 깊이 안내부가 형성될 수 있다.

발명의 효과

[0023] 본 발명에 따르면, 플레이트를 구성하는 줄 결합공에 안전줄을 결합하여 임프레션 캡과 어버트먼트 결합체의 시술 시 환자의 몸속으로 임프레션 캡과 어버트먼트 결합체가 유실되는 것을 방지할 수 있을 뿐만 아니라 그에 따른 경제적 손실 및 시술시간을 절감할 수 있는 효과가 있다.

[0024] 또한, 플레이트의 대각선상에 형성되는 위치 안내홈과 절개부를 통해 임프레션 캡과 어버트먼트 결합체를 지정된 위치에 정확하게 삽입하면서 입안이 손상되는 것을 방지할 수 있을 뿐만 아니라 시술자의 신뢰도를 향상시킬 수 있는 효과가 있다.

[0025] 또한, 잇몸의 본을 뜨는 과정에서 임프레션 캡의 위치를 확인하는 것만으로 어버트먼트의 깊이와 겹합된 위치 등을 정확히 확인할 수 있는 효과가 있다.

도면의 간단한 설명

[0026] 도 1은 본 발명에 따른 임플란트용 스캔바디의 기능을 구비한 임프레션 캡을 나타낸 사시도.

도 2 및 3은 본 발명에 따른 임플란트용 스캔바디의 기능을 구비한 임프레션 캡을 나타낸 평면도 및 정면도.

도 4 및 5는 본 발명에 따른 임플란트용 스캔바디의 기능을 구비한 임프레션 캡을 구성하는 플레이트 어버트먼트 결합홈의 실시 예를 나타낸 저면도.

도 6은 본 발명에 따른 임플란트용 스캔바디의 기능을 구비한 임프레션 캡의 사용상태를 나타낸 도면.

발명을 실시하기 위한 구체적인 내용

[0027] 이하, 본 발명이 속하는 기술 분야에서 통상의 지식을 가진 자가 용이하게 실시할 수 있도록 본 발명의 실시 예에 대하여 첨부한 도면을 참고로 하여 상세히 설명한다. 그러나 본 발명은 여러 가지 상이한 형태로 구현될 수 있으며 여기에서 설명하는 실시 예에 한정되지 않는다. 명세서 전체를 통하여 유사한 부분에 대해서는 동일한 도면 부호를 붙였다.

[0028] 이하, 본 발명의 구성을 첨부된 도면을 참조로 설명하면, 도 1은 본 발명에 따른 임플란트용 스캔바디의 기능을 구비한 임프레션 캡을 나타낸 사시도이고, 도 2 및 3은 본 발명에 따른 임플란트용 스캔바디의 기능을 구비한 임프레션 캡을 나타낸 평면도 및 정면도이며, 도 4 및 5는 본 발명에 따른 임플란트용 스캔바디의 기능을 구비한 임프레션 캡을 구성하는 플레이트 어버트먼트 결합홈의 실시 예를 나타낸 저면도이고, 도 6은 본 발명에 따른 임플란트용 스캔바디의 기능을 구비한 임프레션 캡의 사용상태를 나타낸 도면이다.

[0029] 본 발명인 임플란트용 임프레션 캡(10)은 몸체(20), 상부 플레이트(30), 하부 플레이트(40)를 포함하여 이루어진다.

[0030] 상기 몸체(20)는 환경 및 목적 등에 따라 소정의 크기와 높이를 가지며 여러 가지 형상으로 형성된다.

[0031] 그리고 본원발명에서 상기 몸체(20)는 소정의 지름과 높이를 가지는 원통 형상으로 상부 중앙에 공구 결합홈

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(22)이 형성되고, 하부 중앙에는 어버트먼트 결합홈(24)이 형성된다.

[0032] 즉, 상기 몸체(20)는 상부 중앙으로 시술 시 사용되는 공구와 결합될 수 있도록 공구 결합홈(22)을 형성하고 하부 중앙에는 어버트먼트(5)와 결합될 수 있도록 어버트먼트 결합홈(24)을 형성한 것이다.

[0033] 여기서 상기 공구 결합홈(22)의 형상은 공구의 형상에 따라 여러 가지 형상으로 형성될 수 있을 뿐만 아니라 어버트먼트 결합홈(24)의 형상도 어버트먼트(5)에 따라 여러 가지 형상으로 형성될 수 있음을 밝힌다.

[0034] 그리고 상기 어버트먼트 결합홈(24)의 내면에는 환형돌기 또는 직선면 또는 환형돌기와 직선면을 조합하여 형성되는 어버트먼트 깊이 안내부(26)가 형성된다.

[0035] 즉 상기 어버트먼트 깊이 안내부(26)는 어버트먼트 결합홈(24)의 내면에 환형돌기 또는 직선면 형상으로 적어도 하나 이상 형성되어 상기 어버트먼트(5)의 깊이를 확인할 수 있도록 한 것이다.

[0036] 예를 들어 어버트먼트의 길이가 4밀리미터인 경우에는 환형돌기가 한 개 형성되고 다른 두 면에는 직선면이 형성되도록 하고, 어버트먼트의 길이가 6밀리미터인 경우에는 환형돌기가 두 개 형성되고 다른 한 면에는 직선면이 형성되도록 하며, 어버트먼트의 길이가 8밀리미터인 경우에는 세 면 모두에 환형돌기가 형성되도록 하여 별도의 설명이 없이도 치기공소에서 어버트먼트의 길이를 확인할 수 있도록 한 것이다.

[0037] 이때 상기 어버트먼트(5)의 상부에는 어버트먼트 깊이 안내부(26)와 대응하는 형상이 선택적으로 형성될 수 있음을 밝힌다.

[0038] 이를 좀 더 보충설명하면, 상기 어버트먼트 깊이 안내부(26)는 시술시 의사 또는 간호사의 실수로 인한 어버트먼트(5)의 치수 오기를 방지할 수 있도록 상기 어버트먼트 깊이 안내부(26)의 형상과 어버트먼트(5)의 상부 형상으로 어버트먼트(5)의 길이를 4mm, 6mm, 8mm 중 어느 것인지를 확인할 수 있도록 한 것이다.

[0039] 따라서 어버트먼트(5)의 상부에는 환형돌기 또는 직선면과 일치할 수 있도록 음각된 환형홈 또는 직선홈이 형성되어, 어버트먼트(5)와 임프레션 캡(10)은 서로 일치하는 것들끼리만 결합되도록 제작하는 것이 본 발명의 하나의 특징이다.

[0040] 상기 상부 플레이트(30)는 몸체(20)의 외면에 판 형상으로 형성되고, 내부 일 측 또는 양측에는 줄 결합공(32)이 형성되며, 외면 대각선상에는 위치 안내홈(34)이 형성되고, 외면 반대측 대각선상에는 경사 또는 곡면지게 절개부(36)가 형성된다.

[0041] 그리고 본원발명에서 상기 상부 플레이트(30)는 타원 또는 직사각형 형상으로 형성되면서 양측으로 안전줄(50)과 결합될 수 있도록 줄 결합공(32)이 형성되고, 대각선상에는 " L "자 형상의 위치 안내홈(34)이 형성되며, 반대 측 대각선상에는 경사 또는 곡면지게 절개부(36)가 형성되는 예를 들어 설명하기로 한다.

[0042] 즉 상기 상부 플레이트(30)는 몸체(20)의 최상부에 판 형상으로 형성되면서 양측에 줄 결합공(32)을 대칭형성하고, 양측 대각선상으로 " L "자 형상의 위치 안내홈(34)과 경사 또는 곡면지게 절개부(36)를 형성한 것이다.

[0043] 이를 좀 더 구체적으로 살펴보면, 상기 임플란트용 임프레션 캡(10)은 어버트먼트(5)의 결합 후 줄 결합공(32)에 결합되는 안전줄(50)을 통해 임플란트 시술시 임플란트용 임프레션 캡(10)과 어버트먼트(5)가 환자의 몸속으로 유입되는 것을 방지할 수 있게 되는 것이다.

[0044] 또한 상기 상부 플레이트(30)의 대각선상에 형성되는 " L "자 형상의 위치 안내홈(34)은 3D 스케너를 통한 3차원 스캔시 좌표를 인식시킬 수 있도록 한 것이다.

[0045] 즉 상기 임플란트용 임프레션 캡(10)은 양측 대각선에 형성되는 위치 안내홈(34)의 좌표와 공구 결합홈(32)의 좌표를 통해 3차원 상에서 하나의 직선을 찾을 수 있을 뿐만 아니라 공구 결합홈(32)에서 직선상에 픽스처와 어버트먼트(5)의 위치 및 크기를 확인할 수 있도록 한 것이다.

[0046] 다음으로 상기 상부 플레이트(30)의 반대 측 대각선상에 형성되는 절개부(36)는 경사 또는 곡면지게 형성된다.

[0047] 즉 상기 임플란트용 임프레션 캡(10)은 위치 안내홈(34)과 별도로 반대 측 대각선상에 경사 또는 곡면지게 형성되는 절개부(36)를 통해 상기 임플란트용 임프레션 캡(10)의 회전작동시 모서리 부분에 의해 환자의 입안이 손상되는 것을 방지하게 되는 것이다.

[0048] 상기 하부 플레이트(40)는 상부 플레이트(30)의 하부에 위치한 몸체(20)의 외면에 형성된다.

[0049] 그리고 상기 하부 플레이트(40)는 상부 플레이트(30)와 동일하게 상기 몸체(20)의 외면에 판 형상으로

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형성되고, 내부 일 측 또는 양측에는 안전줄(50)이 결합될 수 있도록 줄 결합공(42)이 형성되며, 외면 대각선상에는 좌표 인식을 위하여 위치 안내홈(44)이 형성되고, 외면 반대측 대각선상에는 경사 또는 곡면지게 절개부(46)가 형성된다.

[0050] 여기서, 상기 하부 플레이트(40)를 구성하는 줄 결합공(42)과 위치 안내홈(44) 및 절개부(46)는 상부 플레이트(30)의 줄 결합공(32)과 위치 안내홈(34) 및 절개부(36)와 대응되므로 간략하게 설명하기로 한다.

[0051] 즉 상기 하부 플레이트(40)는 상부 플레이트(30)와 동일하게 타원 또는 직사각형 형상으로 형성되면서 양측으로 안전줄(50)과 결합될 수 있도록 줄 결합공(42)이 형성되고, 대각선상에는 " L "자 형상의 위치 안내홈(44)이 형성되며, 반대 측 대각선상에는 경사 또는 곡면지게 절개부(46)가 형성되는 것이다.

[0052] 이를 좀 더 보충설명하면, 상기 하부 플레이트(40)는 상부 플레이트(30)와 대응되는 형상으로 형성되면서 간격을 두고 몸체(20)에 형성되고, 양측에 줄 결합공(42)을 형성하고, 양측 대각선상으로 " L "자 형상의 위치 안내홈(44)과 경사 또는 곡면지게 절개부(46)를 형성한 것이다.

[0053] 상기와 같이 구성되는 임플란트용 스캔바디의 기능을 구비한 임프레션 캡의 실시 예를 참조로 설명하면 다음과 같다. 이때, 상기 임플란트용 임프레션 캡(10)은 한 번에 일체로 형성되는 것이 바람직하며 여기서는 설명의 편의를 위하여 단계적으로 형성되는 예를 들어 설명하기로 한다.

[0054] 먼저, 소정의 지름과 높이를 가지는 원통 형상으로 상부 중앙에 공구 결합홈(22)이 형성되고 하부 중앙에는 어버트먼트 결합홈(24)이 형성되는 몸체(20)를 형성한다.

[0055] 그리고 상기 몸체(20)의 상부 끝단으로 판 형상으로 형성되고, 내부 일 측 또는 양측에는 줄 결합공(32)이 형성되며, 외면 대각선상에는 위치 안내홈(34)이 형성되고, 외면 반대측 대각선상에는 경사 또는 곡면지게 절개부(36)가 형성되는 상부 플레이트(30)를 형성한다.

[0056] 다음으로 상기 상부 플레이트(30)와 간격을 두고 판 형상으로 형성되고, 내부 일 측 또는 양측에는 안전줄(50)이 결합될 수 있도록 줄 결합공(42)이 형성되며, 외면 대각선상에는 좌표 인식을 위하여 위치 안내홈(44)이 형성되고, 외면 반대측 대각선상에는 경사 또는 곡면지게 절개부(46)가 형성되는 하부 플레이트(40)를 형성하면 임플란트용 임프레션 캡(10)는 완성되는 것이다.

[0057] 그리고 상기 임플란트용 임프레션 캡(10)을 구성하는 몸체(20)의 어버트먼트 결합홈(24)에 어버트먼트(5)를 결합한 후 상기 플레이트(30, 40)를 구성하는 줄 결합공(32, 42)에 안전줄(50)을 결합한다.

[0058] 다음으로 상기 임프레션 캡(10)과 어버트먼트(5)가 결합된 결합체를 픽스쳐에는 장착한 후 시술을 진행하면 되는 것이다.

[0059] 이상에서 첨부된 도면을 참조하여 본 발명인 임플란트용 스캔바디의 기능을 구비한 임프레션 캡을 설명함에 있어 특정형상 및 방향을 위주로 설명하였으나, 본 발명은 당업자에 의하여 다양한 변형 및 변경이 가능하고, 이러한 변형 및 변경은 본 발명의 권리범위에 포함되는 것으로 해석되어야 한다.

부호의 설명

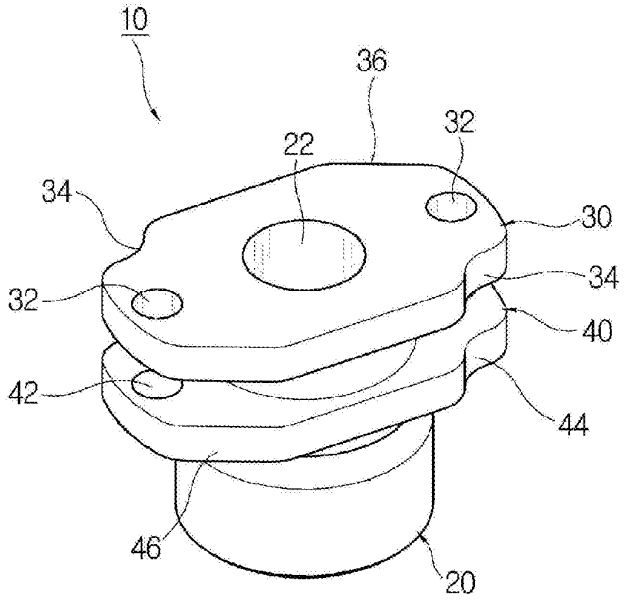
[0060]

5 : 어버트먼트,	10 : 임플란트용 임프레션 캡,
20 : 몸체,	22 : 공구 결합홈,
24 : 어버트먼트 결합홈,	26 : 어버트먼트 깊이 안내부,
30 : 상부 플레이트,	32 : 줄 결합공,
34 : 위치 안내홈,	36 : 절개부,
40 : 하부 플레이트,	42 : 줄 결합공,
44 : 위치 안내홈,	46 : 절개부,
50 : 안전줄.	

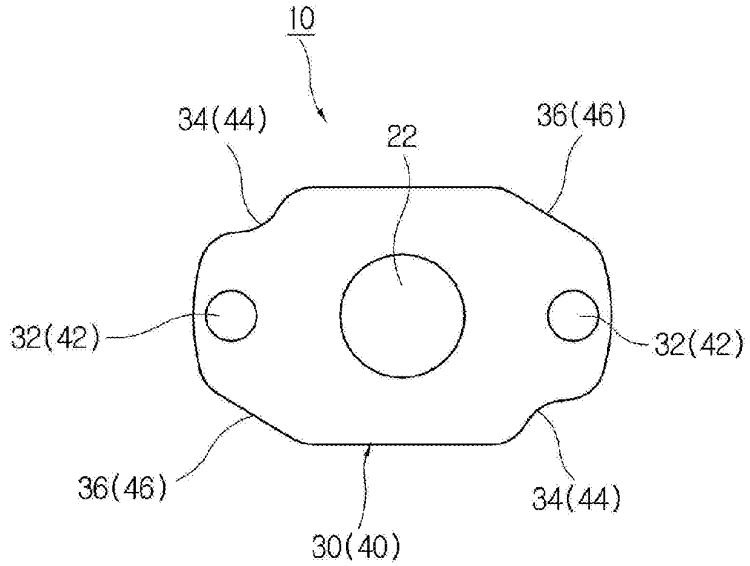
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도면

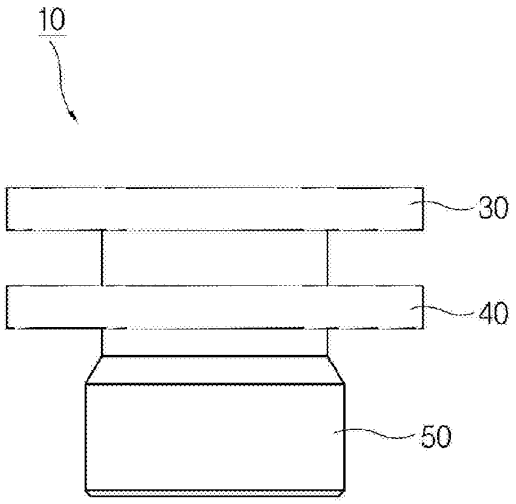
도면1


10
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34
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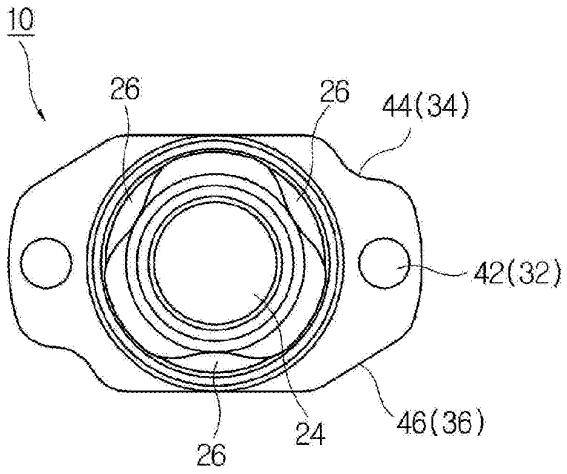
도면2


10
34(44)
22
36(46)
32(42)
32(42)
36(46)
34(44)
30(40)

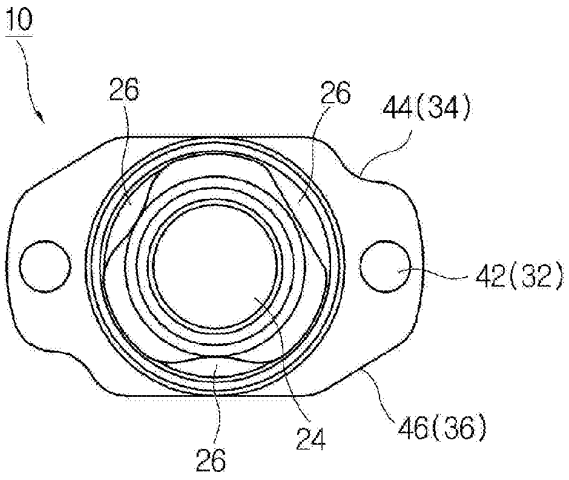
도면3



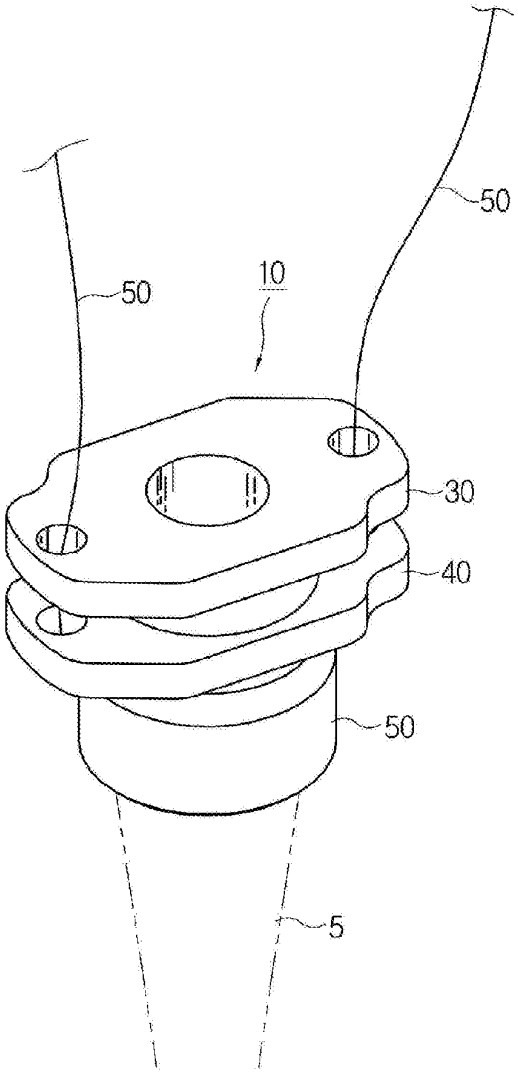
도면4



도면5



도면6



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[Continued on next page]

(54) **Title**: DENTAL IMPLANT DEVICE, SYSTEM AND METHOD OF USE

(57) **Abstract**: The present invention relates to a dental implant device and a method for using the same and in particular, to such a device and method in which the implant device projects the implant anchor's location, orientation and axis while facilitating the treatment of the peri-implant tissues.

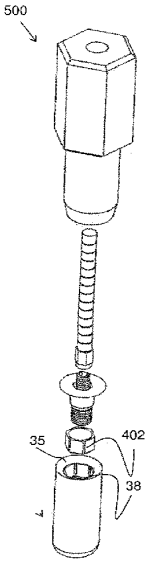


FIG. 1A

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DENTAL IMPLANT DEVICE, SYSTEM AND METHOD OF USE

FIELD OF THE INVENTION

The present invention relates to a dental implant device and a method for using the same and in particular, to such a device and method in which the implant device projects the implant anchor's location, orientation and axis while facilitating the treatment of the peri-implant tissues.

BACKGROUND OF THE INVENTION

Dental implants are well known in the art and typically include a dental implant anchor securely inserted into the patient's jawbone, an abutment member attached to the dental anchor, and a prosthodontic restoration coupled thereon.

The method of implantation generally occurs over various stages where that generally initiates with the implant anchor's introduction into the jawbone and ends with loading the implant anchor with an abutment and restoration. There are a number of intermediates steps and procedures that are undertaken between the implant anchor's introduction and loading that can be spread over a three to nine month period.

The intermediate steps generally involve allowing the host tissue, gingiva and peri-implant tissues to heal and to be modeled in preparation for receiving the abutment and restoration. These intermediates steps are lengthy and require about eight individual medical procedures and/or iterations with a professional caregiver, where following each procedure and/or iteration requires a healing period.

Each intermediate steps requires different implant devices to facilitate the tissue healing and modeling process, for example cover screws, healing abutments, impression copings.

SUMMARY OF THE INVENTION

State of the art dental implant devices utilized during the intermediate steps of the implant procedure require multiple invasive and costly procedures.

Following the implantation of a dental implant anchor, the anchor is not easily discoverable following the healing period. This is due to that fact that during the healing process, the morphology of the gingival tissue covering the anchor is restored, making it difficult to locate and/or discover the underlying anchor. The

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exact location of the anchor is not known, nor readily visible to the practitioner. The approximate implant anchor site is estimated and thereafter located by way of surgical exploratory probing, often utilizing inaccurate surgical incisions.

During the anchor uncovering process much of the host tissue is needlessly lost. Such tissue loss can lead to various medical drawbacks for example, vertical bone loss, prolonged re-healing period, formation of closed and inaccessible voids, pockets, cysts, formation of fibrotic tissue, improper sealing possibly leading to contamination, overlapping of the anchor's margins with proliferated neo-tissue leading to inadequate abutment coupling and loosening.

Once the implant anchor is discovered the host tissue must be prepared for implant loading with various devices such as a healing abutment, to allow the peri-implant tissue to be modeled in preparation for implant anchor loading.

The dental implant device, system and method of use according to embodiments of the present invention provide for a non-invasive and a-traumatic method that remotely treats the peri-implant tissue to promote faster healing, while significantly reducing the number of procedures and care-giver iterations required between anchor implantation and loading. The dental implant device of the present invention further facilitates the implantation process by providing for readily identifying the location, orientation and axis of the implanted dental implant anchor in a non-invasive manner, for example by visual inspection. The dental implant device according to embodiments of the present invention further provides for minimizing peri-implant host tissue loss during the process of discovering and uncovering of the implant anchor, which takes place prior to implant loading.

Optionally and preferably the device according embodiments of the present invention provides for projecting the anchor's axis relative to surrounding structures for example including but not limited to anatomical structures, the opposing jaw, the same jaw, adjacent teeth or prosthodontic elements, morphological elements, or any combination thereof.

Optionally and preferably embodiments of the device according to the present invention provides for a minimally invasive and a-traumatic method for discovering and uncovering the implant anchor.

There is an unmet need for, and it would be highly useful to have, a dental implant device, system and method that provides for seamlessly discovering the implant's anchor. Moreover it would be highly advantageous to have an

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implantable device capable of identifying the anchor's position, orientation and axis while allowing for identifying a projection of the anchor, relative to surrounding prosthodontic elements and/or anatomic structures such as the teeth on the same and/or opposite jaw.

Furthermore optional embodiments according to the present invention may provide a platform on which an abutment assembly, or the like prosthodontics elements may be built.

Optionally prosthodontic elements may be coupled and/or otherwise associated with and/or functionally associated with the dental implant device of the present invention may for example include but is not limited to a transfer and/or attachment (ball attachment), abutment, the like or any combination thereof.

The dental implant device according to optional embodiments of the present invention may further provide for partial and progressive loading of the implanted anchor. Optionally the implant device according to optional embodiments of the present invention, most preferably while coupled with at least one or more optional prosthodontic elements, provides for progressive and/or gradual loading of the anchor, such that the anchor may be adjusted in dynamic relation to the progression and/or rate of bone remodeling and the healing process of the hard tissues.

Optional embodiments of the device of the present invention provides for facilitating treatment of the host tissue surrounding the implant therein providing for the maintenance, treatment and therapy of the host tissues. Preferably such treatment is accomplished in a non-invasive and a-traumatic manner without directly infiltrating the peri-implant and host tissue.

Optionally the device may comprise a treatment port and/or lumen to facilitate applying medical treatment to the surrounding host tissues. Therein optionally the device provides for at least one or more treatments of the host tissue with a flowing fluid for example including but not limited to applying and introducing medicaments, flowing fluids, gasses, antiseptics, irrigating fluids, antibiotics, probiotics, anesthetics, analgesics, dissolvable medicaments, evaporating medication the like or any combination thereof.

An optional embodiment of the present invention provides a dental implant device for associating with an implanted dental implant anchor immediately following implantation, the device provided for facilitating identifying the location, orientation and axis of the implanted dental anchor the device having a distal

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portion , a medial portion and an proximal portion that are defined between a distal end and a proximal end ;the distal portion provided for securely associating the device with the dental implant anchor along the implant borehole ; that is defined between the distal end and medial portion ; the medial portion provided for covering the proximal end of the dental implant anchor ;the proximal portion defined from the medial portion to the proximal end , provided for projecting the location, orientation and axis of implant anchor , characterized in that the proximal portion is a shaft extending proximally from the medial portion corresponding to the plane of the implant anchor's proximal end to assume the orientation and axis of anchor and to readily reveal the location of anchor by way of visual inspection.

Preferably the medial portion and the distal portion are screw form.

Optionally the proximal portion has a smaller diameter than medial portion .

Optionally at least a portion of the distal portion is configured and shaped according to the implant anchor's borehole to provide for coupling therewith.

Optionally the distal portion may be coupled with a mediating member to facilitate coupling with the implant anchor.

Optionally the device may be coupled with the implant anchor via a fixation screw.

Optionally the distal portion may be configured and shaped according to the implant anchor's anti-rotational connection platform aperture.

Optionally the medial portion may be shaped to complement the configuration of the anchor's proximal end so as to allow closure of the implant anchor's borehole

Optionally the medial portion is configured to have an upper surface overlying the peri-implant tissue configured to act as a protective cover of the peri-implant tissues from tissue cutting.

Optionally the medial portion may comprise a lower surface configured to correspond to the distal end of the implant anchor .

Optionally the medial portion may comprise a peri-implant tissue collar portion configured to allow the peri-implant tissue to heal and to assume its final shape.

Optionally the collar portion may be configured and shaped according to the apical portion of the trans-gingival collar of a dental implant abutment.

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Optionally and preferably the device features a continuous central channel disposed between the distal end to the proximal end . Optionally and preferably the channel features at least one or more openings along its length. Optionally and preferably the channel may be utilized for non-invasively and remotely introducing a flowing fluid for treating the peri-implant tissue.

Optionally external surface of proximal portion is configured to facilitate coupling with prosthodontic elements . for example including but not limited to an abutment assembly, abutment, transfer, copying device, tools, dental hand piece, the like or any combination thereof.

Optionally the diameter of the proximal portion may be configured to be from about 1mm to about 5 mm.

Optionally the external surface of proximal portion may be configured and shaped according to the implant anchor's anti-rotational connection platform .

Optionally the external surface of proximal portion may feature graduations or markings hat are indicative of height above the bone level.

Optionally the external surface of proximal portion comprises a reference marker along the length of proximal portion characterized in that the reference marker is correlated to the shape of the implant anchor's connection platform . Preferably the reference marker is indicative of and infers the implant anchor's orientation and the shape of the connection platform therein facilitating the implant impression coping and transfer process.

Optionally the shape of proximal portion, and particularly the external surface of the proximal portion is configured to reflect the shape of the implant anchor's connection platform .

An optional embodiment of the present invention provides a dental implant device for associating with an implanted dental implant anchor immediately following implantation, the device provided for facilitating identifying the location, orientation and axis of the implanted dental anchor following a healing period, the device having a distal portion , a medial portion and an interchangeable proximal portion ;a) the distal portion provided for securely associating the device with the dental implant anchor along the implant borehole ; the distal portion having a threaded channel disposed central within the distal portion body; the threaded channel provided for receiving and securely coupling with the proximal portion , the channel having threading selected from cylindrical threading or conical

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threading; b) the medial portion provided for covering the proximal end of the dental implant anchor ; wherein the medial portion comprises a tooling aperture that is continuous with the distal portion threaded channel the tooling aperture provided in the form of anti-rotational tooling recess for manipulating the device; and c) the interchangeable proximal portion provided for projecting the location, orientation and axis of implant anchor ; is a shaft having a diameter from about 1mm to about 5mm, that extends proximally from the plane of the implant anchor's proximal end to assume the orientation and axis of anchor ; the proximal portion having a distal end including threading configured to complement and couple with the threaded channel threading.

An optional embodiment of the present invention provides for a dental implant system and/or kit including an optional implant device a mediating member , and a device cover and/or plug. .

Optionally the system and/or kit may further comprise a tubular tissue punch provided for uncovering the gingival tissue overlying the dental implant anchor and dedicated driving tools for manipulating the implant device according to the present invention.

Optionally the system and/or kit may further comprise a gingival tissue depth measuring probe configured to measure the peri-implant tissue depth by inserting the probe into the proximal portion channel , the probe characterized in that it is shaped and configured according the luminal surface of channel ; the probe having graduations or markings indicative of the probe height.

Optionally the measuring probe may have a length of up to about 15mm.

An optional embodiment of the present invention provides a method for marking the position, axis and orientation of a dental implant anchor at the time of anchor placement so as to allow for: a-traumatic, minimally invasive uncovering of a dental implant anchor and to facilitating an impression coping of the dental implant anchor while reducing the number of procedures required to load the implant with a dental implant abutment, the method comprising: a) coupling a dental implant device according to the present invention with a dental implant anchor at the time of anchor placement; b) suturing the gingival tissue at the implantation site wherein the proximal portion extends above the gingival tissue level wherein the proximal portion provides for identifying the location and orientation of anchor by visual inspection; c) adjusting the length of the

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proximal portion relative to the gingival tissue by way of cutting or extending the proximal portion ; d) apply a remote a-traumatic non-invasive tissue treatment of the peri-implant tissue through a proximal portion channel (420, 422) of the device; e) undertaking either a digital or analog impression coping of the implantation site wherein at least one of: a marker disposed on along the length of proximal portion , the external surface of proximal portion , inner luminal surface of channel , proximal end aperture , serve as a reference correlating and corresponding to the orientation and geometry of the anti-rotational connection platform aperture of implant anchor; f) a-traumatically anesthetizing the peri-implant tissue by introducing analgesics through proximal portion channel through at least one exit pore; g) uncovering the implant anchor and minimizing the peri-implant tissue loss over the implant anchor's occlusal portion by guiding a tissue punch device along the device's proximal portion ; and h)disassociate device from anchor and proceed to load the implant with an abutment and restoration.

Optionally the method may further comprise associating a measuring probe with the device of the present invention within the lumen of a proximal portion channel prior to undertaking a digital impression by way of an oral digital scan and inferring from the scan the gingival tissue height.

An optional embodiment of the present invention provides a method for introducing a flowing fluid to the peri-implant tissues and host tissue surrounding an implant anchor using the implant device according to the present invention, the device is coupled to an implanted dental implant anchor for anesthetizing or irrigating the peri-implant tissue with the flowing fluid, the method comprising introducing the flowing fluid into the lumen and allowing the fluid to flow from the distal end through the exit pores disposed adjacent to the peri-implant tissues. The flowing fluid may for example include but is not limited to at least one or more of: medicaments, flowing fluids, gasses, antiseptics, irrigating fluids, antibiotics, probiotics, anesthetics, analgesics, dissolvable medicaments, evaporating medication, the like or any combination thereof.

An optional embodiment of the present invention provides a method for determining the peri-implant tissue depth by introducing a measuring probe into the lumen of implant device according to the present invention and obtaining a reading determining the lumen length utilized to infer the tissue depth.

An optional embodiment of the present invention provides a method for reducing the number of intermediate procedures required between a dental anchor placement to the abutment and restoration loading during a dental implant restoration procedure, the method comprising: a) Associating the implant device having a medial portion including a peri-implant collar portion, that is coupled with a dental implant anchor during implant anchor placement; b) Monitoring the healing of the gingival tissue while providing a-traumatic and minimally invasive treatment to the peri-implant tissue as needed via proximal portion channel, the treatment selected from, tissue irrigation, introduction of a medicament to the peri-implant tissue, shaping and protecting the peri-implant tissue with medial portion having a peri-implant collar; c) Facilitating digital or analog impression coping of the implantation site wherein the proximal portion of the implant device facilitates the identification of the orientation and geometry of the connection platform aperture of the implant anchor with at least one feature selected from : a marker disposed on along the proximal portion , the external surface of proximal portion , inner luminal surface of channel , proximal end aperture , the feature serves as a reference correlating and corresponding to the orientation and geometry of the anti-rotational connection platform aperture of implant anchor; d) a-traumatically anesthetizing the peri-implant tissue by introducing anesthetics from the proximal portion channel through at least one exit pore ; e) uncovering the implant anchor and minimizing the peri-implant tissue loss over the implant anchor's occlusal portion by guiding a tissue punch device along the proximal portion of the implant device of the present invention ; and f) disassociating the implant device from the anchor and proceeding to load the implant with an abutment and restoration.

Within the context of this application the term prosthodontics elements is to refer to any elements utilized for dental implant restoration for example including but not limited to abutments, sleeves, interface members, transfers, restorations, impression copying, abutment extension, guide members, bistouries, scalpels over denture abutment, over denture attachment (for example, ball attachment), healing cap, any combination thereof or the like.

Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to

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which this invention belongs. The materials, methods, and examples provided herein are illustrative only and not intended to be limiting.

Implementation of the method and system of the present invention involves performing or completing certain selected tasks or steps manually, automatically, or a combination thereof.

There are many inventions described and illustrated herein. The present inventions are neither limited to any single aspect nor embodiment thereof, nor to any combinations and/or permutations of such aspects and/or embodiments. Moreover, each of the aspects of the present inventions, and/or embodiments thereof, may be employed alone or in combination with one or more of the other aspects of the present inventions and/or embodiments thereof. For the sake of brevity, many of those permutations and combinations will not be discussed separately herein.

As used herein, the indefinite articles "a" and "an" mean "at least one" or "one or more" unless the context clearly dictates otherwise.

Herein the term "proximal" generally refers to the side or end of a device that is intended to be closer to the performing practitioner, further from the location of the intervention. The term "distal" generally refers to the side or end of a device that is intended to be closer to or at the location of the intervention, and therefore further away from the performing practitioner.

Importantly, this Summary may not be reflective of or correlate to the inventions protected by the claims in this or continuation/divisional applications hereof. Even where this Summary is reflective of or correlates to the inventions protected by the claims hereof, this Summary may not be exhaustive of the scope of the present inventions.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is herein described, by way of example only, with reference to the accompanying drawings. With specific reference now to the drawings in detail, it is stressed that the particulars shown are by way of example and for purposes of illustrative discussion of the preferred embodiments of the present invention only, and are presented in order to provide what is believed to be the most useful and readily understood description of the principles and conceptual aspects of the invention. In this regard, no attempt is made to show structural details of the

invention in more detail than is necessary for a fundamental understanding of the invention, the description taken with the drawings making apparent to those skilled in the art how the several forms of the invention may be embodied in practice.

In the drawings:

FIG. 1A-C are schematic illustrative diagrams of exemplary dental implant device and system according to optional embodiments of the present invention;

FIG. 2A-Q are schematic illustrative diagrams of optional implant device according to optional embodiments of the present invention; FIG. 2A-D show a perspective view of optional configurations of implant device; FIG. 2E-N show optional implant device featuring a fluid delivery channel; FIG. 2E shows an optional system featuring a measuring probe and a fluid delivery channel; FIG. 2I-K show an optional implant device featuring a peri-implant tissue protective segment; FIG. 2L-N show optional implant devices featuring a continuous open channel; FIG. 2O-Q show a top view of optional implant devices featuring optional reference markings;

FIG. 2R-S are schematic illustrative diagrams of an optional mediating members according to optional embodiments of the present invention;

FIG. 3A-B are schematic illustrative diagrams of optional implant device according to optional embodiments of the present invention;

FIG. 4A-F are schematic illustrative diagrams of optional implant device of according to optional embodiments of the present invention;

FIG. 5A-B are schematic illustrative diagrams of optional dental implant tissue exposing device according to an optional embodiment of the present invention;

FIG.6A-F are illustrative depictions of an exemplary method according to the present invention;

FIG. 7 is a flowchart of an exemplary method for utilizing the dental implant device and systems, as depicted in FIG. 6A-F according to an optional embodiment of the present invention; and

FIG. 8A-C are schematic illustrations of an extension member according to and optional embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention relates to a dental implant device and a method for using the same and in particular, to such a device and method in which the implant device provides a projection of the implant anchor's connection platform, location, orientation and axis while facilitating a-traumatic, non-invasive treatment of the peri-implant tissues from a remote location above the host peri-implant tissue.

The dental implant device, system and method of use according to embodiments of the present invention provide for a non-invasive and a-traumatic method that remotely treats the peri-implant tissue to promote faster healing, while significantly reducing the number of procedures and care-giver iterations required between anchor implantation and loading. The dental implant device of the present invention further facilitates the implantation process by providing for readily of identifying the location, orientation and axis of the implanted dental implant anchor in a non-invasive manner, for example by visual inspection. The dental implant device according to embodiments of the present invention further provides for minimizing peri-implant host tissue loss during the process of discovering and uncovering of the implant anchor.

The device of the present invention is preferably coupled with an implant anchor at the time of implant anchor placement and thereafter provides for reducing the number of intermediate procedures required between implant anchor placement and anchor loading, while facilitating non-invasive and a-traumatic care of the peri-implant tissues.

The device comprises a distal portion preferably for coupling with the implant anchor, a medial portion preferably for covering the distal end of the implant anchor, and a proximal portion preferably for projecting the implant anchor location, orientation and axis. Optionally the proximal portion provides for a non-invasive and a-traumatic care of the peri-implant tissues.

The present invention is of a dental implant device, system and a method of use during a dental implantation. Most preferably the dental implant device provides for allowing a practitioner to seamlessly discover the implant's anchor site, its orientation, and the anchor's axis by utilizing a projection thereof. Most preferably the device is discoverable by way of visual inspection without requiring unnecessary exploratory surgery to find the implant anchor.

Optional embodiments of the implant device of the present invention provides for facilitating treatment of the peri-implant tissue by way of remotely introducing a therapeutic agent and/or medicament to the host tissue surrounding the implant therein providing for the maintenance, treatment and therapy of the host tissues.

Optionally the implant device may comprise a treatment port channel for delivering a therapeutic agent to facilitate applying medical treatment to the surrounding host tissues, therein optionally providing for at least one or more treatments of the host tissue during the healing period following implantation. Therapeutic agents and/or substances that may be delivered and/or introduced through the port may for example include but is not limited to a therapeutic agent, flowing fluids, gasses, antiseptics, irrigating fluids, antibiotics, probiotics, anesthetics, analgesics the like or any combination thereof.

Preferably the device according to optional embodiments of the present invention provides for reducing the healing time and reduces the number of procedures required for a full dental restorative process, in particular during the intermediate stages between implant placement and implant loading.

The principles and operation of the present invention may be better understood with reference to the drawings and the accompanying description. The following figure reference labels are used throughout the description to refer to similarly functioning components are used throughout the specification hereinbelow.

12e extension member;
12t extension member coupling threading;
32 anchor;
34 implant anchor internal borehole;
35 anchor proximal end or coronal end;
38 anchor aperture connection platform;
400 system;
402 anchor mediating member;
404 distal mediating member;
404 anti-rotational surface
406 proximal portion measuring probe;
408 proximal portion cover/plug;
410 dental implant device;
410d distal end;
410p proximal end/occlusal end;
412 proximal portion / occlusal portion;

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412a adjustment portion;
412b proximal base;
412n correlated external reference marking;
412m reference marker
412r anti-rotational aperture;
412s occlusal surface;
412t proximal threading; coupling
414 medial portion;
414a medial aperture;
414b abutment platform;
414c implant cover portion
414p peri-implant tissue collar;
414n narrow medial portion;
414r rimmed medial portion;
414w wide medial portion;
416 distal portion (anchor) portion;
416a,b,d distal couplers;
416c coupling portion;
416s sealing portion;
416r coupling recess
416t distal threading;
416u universal distal portion;
420 lumen/medicament channel port;
420m correlated inner luminal reference marker;
420d lumen distal end;
420e lumen exit pores;
420p lumen proximal end;
422 full channel;
500 anchor exposer;
512 distal portion;
512s exposing surface;
514 proximal end handle;
516 exposer central lumen;
516d distal end;
516p proximal end;
518 anchor projection guide;
518b guide base;
518g guide shaft;

Now referring to FIG. 1A-C, FIG.2E-F that show optional forms of a dental implant device 410 according to the present invention that functions as an integral member of system 400. Optionally system 400 may be provided in the form of a kit. Further optional systems are depicted in FIG.2E-F showing system 400 comprising device 410 with a measuring probe 406, as shown in FIG. 2E, and a plug 408 as shown in FIG. 2F.

System 400 and kits thereof comprises device 410 and at least one additional member selected from an anchor mediating member 402 (FIG. 1A-C), mediating member 404 (FIG. 2R-S), guide 518 (FIG. 8C), measuring probe 406 (FIG.2E), plug 408 (FIG.2F), extension member 12e (FIG. 8A-B), and anchor exposing device 500 (FIG. 5A-B).

FIG. 1C shows system 400 comprising a device 410 and mediating member 402. Preferably mediating member 402 provides for interfacing and forming a seal with the internal lumen of dental implant anchor 32.

FIG. 1B shows system 400 similar to that of FIG. 1C however further comprising an extension member 12e, that will be described in greater detail in FIG. 8A-B. Extension member 12e facilitates utilizing device 410 in associating and building an abutment assembly thereon, for example the dental implant abutment assembly described in co-owned PCT Application No. PCT/IB2012/053829, incorporated herein by reference as if fully set forth.

FIG. 1A shows system 400 similar to that depicted in FIG. 1B however further comprising a dedicated tissue exposing device 500, described in greater detail in FIG. 5A-B. Most preferably anchor exposing device 500 is provided to perform precise incision and remove minimal amount of tissue necessary to uncover both the anchor's 32 location, orientation. Preferably exposing device 500 is characterized in that it may be guided toward the location anchor 32 by at least one of the proximal portion 412 of device 410 and/or an extension 12e associated therewith and/or a guide 518.

Most preferably device 410 and system 400 are provided to interface with a dental implant anchor 32 that has already been prepared and implanted in the jawbone as is known in the art. Optionally and preferably device 410 may be further provide for mediating and/or interfacing between both anchor 32 and an implant abutment (not shown).

The following description describing device 410 collectively and interchangeably refers to aspects of the dental device 410 as shown in FIG. 1-4.

Most preferably device 410 is generally a unitary screw form device having a proximal end 410p and a distal end 410d comprising three segments and/or portions, a proximal portion 412, a medial portion 414 and a distal portion 416. Most preferably the medial portion 414 and distal portion 416 take the screw-form, where medial portion takes the form of a screw-head and distal portion takes the form of a screw body, while proximal portion 412 is a rod like body that extends proximally from the medial portion 414. Optionally proximal portion 412 has a generally smaller diameter than the medial portion 414.

Optionally and preferably each portion of device 410 may be individually configured.

Optionally device 410 may be provided as a two piece device comprising a proximal portion 412 that may be securely fastened to a screw form body including the distal portion 416 and medial portion 414, characterized in that the distal portion and medial portion form a single body having a central a recess adapted for receiving and securely coupling with and optional proximal portion 412.

Most preferably device 410 comprises proximal portion 412 defining an occlusal extension, associated with an implant anchor 32 via distal portion 416 and medial portion 414. Such an occlusal extension 412 facilitates readily locating the implant anchor 32 while identifying the implant anchor's (32) orientation and axis of implantation within the bone by visual inspection following the healing period. Device 410 therefore affords to reduce the number of physician visits required, intermediate steps during implantation, following the initial anchor 32 placement from about eight visits to about two visits. Furthermore device 410 obviates the need for healing caps, healing abutments, coping transfer, and serves to streamline and reduce the overall dental implantation procedure.

Most preferably distal portion 416 provides for associating and/or coupling device 410 with an implanted anchor 32 along the anchor's internal lumen 34 that is usually utilized to couple an abutment and/or a fixation screw. Coupling may optionally be achieved by optional means for example including but not limited to threading, Morse angle, snap fit, friction fit, connectors, fixation screws or the like coupling means that is configured according to the anchor 32 utilized.

Distal portion 416 may comprise a coupling portion 416c and a sealing portion 416s, both provided to facilitate associating device 410 with anchor 32. Preferably coupling portion 416c and sealing portion 416s are configured according to the anchor's 32 borehole 34.

Optionally distal portion 416 may be provided in the form of a universal distal portion 416u that is devoid of sealing portion 416s and coupling portion 416t. Preferably universal distal portion 416u, FIG. 2N allows for associating device 410 with any anchor 32 utilizing a fixation screw (not shown) and a mediating member 404 (FIG. 2R-S) discussed in greater detail below.

Distal portion 416 may comprise coupling means in optional forms that are disposed along coupling portions 416c. Optionally coupling portion 416c may be provided in the form of threading 416t for example as shown in FIG. 1A-C, 2A-D, 2F-K, 3A-B, 4A-4C and FIG. 4F.

Optionally coupling portion 416c may be fit with snap fit distal coupling members 416a, b, d, for example as shown in FIG. 4D-F. Optionally distal coupling members 416a,b,d may be fit with threading for example as shown in FIG. 4F depicted distal coupling member 416d having both a snap fit configuration and threading. Optionally snap fit coupling member 416a,b,d may be adapted with an optional mediating member 402, 404 to assume other form coupling forms.

Optionally distal portion 416 may be devoid of threading, for example as shown in FIG.2E and FIG.2L-M. Distal portion 416 that are devoid of threading may be securely fastened to implant anchor 32 along borehole 34 threading with a fixation screw to securely couple device 410 to implant anchor 32. Optionally a fixation screw, not shown, may be introduced at the distal portion 416 through an open channel 422 spanning the length of device 410, for example as shown in FIG. 2M.

Optionally the sealing portion 416s of distal portion 416 may be configured according to anchor 32 and in particular the connection platform aperture 38 of anchor 32 and/or borehole 34 of anchor 32. For example as shown in FIG. 2L-N, the distal portion of sealing portion 416s is configured according to the geometry of the implant anchor's 32 connection platform 38. Such that sealing portion 416s matches the shape of connection platform 38. In such configuration distal portion 416 may be devoid of a coupling segment and may therefore be coupled with anchor 32 via a fixation screw (not shown).

Optionally and preferably sealing portion 416s may be configured according to at least one or more parameter for example selected from size, angle, shape, slope, surface, diameter, length or the like, or any combination thereof.

Optionally sealing portion 416s may be provided with optional surface configuration for example including but not limited to circular, oval, conical, polygonal of n sides where n is equal to at least 3 (n>2), lobular, tri-lobe, internal hex, external hex, internal octagonal, Morse, the like, any combination thereof, or the like connection platform as is known in the art.

Optionally sealing portion 416s may be configured to assume the anti-rotational connection platform 38 of anchor 32, for example as shown in FIG. 2L-FIG.2M.

Optionally, the length of sealing portion 416s may be short, for example as depicted in FIG. 4A-F, or may be minimal to altogether removed as shown in FIG.

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2D, for example, or may be of average and/or standard length for example as shown in FIG. 2A-C and FIG.3A-B.

Optionally and preferably distal portion 416 and in particular sealing portion 416s may be further fit with and/or mediated to fit within borehole 34 of implant anchor 32 with an external sealing member for example in the form of mediating members 402, 404, for example as shown in FIG. 1A-C and FIG.2R-S .

Optionally mediating member 402, 404 may be formed from biocompatible materials, titanium, silicone, sealing material, the like or any combination thereof. Most preferably mediating member 402, as shown in FIG. 1-C, provides for mediating between sealing portion 416s and the connection platform 38 and/or inner borehole 34 surface of anchor 32. Optionally and preferably the outer surface of mediating member 402 is provided to fit with and/or assume the inner borehole surface 34 or connection platform 38 of anchor 32.

Optionally distal portion 416 and in particular sealing portion 416s may feature at least one or more recess 416r along its external surface, for example as shown in FIG. 2G-2M. Preferably recess 416r is provided to facilitate sealing when utilizing a flexible mediating member 402, for example provided from flexible and/or shape deformable materials such as silicone. Preferably recess 416r is adapted to house portion of mediating member 402 when a flexible mediating member 402, for example made of silicone, is pressed between the external surface of sealing portion 416s and the internal borehole wall 34 of anchor 32. Accordingly, recess 416r provides for firmly associating and retaining device 400 within the borehole of anchor 32.

Varying views of an optional mediating member 404 are shown in FIG. 2R-S. Mediating member 404 is optionally provided from non-flexible biocompatible materials for example medical grade titanium, steel, alloys, polymers or the like biocompatible materials as is known in the art. Preferably mediating member 404 is provided to convert the distal portion 416 to correspond to and fit with the anti-rotational connection platform aperture 38 of an implant anchor 32. Optionally and preferably mediating member 404 may be utilized to convert a non-specific and/or universal distal portion 416 of device 410, for example in the form of a universal distal portion 416u, as shown in FIG. 2N.

Universal distal portion 416u is provided so as to allow device 410 to be non-selectively and/or universally fit into a plurality of dental implant borehole's

34. Mediating member 404 preferably has an external anti-rotational surface 404a that is specific to match the anti-rotational connection platform 38 of an implant anchor 32. Most preferably mediating member 404 is provided with an internal surface 404b configured to complement and/or to facilitate coupling to universal distal portion 416u. Accordingly, a universal portion 416u may be coupled with mediating member 404 along its internal surface 404b so as to allow a device 410 having universal distal portion 416u to specifically and securely with implant anchor 32 along it anti-rotational aperture 38.

Most preferably medial portion 414 is fluid with distal portion 416 and provides for covering the distal end 35 of anchor 32 as well as the connection platform aperture 38 of anchor 32. Optionally and preferably at least one surface of medial portion 414 is configured to assume the shape of distal end 35 having a generally planar circular configuration capable of covering distal end 35. Optionally medial portion 414 may be configured to be substantially cylindrical having varying diameters along the length of medial portion, for example as shown in FIG.2I-K.

Optionally medial portion 414 may be configured to have a substantially cylindrical configuration, further provide for modeling and protection the peri-implant tissue to create a peri-implant collar adjacent to implant anchor 32.

Most preferably medial portion 414 provides for capping and/or sealing the distal opening 35 of anchor 32, and may therefore be configured according to the shape, size, geometry of the coronal portion 35 of anchor 32, particularly about its borehole aperture 38. Therein optionally medial portion 414 provides for covering the borehole of anchor 32, for example acting as a lid.

Optionally medial portion 414 may be provided in optional configurations and shape for example including but not limited to wide, narrow, thin, thick, or just in the form of a flange surface, the like, or any combination thereof. Optional formations and/or configurations of medial portion 414 are shown in FIG. 1- 4. Specifically, FIG. 1-2B and 3A show a wide medial portion 414w, configuration that assumes a flange discoid shape. FIG. 3B shows narrow medial portion 414n, while FIG. 2D shows rimmed medial portion 414r, having minimal profile.

Optionally and preferably medial portion 414 may be provided with optional profiles configured to fit with and correspond to anchor 32. For example, optional profiles of medial portion 414 are depicted in FIG. 4A-C, showing that the angle,

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slope and direction of medial portion 414 may be configured and vary, most preferably based on the configuration of anchor 32, particularly along borehole 34. FIG. 4A shows a cylindrical configuration of medial portion 414; FIG.4B-C show trapezoidal configurations of medial portion 414 with opposite orientation.

Most preferably the occlusal surface of medial portion 414 may comprise an aperture 414a, as shown in FIG. 3A-B, configured with an anti-rotation geometry. Optionally and preferably the aperture 414a is provided to facilitate manipulating cover-screw 410 with corresponding tools, for example to couple cover-screw 410 to anchor 32.

Optionally and preferably aperture 414a may further provide an interface and/or recess for receiving a portion of an extension member 12e, or the like abutment portion.

Optionally medial portion 414 may be configured to model and/or mold the peri-implant tissue during the healing period and to protect the peri-implant tissue when uncovering the implant anchor 32. Most preferably the protective medial portion comprises an upper surface 414b for sheltering the underlying peri-implant tissue, a lower surface 414c for covering distal end 35 of anchor 32, and a peri-implant tissue collar portion 414p disposed therebetween provided a surface for modeling the peri-implant tissue during healing.

Preferably upper surface 414b overlies the peri-implant tissue configured to act as a protective cover of said peri-implant tissues from tissue cutting. Optionally upper surface 414b may be configured to have a diameter selected from about 2.5mm up to about 10mm, about 3mm to about 7mm, about 2mm, about 5mm, about 6mm, up to about 10mm, or the like.

Optionally the diameter of upper surface 414b may be configured according to at least one or more of implant anchor 32, abutment, tissue cutting device, tissue punch (500), the like or any combination thereof. Optionally the diameter of upper surface 414b may be configured to be larger than the diameter of tissue punch 500 (FIG. 5A-B).

Preferably lower surface 414c is configured to correspond to and/or match distal end 35 of implant anchor 32 wherein upper surface 414b is configured extending above the distal end 35 of implant anchor's 32, therein forming collar portion 414p.

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Preferably peri-implant tissue collar portion 414p is configured to allow the peri-implant tissue to heal and to assume its final shape.

Optionally the external surface and shape of collar portion 414p may be configured and shaped according to the apical portion of the trans-gingival collar of a dental implant abutment. Optionally collar portion 414p may be configured to have a height of from about 0.3mm up to about 4mm, more preferably about 1mm.

Optionally collar portion 414p may further comprises at least one or more exit port 420e for introducing a flowing fluid and/or medicament to the peri-implant tissue, as will be described in greater detail below.

Most preferably proximal portion 412 (also referred to as occlusal portion and/or occlusal extension) is disposed opposite the distal portion 416 and extending from and/or projecting from medial portion 414 toward proximal end 410p. Preferably proximal portion 412 is fluid and continuous with medial portion 414 and distal portion 416 forming a unitary device. Optionally proximal portion 412 may be coupled with a unitary distal portion 416 and medial portion 414 therein providing device 410 configured to have at least two parts.

Proximal portion 412 is an elongated shaft having a diameter from about 1mm to about 5mm, and a height that may be readily adjusted and/or cut to size during the anchor placement procedure such that it protrudes above the gum line after implant anchor implantation.

Proximal portion 412 most preferably provides for readily and visibly discovering the location, orientation and axis of anchor 32 following implantation and after the healing period, preferably by visual inspection. Therein device 410 having an elongated proximal portion 412 saves unnecessary prodding and/or exploratory surgery utilized today to find and identify the location of implant anchor 32 following the healing period.

Optionally, proximal portion 412 may further provide and facilitate the build-up of an abutment assembly onto anchor 32 via device 410. For example, proximal portion 412 may facilitate coupling anchor 32 with optional prosthodontics elements.

Optionally the proximal portion 412 may provide for associating with optional abutment assembly member for example including but not limited to extension member 12e (FIG. 8A-B) that may be utilized to form and build up an

abutment assembly for example as described in co-owned PCT Application No. PCT/IB2012/053829.

Optionally proximal portion 412 may be utilized to interface and/or couple additional optional prosthodontic elements for example by way of threading. Optional prosthodontic element may for example include but is not limited to: impression coping, transfer, extension 12e, anchor guides (518, FIG. 8C), overdenture abutment, overdenture attachment, ball attachment, prosthetic elements, the like or any combination thereof.

Most preferably proximal portion 412 provides for interfacing an abutment assembly and dental restoration. Optionally and preferably proximal portion 412 may be configured according to at least one or more parameters for example including but not limited to shapes, sizes, clinical parameters, restoration parameters, abutment assembly parameters, the like or any combination thereof. For example as shown in FIG. 2-3 the proximal portion 412 may be configured to assume a plurality of optional configurations.

Most preferably proximal portion 412 provides an occlusal extension to anchor 32. Most preferably proximal portion 412 provides for identifying the location, orientation and axis of anchor 32.

Optionally the length of proximal portion 412 may be configurable. Optionally the length of proximal portion 412 may be long or short. Optionally the length of proximal portion 412 may be adjustable by way of milling and/or cutting its length with dental tools such as a dental hand piece. Optionally proximal portion 412 may be adjustable so as to assume a plurality of angles and/or configurations.

Optionally proximal portion 412 may be provided with a base 412b, for example as shown in FIG. 2A-D, 2F-G, 2J. Optionally and preferably base 412b extends occlusally beyond the occlusal surface of medial portion 414, as shown.

Optionally base 412b may be configured within medial portion 414, such that it does not extend beyond the surface of medial portion 414, for example as shown in FIG. 3B, within a recess and/or medial portion anti-rotational aperture 414a, as shown.

Optionally base 412b may be provided with an anti-rotation configuration, for example a hexagon as shown, so as to facilitate manipulation of device 410 with a tool. Optionally base 412b may be provided in any shape or anti-rotational

configuration for example including but not limited to polygon of n sides where n is at least 3 or more, or the like as is known in the art.

Optionally proximal portion 412 may comprise threading 412t along its external surface, for example a shown in FIG. 1-A-B, 2A, 2D, 3A-B. Threading 412t is preferably provided to couple and/or otherwise associate with other prosthodontic restorative structures known in the art.

Optionally threaded proximal portion 412t may optionally comprise adjustment points 412a about its length, as shown in FIG. 2A , 2D. Optionally adjustment points 412a may provide for cutting and/or bending or the like manipulation of proximal portion 412.

Optionally threading 412t may provide for coupling with extension member 12e or a guiding member 518, shown in FIG. 8A-C, that may be utilized to extend the length of occlusal portion 412 or to act as a guiding member. Optionally and preferably extension member 12e, and guiding member 518 preferably comprise threading 12t corresponding threading 412t to facilitate coupling thereof.

Optionally threading 412t may be utilized to serve as a base onto which an abutment assembly, for example as disclosed in co-owned PCT Application No. PCT/IB2012/053829, may be built. Optionally an abutment assembly may be built onto a proximal portion 412 coupled with an extension member 12e along threading disposed along its length.

Optionally occlusal portion 412 may be provided with optional external surfaces 412s for example as depicted in FIG. 2A-N. Optionally external surface 412s may be provided with threading 412t (FIG. 2A,2D), anti-rotational shaped (FIG.2E), smooth cylindrical (FIG.2B,2F), graduation and/or markings 412m, 412n (FIG. 2N), segmentations (FIG.2G), snap-ring coupling structure (FIG.2C), coatings, bio-absorbable materials, respobable materials any combination thereof or the like.

Optionally proximal portion 412 may optionally comprise anti-rotational geometry aperture 412r disposed about its proximal end 410p, for example as shown in FIG. 3A-B, depicting two optional configurations. Optionally aperture 412r may provide for facilitating tool manipulation and/or facilitating abutment coupling.

Optionally proximal end 410p may comprise anti-rotational geometry along external surface 412s and/or along internal surfaces 412r, for example as shown in

FIG.2E. Optionally the external surface 412s or a portion thereof, for example in the form of markings 412n, may be configured to duplicate and/or replicate and/or reproduce the anti-rotational aperture 38 of anchor 32, above the gingiva, for example as shown with cover-screw 410 depicted in FIG. 2E. Most preferably in replicating aperture 38 of implant anchor 32 cover-screw 410 provides for projecting the direction, angle of implant anchor 32 and the shape of the connection platform aperture 38 to facilitating the transfer and impression process.

Optionally external surface 412s may be provided with external markings 412n configured to complement anti-rotational aperture 38 of anchor 32 so as to provide a reference correlated to the implant anchor's anti-rotational geometry, without having to remove gingival tissue to expose the implant anchor 32. FIG. 2O-P show a top view of external surface 412s comprising external reference markings 412n that are configured to correlate to the implant anchor's 32 anti-rotational connection platform aperture 38.

Optionally external surface 412s may feature external graduations and/or markings 412m, for example as shown in FIG. 2N. Optionally the markings or graduations 412m are indicative of height above the bone level where the implant 32 is placed. . Optionally marking 412m may be shaped to facilitated identification and/or calculating the bone level height may for example be selected from triangular, trapezoidal or polygonal of n sides where n>2 or the like. Optionally markings or graduations 412m may be scored and/or etched and/or painted onto the external surface 412s.

Optionally the internal surface of proximal end 410p may form an aperture 412r at proximal end 410p that may be configured to duplicate and/or replicate and/or reproduce the anti-rotational aperture 38 of anchor 32, above the gingiva, for example as shown with cover-screw 410 depicted in FIG. 2E. Most preferably external surface 416s, as shown in FIG. 2E, provides for associating with anti-rotational aperture 38 of anchor 32, while external surface 412s having the shame shape mirrors that surface above the gingiva. Most preferably external surface 416s and 412s are configured to correspond with one another and to the anti-rotational aperture 38 of anchor 32 such that surfaces 416s and 412s effectively replicate the geometry, orientation and direction of aperture 38 and implant anchor 32.

Optionally proximal portion 412 may be configured to have an extendible compressed spring core, for example provided in a spring form for example a stent-

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like material such as nitinol that may extend the length of proximal portion over time. For example, proximal portion 412 may comprise spring like core that is compressed and configured to decompress and therefore expand proximally over time. Optionally the compressed spring core defining proximal portion 412 may be coated with bio-absorbable materials to define its external surface 412s, for example surface 412s may be formed from bio-absorbable sutures that undergo resorption over time gradually allowing the spring-core to decompressing and extend proximally, to reveal the location, orientation and axis of implant anchor 32.

Optionally distal portion 412 core may be realized as a self-inflating capsule that expands by osmotic principles.

Optionally device 410 may feature a central fluid lumen and/or channel 420,422 that may span from the proximal end 410p to the distal end 410d. Most preferably channel 420, 422 span the length of proximal end 412, preferably from proximal end 420p to base 412b, for example as shown in FIG. 2E-2N. Most preferably channels 420,422 comprise at least one or more exit pores 420e to allow for delivery of a flowing fluid introduced from the proximal 410p. Most preferably channel 420,422 facilitate non-invasively and a-traumatically, by remotely introducing a flowing fluid that may be utilized to treat the peri-implant host tissue.

FIG. 2F and 2E shows a schematic illustration of an optional device 410 according to the present invention wherein proximal portion 412 comprises a channel 420 and a plurality of exit pores 420e that optionally and preferably provides for introducing a flowing fluid for example, a medicament and/or therapeutic agent, to the tissue surrounding anchor 32.

Optionally lumen 420 may span the length of cover-screw 410, for example spanning proximal end 410p to distal end opening 410d, and feature at least one or more exit pores 420e disposed along the length of device 410. Optionally exit pores 420e may be provided along at least one or more segment of device 410 for example proximal portion 412, medial portion 414, distal portion 416. Optionally medial portion 414 may comprise exit pores 420e along the peri-implant tissue collar 414p.

Optionally lumen 420 may span the length of proximal portion 412 of cover-screw 410, from proximal end 420p ending adjacent to medial portion 414, and features at least one or more exit pores 420e adjacent to medial portion 414 on the proximal portion 412.

Preferably lumen 420 facilitates applying medical treatment to the surrounding host tissues, therein optionally providing for at least one or more treatments of the host tissue for example including but not limited to applying and/or introducing medicaments, therapeutic agents, flowing fluids, gasses, antiseptics, irrigating fluids, antibiotics, probiotics, anesthetics, the like or any combination thereof.

Optionally and preferably lumen 420 may further allow for introducing retrograde flow of anesthetic material to infiltrate the host tissue adjacent to exit pores 420e, therein alleviates the need for multiple trans-gingival needle-prick near anchor 32.

Most preferably such retrograde flow allows therapeutic agent and/or materials, for example periochip, optionally deposited and/or stored and or placed within the lumen of anchor 32, to penetrate host tissues adjacent to exit pores 420e by way of retrograde flow where such therapeutic active agents flow from distal end 420d toward exit pores 420e through lumen 420.

Optionally channel 422 spanning the length of device 410, for example as shown in FIG. 2L-N, provides for introducing a fixation screw to couple device 410 to anchor 32.Optionally channel 420, 422 may be utilized to house a controlled release capsule and/or medicament adjacent to exit pores 420e to allow for controlled and time release of a therapeutic agents into the peri-implant tissue.

Optionally the internal surface of channel 420, 422 may feature a correlated inner luminal reference marker 420m, as shown in FIG. 2Q, configured to complement anti-rotational aperture 38 of anchor 32 so as to provide a reference correlated to the implant anchor's anti-rotational geometry, without having to remove gingival tissue to expose the implant anchor 32. FIG. 2Q shows a top view of channel 420, 422 comprising correlated reference markings 420m that are configured to correlate to the implant anchor's 32 anti-rotational connection platform aperture 38.

Optionally the internal surface of channel 420,422 may be configured to match the anti-rotational connection platform aperture 38, facilitating the transfer coping process.

Channel 420, 422 may be utilized to introduce a measuring probe 406, FIG. 2E, provided to determine the height of the gingival tissue. Preferably measuring probe 406 is shaped to match the shape of channel 422, 420. Optionally probe 406

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is configured to a have a preset length of up to about 15mm so as to act as a reference point for measuring the height of the gingival tissue. Optionally probe 406 may feature graduations or markings along its length indicative of the probe height.

Optionally channel 420, 422 may be plugged and/or covered at proximal end 420p with a plug and/or cover 408 for example as shown in FIG. 2F, depicting and optional system 400. Preferably plug 408 provides for closing the proximal open end 420p of channel 420,422.

Optionally lumen 420 and exit pores 420e may further provide a means and method for splinting and confining anchor 32 and cover-screw 410 to the maxilla, particularly over the maxillary sinus. Most preferably lumen 420 and exit pores 420e may be utilized to confine anchor 32 and cover-screw 410 disposed adjacent to maxillary sinus so as to prevent migration and loss of anchor 32 into the maxillary sinus cavity. Optionally exit pores 420e and lumen 420 may be utilized to introduce sutures, and/or fixation wires or the like, to suture and/or wire device 410 to the maxilla, most preferably to act as a stopper that prevents potential migration of anchor 32 into the maxillary sinus. Optionally a plurality of exit pores 420e in a single device 410 may be sutured and/or wired to the maxilla. Optionally a plurality of exit pores 420e spanning at least two or more, or more preferably a plurality of cover-screws 410, may be jointly sutured and/or wired to the maxilla, preferably to act as a stopper that prevents potential migration of anchor 32 into the maxillary sinus.

FIG. 5A-B shows views of an optional non-limiting configuration of anchor exposing and/or surfacing tool 500. FIG. 5A shows a perspective view while FIG. 5B shows the corresponding cross-sectional view.

Most preferably anchor exposing tool 500 is provided as a single piece device that may be manipulated manually. Optionally anchor exposer 500 may be configured to be associated with a manually manipulating handle and/or arm. Optionally exposer 500 may be coupled or otherwise associated with a motorized auxiliary device provided to facilitate its manipulation, for example including but not limited to a dental hand-piece, or the like.

Exposing tool 500 most preferably comprises a proximal portion having proximal portion 514 and a distal portion 512. Optionally and preferably distal portion 512 comprises a sharp exposing surface 512s provided for exposing and/or

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surfacing the anchor 32 from below the gingival surface. Exposing surface 512s is a sharp edge surface that facilitates cutting the gingival surface covering anchor 32.

Optionally exposer 500 may be configured to be as a single use disposable device. Optionally exposer 500 may be configured to be a multi-use device that may be readily sterilized for example by way of an autoclave.

Most preferably proximal portion 514 provides a manipulating handle that may be manipulated manually or utilized with additional tools for example a handle as previously described. Optionally and preferably proximal portion 514 is provided with a shape that may be readily handled by tools.

Most preferably anchor exposing device 500 comprises a continuously open lumen 516 spanning both proximal portion 514 and distal portion 512. Most preferably open lumen 516 may be shaped to facilitate receiving at least a portion of device 410 and/or anchor 32. More preferably distal end 516d of open lumen 516 may be configured and/or shaped and/or sized to receive a portion of anchor 32 and/or a distal portion 416 of device 410. More preferably proximal end 516p of open lumen 516 may be configured and/or shaped and/or sized to receive a proximal portion 412 of device 410.

Optionally exposer 500 may be associated with anchor axis projection guide 518, FIG. 8C, or proximal portion 412 of device 410 that provides for guiding exposer 500 toward anchor 32. Optionally exposer 500 is associated with guide 518 along guide shaft 518g or proximal portion 412 through lumen 516 allowing exposing surface 512s to be guided along shaft 518g or proximal portion 412 toward guide base 518b or medial portion 414 allowing surface 512s to come into contact with the gingival surface overlying anchor 32, therein most preferably minimizing the amount of host tissue lost in and around anchor 32 while exposing the anchor, therein alleviating the need for suturing, and significantly reducing the healing period.

Optionally exposing tool 500 may be provided in various sizes and shapes. Optionally the size and shape of exposer 500 may be provided relative to the size and/or diameter of the implant anchor 32 and/or cover-screw 410.

FIG. 6A-F and FIG. 7 provide depiction of a preferred method according to the present invention for utilizing device 410 and system 400 provided to reduce the number of intermediate procedures and physician iterations required between implant anchor placement and implant loading.. FIG.7 provides a flowchart of the

method while FIG. 6A-F provide corresponding schematic illustrations of the method.

First in stage 700 the implantation site is prepared, as is known in the art, for example as illustrated in FIG. 6A. FIG. 6A shows the initiation of the implantation process starts by exposing an implantation site by creating a gingival flap, for example a midline flap, as is known in the art. This is followed by creating of a recess (surgical alveoli) is formed for receiving a dental implant anchor 32 and implanting implant anchor 32within the recess (surgical alveoli). Next in stage 701 and as shown in FIG. 6B, the anchor 32 is securely placed within the recess.

Next in stage 702 and as shown in FIG. 6C the anchor 32 is coupled with device 410 along the anchor's borehole 34 while covering distal end 35. Most preferably device 410 and in particular distal portion 416 is configured to fit securely with anchor 32 about borehole 34 and/or aperture 38, while medial portion 414, 414c is provided to cap the anchor's distal end 35, and allowing proximal portion 412 to project from the anchor's distal end 35.

Optionally distal portion threading 416t may be utilized to couple with the anchor's internal threading disposed along borehole 34. Optionally distal portion 416 may be coupled via a fixation screw introduced through channel 422. Optionally distal portion 416 may be coupled with anchor 32 utilizing a mediating member 402 to interface with recess 416r. Optionally distal portion 416u may be fit with mediating member 404 to correspond to connection platform aperture 38 while coupling to anchor 32 with a fixation screw.

Next in stage 703, as shown in FIG. 6D the implantation site and/or anchor site is closed to allow for healing.

Next in state 704, as shown in FIG. 6D, the proximal portion 412 of cover-screw 410 may be adjusted, sized and/or cut-down according to the needed level following closure of the implantation site.

Optionally proximal portion 412 may be left exposed above the gingival tissue and not cut down relative to the gingiva.

Optionally proximal portion 412 may be capped with cover 408. Optionally proximal portion 412 may be capped with filling material, temporary filling materials or the like.

Optionally proximal portion 412 is sized and exposed such that it does not interfere with the placement of a temporary restoration. Optionally an exposed

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proximal portion 412 may further constitute a lever for the surrounding elements to remove significant forces acting on anchor 32.

Optionally the gingival tissue may enclose over and/or cover the anchor and device 410 with the gingival flap such that the proximal end 412 of device 410 is covered and/or submerged beneath by the gingival tissue.

Optionally and most preferably the gingival tissue is sutured over to cover anchor 32 and cover-screw 410 such that at least a portion of the proximal end 412 of cover-screw 410 remains exposed during the healing phase, and therein protrudes through the gingival tissue. Optionally proximal end 412 exposed through the gingival surface may be coupled or otherwise associated with a dedicated cap 408.

Most preferably the proximal end 410p is adjusted relative to the gingiva so as to allow visualization of the anchor location, orientation and axis by visual inspection. Most preferably proximal end 410p of proximal portion 412 comprises correlated external reference marking 412n, 420m indicative of the connection platform aperture 38.

Optionally following sizing of proximal portion 412 in stage 704 an analog or digital impression of the oral cavity may be taken, as outlined in stage 706, so as to capture the position, orientation and axis of implant anchor 32 and connection platform aperture 38 from reference markings 412n, 420m, 412r therein facilitating the transfer and impression processes.

Next in stage 705 the implantation site may be allowed to heal as necessary as is known in the art. Preferably during the healing period the peri-implant tissue may be treated remotely via channels 420,422 to irrigate and/or introduce a medicament in and around the peri-implant tissue, that are delivered through exit pores 420e, for example as schematically shown in FIG. 6D. FIG. 6D depict remote and non-invasive introduction of a flowing fluid from a syringe to the peri-implant tissue as indicated with the positional arrow through channel 420, 422 via exit pores 420e.

Optionally when utilizing device 410 having medial portion comprising a peri-implant tissue collar portion 414p, as shown in FIG. 2I-K, the portion 414p provides for modeling the peri-implant tissues therein facilitating the healing process and obviating the need for a healing abutment.

Optionally healing period may not be required in an immediate loading configuration of anchor 32 and cover-screw 410 according to an optional embodiment of the present invention.

Next in stage 706, optionally and preferably following the healing periods, the impression and transfer process of the implantation site is facilitated with device 410. Device 410 may facilitated either digital or analog impression transfer of the implantation site. Impression coping and /or the transfer process is facilitated by device 410 in that exposure of the implant anchor 32 is not required to carry out the impression and transfer process, as is currently implemented in the art. Device 410 provides for maintaining implantation site without exposing anchor 32 by utilizing proximal portion 412 to remotely indicate the position, orientation and axis of anchor 32 and connection platform aperture 38. Most preferably reference markings 412n, 420m, 412r and/or external surface 412s are correlated to the shape and orientation of connection platform aperture 38 therein facilitating the transfer and impression processes by projection the configuration of aperture 38 on proximal portion 412 making it readily available.

Next in stage 707, following the healing process and impression of the implantation site, prior to the uncovering of the implant anchor 32 as depicted in stage 708, the peri-implant tissue may be remotely and a-traumatically anesthetized by delivering anesthesia via channel 420, 422, to the peri-implant tissue via exit pores 420e, for example as shown in FIG. 6E. FIG. 6E shows a syringe comprising anesthetics delivered to the peri-implant tissue, as shown by directional arrow, through proximal end 420p of channel 420.

Next in stage 708 the implant anchor 32 is uncovered by removing the gingival tissue above the anchor. Most preferably, device 410 provides for removing minimal tissue by providing tissue removal device 500 with a guide utilizing proximal portion 412, 518 to guide device 500 toward anchor 32, for example as shown in FIG. 6E. Exposer 500 provides for exposing the anchor directly in a minimally invasive manner that does not require poking and prodding as the implantation site is readily viewable due to the projection provided by proximal portion 412 of cover-screw 410. Most preferably minimal gingival tissue covering anchor 32 is excised with exposing surface 512s, FIG. 5A-B, to reveal anchor 32 and cover-screw 410, as they are received into proximal end lumen 516.

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Most preferably this further provides for saving gingival tissue while exposing the anchor both in its location and implantation axis.

Next in stage 709 the implant loading process is undertaken as is known in the art. Optionally and preferably device 410 is disassociated from anchor 32 allowing abutment loading as is known in the art.

Optionally device 410 comprising proximal end threading 412t may be retained and associated with anchor 32 to allow for an abutment assembly, an over denture attachment or additional prosthetic elements, may be built, coupled or otherwise associated directly onto cover-screw 410 about its proximal end 412 optionally utilizing extension member 12e, for example as shown in FIG. 6F. Optionally an abutment assembly may be built on proximal portion threading 412t and/or extension member 12e, for example as described in co-owned PCT Application No. PCT/IB2012/053829, incorporated herein by reference as if fully set forth.

Optionally exposer 500 may be utilized to facilitate abutment assembly buildup about proximal end 412. Optionally, distal end opening 516d and central lumen 516 may be utilized to facilitate introducing an optional extension member 12e to facilitate the initiating an abutment buildup about anchor 32, for example as shown in FIG. 6E-F.

While the invention has been described with respect to a limited number of embodiment, it is to be realized that the optimum dimensional relationships for the parts of the invention, to include variations in size, materials, shape, form, function and manner of operation, assembly and use, are deemed readily apparent and obvious to one skilled in the art, and all equivalent relationships to those illustrated in the drawings and described in the specification are intended to be encompassed by the present invention.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not described to limit the invention to the exact construction and operation shown and described and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

It is appreciated that certain features of the invention, which are, for clarity, described in the context of separate embodiments, may also be provided in combination in a single embodiment. Conversely, various features of the invention, which are, for brevity, described in the context of a single embodiment, may also be provided separately or in any suitable sub-combination or as suitable in any other described embodiment of the invention. Certain features described in the context of various embodiments are not to be considered essential features of those embodiments, unless the embodiment is inoperative without those elements.

Citation or identification of any reference in this application shall not be construed as an admission that such reference is available as prior art to the invention.

Section headings are used herein to ease understanding of the specification and should not be construed as necessarily limiting.

While the invention has been described with respect to a limited number of embodiments, it will be appreciated that many variations, modifications and other applications of the invention may be made.

What is claimed is:

1) A dental implant device (410) for associating with an implanted dental implant anchor (32) immediately following implantation, the device (410) provided for facilitating identifying the location, orientation and axis of the implanted dental anchor (32) following a healing period, the device (410) having a distal portion (416), a medial portion (414) and an proximal portion (412) that are defined between a distal end (410d) and a proximal end (410o);
   a) the distal portion (416) provided for securely associating said device (410) with the dental implant anchor (32) along the implant borehole (34); that is defined between said distal end (410d) and medial portion (414);
   b) the medial portion (414) provided for covering the proximal end (35) of the dental implant anchor (32);
   c) the proximal portion (412) defined from said medial portion to said proximal end (410p), provided for projecting the location, orientation and axis of implant anchor (32), characterized in that said proximal portion (412) is a shaft extending proximally from said medial portion (414) corresponding to the plane of the implant anchor's proximal end (35) to assume the orientation and axis of anchor (32) and to readily reveal the location of anchor (32) by way of visual inspection.
2) The device of claim 1 wherein said medial portion (414) and said distal portion (416) are screw form.
3) The device of claim 1 wherein said proximal portion has a smaller diameter than medial portion (414).
4) The device of claim 2 wherein said distal portion (416) is configured and shaped according to the implant anchor's borehole (34) to provide for coupling therewith.
5) The device of claim 2 wherein said distal portion (416) comprises a coupling portion including threading (416t) configured to couple with threading internal to the implant anchor's borehole (34).
6) The device of claim 2 wherein said distal portion (416) comprises a sealing portion (416s) disposed distally to said medial portion (414).
7) The device of claim 6 wherein said sealing portion (416s) is configured according to and to fit with the implant anchor's borehole (34).

8) The device of claim 6 wherein said sealing portion (416s) comprises a coupling recess (416r).

9) The device of claim 1 wherein said distal portion (416) is configured to associate with and receive a mediating member (402, 404) that facilitates for coupling with the implant anchor's borehole (34).

10) The device of claim 8 wherein said distal portion (416) further comprises threading (416t) configured to couple with threading internal to the implant anchor's borehole (34); wherein said threading (416t) is disposed distally to said coupling recess (416r).

11) The device of claim 1 wherein said distal portion (416) is configured to be coupled with an implant anchor (32) by way of utilizing an external fixation screw that features threading complementing the threading internal to the implant anchor's borehole (34).

12) The device of claim 11 wherein said distal portion (416) is configured and shaped according to the implant anchor's (32) anti-rotational connection platform (38).

13) The device of claim 11 wherein said distal portion (416) is configured to associate with a mediating member (404) wherein the external surface of said mediating member (404) is configured and shaped according to the implant anchor's (32) anti-rotational connection platform (38).

14) The device of claim 1 wherein said medial portion (414) is shaped to complement the configuration of the anchor's proximal end (35) so as to allow closure of borehole (34) with said medial portion (414).

15) The device of claim 1 wherein said medial portion (414) is configured to have an upper surface (414b) overlying the peri-implant tissue configured to act as a protective cover of said peri-implant tissues from tissue cutting.

16) The device of claim 14 wherein the diameter of said upper surface (414b) is configured according to at least one or more of implant anchor 32, abutment, tissue cutting device, tissue punch (500).

17) The device of claim 15 wherein the diameter of said upper surface (414b) is configured to be larger than the diameter of tissue punch (500).

18) The device of claim 1 wherein said medial portion (414) comprises a lower surface (414c) configured to correspond to the distal end (35) of implant anchor (32).

19) The device of claim 1 wherein said medial portion (414) comprises a peri-implant tissue collar portion (414p) configured to allow the peri-implant tissue to heal and to assume its final shape.

20) The device of claim 19 wherein said collar portion (414p) is configured and shaped according to the apical portion of the trans-gingival collar of a dental implant abutment.

21) The device of claim 19 wherein said collar portion (414p) further comprises at least one or more exit port (420e).

22) The device of claim 1 wherein said medial portion (414) is configured to have an upper surface (414b), a lower surface (414c) and a collar portion disposed therebetween;

a) wherein said an upper surface (414b) is overlying the peri-implant tissue configured to act as a protective cover of said peri-implant tissues from tissue cutting;

b) wherein said medial portion 414 comprises a lower surface (414c) configured to correspond to the distal end (35);

c) wherein said collar portion (414p) configured to allow the peri-implant tissue to heal and to assume its final shape.

23) The device of claim 1 wherein said device features a continuous central channel (420, 422) disposed between said distal end (410d) to said proximal end (410p).

24) The device of claim 23 wherein said channel (420,422) comprises an open end defined at said proximal end (410o).

25) The device of claim 23 wherein said channel (420,422) comprises two open ends defined at each of said proximal end (410o) and distal end (410d).

26) The device of claim 23 wherein said channel (420,422) comprises at least one exit pore (420e) along its length.

27) The device of claim 26 wherein said channel (420,422) comprises a plurality of exit pores (420e).

28) The device of claim 26 wherein said at least one exit pore (420e) is disposed along the proximal portion (412).

29) The device of claim 27 wherein at least one exit pore is disposed along the proximal portion (412) and at least one exit pore is disposed along the medial portion (414).

30) The device of claim 28 wherein said at least one exit pore (420e) is disposed along the proximal portion (412) and is adjacent to medial portion (414).

31) The device of claim 23 wherein said channel (420,422) is closed with a removable plug or cover.

32) The device of claim 24 wherein said channel (420) is defined between said proximal end (410p) and the upper surface (414b).

33) The device of claim 24 wherein said channel (420) is defined between said proximal end (410p) and the lower surface (414c).

34) The device of claim 1 wherein the proximal portion (412) is a hollow shaft defining a continuous channel (420) between proximal end (410p) and medial portion (414), said channel (420) having an open end (420p) defined at the proximal end (410p) and at least one exit pore (420e) disposed along the length of said proximal portion (412).

35) The device of claim 34 wherein said at least one exit pore (420e) is disposed adjacent to medial portion (414).

36) The device of claim 1 wherein the external surface (412s) of proximal portion (412) is configured to facilitate coupling with prosthodontic elements.

37) The device of claim 36 wherein said prosthodontic elements are selected from abutment assembly, abutment, transfer, copying device, tools, dental hand piece, any combination thereof.

38) The device of claim 36 wherein at least a portion of said external surface (412s) comprises threading.

39) The device of claim 36 wherein said external surface (412s) further features adjustment points (412a).

40) The device of claim 36 wherein said external surface (412s) features a tooling interface disposed along its base (412b) adjacent to medial portion (414).

41) The device of claim 1 wherein the length of said proximal portion (412) is adjustable.

42) The device of claim 1 wherein the diameter of said proximal portion (412) is from about 1mm to about 5 mm.

43) The device of claim 1 wherein the external surface (412s) of proximal portion (412) is configured and shaped according to the implant anchor's (32) anti-rotational connection platform (38).

44) The device of claim 1 wherein the external surface (412s) of proximal portion (412) features graduations or markings (412m).

45) The device of claim 44 wherein said markings or graduations (412m) are indicative of height above the bone level.

46) The device of claim 44 wherein said markings (412m) are selected from triangular, trapezoidal or polygonal of n sides where n>2.

47) The device of claim 44 wherein said markings or graduations (412m) are scored onto said external surface (412s).

48) The device of claim 1 wherein the external surface (412s) of proximal portion (412) comprises a reference marker (412n) along the length of proximal portion (412); and wherein said distal portion (416) is configured and shaped according to the implant anchor's (32) to assume the shape of the anti-rotational connection platform (38); characterized in that said reference marker (412n) is correlated to the shape of said connection platform (38).

49) The device of claim 48 wherein said reference marker (412n) is indicative of and infers the implant anchor's (32) orientation and the shape of the connection platform (38) provided to facilitate implant impression coping and transfer process.

50) The device of claim 1 wherein the external surface (412s) of proximal portion (412) comprises a reference marker (412n) along the length of proximal portion (412); and wherein the distal portion (416) is configured to associate with a mediating member (404) wherein the external surface of said mediating member (404) is configured and shaped according to the implant anchor's (32) anti-rotational connection platform (38); characterized in that said reference marker (412n) is correlated to the shape of said connection platform (38).

51) The device of claim 1 wherein the shape of proximal portion (412) is configured to reflect the shape of the implant anchor's (32) connection platform (38).

52) The device of claim 1 wherein the proximal; portion (412) comprises an anti-rotational connection platform aperture(412r) at proximal end (410p) wherein said aperture (412r) is reflective of the anti-rotational aperture (38) of implant (32) is configured to reflect the shape of the implant anchor's (32) connection platform (38).

53) The device of claim 40 wherein said base (412b) comprises at least one or more exit pores (420e).

54) The device of claim 1 wherein the upper surface of medial portion (414) comprises a tooling aperture (414a) in the form of an anti-rotational tool recess.

55) A dental implant device (410) for associating with an implanted dental implant anchor (32) immediately following implantation, the device (410) provided for facilitating identifying the location, orientation and axis of the implanted dental anchor (32) following a healing period, the device (410) having a distal portion (416), a medial portion (414) and an interchangeable proximal portion (412);

a) the distal portion (416) provided for securely associating said device (410) with the dental implant anchor (32) along the implant borehole (34); the distal portion (416) having a threaded channel disposed central within the distal portion body; said threaded channel provided for receiving and securely coupling with said proximal portion (412), the channel having threading selected from cylindrical threading or conical threading;

b) the medial portion (414) provided for covering the proximal end (35) of the dental implant anchor (32); wherein the medial portion comprises a tooling aperture (414a) that is continuous with said distal portion threaded channel said tooling aperture (414a) provided in the form of anti-rotational tooling recess for manipulating said device; and

c) the interchangeable proximal portion (412) provided for projecting the location, orientation and axis of implant anchor (32); is a shaft having a diameter from about 1mm to about 5mm, that extends proximally from the plane of the implant anchor's proximal end (35) to assume the orientation and axis of anchor (32); the proximal portion (412) having a distal end including threading configured to complement and couple with said threaded channel threading.

56) A dental implant system (400) comprising: a device according to any of claims 1-55, a mediating member (402,404), and a plug (408) wherein said plug is provided for covering the proximal end (410p) .

57) The system of claims 56 further comprising , a tubular tissue punch (500) provided for uncovering the gingival tissue overlying the dental implant anchor (32) and dedicated driving tools for manipulating device (410).

58) A dental implant system of claim 56 further comprising a gingival tissue depth measuring probe (406) configured to measure the peri-implant tissue depth by inserting the probe into the proximal portion (412) channel (420, 422), the probe characterized in that it is shaped and configured according the luminal surface of channel (420,422); the probe having graduations or markings indicative of the probe height.

59) The system of claim 58 wherein said probe (406) has a length of up to about 15mm.

60) A method for marking the position, axis and orientation of a dental implant anchor at the time of anchor placement so as to allow for: a-traumatic, minimally invasive uncovering of a dental implant anchor (32) and impression coping of the dental implant anchor (32) while reducing the number of procedures required to load the implant with a dental implant abutment, the method comprising:

a) coupling a dental implant device (410) according to any one of claims 1-60 with a dental implant anchor (32) at the time of anchor placement;

b) suturing the gingival tissue at the implantation site wherein the proximal portion (412) extends above the gingival tissue level wherein said proximal portion provides for identifying the location and orientation of anchor (32) by visual inspection;

c) adjusting the length of the proximal portion (412) relative to the gingival tissue by way of cutting or extending the proximal portion (412);

d) apply a remote a-traumatic non-invasive tissue treatment of the peri-implant tissue through a proximal portion (412) channel (420, 422) of said device (410) ;

e) undertaking either a digital or analog impression coping of the implantation site wherein at least one of: a marker (412n) disposed on along the length of proximal portion (412), the external surface (412s) of proximal portion (412), inner luminal surface(420m) of channel (420), proximal end aperture (412r), serve as a reference correlating and corresponding to the orientation and geometry of the anti-rotational connection platform aperture (38) of implant anchor (32);

f) a-traumatically anesthetizing the peri-implant tissue by introducing analgesics through proximal portion (412) channel (420, 422) through at least one exit pore (420e);

g) uncovering the implant anchor (32) and minimizing the peri-implant tissue loss over the implant anchor's occlusal portion (35) by guiding a tissue punch device (500) along the proximal portion (412); and

h) disassociate device (410) from anchor (32) and proceed to load the implant with an abutment and restoration.

61) The method of claim 61 further comprising associating an extending member with said proximal portion to act as an external guide for the tissue punch (500).

62) The method of claim 61 further comprising associating a measuring probe (406) within the lumen of channel (420,422) prior to undertaking a digital impression coping by way of an oral digital scan and inferring from the scan the gingival tissue height.

63) A method for introducing a flowing fluid to the peri-implant tissues and host tissue surrounding an implant anchor using the device of claim 34 or 35 that is coupled to an implanted dental implant anchor (32) for anesthetizing or irrigating the peri-implant tissue with said flowing fluid, the method comprising introducing said flowing fluid into the lumen (420) and allowing the fluid to flow from the distal end (420d) through the exit pores (420e) disposed adjacent to the peri-implant tissues.

64) The method of claim 63 wherein said flowing fluid is selected from the group consisting of medicaments, flowing fluids, gasses, antiseptics, irrigating fluids, antibiotics, probiotics, anesthetics, analgesics, dissolvable medicaments, evaporating medication, any combination thereof.

65) A method for determining the peri-implant tissue depth with the system of claim 58 wherein a measuring probe (406) is introduced into the lumen of channel (420, 422) and obtaining a reading determining the lumen length utilized to infer said tissue depth.

66) A method for reducing the number of intermediate procedures required between a dental anchor placement to the abutment and restoration loading during a dental implant restoration procedure, the method comprising

a) Associating the implant device (410) according to any one of claims 1-60 with a dental implant anchor (32) during implant anchor placement;

b) Monitoring the healing of the gingival tissue while providing a-traumatic and minimally invasive treatment to the peri-implant tissue as needed via proximal portion channel (420), the treatment selected from, tissue irrigation, introduction of a medicament to the peri-implant tissue, shaping and protecting the peri-implant tissue with medial portion (414, 414p, 414b, 414c); and

c) Facilitating digital or analog impression coping of the implantation site wherein the proximal portion (412) of device (410) facilitates the identification of the orientation and geometry of aperture (38) of implant anchor (32) with at least one of: a marker (412n) disposed on along the length of proximal portion (412), the external surface (412s) of proximal portion (412), inner luminal surface(420m) of channel (420), proximal end aperture (412r), that serve as a reference correlating and corresponding to the orientation and geometry of the anti-rotational connection platform aperture (38) of implant anchor (32);

d) a-traumatically anesthetizing the peri-implant tissue by introducing anesthetics through proximal portion (412) channel (420, 422) through at least one exit pore (420e);

e) uncovering the implant anchor (32) and minimizing the peri-implant tissue loss over the implant anchor's occlusal portion (35) by guiding a tissue punch device (500) along the proximal portion (412); and

f) disassociate device (410) from anchor (32) and proceed to load the implant with an abutment and restoration.

67) The device of claim 1 or claim 55 wherein said proximal portion (412) is realized in the form of a self-inflating capsule that expands by osmotic principles.

68) The device of claim 1 or claim 55 wherein said proximal portion (412) may be configured to have an extendible compressed spring core that may extend the length of proximal portion over time.

69) The device of claim 68 wherein said proximal portion (412) comprises a spring like core that is compressed and configured to decompress over time.

70) The device of claim 68 wherein said compressed spring core may be coated with bio-absorbable materials to defining external surface (412s).

71) The device of claim 70 wherein said external surface (412s) is formed from bio-absorbable sutures that undergo resorption over time gradually allowing the spring-core to decompress and extend proximally, to reveal the location, orientation and axis of implant anchor (32).

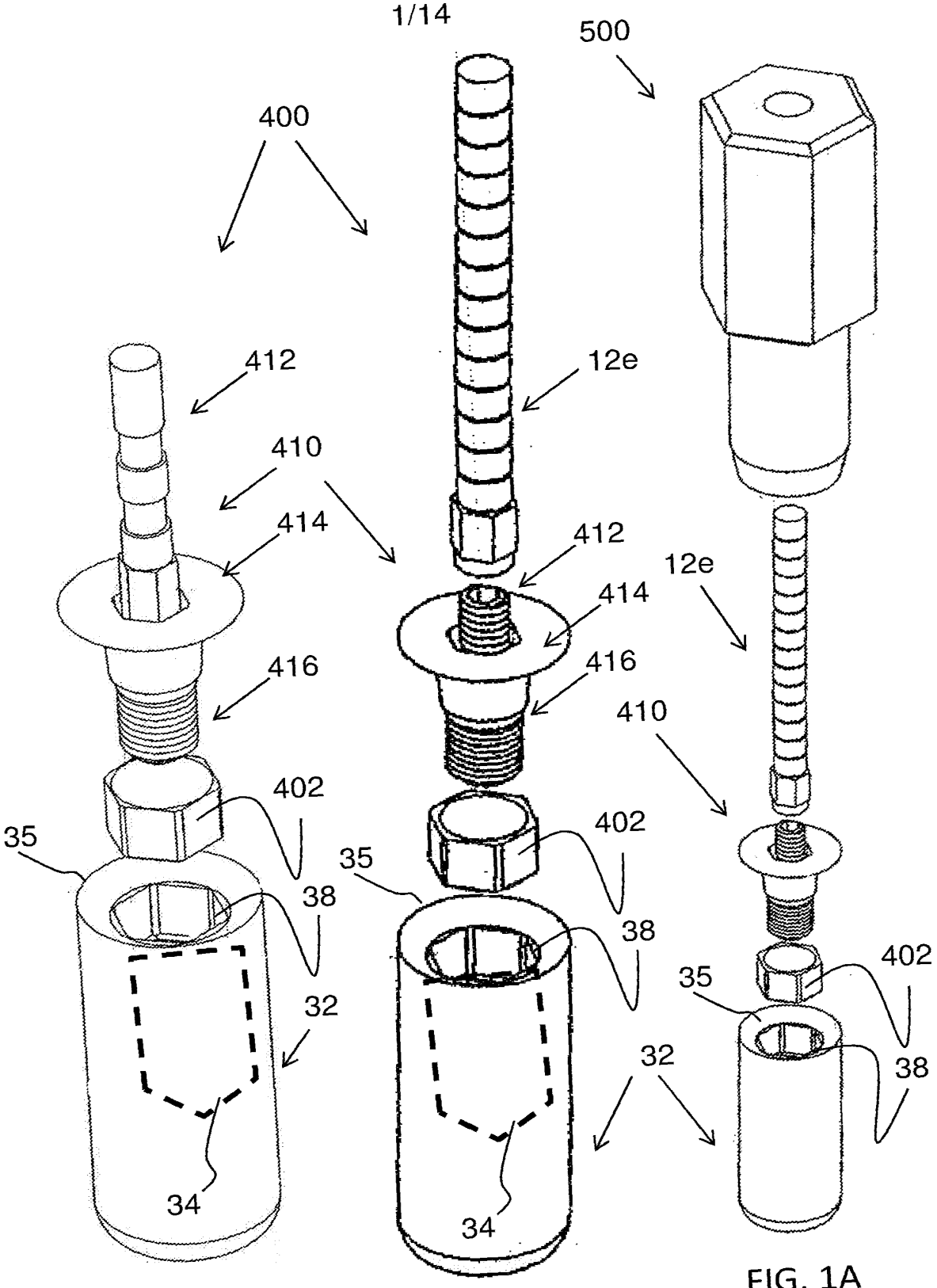
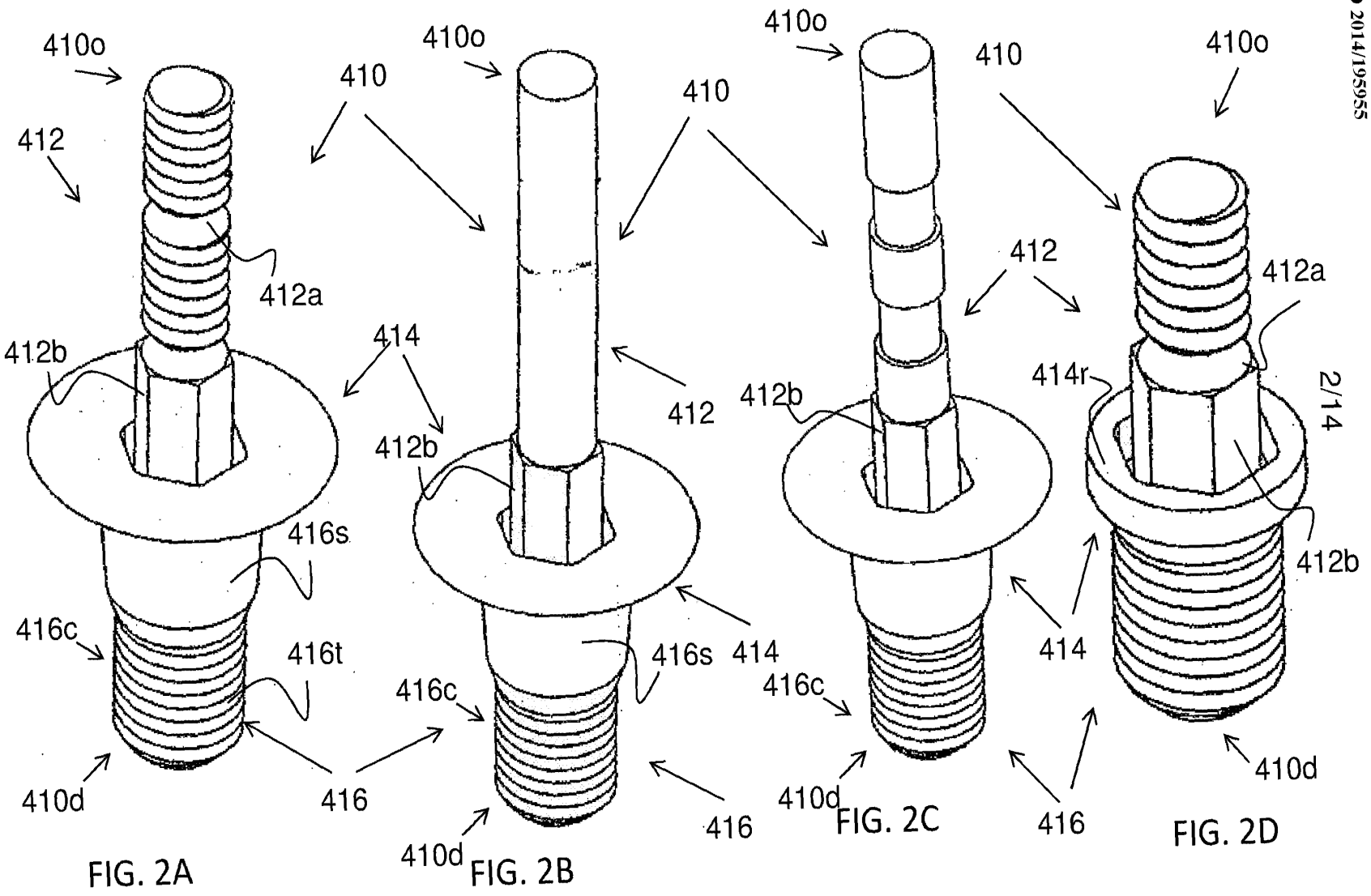


FIG. 1C FIG. 1B FIG. 1A


410o
410
412
412a
412b
414
416s
416c
416t
410d
416
FIG. 2A
410o
410
412
412b
414
416s
416c
410d
416
FIG. 2B
410o
410
412
412b
414r
414
416c
410d
416
FIG. 2C
410o
410
412a
412b
414
416
410d
FIG. 2D

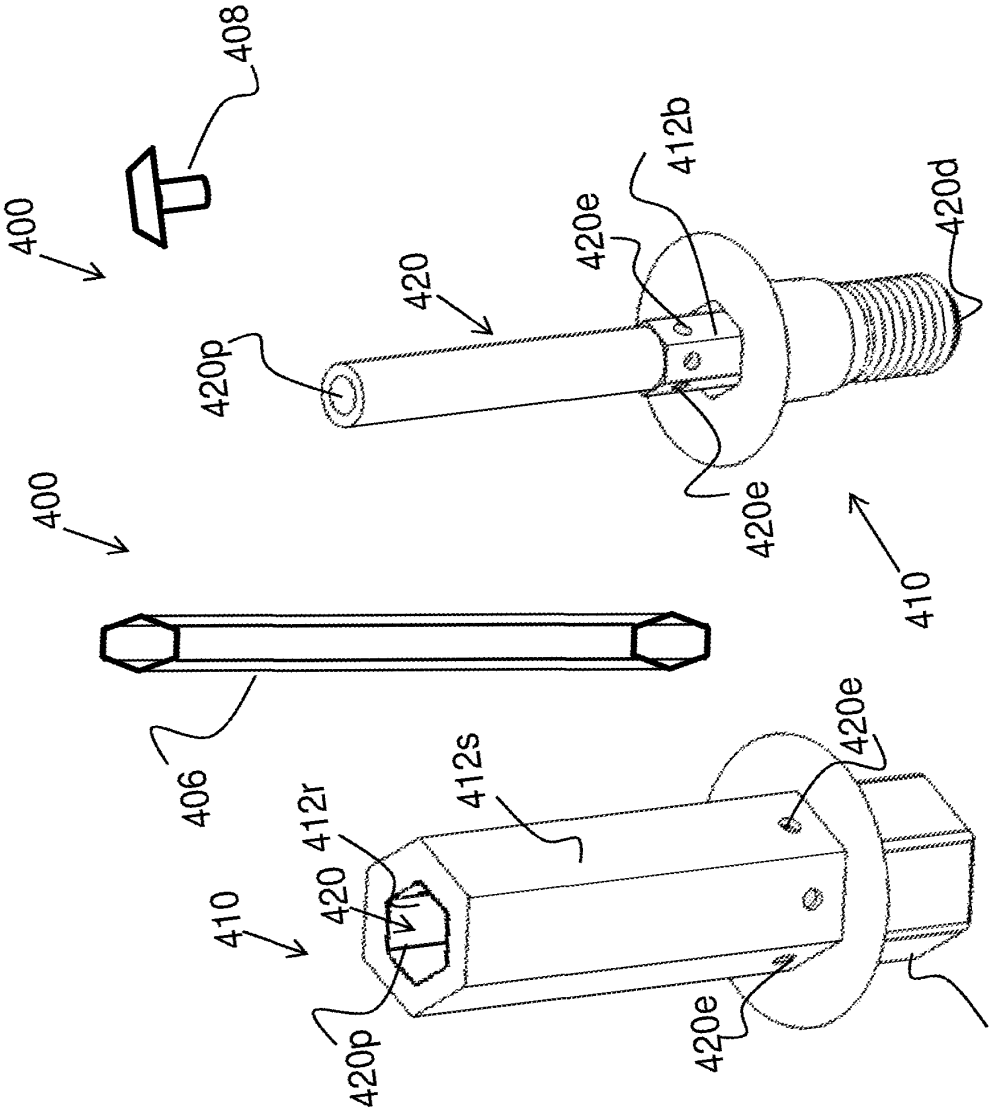


FIG. 2F

FIG. 2E

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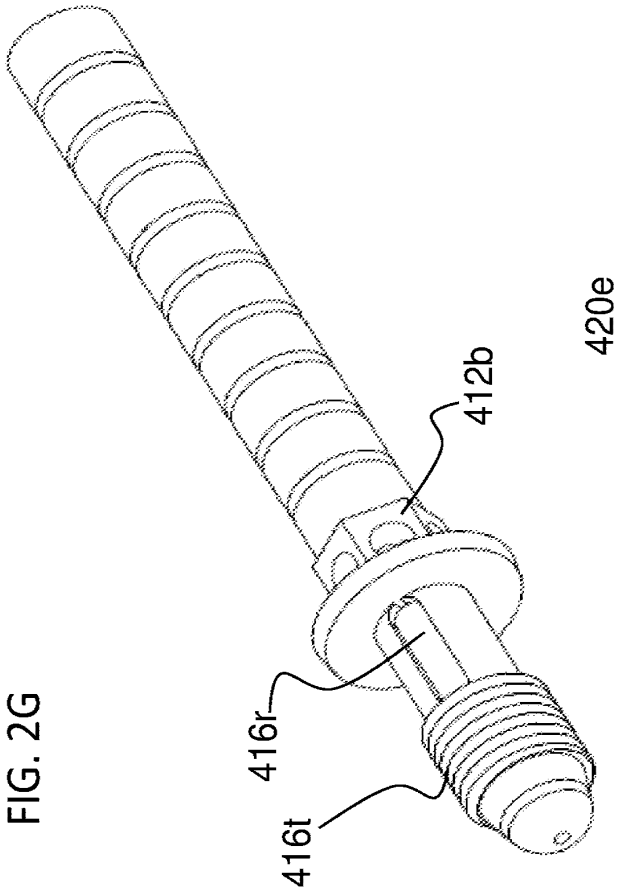


FIG. 2G

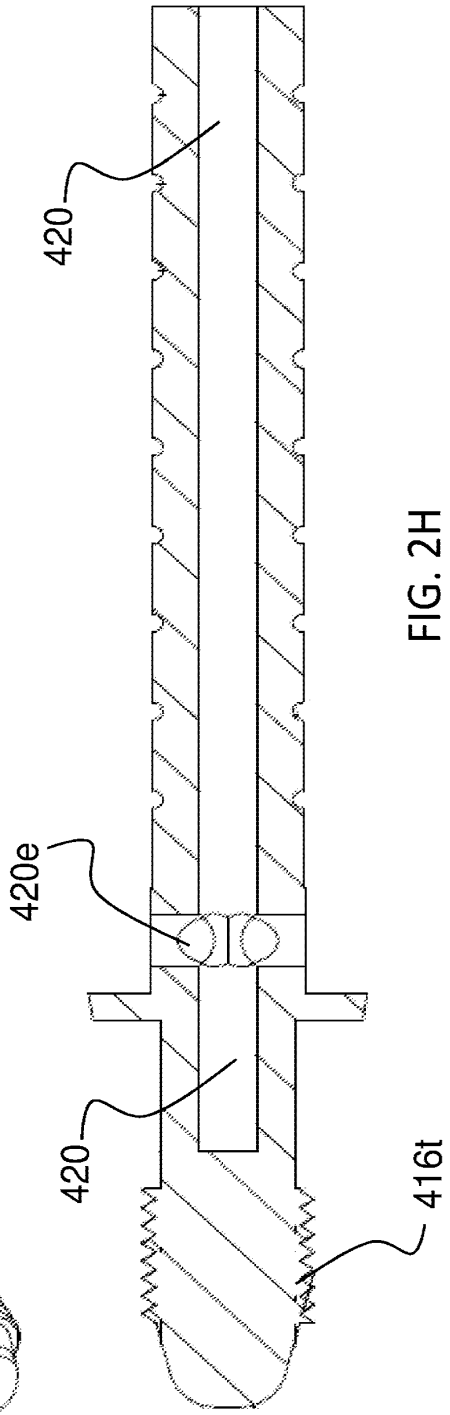


FIG. 2H

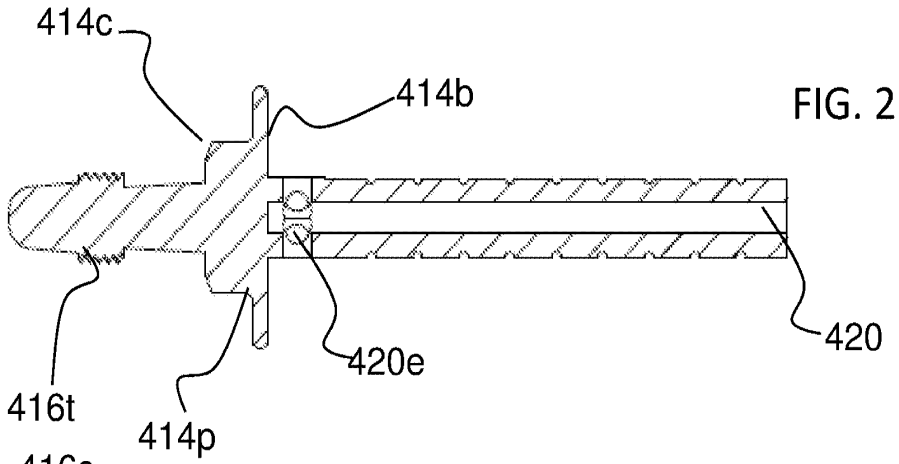


FIG. 2K

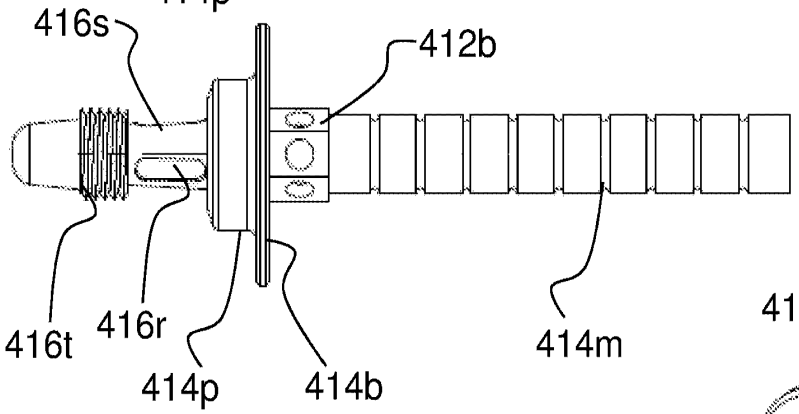


FIG. 2J

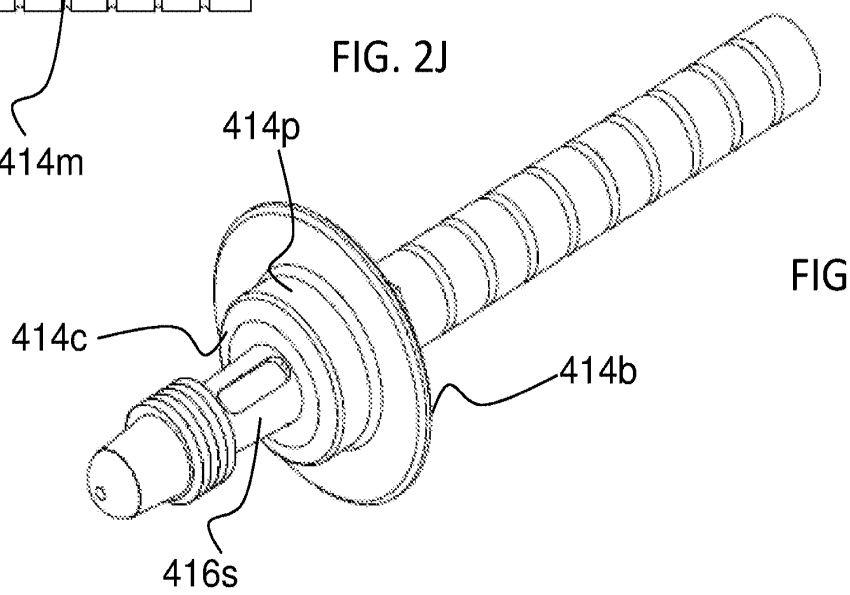


FIG. 2I

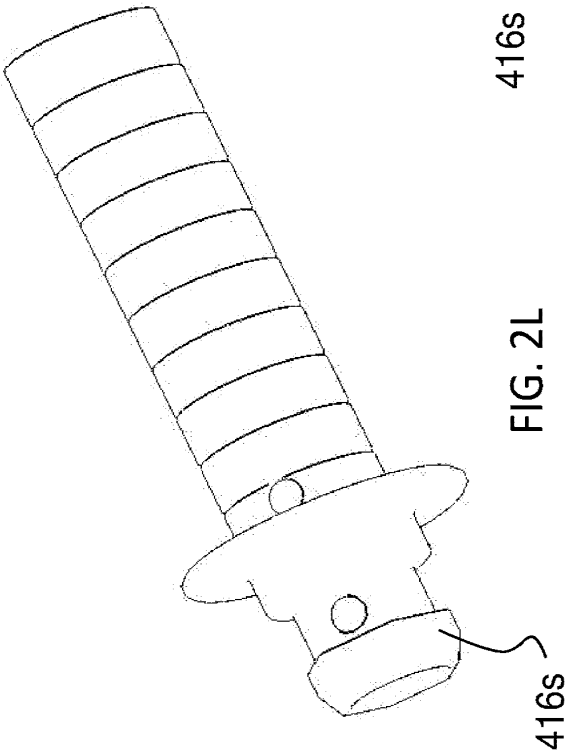


FIG. 2L

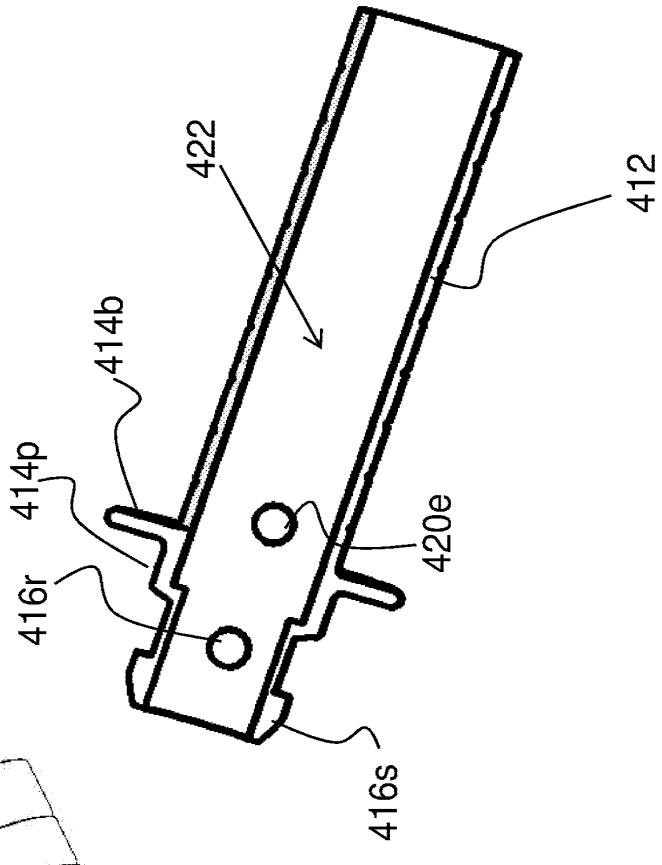


FIG. 2M

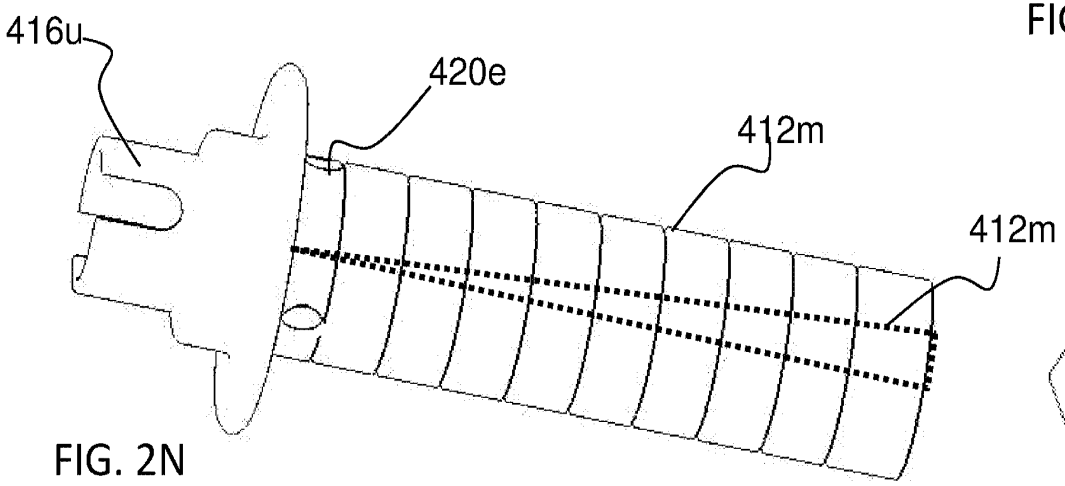


FIG. 2N

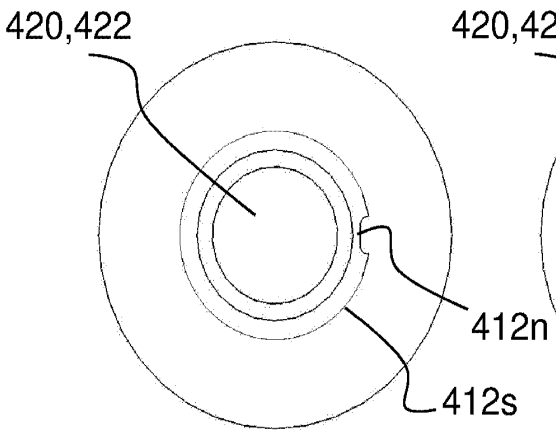


FIG. 2O

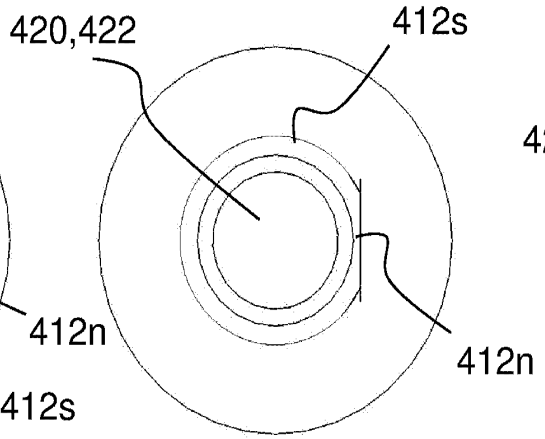


FIG. 2P

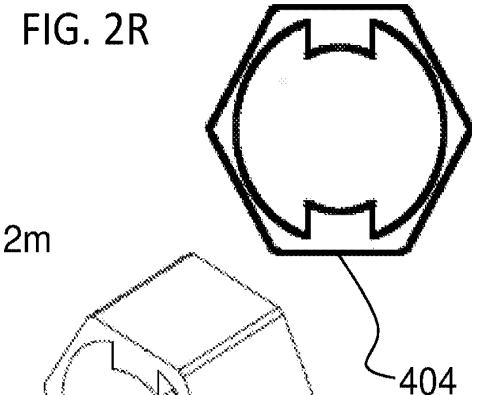


FIG. 2R

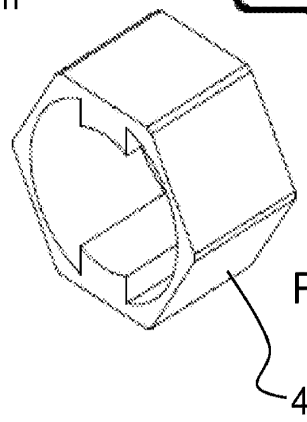


FIG. 2S

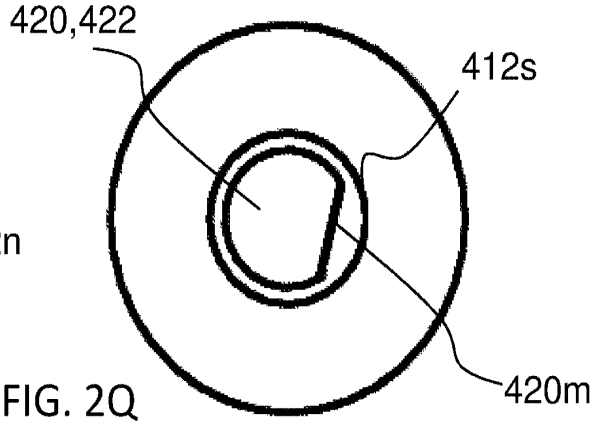


FIG. 2Q

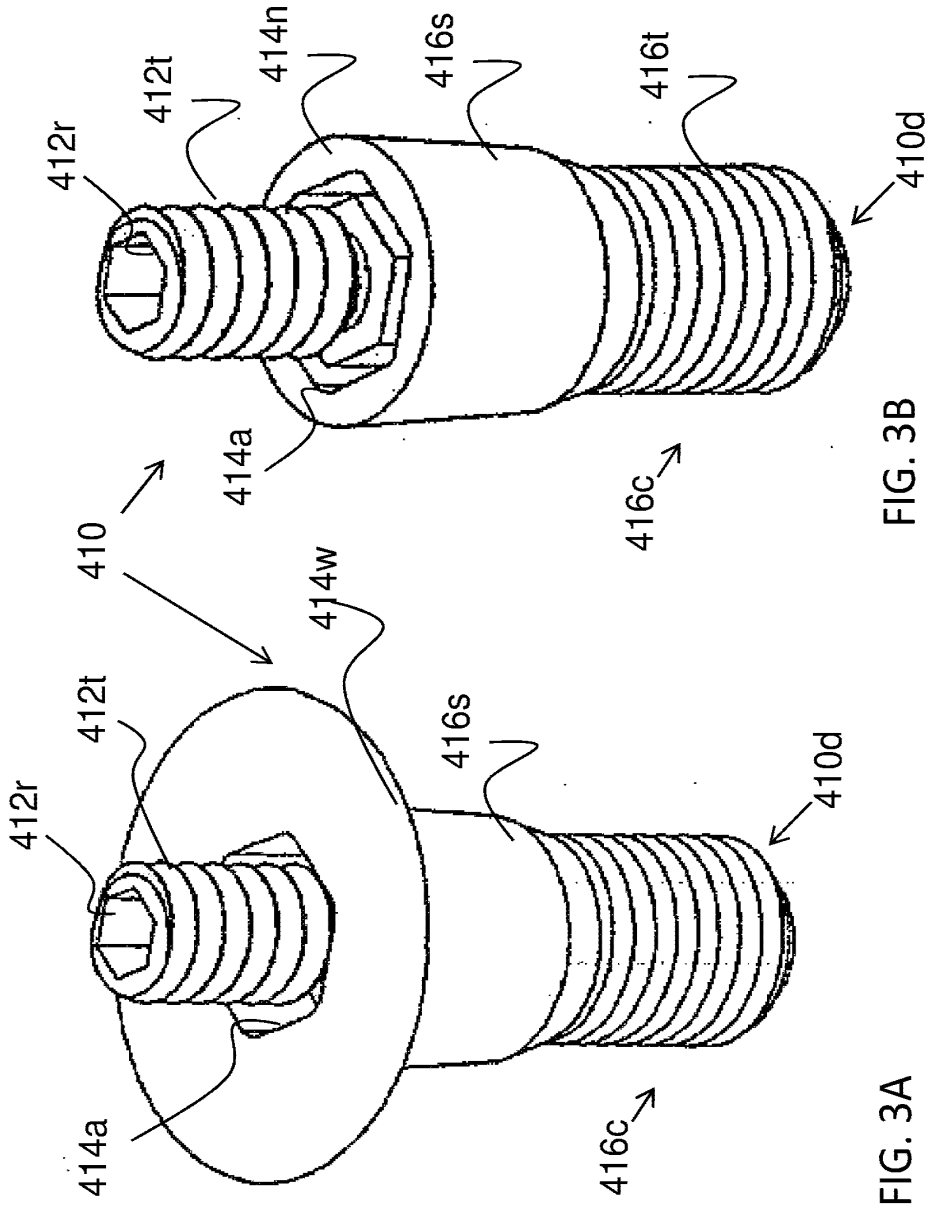


FIG. 3B

FIG. 3A

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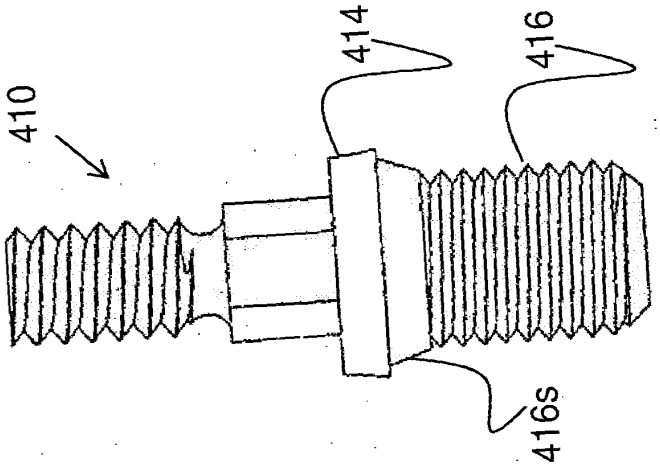


FIG. 4C

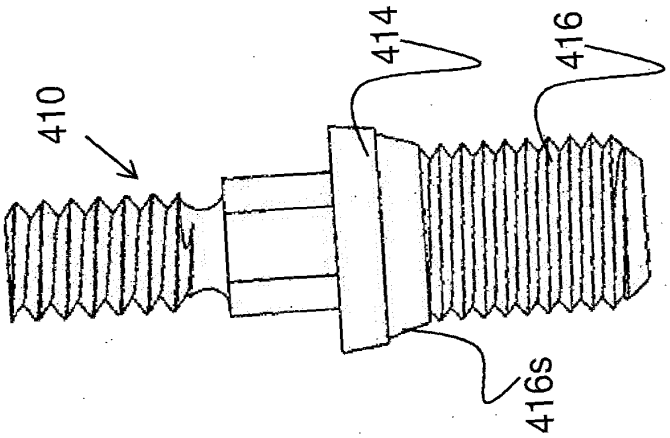


FIG. 4B

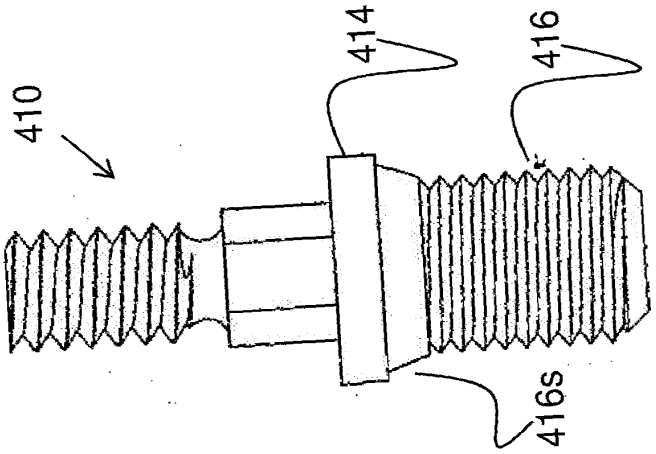


FIG. 4A

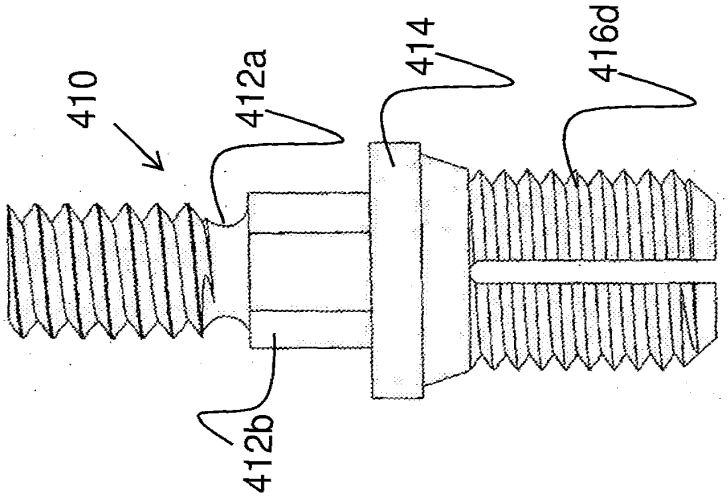


FIG. 4F

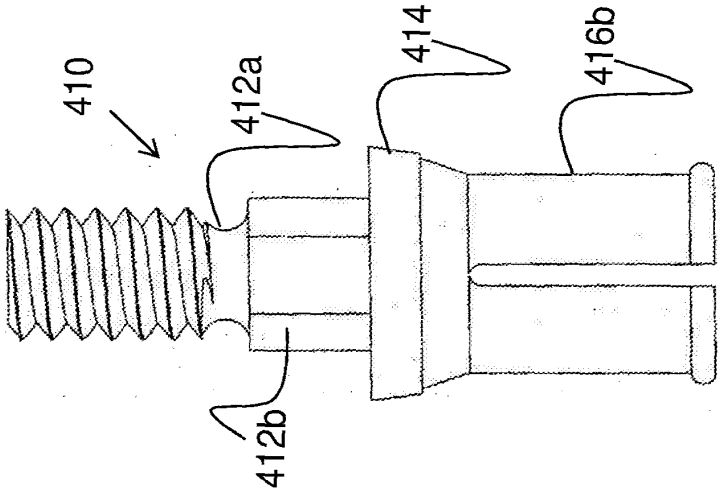


FIG. 4E

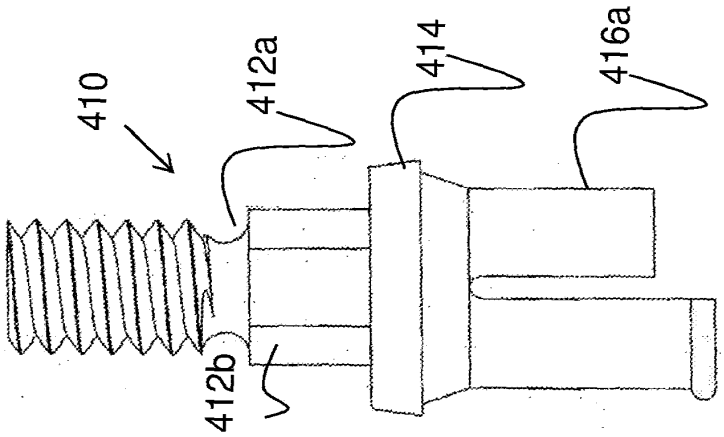


FIG. 4D

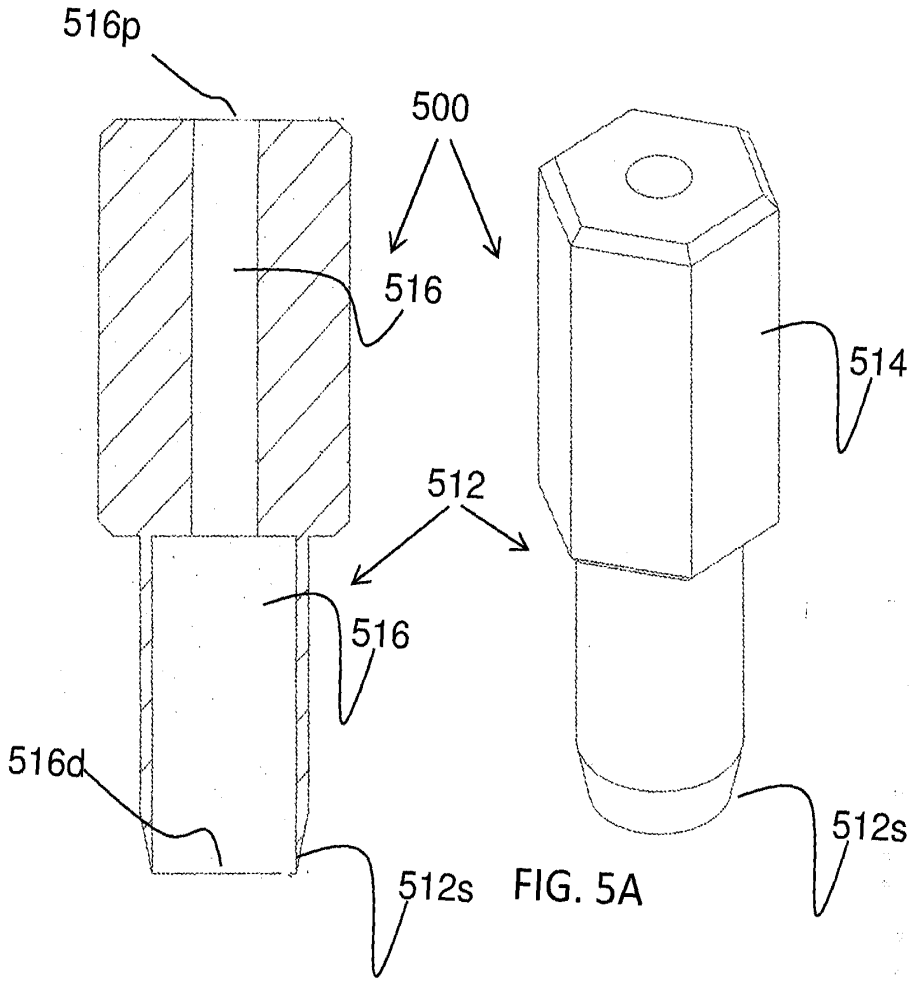


FIG. 5B

FIG. 5A

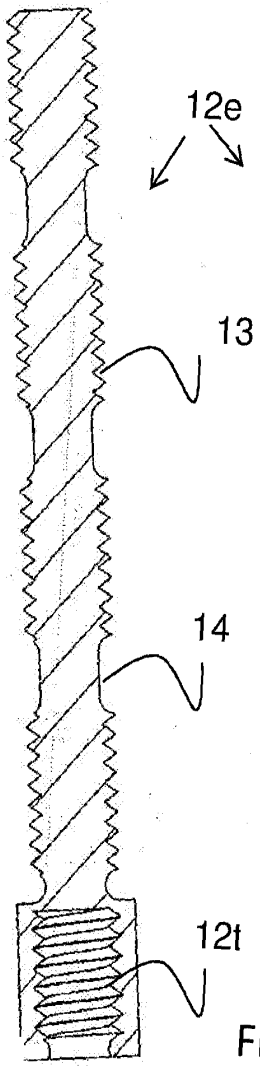


FIG. 8A

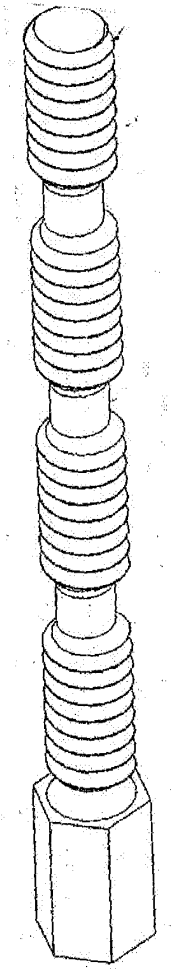


FIG. 8B

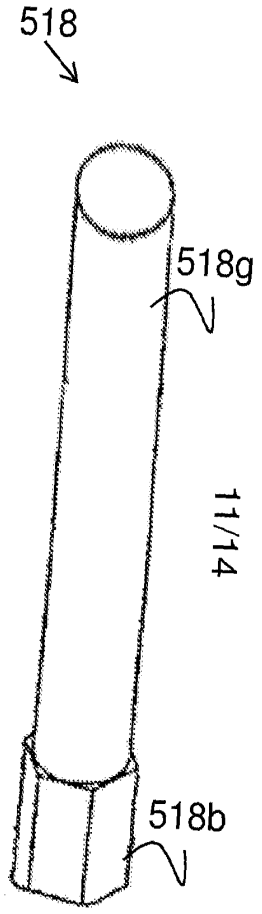


FIG. 8C

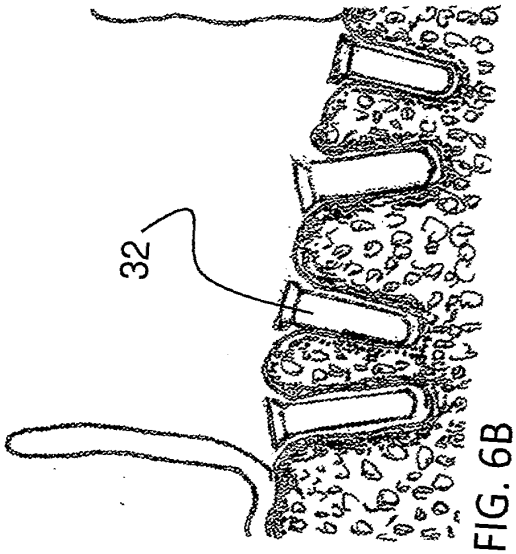


FIG. 6B

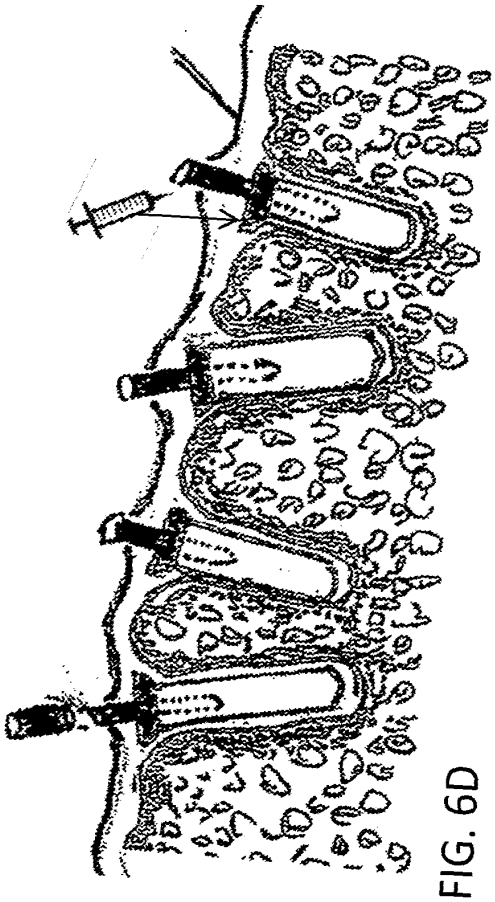


FIG. 6D

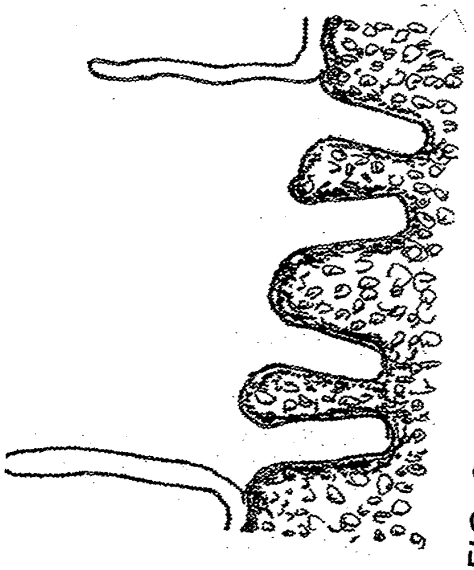


FIG. 6A

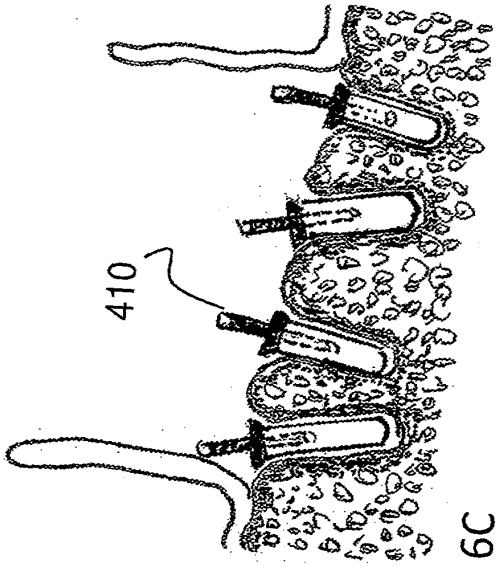


FIG. 6C

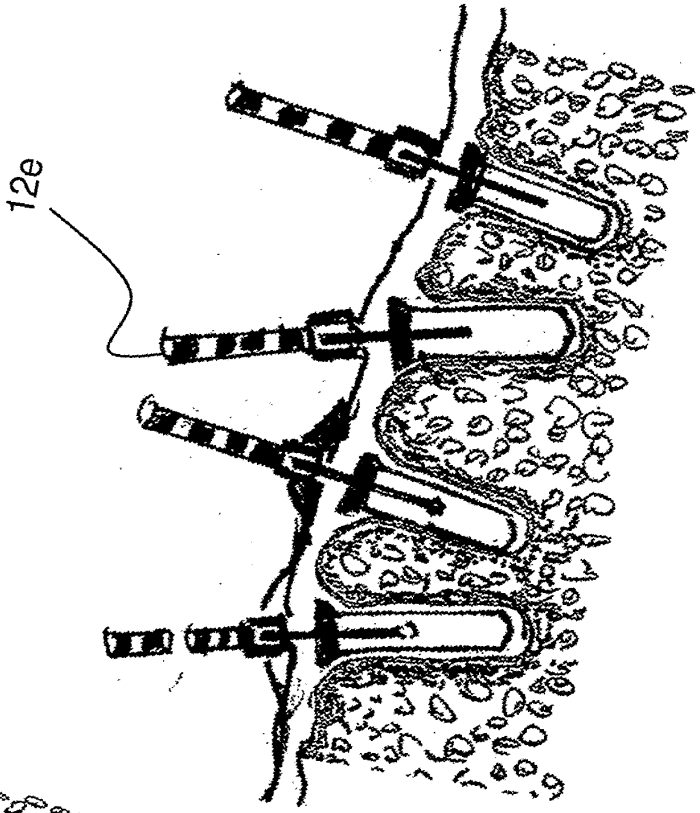


FIG. 6F

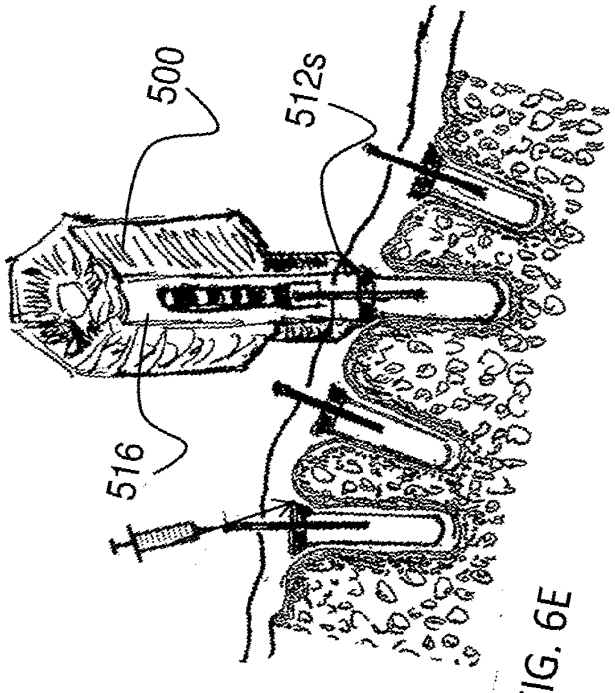


FIG. 6E

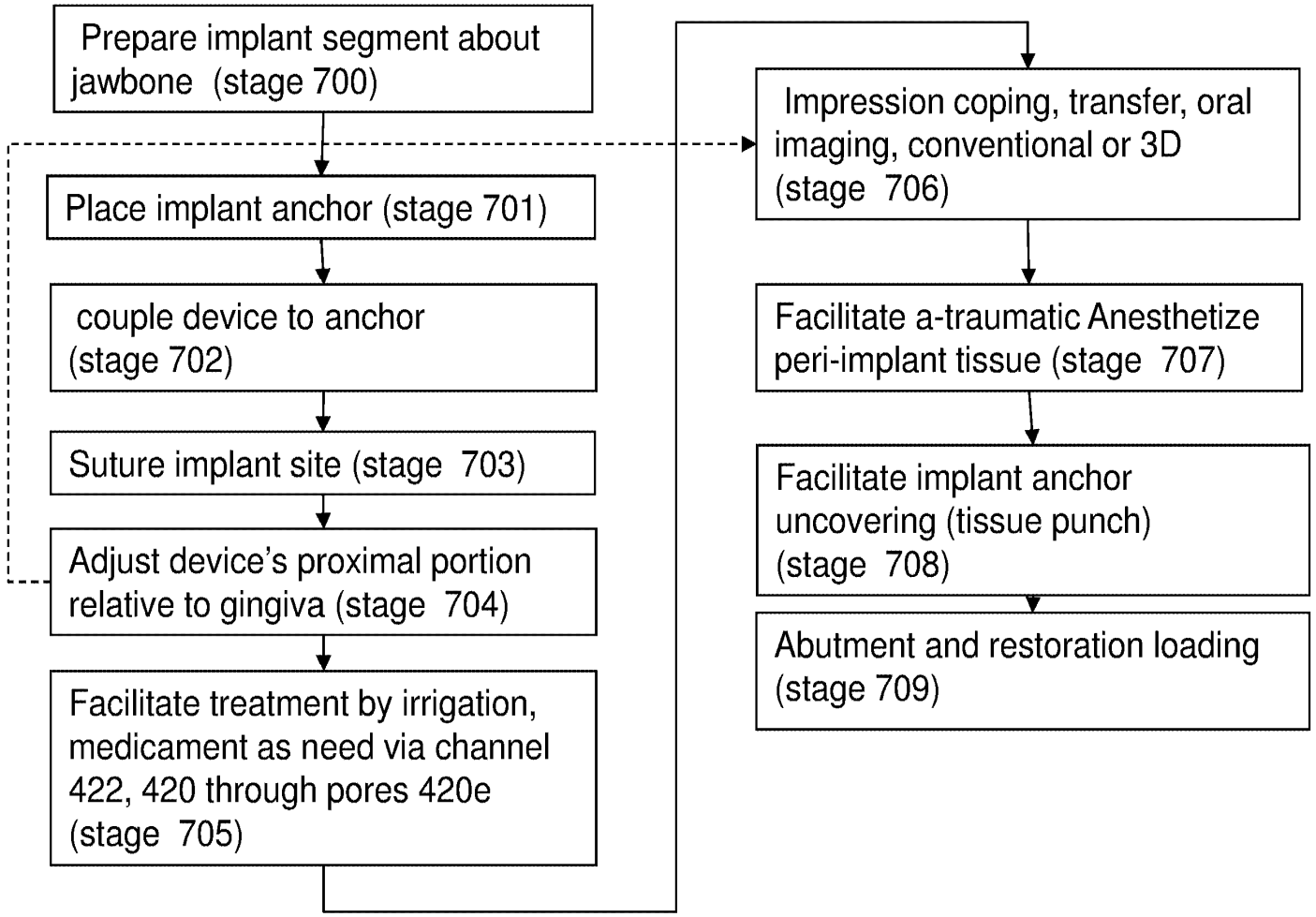

Prepare implant segment about jawbone (stage 700)
Place implant anchor (stage 701)
couple device to anchor (stage 702)
Suture implant site (stage 703)
Adjust device's proximal portion relative to gingiva (stage 704)
Facilitate treatment by irrigation, medicament as need via channel 422, 420 through pores 420e (stage 705)
Impression coping, transfer, oral imaging, conventional or 3D (stage 706)
Facilitate a-traumatic Anesthetize peri-implant tissue (stage 707)
Facilitate implant anchor uncovering (tissue punch) (stage 708)
Abutment and restoration loading (stage 709)

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IL2014/050511

A. CLASSIFICATION OF SUBJECT MATTER
IPC (2014.01) A61C 8/00

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC (2014.01) A61C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Databases consulted: THOMSON INNOVATION, FamPat database

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/0295223 A1 (BIOMET 3i, LLC) 22 Nov 2012 (2012/11/22) paragraphs [0011], [0041], [0042], [0050], [0055]; figures 1A-B, 6A-B	1-4,8-13,18-20, 23-25,31-33,41-43,50-52, 54,56-59,65
Y		44-49
X	US 2007/0275351 A1 (PARK ET AL.) 29 Nov 2007 (2007/11/29) paragraphs [0044]-[0048], [0063]-[0068], [0072]-[0073]; figures 3, 8	1-8,10,14-18,41,42, 52
X	US 5816809 A (GENETIC IMPLANT SYSTEMS, INC.) 06 Oct 1998 (1998/10/06) Abstract; column 3, line 45 - column 4, line 31; column 5, lines 12-30; figure 2	1-8,14-20,22,36-39, 41,42
Y	US 2008/0241789 A1 (MUNDORF S.) 02 Oct 2008 (2008/10/02) paragraph [0079]; figure 2	44-47

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
01 Oct 2014	01 Oct 2014
Name and mailing address of the ISA: Israel Patent Office Technology Park, Bldg.5, Malcha, Jerusalem, 9695101, Israel Facsimile No. 972-2-5651616	Authorized officer SEGAL Liviu Telephone No. 972-2-5651782

Form PCT/ISA/210 (second sheet) (July 2009)

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2011/0117522 A1 (COUNCIL OF SCIENTIFIC & IND. RESEARCH, NEW DELHI) 19 May 2011 (2011/05/19) paragraph [0145]; figures 4-6	48,49
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Bacterial Colonization of the Dental Implant Fixture–Abutment Interface: An In Vitro Study

Michael Tesmer,* Shannon Wallet,*† Theofilos Koutouzis,* and Tord Lundgren*

Background: The geometry of the fixture–abutment interface (FAI) might influence the risk of bacterial invasion of the internal part of the implant. The aim of this study was to use an in vitro model to assess the potential risk for invasion of oral microorganisms into the FAI microgap of dental implants with different characteristics of the connection between the fixture and abutment.

Methods: Thirty implants were divided into three groups (n = 10 per group) based on their microgap dynamics. Groups 1 and 2 were comprised of fixtures with internal Morse-taper connections that connected to standard abutments and the same abutments with a 0.5-mm groove modification, respectively. Group 3 was comprised of implants with a tri-channel internal connection. Fixtures and abutments were assembled and allowed to incubate in a bacterial solution of Aggregatibacter actinomycetemcomitans (previously Actinobacillus actinomycetemcomitans) and Porphyromonas gingivalis. Two standard abutments were either exposed to bacterial culture or left sterile to serve as positive and negative controls. After disconnection of fixtures and abutments, microbial samples were taken from the threaded portion of the abutment, plated, and allowed to culture under appropriate conditions.

Results: Three of the 10 samples in group 1 developed one colony forming unit (CFU) for A. actinomycetemcomitans, whereas zero of 10 samples developed CFUs for P. gingivalis. Ten of 10 and nine of 10 samples from groups 2 and 3, respectively, developed multiple CFUs for A. actinomycetemcomitans and P. gingivalis.

Conclusion: This study indicated that differences in implant designs may affect the potential risk for invasion of oral microorganisms into the FAI microgap. J Periodontol 2009;80:19911997.

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† Department of Oral Biology, College of Dentistry, University of Florida.

KEY WORDS

Bacteria; dental leakage; endosseous dental implantation; microbiology; osseointegration; titanium.

The quantity and quality of the bone surrounding a dental implant influences implant osseointegration and affects the shape and contour of the overlying soft tissues and, consequently, the esthetic outcome. Only with careful considerations of the biologic principles of peri-implant soft and hard tissues, as well as the appropriate selection of implant type and position, can a functional and esthetic treatment result be achieved.[1,2] Early bacterial colonization around implants by microorganisms associated with periodontitis was reported,[3-5] and this colonization of implant surfaces and peri-implant tissues can occur within minutes after implant placement.[6]

When a prosthetic abutment is connected to a fixture, a microgap is created between the components. Microorganisms may grow into this fixture–abutment interface (FAI) microgap[7-9] and set up a bacterial reservoir, resulting in an area of inflamed soft tissue facing the fixture– abutment junction.[10] A study by Callan et al.[9] used DNA probe analysis to examine the bacterial colonization into the FAI in patients. The authors reported moderate to high levels of eight different putative periodontal pathogens, including Aggregatibacter actinomycetemcomitans (previously Actinobacillus actinomycetemcomitans) and Porphyromonas gingivalis, colonizing the FAI. These findings support the results of other researchers[4,5] indicating a translocation

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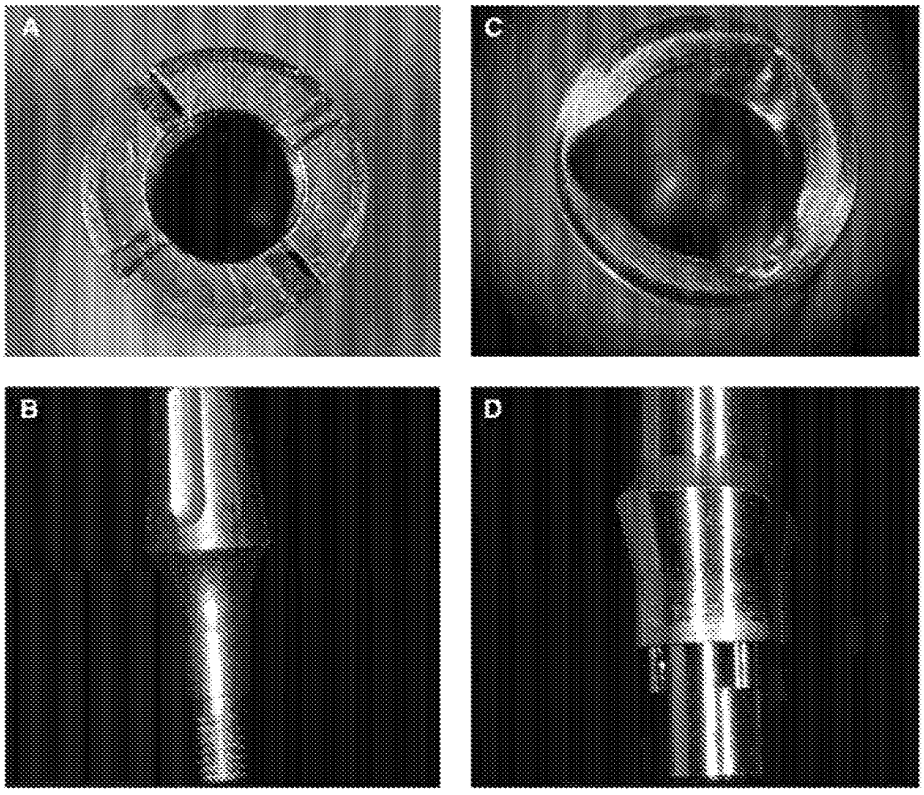


Figure 1.
A) Implant of group 1. B) Abutment of group 1. C) Implant of group 3. D) Abutment of group 3.

of microorganisms from the remaining dentition to implants.

Thus, the presence of an FAI microgap in close relation to bone may have a role in the development of peri-implant inflammation and bone loss.[11-16] Furthermore, when using one-piece implants that do not have an FAI microgap, minimal early bone resorption was found.[12] This result is consistent with the favorable 8-year outcomes of one-piece implants in patients reported by Buser et al.[17] and suggests the potential impact of the FAI microgap on successful implant therapy.

The design of the FAI may have an impact on the amount of microbial penetration into the internal part of dental implants.[8,16,18] For instance, in an in vitro study, Quirynen et al.[8] demonstrated the microbial penetration of the FAI microgap of fixtures with an external hex design. However, there was no comparison among implants with different FAI designs in the study. Jansen et al.[18] reported microbial leakage of 13 different implant–abutment combinations using Escherichia coli as indicator bacteria. Among the different implant–abutment combinations, an implant with an internal connection and a silicon washer demonstrated the fewest cases of leakage. In the report by implants were compared based on their FAI microgap geometry. Ten implants were tested in each experimental group: group 1 = fixtures with an internal Morse-taper connection‡ were connected to standard straight abutments§ with a height of 6 mm (Fig. 1); the Callan et al.,[9] implants from different manufacturers were used without the authors specifying thecharacteristicsoftheFAIgeometry. Therefore, despite the fact that they reported moderate to high levels of colonization of the FAI microgap by periodontal pathogens, it was not possible to evaluate the impact of the design of the FAI on the microbial penetration. Thus, there is limited information regarding differences in the microbial penetration of the FAI microgap of implants withdifferent internal connection designs. The aim of this study was to use an in vitro model to assess the potential risk for invasion of oral microorganisms into the FAI microgap in dental implants with different internal connection designs.

MATERIALS AND METHODS

Implant Experiment Groups

For this study, three groups of abutments were connected to the fixtures with a torque of 25 Ncm according to the manufacturer's protocol; group2=identicalfixturesandabutmentsasdescribed in group 1 were used with the exception that prior to fixture–abutment connection, a vertical groove of ;0.5 mm depth was prepared with a fissure bur‖ on one side of the abutment (Fig. 2). The fixtures and abutments were connected using a torque of 25 Ncm according to the manufacturer's protocol. The introduction of a 0.5-mm groove to the abutment was to ensure microbial penetration to the internal part of the implant, while allowing for the exact same torque for connecting the abutment as the implants in group 1; group 3 = fixtures with a tri-channel internal connection¶ were connected to 3-mm high abutments#

‡ Ankylos Fixtures (B14), 4.5 · 14 mm, Dentsply Friadent, Mannheim, Germany.
§ Standard C/Abutment b/3.0/6.0 straight, Dentsply Friadent.‖ US#557MX, XtremeCut, Brasseler, Savannah, GA ¶ Nobel Biocare Replace Select, 4.3 · 13 mm, Nobel Biocare, Gothenburg, Sweden
Esthetic Abutment Nobel Replace RP 3 mm, Nobel Biocare

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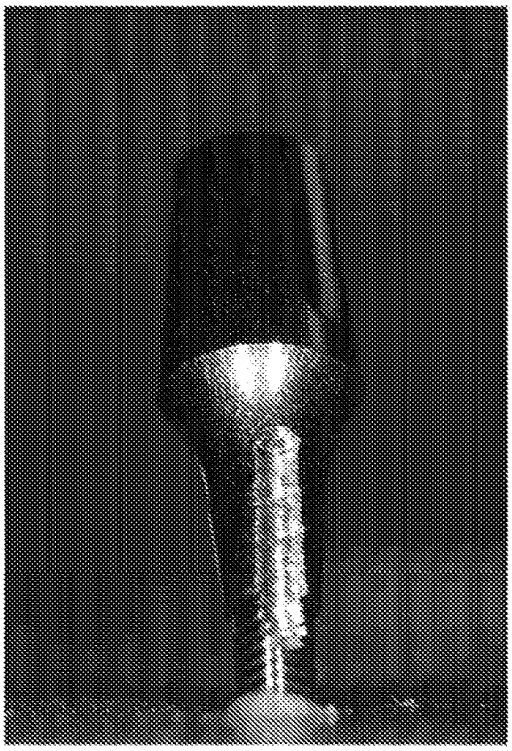


Figure 2.
Standard straight abutment of group 2 with 0.5-mm vertical groove.

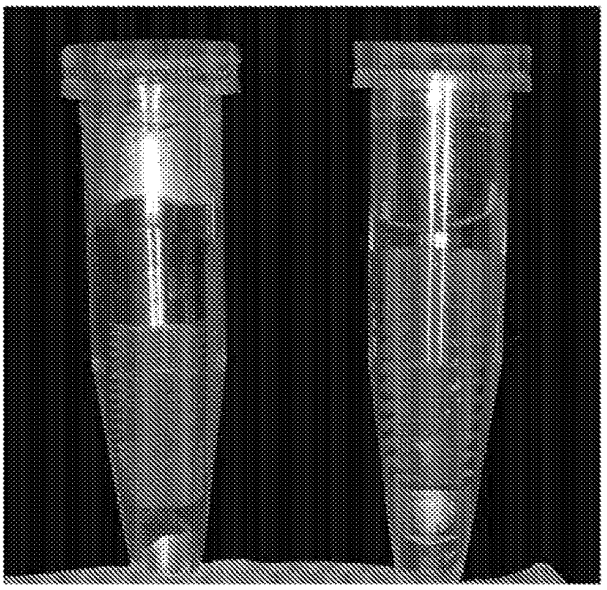


Figure 3.
Implant and abutment of group 1 (right) and group 3 (left) in a plastic container with the bacterial solution.

(Fig. 1). The components were connected with a torque of 35 Ncm according to manufacturer's recommendation.

To evaluate the microbial detection techniques, two standard straight abutments with a height of 6 mm were used as negative and positive controls. The negative-control abutment was not connected to a fixture and was not subjected to bacterial culture. The positive-control abutment was not connected to a fixture but was subjected to the same bacterial cultures as groups 1 through 3.

All fixtures and abutments were connected in a sterile environment and placed in a plastic container with a bacterial solution covering the FAI interface and containing microorganisms as described (Fig. 3).

Bacterial Culture Conditions

A. actinomycetemcomitans VT1169 (State University of New York [SUNY] 465 nalidixic acid resistant rifampicin resistant) was grown in liquid tryptic soy broth supplemented with yeast extract and cultured at 37C in 10% CO_2 to the mid-logarithmic phase. P.gingivalis W83 was grown in liquid tryptic soy broth supplemented with hemin, vitamin K, yeast extract, and L-cysteine hydrochloride at 37C under anaerobic conditions to the mid-logarithmic phase. Implants were placed in an aliquot of a 1:10 dilution of a 1:1 stock solution of A. actinomycemcomitans VT1169 and P. gingivalis W83 and incubated at 37C under anaerobic conditions for 5 days.

Microbial Sampling and Detection

After disconnection of fixtures and abutments under sterile conditions, microbial samples were taken from the threaded portion of the abutment using sterile cotton swabs. Samples were plated onto tryptic soybroth agar plates supplemented with yeast extract for the detection of A. actinomycetemcomitans and onto tryptic soy-broth agar plates supplemented with hemin, vitamin K, yeast extract, and L-cysteine hydrochloride for detection of P. gingivalis colony forming units (CFUs). Plates were incubated at 37C in 10% CO_2 for 7 and 2 days, respectively. Individual CFUs were counted and recorded.

Statistical Analyses

Median values and interquartile ranges were calculated for the number of CFUs for A. actinomycetemcomitans and P. gingivalis. In addition, the total number of implants per group exhibiting bacterial colonization of the FAI microgap was calculated. The KruskalWallis test with Dunn comparisons was applied to evaluate differences among the three groups regarding the number of CFUs for A. actinomycetemcomitans and P. gingivalis. The x^2 test was used to evaluate differences in the number of implants exhibiting bacterial colonization of

the FAI microgap among the different groups. A P value <0.05 was considered significant.

RESULTS

To validate the colonization and detection techniques, abutments similar to those in group 1 were left unassembled and either exposed to bacterial culture or left sterile. Zero CFUs of A. actinomycetemcomitans or P. gingivalis were detected from sampling of abutments that were left sterile (negative control), whereas 188 CFUs of A. actinomycetemcomitans and 113 CFUs of P. gingivalis were detected in samples from abutments exposed to bacterial culture (positive control). These data indicate that the conditions for colonization and sample collection were appropriate for the experimental design.

To semiquantitate the ability of A. actinomycetemcomitans or P. gingivalis to colonize the FAI microgap, CFUs from cultured samplings were quantified (Table 1). Group 1 exhibited significantly lower numbers of CFUs for A.actinomycetemcomitans (median: 0; interquartile range: 0 to 1) compared to group 2 (median: 81; interquartile range: 44.5 to 96.5) (difference: -36.25; P <0.05) and group 3 (median: 24.5; interquartile range: 11 to 56.5) (difference: -22; P <0.05). There was a significant difference in the number of CFUs for P. gingivalis between group 1 (median: 0; interquartile range: 0 to 0) and group 2 (median: 55; interquartile range: 35.5 to 96) (difference: -35.8; P <0.05). However, the difference in the number of CFUs for P. gingivalis between group 1 and group 3 (median: 12, interquartile range: 6 to 29.5) did not reach a statistically significant level (difference: -19.05; P >0.05).

The number of implants that had an FAI microgap contaminated with A. actinomycetemcomitans and P. gingivalis according to the different implant groups is presented in Table 2. Three of ten implants of group 1 had FAI microgaps colonized by A. actinomycetemcomitans, whereas none of the implants of this group had FAI microgaps colonized by P. gingivalis. In contrast, 10 of 10 implants in group 2 and nine of 10 implants in group 3 had FAI microgaps colonized by both A. actinomycetemcomitans and P. gingivalis. There was a statistically significant difference for the number of implants that had FAI microgaps colonized by A. actinomycetemcomitans between groups 1 and 2 (x^2 = 10.76; P<0.05) and between groups 1 and 3 (x^2=7.5; P <0.05). Similarly, there was a statistically significant difference between groups 1 and 2 (x^2 = 20; P <0.05) and between groups 1 and 3 (x^2=16.36; P <0.05) regarding the number of implants that had FAI microgaps colonized by P. gingivalis.

Table 1.

Median Number of CFUs (interquartile range) for A. actinomycetemcomitans and P. gingivalis by Implant Group

Group	A. actinomycetemcomitans (CFU)	P. gingivalis (CFU)
1 (n = 10)	0 (0 to 1)*†	0 (0 to 0)‡
2 (n = 10)	81 (44.5 to 96.5)	55 (35.5 to 96)
3 (n = 10)	24.5 (11 to 56.5)	12 (6 to 29.5)

* P <0.05; group 1 versus group 2 for A. actinomycetemcomitans (KruskalWallis test with Dunn comparisons).
† P <0.05, group 1 versus group 3 for A. actinomycetemcomitans (KruskalWallis test with Dunn comparisons).
‡ P <0.05; group 1 versus group 2 for P. gingivalis (Kruskal-Wallis test with Dunn comparisons).

Table 2.

Number of Implants With an FAI Microgap Contaminated With A. actinomycetemcomitans and P. gingivalis by Implant Group

Group	Number of Implants Contaminated With A. actinomycetemcomitans	Number of Implants Contaminated With P. gingivalis
1 (n = 10)	3*†	0‡§
2 (n = 10)	10	10
3 (n = 10)	9	9

* P <0.05, group 1 versus group 2 for A. actinomycetemcomitans (x^2 test). † P <0.05, group 1 versus group 3 for A. actinomycetemcomitans (x^2 test).
‡ P <0.05; group 1 versus group 2 for P. gingivalis (x^2 test). § P <0.05; group 1 versus group 3 for P. gingivalis (x^2 test).

DISCUSSION

The present study shows that the tested dental implants with a Morse-taper internal connection had negligible bacterial penetration down to the threaded part of the FAI under in vitro conditions. Three of 10 implants with this connection (group 1) had one CFU of A. actinomycetemcomitans. In addition, none of those implants developed CFUs for P. gingivalis. These results seem to be relevant with the geometry of the internal connection because nine of 10 implants with a tri-channel internal connection (group 3) developed multiple CFUs for both A. actinomycetemcomitans and P. gingivalis.

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However, there was no statistically significant difference between implants of groups 1 and 3 regarding the number of CFUs of P. gingivalis.

Microbial penetration along the internal part of dental implants was reported in some in vitro studies[8,16,18] using implants with different geometries of the FAI. For instance, Quirynen et al.[8] demonstrated that bacterial invasion of the FAI microgap was detected when fixtures and abutments were assembled and installed in a liquid blood medium inoculated with oral microorganisms. Similarly, Jansen et al.[18] reported microbial leakage of 13 different implant–abutment combinations using E. coli as the indicator bacteria. In addition, an in vivo study by Quirynen and van Steenberghe[7] reported the presence of microorganisms in the inner threads of external hex implants. All screw threads in this study harboredsignificantquantitiesofmicroorganisms.Most recently,Callanetal.[9]describedmoderatetohighlevels of eight different periodontopathogenic microorganisms,includingA.actinomycetemcomitansandP.gingivalis, colonizing the FAI using DNA-probe analysis. Interestingly, the study did not detect the colonization ofthescrew-threadsoftheabutments.Thisisincontrast to what was found in the present study, where the threads of the abutments of groups 2 and 3 were colonized with bacteria. This difference may lie in the sample-collection technique. Callan et al.[9] used paper points for sample collection, whereas in the present study, sterile cotton swabs were used for the microbial sampling. In addition, our group used CFUs, whereas Callan et al.[9] used DNA-probe analysis.

In the present study, we tested for microbial colonization of the FAI microgap by A. actinomycetemcomitans and P. gingivalis because both microorganisms have an established role as putative periodontal pathogens.[19] In this context, the bacterial flora associated with peri-implantitis resembles that of chronic periodontitis[20,21] with significant levels of bacteria such as Fusobacterium spp., Treponema spp., Tannerella forsythia (previously T. forsythensis), Prevotella intermedia, A. actinomycetemcomitans, and P. gingivalis. An FAI that is colonized early by putative periodontal pathogens such as A. actinomycetemcomitans and P. gingivalis may act as a reservoir of bacteria. This contributes to the establishment and maintenance of microflora that resembles that of chronic periodontitis. In fact Quirynen et al.,[5] using a checkerboard DNA–DNA hybridization and real-time polymerase chain reaction, revealed that a complex microbiota with several pathogenic species was established in peri-implant pockets within 2 weeks after abutment connection. However, the mere presence of putative periodontal pathogens does not indicate a direct etiologic relationship that may lead to a destructive process but may simply indicate a potential pathogenic environment.[22]

Few studies[23-25] focused on the decontamination of the inner-implant cavity of two-stage implants. In a recent study, Paolantonio et al.[25] reported that the application of a 1% chlorhexidine gel in the internal part ofthe fixturebefore abutment placement and screw tightening could be an effective method to reduce bacterial colonization over a 6-month period. The authors reported their findings for dental implants with an external hex design that was previously shown to exhibit microbial leakage at the FAI microgap.[7,8] In addition, Groenendijk et al.[24] reported that, the internal implant decontamination with0.2%chlorhexidinesolutionledtoareducedgingival index and crevicular fluid flow compared to saline treated controls. Although, the clinical impact of bacterial leakage on the implant survival rate seems to be very limited, as shown by longitudinal and cross-sectional studies,[26] the exclusion of bacteria from peri-implant regenerative procedures is considered of paramount importance to obtain clinical success.[27]

Loading forces on implants may also contribute to the bacterial colonization of the FAI microgap. One disadvantage of the present in vitro study is that loading conditions were not applied. For instance, in an in vitro experiment using loading forces, Steinebrunner et al.[16] evaluated bacterial leakage along the FAI microgap and discovered statistically significant differences between five implant systems withrespecttothenumberofchewingcycles andbacterial colonization. Thus, it is important to confirm or contrast the results of the present study using loading conditions.

The importance of the position, size, and geometry of the implant on marginal bone levels was a subject of various studies[13,14,28,29] demonstrating that several factors are important regarding peri-implant marginal bone loss. The bacterial colonization of the FAI microgap was reported to be one of these factors. The potential colonization of oral microorganisms of the FAI microgap is presumably impacted by multifactor conditions like the precision fit between the implant components, torque forces when the components are connected, and loading forces when the implants are in function. Indeed, Zipprich et al.[30] evaluated the dynamic behavior of dental implants with different designs of the fixture–abutment connection with respect to microbial colonization. The authors reported the micromovement of the fixture–abutment complex of implants loaded at an angle of 30 when a force of up to 200 N was applied. Interestingly, the same implant system used in our experiment was one of four systems reported to exhibit no micromovement when loaded at 100 N and one of two systems showing no measurable microgap when loaded at 200 N.[30] The authors speculated that certain implant designs would minimize the pumping effect between the fixture and the abutment, thus preventing bacterial colonization of the FAI interface.

CONCLUSIONS

The present study indicated that differences in implant design may affect the potential risk for colonization of oral microorganisms into the FAI microgap. Also, this study indicated a negligible bacterial penetration down to the threaded part of the FAI of dental implants with a Morse-taper connection, although the effects of functional loading still need to be assessed.

ACKNOWLEDGMENTS

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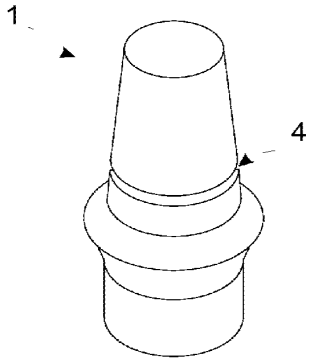
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(54) **Title:** IMPRESSION AND MODEL COMPONENTS

(57) **Abstract:** This invention is related to the impression and model component in order to determine easily and extremely sensitively the place of metal superstructure of implant supported prostheses (screw, cement and bar retained restorations).

Figure 1



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Description

IMPRESSION AND MODEL COMPONENTS

[I] Technical Field:

[2] This invention is related to the impression and model components in order to determine easily and highly sensitively the place of metal superstructure of implant supported prostheses (screw, cement and bar retained restorations).

[3] Prior Art:

[4] Today, implants are placed in jawbone in case of full, partial or single tooth loss and excellent mouth rehabilitation is achieved by placing fixed or mobile prosthesis on them.

[5] Implant supported prostheses has a metal superstructure in order to mount them in their place in the mouth. To manufacture metal superstructure, a model prepared by taking impression from the patient is required. For said model, impression is taken from the patient with closed tray or open tray techniques.

[6] Closed tray impression technique:

[7] To take mouth impression;

[8] Impression pick-up (impression cap) is placed using snap-on mechanism on the abutment screwed on the implant. Snap-on mechanism operates in such way that rabbet part whose plastic impression pick-up diameter is smaller than the abutment stretches and covers around the abutment.

[9] Mouth impression and position of impression pick-up in the mouth are obtained through placing impression tray filled with rubber based impression material into the mouth and polymerizing the same. When the impression is removed from the mouth, impression pick-up remains inside the impression because polymerized impression material holds the impression pick-up by means of groove and extensions located on the impression cap.

[10] Modelling according to the impression;

[II] Analog which is a replica of the abutment in the mount is placed on the impression pick-up via snap-on mechanism. Plaster is poured into the impression in such way to include analog and left to harden. After hardened plaster is removed from the impression and thus a mouth model with abutment analog is provided.

[12] Casting cylinder (wax-up coping, burn-out cap, burn-out cylinder) is placed on abutment analog using snap-on mechanism or directly. Metal superstructure form is provided by waxing up the casting cylinder, that is wax figure of metal superstructure with casting cylinder in it is obtained. Wax figure is removed from abutment analog and invested, and casting is conducted conventionally. Thus, metal superstructure is manufactured.

[13] Furthermore, in certain systems impression is taken by screwing transfer coping instead of abutment into implant. Impression is removed from the mouth, transfer coping is unscrewed from implant and implant analog is screwed to the same. Transfer coping on which implant analog is screwed is then repositioned in the slot inside the impression and plaster is poured in. After hardening, plaster is removed from the impression. Hence, implant analog is inside the plaster model and transfer coping is on this model. Transfer coping is removed from the plaster model and abutment is screwed in the same place. Casting cylinder is placed on the abutment via snap-on mechanism or directly and metal superstructure is provided using the casting method as described above.

[14] There also exist systems in which transfer cap is placed on the transfer coping and said transfer cap remains in the impression. In those systems, transfer coping is required to be placed in the transfer cap remaining in the impression after transfer coping is unscrewed from the implant and implant analog is screwed instead.

[15] Open Tray Impression Technique:

[16] To take mouth impression;

[17] Plaster model is produced by taking mouth impression of the patient. Individual impression tray specific to the patient (custom made impression tray) is prepared on the said model. Hole is made on the custom made impression tray by being aligned to the implant. Impression pick-up is screwed on the implant using integral positioning screw (implant guide pin). Individual impression tray is filled with rubber based impression material and then applied into the patient's mouth in such way to the screw head protrude from the hole.

[18] Modelling according to the impression;

[19] After polymerization of the impression material, screw is loosened and the impression is removed from the mouth. Implant analog (implant replica) is screwed into the impression pick-up remaining in the impression and plaster is poured in. After plaster harden, screw is loosened and removed from the impression. Thus, plaster model in which implant analog is present is provided. Abutment is screwed into the implant analog and casting cylinder is placed on the abutment and metal superstructure is manufactured via casting method as described above.

[20] Furthermore, in certain systems transfer copings and transfer pick-ups used in the closed tray method are also used in this method. Weakened area on the transfer caps is punctured and integral positioning screws are screwed into the implant by passing through this hole and the channel in the transfer coping. As described above, impression is taken in such way that screw heads protrude from the custom made impression tray and the same procedures are followed.

[21] Technical problem:

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[22] In the prior art; impression is taken by using the combinations of

[23] - Impression pick-up + abutment analog,

[24] - Transfer coping + implant analog or;

[25] - Transfer cap + transfer coping + implant analog.

[26] During the combinations, abovementioned parts were screwed to each others and unscrewed and then screwed again or inserted in each other, then removed and then inserted again or removed from the impression and then repositioned inside the impression. During these procedures some mistakes were possibly be made. For instance, during screwing, unscrewing, screwing again, torque force could not be standardized, therefore screw might be sometimes wound excessively and sometimes less than required.

[27] Moreover; as a result of

[28] - slipping into foreign objects into the gap during inserting parts to each other and removing parts from each other, or

[29] - folding very thin rubber extensions during the procedure of removing from the impression and repositioned into the impression;

[30] position of the implant in the plaster model or abutment analogs on the plaster model might be different from the position in the mouth. Thus, it is highly possible to manufacture an incompatible metal superstructure because of obtaining a faulty plaster model.

[31] Dental technician obtains wax figure of the metal superstructure to be used in the casting by placing casting cylinders on the abutments in the plaster model and waxing up. In prior art, dental technician removes this wax figure and then invests it and performs casting procedure.

[32] Especially in the long bridges and full mouth restorations, deformations may occur during removing and investing the wax figure and metal superstructure may not fit with the desired accuracy.

[33] Open tray impression is a technique developed in order not to remove the impression pick-up or transfer coping from the impression. Necessity of such method can be showed as a proof of existence of the problems listed above. However, in the further steps of the open tray impression technique; screwing, unscrewing and screwing again procedures are performed sequentially.

[34] In most of the systems according to the prior art, snap-on mechanism is used on the shoulder of the implant in order to fit properly casting cylinders on the abutment analogs and to keep them fixed during wax-up. When metal superstructure is cast, this snap-on mechanism is required to be removed using finishing instruments because metal is not elastic. No matter how carefully was this process performed, it was impossible to be performed sensitive by hand. However, marginal fit should be perfect

for the success of an implant for a long time. Casting cylinder of the systems in which snap-on mechanism is not used are placed directly on the abutment analog. However, in this case any attachment was not used; therefore, casting cylinders could not be kept fixed on the abutment during wax-up, so incompatibility could be seen in metal super-structure.

[35] Primary and secondary, if any, objects of the invention

[36] Object of the invention is to provide the impression and model components in order to determine precisely the position of implant during taking impression from the mouth in which implant is placed and producing model.

[37] Detailed Description of Embodiment according to the Invention related to Cement retained Restorations

[38] Impression and model components provided for attaining the objects of the invention are shown in the accompanying drawings wherein;

[39] Figure 1- is a perspective view of abutment according the invention.

[40] Figure 2- is a cross-section view of embodiment of hybrid cylinder with wide-spaced ledge according to the invention.

[41] Figure 3- is a cross-section view of embodiment of hybrid cylinder with narrow-spaced ledge according to the invention.

[42] Figure 4- is a cross-section view of peripheral ledge embodiment of hybrid cylinder according to the invention.

[43] Figure 5- is a perspective view of the guide piece according to invention.

[44] Figure 6- is a perspective view of die pin according to invention.

[45] Figure 7- is a cross-section perspective view in which die pin guide piece and hybrid cylinder according to invention are inserted in each other.

[46] Figure 8- is the cross-section view of position of the abutment according to the invention in the mouth.

[47] Figure 9- is the cross-section view of the hybrid cylinder which is inserted into the abutment in the mouth.

[48] Figure 10- is the cross-section view of the impression which is taken after the hybrid cylinder according to the invention is inserted in the abutment.

[49] Figure 11- is the cross-section view of the hybrid cylinder according to the invention while being disengaging from the abutment when the impression is removed from the mouth.

[50] Figure 12- is the cross-section view in which die pin according to the invention is passed through the hybrid cylinder by means of the guide piece and inserted in the impression material.

[51] Figures 13- is the cross-section view of the hybrid cylinder and die pin according to the invention after the guide piece is removed.

[52] Figure 14- is a cross-section view of the investment model on which hybrid cylinder according to the invention is present.

[53] Figure 15- is a perspective view of abutment analogue according to the invention.

[54] Figure 16- is a cross-section view of hybrid cylinder according to the invention and the abutment analogue placed in it.

[55] Parts included in the Figures are separately numbered and the numbers refer to the following:

[56] 1. Abutment

[57] 2. Hybrid cylinder

[58] 3. Ledge (in the hybrid cylinder)

[59] 4. Groove (on the abutment)

[60] 5. Retentive extensions (on the hybrid cylinder)

[61] 6. Die pin

[62] 7. Guide piece

[63] 8. Channel (in the guide piece)

[64] 9. Grip (on the guide piece)

[65] 10. Horizontal grooves (on the die pin)

[66] 11. Sharp pointed end (die pin)

[67] 12. Abutment analog

[68] Basically, the embodiment related to cement retained restorations according to the invention comprises;

[69] - a groove (4) around the abutment (1) and toward the inner part of the abutment (1) and;

[70] - a ledge (3) on interior surface of the hybrid cylinder (2) and located in such way to receive groove (4) on the abutment (1);

[71] in order to insert abutment (1) and hybrid cylinder (2) in each other (Figure 1-4).

[72] Groove (4) preferably is on the abutment (1), lmm above of the cervical margin and in the form of slot surrounding the abutment (1) (Figure 1).

[73] Hybrid cylinder (2) is a receiving piece of the abutment (1). Therefore, ledges (3) cross-section of which is almost a semi-circle is positioned at a level to receive the groove (4) on the abutment (1) (Figure 2-4). As a result of conical shape due to tapering diameter of the exterior surface of abutment (1) and the conical shape on the interior surface of the hybrid cylinder (2) receiving the former, ledge (3) and groove (4) are easily engaged to each other and disengaged from each other. To facilitate the operation of the snap-on mechanism comprising said engaging and disengaging procedures, hybrid cylinder (2) preferably is manufactured from an elastic material, e.g. a plastic derivative.

[74] There are peripheral retentive extensions (5) on the occlusal end of the exterior

surface of the hybrid cylinder (2). Thus, hybrid cylinder (2) is allowed to remain in impression by disengaging from the abutment (1) while the impression is removed from the mouth. Furthermore, it is also possible to add sequentially more than one retentive extensions (5) in parallel in order to shorten the excessive length of hybrid cylinder (2) during usage. Hence, it is possible to use a hybrid cylinder (2) with abutments (1) in various sizes (figure 2-4).

[75] In implementation of the invention, investment is filled in the impression instead of plaster to produce master cast. However, die pin (6) is used in order not to break investment which is a weak material during removing from the impression (figure 6). Because of its structure, die pin (6) is much smaller than the interior diameter of hybrid cylinder (2). Therefore, guide piece (7) is used to orient die pin (6) in the hybrid cylinder (2) (figure 5-7). There is a longitudinal channel (8) in the centre of the guide piece (7) through which die pin (6) can pass (figure 5).

[76] To orient die pin (6) passing through the channel (8), first of all guide piece (7) needs to be fitted properly in the hybrid cylinder (2). To this end, guide piece (7) has the same exterior surface bevelling as the interior bevelling of the hybrid cylinder (2). The largest diameter of the hybrid cylinder is smaller than the narrowest diameter of the end of the ledge (3) inside the hybrid cylinder (2). Thereby, guide piece (7) fits into the hybrid cylinder (2) without being engaged with the ledge (3). After die pin (6) is passed through the channel (8) following central axis of the guide piece (7) and inserted into the impression material, this guide piece (7) can be removed from the hybrid cylinder (2) perpendicularly (figure 7). There is a grip (9) in the shape of cylindrical handle on the exterior part of the guide piece (7). This grip (9) enables easy removal of the guide piece (7) by means of a forceps from the hybrid cylinder (2).

[77] There exist horizontal grooves (10) located vertically to the central axis of the die pin (6) in order to allow it to attach to the investment. In addition, die pin (6) can be easily inserted into the impression material as its end (11) is sharp pointed. Besides, sharp pointed end (11) has a smaller diameter in comparison to the body of the die pin (6); thereby, pointed end is only inserted into the impression.

[78] The models are provided using the components described above according to the procedures listed in the following;

[79] - In the first visit, two identical impressions are taken from the patient, thus two hybrid cylinders (2) are used (101).

[80] - Abutment (1) is screwed to the implant during taking the impression (figure 8). Length of the abutment (1) and hybrid cylinders (2) are modified by cutting or without cutting their crest beforehand according to the interocclusal distance (102).

[81] - One of the hybrid cylinders (2) are placed on the abutment (1) via snap-on mechanism (figure 9)

[82] - The first impression is made with the rubber-based impression material (103) (figure 10).

[83] - Repeating this procedure, the other hybrid cylinder (2) is placed on abutment (1) via snap-on mechanism and second impression is taken using again rubber based impression material (104).

[84] - When the impressions are removed from the mouth, hybrid cylinders (2) remain in the impression due to retantive extensions (5) on them (105) (figure 11).

[85] - Guide piece (7) is placed on the hybrid cylinder (2) in the first impression and sharp pointed end (11) of the die pin (6) is inserted in the impression material passing through the channel (8) at the centre of this piece (106) (figure 12).

[86] - Die pin (6), thus, is provided to pass through the centre of the hybrid cylinder (2) (107).

[87] - Guide piece is removed (figure 13).

[88] - Die pins (6) are placed on the appropriate places for the natural teeth (108).

[89] - An investment which has a high strength to resist fracture is poured in the impression. (some investment products have compressive strength of 40-50MPa similar to dental stone) (109).

[90] - After hardening, investment is removed from the impression, end of the die pin (6) is cut, thereby a investment model with hybrid cylinder (2) and natural teeth is produced (110) (figure 14).

[91] - In this model, wax figure of the metal superstructure is obtained by waxing up the hybrid cylinder (2) (111).

[92] - Areas other than metal superstructure in the investment model are sawed. (112).

[93] - Sprues, reservoirs and sprue former are attached to the wax figure (113).

[94] - Investment part on which wax figure of the metal superstructure is present is placed in a ring and then invested again (114).

[95] - Casting procedure is performed according to the conventional methods (115).

[96] - Ledge (3) comprising snap-on mechanism in the hybrid cylinder (2) is removed by grinding (116).

[97] In addition, in case the number of the natural teeth in the 109th step, plaster can be filled in the natural teeth area and investment can be filled in the implant area.

[98] In the 110th step, to provide investment model; optimal values for the groove (4) and ledge (3) comprising snap-on mechanism between abutment (1) and hybrid cylinder (2), extension at the occlusal tip of exterior surface of the hybrid cylinder (2) can be determined by the simple tests conducted by the Universal testing machine.

[99] It is possible to use hybrid cylinder wide spaced ledge in order to grind easily the ledges (3) which are part of snap-on mechanism mentioned in the 116th step (figure *X*). Excessive grinding of the ledges (3) does not prevent operation of system as remaining

surfaces keep their places.

[100] - Abutment analog (12) is placed in the hybrid cylinder (2) in the second impression in order to manufacture plaster model in which dental technician orients the metal superstructure and then performs the following procedures (figures 15-16). Plaster model with abutment analog (12) on it is fabricated by pouring plaster inside the impression.

[101] Detailed Description of 1st Embodiment of the Invention related to the Screw Retained Restorations

[102] Impression and model components provided for attaining the objects of the invention are shown in the accompanying drawings wherein;

[103] Figure 17- is cross section perspective view in which the hybrid cylinder and the impression cap according to the invention are mounted on the abutment.

[104] Figure 18- is the cross-section perspective view of the hybrid cylinder according to the invention.

[105] Figure 19- is the perspective view of the hybrid cylinder according to the invention.

[106] Figure 20- is the cross-section perspective view of the impression cap according to the invention.

[107] Figure 21- is the perspective view of the impression cap according to the invention.

[108] Figure 22- is the perspective view of the die pin which is seated in the slot in the hybrid cylinder according to the invention.

[109] Figure 23- is the cross-section perspective view of the lengthening part of the hybrid cylinder according to the invention.

[110] Figure 24- is the cross section view in which the hybrid cylinder according to the invention is screwed to the abutment on the implant.

[Ill] Figure 25- is the cross section perspective view showing the position of the hybrid cylinder and the impression cap according to the invention after they are seated on the abutment.

[112] Figure 26- is the perspective view showing the hybrid cylinder and the impression cap according to the invention together with their notch and nail.

[113] Figure 27- is the cross section perspective view of the impression which is taken after hybrid cylinder and impression cap according to the invention is seated on the abutment.

[114] Figure 28- is the cross-section perspective view showing removal of the impression cap from the hybrid cylinder when the impression is removed from the mouth.

[115] Figure 29- is the cross section perspective view in which die pin according to the invention is placed in the hybrid cylinder.

[116] Figure 30- is the cross section perspective view in which the hybrid cylinder according to the invention is seated in the impression cap in the impression after the die pin is placed.

[117] Figure 31- is the cross section perspective view of the hybrid cylinder, the die pin together with the lengthening part of the hybrid cylinder according to the invention.

[118] Figure 32- is the perspective view of the abutment analog.

[119] Figure 33- is the cross section perspective view in which the hybrid cylinder according to the invention is placed in the impression cap after the abutment analog is screwed.

[120] Parts included in the Figures are separately numbered and the numbers refer to the following:

[121] 13. Screwed abutment

[122] 14. Hybrid cylinder

[123] 15. Impression cap

[124] 16. Groove (on the hybrid cylinder)

[125] 17. Nail (on the impression cap)

[126] 18. Retentive extensions (on the impression cap)

[127] 19. Die pin

[128] 20. Horizontal grooves (on the die pin)

[129] 21. Lengthening part of the hybrid cylinder

[130] 22. Screwed abutment analog

[131] The embodiment of the invention related to screw retained restorations comprises principally;

[132] - a hybrid cylinder (14) to be placed on the screwed abutment (13);

[133] - a impression cap (15) to determine the direction and the position of the hybrid cylinder (14) in the impression material,

[134] - die pin (19),

[135] - lengthening part of the hybrid cylinder (21) (figure 23).

[136] Hybrid cylinder (14) is similar with the plastic casting cylinders currently manufactured and is an access part of the screw retained abutments (13). However, hybrid cylinder (14) differs from the casting cylinders as its height align with the top of the screw and it has a deep notch (16) on its upper edge allowing to be placed in the impression cap in the same position (figure 18-19).

[137] Impression cap(15) is a part that is fixed to top of the hybrid cylinder (14), has nail (17) on its inferior side surface and exterior diameter of which is larger than the hybrid cylinder (14) (figures 20-21). There present retentive extensions (18) both on the exterior top surface for retention and for being retained by forceps and also on the exterior side surfaces for retention.

[138] The basic function of the die pin (19) is to prevent investment from breaking and the secondary function is to provide screw slot in the casting (figure 22). Therefore, head of die pin (19) has a similar form with the screw and has an appropriate diameter to fit

into the hybrid cylinder (14) properly. Die pin is cylindrical and made of high fusing alloy. There are horizontal grooves (20) for retention of the investment on it.

[139] Lengthening part of the hybrid cylinder (21) is developed in order that the dental technician performs wax-up procedure (figure 23). It is a tubular plastic part which can be seated the same place after the impression cap (15) is removed.

[140] Manufacturing models by using abovementioned components:

[141] - In the first visit, two identical impressions are taken from the patient (201).

[142] - Thus two hybrid cylinders (14) and two impression caps (15) are used (202).

[143] - In taking impression, hybrid cylinder (14) is screwed gently to the screwed-abutment (13) on the implant (203) (figure 24).

[144] - Impression cap (15) is placed on the hybrid cylinder (14). In this process, it is ensured that nail (17) on the internal side surface of the impression cap (15) is fitted properly into the notch (16) on the upper edge of the hybrid cylinder (14) (204) (figures 25-26).

[145] - First impression is taken with rubber based impression material (205) (figure 27).

[146] - Other hybrid cylinder (14) is screwed gently on the screwed-abutment (13) and the second impression is taken by repeating the same procedure (206).

[147] - When the first impression is removed from the mouth, the impression cap (15) remains in the impression due to retentive extensions (18) both on the top and side surfaces (207) (figure 28).

[148] - Hybrid cylinder (14) is unscrewed from the abutment (13) (208).

[149] - To prevent investment from breaking and to provide screw slot in the casting, die pin (19) is placed in the hybrid cylinder (14) (209) (figure 29).

[150] - Hybrid cylinder (14) on which die pin (19) is seated is placed on the impression cap (15) in the impression. In this process, it is ensured that nail (17) on the internal side surface of the impression cap (15) is fitted properly into the notch (16) on the upper edge of the hybrid cylinder (14) (210) (figure 30).

[151] - Die pins (19) are placed in the appropriate places for the natural teeth and an investment which has a high strength to resist fracture is poured in the impression (some investment products have compressive strength of 40-50MPa similar to dental stone) (211).

[152] - In case the number of the natural teeth is more, plaster may be poured into the natural teeth area and investment to be poured into the implant area (212).

[153] - After hardening, investment model is removed from the impression, thereby investment model on which hybrid cylinder (14) and natural teeth are present is manufactured (213).

[154] - After modifying the height of the lengthening part of the hybrid cylinder (21) according to the interocclusal distance dental technician places the same on the hybrid

cylinder (14) (214) (figure 31).

[155] - Wax figure of the metal superstructure is manufactured by waxing up and casting procedure is performed as described in the cemented abutments part (215).

[156] - Investment residue on the metal superstructure is cleaned and die pin is removed from its slot (216).

[157] - In the second impression taken in order to manufacture plaster model on which dental technician orients the metal superstructure and performs the following procedures, the impression cap (15) also remains in the impression as stated before (217).

[158] - Hybrid cylinder (14) is unscrewed from the abutment (13) (218).

[159] - Abutment analog (22) is screwed to the hybrid cylinder (14) (219) (figure 32).

[160] - Hybrid cylinder (14) is placed in the impression cap (15) in the impression considering the nail (17) and notch (16) (220) (figure 33).

[161] - After pouring plaster, a plaster model on which abutment analog (22) is present is manufactured (221).

[162] Detailed Description of 2nd Embodiment according to the Invention related to the Screw-Retained Restorations

[163] Impression and model components provided for attaining the objects of the invention are shown in the accompanying drawings wherein;

[164] Figure 34 - is the cross-section perspective view in which hybrid cylinder and hybrid cylinder cap according to the invention are mounted on the screwed-abutment by means of snap-on screw.

[165] Figure 35 - is the cross-section perspective view of the hybrid cylinder according to the invention.

[166] Figure 36 - is the perspective view of the snap-on screw according to the invention.

[167] Figure 37 - is the cross-section perspective view of the hybrid cylinder according to the invention.

[168] Figure 38 - is the perspective view of the die pin to be screwed to the hybrid cylinder cap according to the invention.

[169] Figure 39 - is the cross-section perspective view of the lengthening part of the hybrid cylinder according to the invention.

[170] Figure 40 - is the cross-section perspective view in which hybrid cylinder according to the invention is seated in the abutment on the implant by means of snap-on screw.

[171] Figure 41 - is the cross-section perspective view of the position of the hybrid cylinder according to the invention on the abutment after hybrid cylinder cap is mounted.

[172] Figure 42 - is the cross-section perspective view of the impression taken after hybrid cylinder cap is mounted on the hybrid cylinder according to the invention.

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[173] Figure 43 - is the cross-section perspective view showing the removal of the hybrid cylinder according to the invention from the snap-on screw when the impression is removed from the mouth.

[174] Figure 44 - is the perspective view in which the die pin is screwed to the hybrid cylinder cap according to the invention.

[175] Figure 45 - is the cross-section perspective view of the hybrid cylinder according to the invention on the investment model.

[176] Figure 46 - is the cross-section perspective view of the hybrid cylinder and the lengthening part mounted on the same.

[177] Figure 47 - is the perspective view of the abutment analog.

[178] Figure 48 - is the perspective view of the intermediary screw.

[179] Figure 49 - is the cross-section perspective view in which abutment analog is screwed to the hybrid cylinder cap according to the invention by means of intermediary screw.

[180] Parts included in the Figures are separately numbered and the numbers refer to the following:

[181] 23. Screwed abutment

[182] 24. Hybrid cylinder

[183] 25. Retentive extension (on hybrid cylinder)

[184] 26. Snap-on screw

[185] 27. Retentive area (snap-on screw)

[186] 28. Hybrid cylinder cap

[187] 29. Screw threads (in the hybrid cylinder cap)

[188] 30. Die pin

[189] 31. Screw threads (at the end of the die pin)

[190] 32. Horizontal grooves (on the die pin)

[191] 33. Lengthening part of the hybrid cylinder

[192] 34. Intermediary screw

[193] 35. Screwed abutment analog

[194] The embodiment of the invention related to screw retained restorations comprises principally;

[195] - A hybrid cylinder (24) to be seated on the screwed abutment (23) by means of snap-on system,

[196] - Screw comprising snap-on system (26),

[197] - hybrid cylinder cap (28),

[198] - die pin (30) to be screwed to the hybrid cylinder cap (28),

[199] - lengthening part of hybrid cylinder (33); (figure 34).

[200] Hybrid cylinder (24) is similar to the plastic casting cylinders currently produced by

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the manufacturers. However, length of the hybrid cylinder is shortened and a peripheral retentive extension (25) is made at the occlusal end of its exterior surface in order to enable the hybrid cylinder to remain in the impression while the impression is removed from the mouth. Hence, hybrid cylinder (24) is enabled to remain in the impression while the impression is removed from the mouth (figure 35).

[201] A specific snap-on screw (26) is developed in order to provide snap-on mechanism between the hybrid cylinder (24) and screwed abutment (23). A peripheral retentive area (27) just under the head of this screw is provided by tapering slightly side parts of the head of screw (figure 36). Thereby, snap-on mechanism is maintained between the hybrid cylinder (24) and the screwed abutment (23).

[202] Hybrid cylinder cap (28) is a part which is fixed to top of the hybrid cylinder (24) and has threads (29) on the end facing to the snap-on screw (26). It is seated on top of the edge of the hybrid cylinder (24) before taking the impression. When the impression is removed from the mouth, die pin (30) is screwed to the screw threads (29) which are present in the hybrid cylinder cap (28) (figure 37).

[203] Die pin (30) prevents investment from breaking and provide a screw hole. It is a cylindrical part having the same diameter with the screw. One of its ends has screw thread (31) in order to be screwed to the hybrid cylinder cap (28), the other end remains in the investment model and it has horizontal grooves (32) for retention of the investment on it. Die pin (30) is made of high fusing alloy.

[204] Lengthening part of the hybrid cylinder (33) is developed in order that dental technician performs wax up procedure. It is a tubular plastic part which can be seated top of the hybrid cylinder (24) after the hybrid cylinder cap (28) is removed (figure 39).

[205] Manufacturing models by using abovementioned components:

[206] - In the first visit, two identical impressions are taken from the patient. Thus two hybrid cylinders (24) and two hybrid cylinder cap (28) are used (301).

[207] - In taking the impression, one of the hybrid cylinders (24) is screwed gently to the abutment (23) on the implant by means of snap-on screw (26) in such way to provide snap-on mechanism (302). (figure 40)

[208] - Hybrid cylinder cap (28) is mounted on the hybrid cylinder (24) and the first impression is taken with the rubber based impression material (303). (figures 41-42)

[209] - Other hybrid cylinder (24) is screwed gently on the abutment (23) by means of snap-on screw (26) and the second impression is taken by repeating the same procedures (304).

[210] - When the first impression is removed from the mouth, hybrid cylinder (24) disengage from the snap-on mechanism due to the peripheral retentive extensions (25) on the occlusal end and remains in the impression (305) (figure 43).

[211] - Die pin (30) is screwed to the hybrid cylinder cap (28) on the hybrid cylinder (24) (306) (figure 44).

[212] - Die pins are placed in the appropriate places for the natural teeth and an investment which has a high strength to resist fracture is poured in the impression (some investment products have compressive strength of 40-50MPa similar to dental stone) (307).

[213] - After hardening, investment model is removed from the impression. Thereby, the investment model on which hybrid cylinder (24) and natural teeth are present is manufactured (308) (figure 45).

[214] - Hybrid cylinder cap (28) is unscrewed from the die pin (30) (309).

[215] - After dental technician modifies the height of the lengthening part of the hybrid cylinder (33) according to the interocclusal distance, it is mounted on the hybrid cylinder (24). The following procedures are performed as described under the cemented abutments and the metal superstructure is manufactured (310) (figure 46).

[216] - In the second impression taken in order to manufacture plaster model on which dental technician orients the metal superstructure and performs the following procedures, the hybrid cylinder (24) also remains in the impression by disengaged from the snap-on mechanism as stated before (311).

[217] - Abutment analog (35) is screwed to the hybrid cylinder cap (28) by means of the intermediary screw and the plaster model on which hybrid cylinder (24) is present is manufactured (312) (figure 47-49)

[218] - The hybrid cylinder (24) is removed from the abutment analog (35) by unscrewing the hybrid cylinder cap (28) (313).

[219] In 311th step, optimal values for allowing hybrid cylinder (24) to remain in the impression by disengaging from the snap-on mechanism can be determined by the simple tests conducted by the Universal testing machine.

[220] In the 312th step, in case the number of natural teeth is more, plaster may be filled in the natural teeth area and investment may be filled in the implant area.

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Claims

[1] A hybrid cylinder system enabling to fit the metal superstructure of the implant supported prosthesis in the embodiment related to the cement retained restorations;
allowing abutment (1) and hybrid cylinder (2) to be inserted in each other;
comprising:
- a groove (4) around the abutment (1) and to the inner part of the abutment (1) and;
- ledge (3) on interior surface of the hybrid cylinder (2) and located in such way to receive the grove (4) on the abutment (1);
characterized with
- the groove (4) on the abutment (1) to be inserted in each other and to be removed from each other and the receiving ledge (3) in the hybrid cylinder (2) and;
- the retentive extensions (5) located on the occlusal end of exterior surface of the hybrid cylinder (2) to allow hybrid cylinder (2) to remain in the impression by disengaging from the abutment (1) during taking the mouth impression.

[2] A hybrid cylinder (2) system according to Claim 1 characterized with a die pin (6) having the same exterior surface bevelling with the interior bevelling of the hybrid cylinder (2) in the impression, oriented through a channel (8) in the guide piece (7) largest diameter of which is smaller than the narrowest diameter of the end of the ledge (3) inside the hybrid cylinder (2) in order to prevent investment from breaking while manufacturing mouth model corresponding to the impression via investment.

[3] A hybrid cylinder (2) system according to claims 1 or 2 characterized with a die pin (6) having horizontal grooves (10) in order to attach to the investment.

[4] A hybrid cylinder (14) system enabling to fit the metal superstructure of the implant supported prosthesis in the embodiment related to the screw retained restorations; comprising
- A hybrid cylinder (14) to be placed on the screwed abutment (13);
- An impression cap (15) to determine direction and position of the hybrid cylinder (14) in the impression material;
characterized with:
to provide inserting of the abutment (13) and hybrid cylinder (14) in only one position;
- a nail (17) comprise a extension from the inner side of the impression cap (15) and;

- a groove (16) on the hybrid cylinder (14) in which nail (17) on the impression cap (15) is seated,

the retentive extensions (18) on the exterior side surface of the impression cap (15) to allow impression cap (15) remain in the impression material.

[5] A hybrid cylinder (24) system enabling to fit the metal superstructure of the implant supported prosthesis in the embodiment related to the screw retained restorations; comprising

- hybrid cylinder (24) to be seated on the screwed abutment (23) by means of snap-on mechanism,
- a screw comprising snap-on mechanism (26),
- hybrid cylinder cap (28);

characterized with:

- a hybrid cylinder (24) having retentive extensions (25) to hold impression material while removing from the mouth, and
- a hybrid cylinder cap (28) providing easy removal of the hybrid cylinder (24) from the screwed abutment (23);
- a snap-on screw (26) having a peripheral retentive area (27) just under the head of screw provided by tapering slightly side parts of the head of screw upwards, and
- a hybrid cylinder cap (28) to cover top of the hybrid cylinder (24), having a screw hole in its centre providing retention of screwed die pin (30) when hybrid cylinder (24) remains in the impression material together with the hybrid cylinder cap (28).

Figure 1

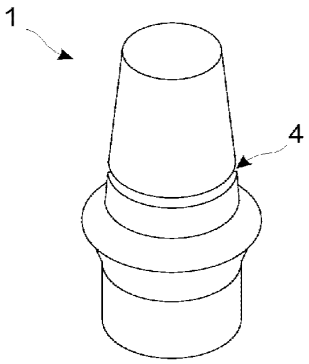


Figure 2

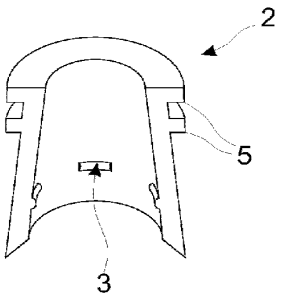


Figure 3

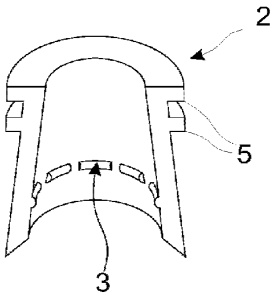


Figure 4

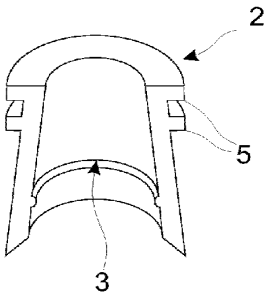


Figure 5

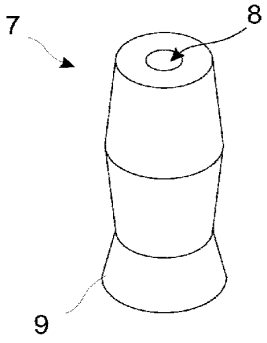


Figure 6

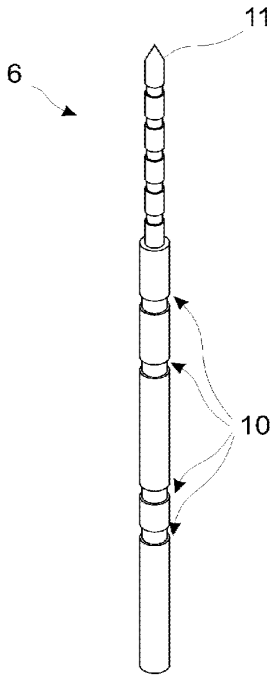
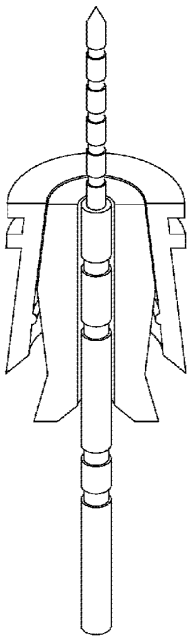


Figure 7



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Figure 8

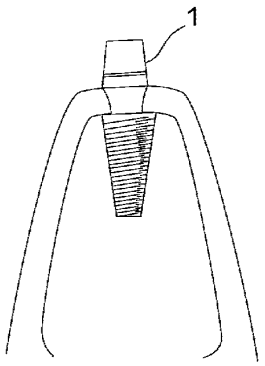


Figure 9

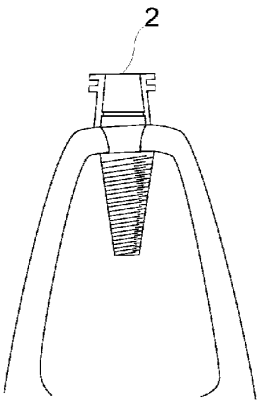


Figure 10

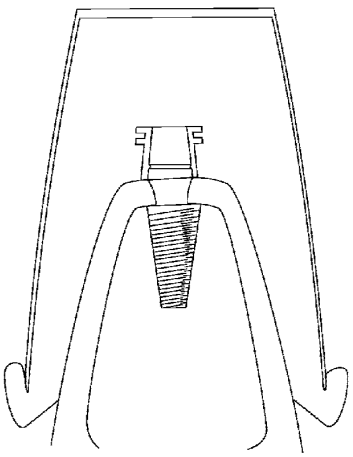
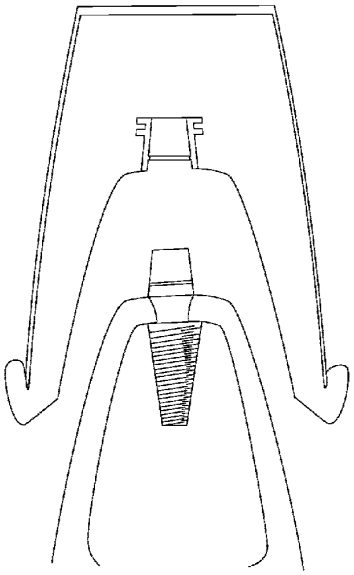


Figure 11



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Figure 12

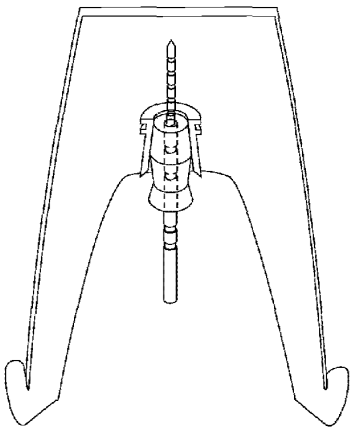


Figure 13

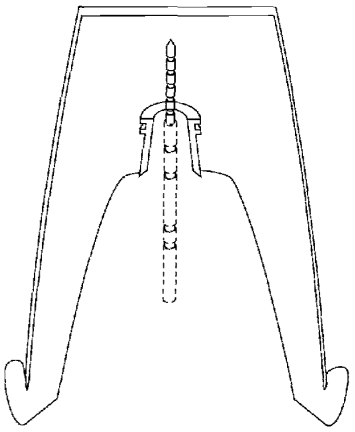
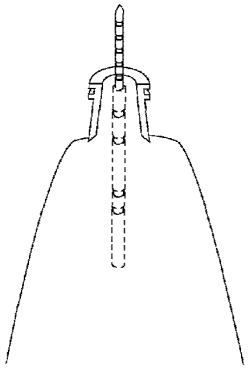


Figure 14



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Figure 15

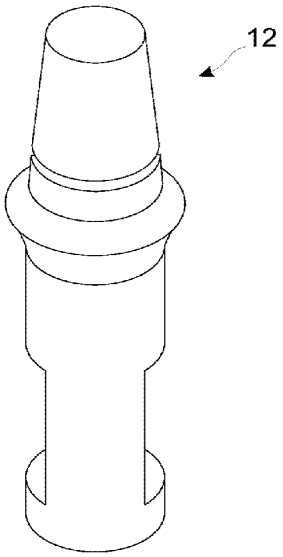


Figure 16

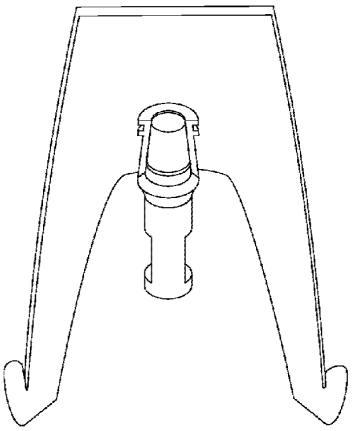


Figure 17

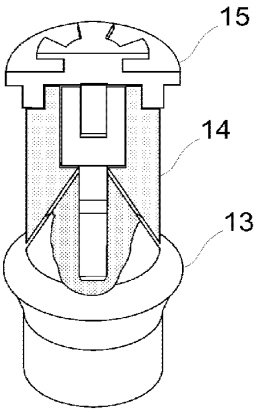


Figure 18

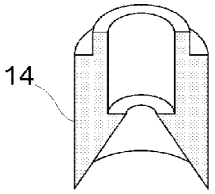


Figure 19

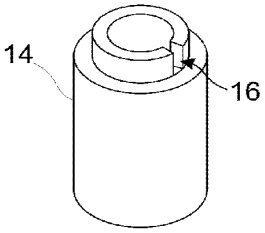


Figure 20

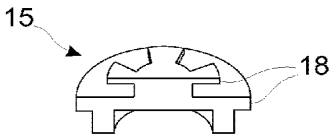


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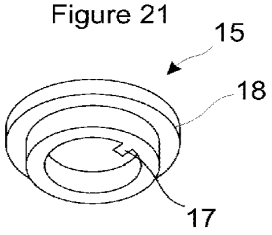


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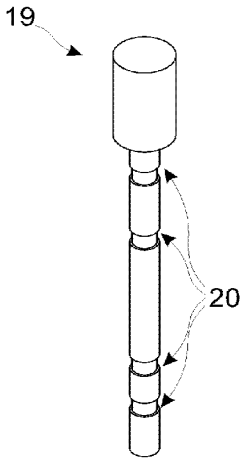


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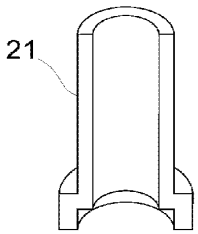


Figure 24

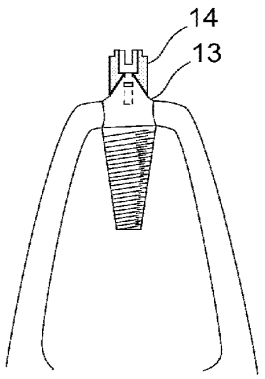


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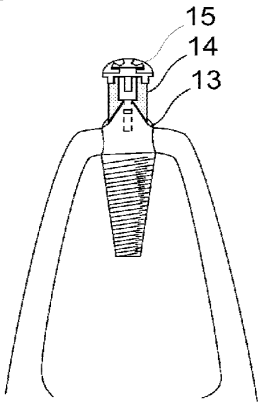


Figure 26

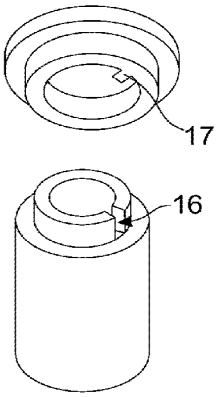


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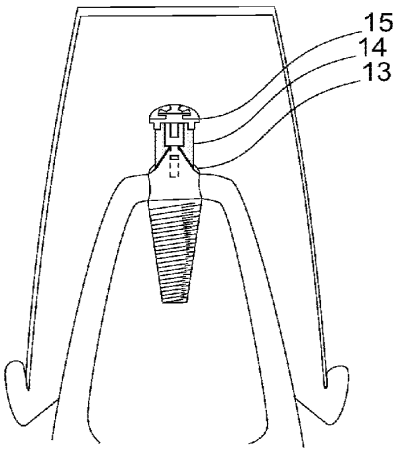


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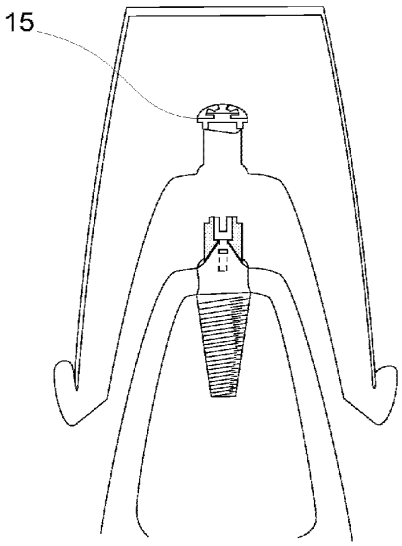


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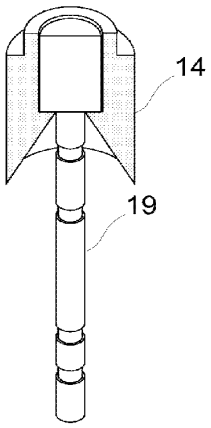


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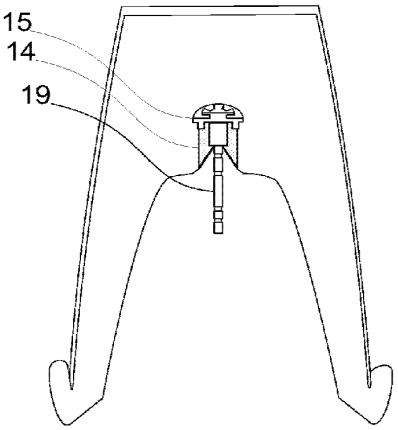


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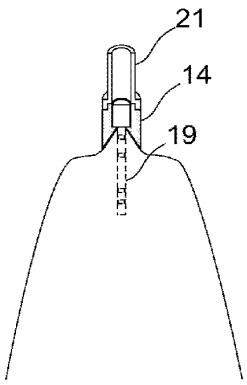


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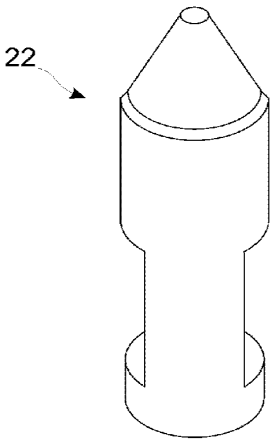


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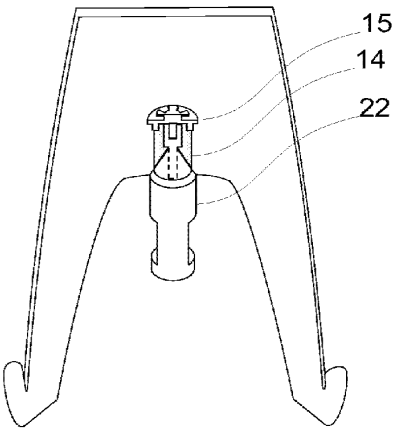


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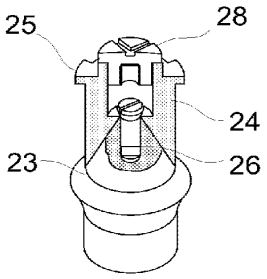


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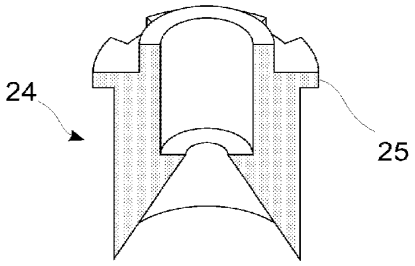


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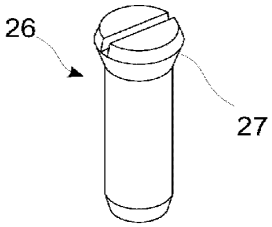


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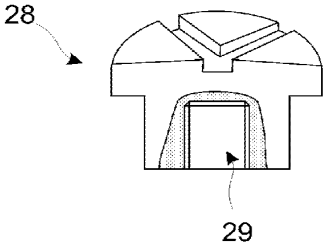


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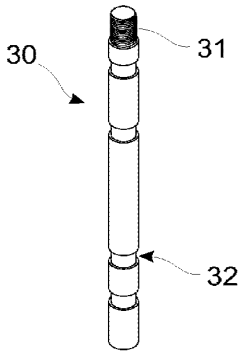


Figure 39

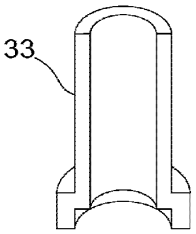


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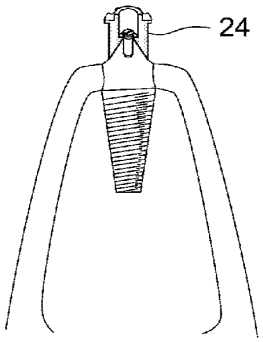


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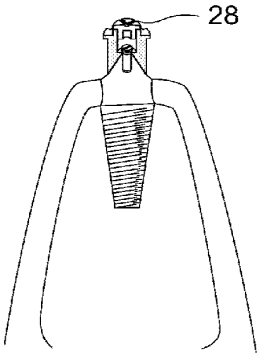


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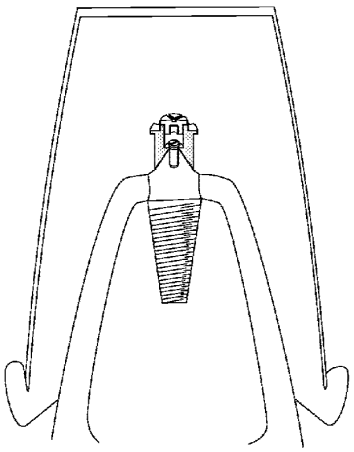


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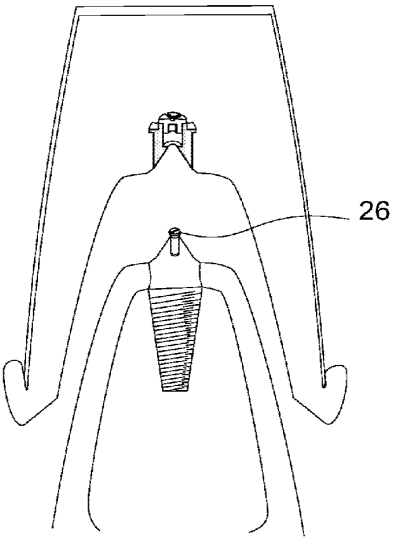


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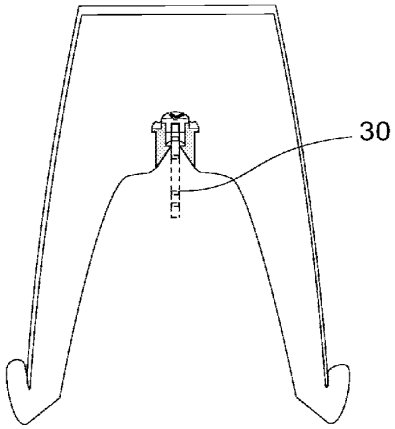


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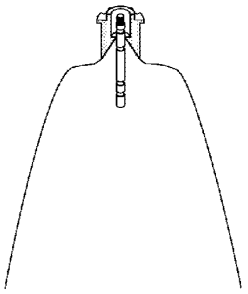


Figure 46

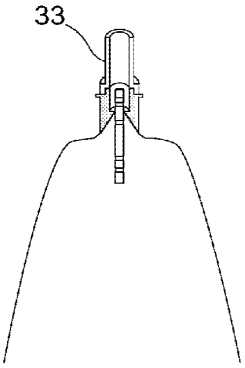
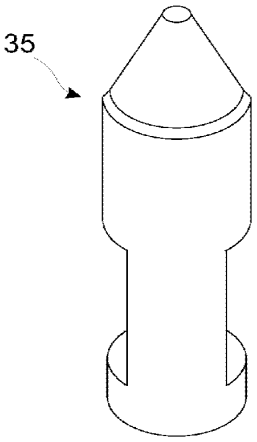


Figure 47



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Figure 48

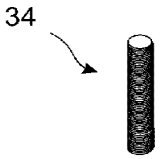
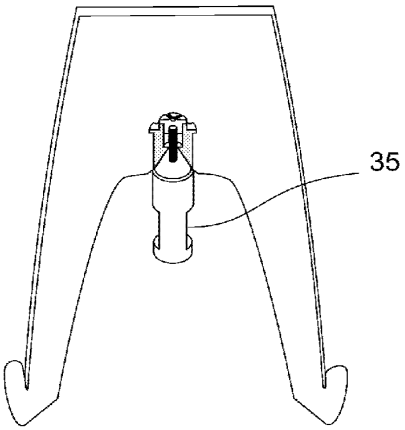


Figure 49



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(54) Title: DENTAL IMPLANT SYSTEM COMPRISING MEANS FOR PREVENTING ROTATION OF THE SUPERSTRUCTURES AND METHODS OF FORMING AND INSTALLING

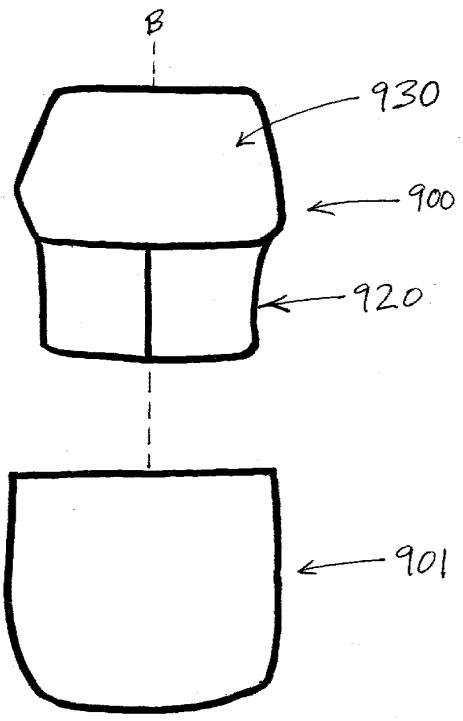


FIG. 9

(57) Abstract: Dental implants for fixed and removable prosthetic devices, having application to single tooth replacement, e.g., caps and crowns, and multiple tooth replacement using one or more implants, e.g., bridges, and multiple implants for full and partial prosthetic devices. Dental implants comprise a non-cylindrical implant and an abutment configured to mate with the implant in a non-rotatable fashion. Further, dental reconstruction and abutment installation methods utilizing the dental implant systems and instruments are disclosed. Also provided are impression taking procedures, and impression copings that produce an accurate fit between the dental prosthesis and the dental implant.

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DENTAL IMPLANT SYSTEM COMPRISING MEANS FOR PREVENTING ROTATION OF THE SUPERSTRUCTURES AND METHODS OF FORMING AND INSTALLING

CROSS REFERENCE TO RELATED APPLICATION

This application claims the benefit of priority under 35 U.S.C. § 119(e) to U.S. Provisional Patent Application Serial No. 61/804,159, filed March 21, 2013, which is incorporated herein by reference.

TECHNICAL FIELD

This disclosure describes a dental implant system having improved structural features for ensuring proper alignment and orientation with improved implant stability and fixation and which prevents the rotation of the superstructures, such as a post or abutment, on the implant body of an abutment assembled on an implant. This disclosure also provides methods and materials for preparing an accurate dental impression and mold representing the implantation site and its relationship to adjacent teeth structure. The disclosure further describes a multi-component kit containing the dental implant system components and related devices and instructions for proper use and implantation.

BACKGROUND

Natural teeth in the human mouth are supported in bone by periodontal fibers that function as shock absorbers when a compressive force is applied, such as during chewing. Through disease, accidental injury, anatomical abnormalities, age, and the like, a natural tooth may be removed or missing, such that a dental appliance or prosthetic device (e.g. a crown) is implanted in the patient's bone structure to improve the patient's physical appearance and/or quality of mastication. However, conventional implants are often too rigid to function like natural teeth. Problems such as crown breakage, crown rotation, screw loosening and screw breakage are inherent problems with a rigid crown implant. Failure is also known to occur when an implant is used in a bridge abutment with a natural tooth or when improper occlusion is created by the implant crown.

As shown in Figure 1, most conventional dental implants include an implant 1 having a screw part, and an abutment 3 integrally formed with the upper end of the implant, such that the implant and the abutment 3 are fixedly secured to each other by means of a screw 4. The abutment is secured to a dental prosthesis (such as a crown) 2 whereby combined 5, the dental prosthesis 4 covers the abutment 3, leaving the implant

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imbedded in the patient's jawbone. Figure 2 shows such conventional dental implant 1 supporting a crown 2 between adjacent teeth 6. Embrasures, or periodontal gaps 12 between the bottom portion of the crown 2 and adjacent teeth 6 may become irritated or infected following food impaction and collection.

Screws associated with conventional crowns sometimes break because of over tightening and due to tension and lateral stress to which the crown is subjected during use. Besides the time and inconvenience associated with conventional procedures for implanting, it is also difficult in some cases to properly orient the implant and maintain it in a stable orientation after the prosthesis has been fitted. This can contribute to longer healing periods before the implant and the bony tissue integrate because of the lack of substantial close bone contact. Screw-type implants also are difficult to orient and stabilize. Typically, the thread pattern of screw-type implants require multiple turns to set the implant. The hardness of the bony tissue in and around the implant cavity varies. With a multiple-turn implant, the threads tend to draw the implant towards and through softer bony tissue. This can result in the entire implant misaligning within the alveolar bone structure of the patient. Such implants are typically designed such that they conform to a generally cylindrical configuration. In addition, typical implants are of a single piece construction and do not include additional or auxiliary means for interlocking the implant to the alveolar bone structure. Once the prosthesis has been attached to the top portion of the implant and the patient starts to use the implant to chew food, the stress, vertical and lateral forces, as well as frequent temperature changes of over 100 °F from hot versus cold foods and liquids, and rotational torques placed on the prosthesis, are transferred downwardly to the implant. In cases where the implant is not stable and tightly secured within the implant cavity, the implant tends to rotate and turn under these stresses and torque. This results in the implant becoming loose within the implant cavity and that often results in the implant becoming dislodged from the cavity or being so loose and unstable within the cavity that the implant has to be removed from the patient's alveolar bone. Imperfections in the manufacture of dental implant systems also contribute to screw loosening.

It is expensive and time consuming to retrieve and/or repair such loose or broken screws. In addition, special purpose torque drivers are required to install the screws. Once the crown is implanted, it may take several months to achieve suitable bone integration of the root portion with the surrounding bone structure thereby resulting in increased loading time before the root portion can be reliably anchored. Improperly anchored implants or

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crowns loosened by rotation may be susceptible to damage or reduced life and may be unable to provide the function of a natural tooth, including the quality of mastication.

Accordingly, it is desirable to overcome the problems associated with conventional crowns by avoiding dental implant system screws which can break or loosen due to rotation of the crown. It would also be desirable to decrease integration time by increasing stabilization between the root portion of the implant and the bone structure of the patient. With such system, patient comfort will be enhanced, the life of the crown will be increased, and the need to make repairs, and corresponding costs, can be reduced.

Each of the foregoing disadvantages are overcome by the implant system and methods provided in this disclosure. Additionally, the implant system and methods provided in this disclosure achieve other advantages described more fully below.

SUMMARY

In one aspect, this disclosure provides a dental implant adapted to be embedded within a patient's jawbone comprising a non-cylindrical apical end adapted to engage the jaw bone, and a top end, opposite the apical end, the top end having an abutment or prosthesis receiving portion. In some embodiments, the apical end of the dental implant has a shape substantially consistent with a square, an oval, a rectangle, a pentagon, or a hexagon. In one embodiment, the dental implant has an apical end shaped substantially consistent with a rectangle. In another embodiment, the dental implant has an apical end shaped substantially consistent with an hourglass in the mesial-distal plane, having two wider lobes, and a narrower center portion between the two lobes.

The dental implants of this disclosure may be made of at least one material selected from titanium or titanium alloys, gold alloys, zirconium, and a ceramic.

The dental implants of this disclosure may have a smooth surface texture or a rough surface texture. Additionally, these dental implants may have one surface portion with a rough surface texture, and one surface portion with a smooth surface texture.

Dental implants of this disclosure may have a surface coating with materials selected from an artificial hydroxyapatite, a bisphosphonate, a platelet-rich plasma (PRP), a PRP-bone matrix mix, and combinations thereof. Such surface coatings may be uniformly applied over the external surface of the implant, or the surface coating may be applied to only a portion of an external surface of the implant. For example, such surface coatings may be applied to a portion of an external surface of the implant that resides below the gum line in the surrounding tissues within the patient's mouth following implantation of the implant. Alternatively, such coating may be absent in a portion of the

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external surface of the implant that will reside above the gum line in the surrounding tissues within the patient's mouth following implantation of the implant. In certain embodiments, the external surface of the implant that will reside above the gum line in the surrounding tissues within the patient's mouth is smooth and free of surface coatings.

In certain embodiments, the dental implant of this disclosure may include a top end that is adapted to receive a prosthesis without the use of an abutment.

In some embodiments, the dental implants of this disclosure may be formed such that the top end comprises a dental fixture integrally formed with the implant. In other embodiments, the dental implant has a top end adapted to receive an abutment. Such abutment-receiving portion of the implant may be a cavity formed within the top end of the implant to receive an abutment, or other dental prosthetic structure. The abutment-receiving portion of the implant may include a plurality of projections formed on an interior wall of the cavity comprising the abutment-receiving portion of the implant. Such projections may extend from the interior wall into the cavity comprising the abutment-receiving portion of the implant. Such projections are of a size and/or shape to engage with an abutment in a manner that will prevent rotation of an abutment disposed in the abutment-receiving portion of the implant. Such projections may be located in the cavity comprising the abutment receiving portion of the implant in a non-symmetrical pattern that will prevent rotation of an abutment disposed in the abutment-receiving portion of the implant. The projections may have a shape that prevents the rotation of an abutment disposed in the abutment-receiving portion of the implant. In a specific embodiment, the dental implant has an abutment-receiving portion that has a substantially pentagonal shape. In other embodiments, the dental implant may have an abutment receiving portion which has a substantially non-cylindrical shape selected from a square, an oval, a rectangle, a hexagon, and an hourglass shape.

In one embodiment, the dental implant has an abutment-receiving portion which comprises a cavity formed within the implant to receive an abutment, or other dental prosthetic structure, and the cavity further comprises a hole configured for receiving a fixation implant screw that will secure the implant into a jawbone. Such hole may comprise a circular opening in the apical end adapted for receiving a fixation screw that will pass through the circular opening in the abutment-receiving portion and extend below the apical end of the implant, and into a jawbone. Such hole in the apical end of the implant may have a countersunk central opening adapted to fit a countersink head on the fixation screw.

Another aspect provided by this disclosure is a dental implant abutment adapted to receive a dental prosthesis surmounted with a crown, or other dental fixture, comprising an implant insertion portion and prosthesis receiving portion opposite the implant insertion portion.

Such abutment may comprise a material including titanium, zirconium, or a combination thereof. In one embodiment, the abutment has an implant insertion portion that has a substantially pentagonal shape. In other embodiments, the abutment has an implant insertion portion that has a shape substantially consistent with a square, an oval, a rectangle, a pentagon, a hexagon, or an hourglass shape. In specific embodiments, the dental implant abutment has an implant insertion portion having a substantially cylindrical shape comprising a plurality of indentations configured to mate with projections on an abutment-receiving portion of a dental implant.

Another aspect provided by the present disclosure is a surgical drill guide adapted to guide the formation of drill holes in a jawbone comprising a guide comprising a plurality of holes of varying sizes and spatial arrangements that will guide a dental drill into the jawbone to form patterns of drill holes.

Another aspect provided by the present disclosure is a method for securing a dental prosthesis to a patient's jawbone, including drilling at least one pilot hole in the jawbone to form an extraction cavity, expanding the extraction cavity to accept a non-cylindrical implant, setting a non-cylindrical implant into the extraction cavity, affixing a dental prosthesis on the non-cylindrical implant. The drilling may be conducted using a surgical drill guide secured about an extraction site to guide the formation of pilot holes. The surgical drill guide may include a plurality of holes of various sizes and spatial arrangements configured to guide a dental drill into the jawbone to form patterns of drill holes. The expanding step may include using an osteotome to expand the extraction cavity to fit the chosen implant. The expanding step may also include reaming to shape and contour the extraction cavity to accept the selected implant. The affixing step may include anchoring the non-cylindrical implant to the jawbone with a fixation screw extending from an apical end of the non-cylindrical implant. The method may include closing the implant site after setting the non-cylindrical implant into the extraction cavity prior to affixing a dental prosthesis on the non-cylindrical implant. The method may include attaching a temporary cap to the non-cylindrical implant after setting the non-cylindrical implant into the extraction site. The method may include closing the implant site by placing a gingival flap across the non-cylindrical implant. The affixing step may be conducted about 3

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months to about 12 months after setting a non-cylindrical implant into the extraction cavity. The affixing step may include securing a false tooth to the implant. The affixing step may include securing an abutment to the implant. The method may include forming an impression of the non-cylindrical implant in the extraction cavity including surrounding dentitia.

Another aspect of the present disclosure provides an impression coping comprising an implant mating portion and an impression material contact portion, and a top. The impression coping may include an impression material contact portion that is substantially cylindrical. The impression material contact portion may include at least one of surface projections, surface texturing, roughening, and other surface features, to enhance contact and retention in an impression material. The implant mating portion may be configured to be received by and mate with an interior portion of a dental implant with an indented feature configured to permit a mating fit with a cooperating protrusion. The implant mating portion may include a plurality of flanges situated around the impression material contact portion, opposite the top of the impression coping. The flanges may be spaced regularly around the generally cylindrical impression material contact portion.

Another aspect of the present disclosure provides an impression coping securing screw for securing an impression coping to an implant comprising at least one material selected from a heat labile plastic and silicone. In certain embodiments, the impression coping securing screw comprises threads made of metal or plastic and coated with a heat labile plastic or silicone. In use, the impression coping securing screw is threaded into the internal threading in a dental implant by exerting a rotational force on the impression coping securing screw. At the time of removal, the heat labile plastic, or silicone threads (or heat labile plastic, or silicone-coated threads) are activated to allow the impression coping, secured by the impression coping securing screw, to be disengaged from the implant and removed with the impression of the patient's dentitia.

Another aspect of the present disclosure provides a dental implant system comprising a dental implant and an impression coping member and an impression coping securing screw comprising a heat-labile plastic or silicone material configured to cooperatively engage the dental implant and the impression coping member, thereby ensuring proper alignment and orientation of a dental prosthesis assembled on the implant.

Another aspect of the present disclosure provides a method of making an impression and dental reconstruction, which method includes providing an impression coping including a screw access channel in the impression coping configured to receive an

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impression coping securing screw, securing the impression coping on a dental implant set in a jawbone by passing an impression coping securing screw through the screw access channel and mating an end of the impression coping securing screw with the dental implant, activating a heat liable plastic or silicone on the impression coping securing screw to dissolve or soften the plastic or silicone sufficiently to allow removal of the impression coping securing screw from the implant without unscrewing the impression coping securing screw, and removing the impression coping securing screw from the implant. In this method, an impression material may be used to form an impression of the implant and surrounding dentitia before the step of removing the impression coping securing screw from the implant.

Another aspect of the present disclosure provides a method for obtaining an accurate translation of an orientation and position of an implant, including securing a dental implant in a jawbone, wherein the dental implant has a plurality of protrusions internal to an interior cavity of the implant, which protrusions are configured to matingly-engage flanges on an impression coping in a snap-fit engagement when the flanges extend beneath the protrusions, and seating an impression coping comprising flanges that engage two or more of the protrusions internal to the interior cavity of the implant by deflecting and springing back to an un-deflected state upon seating of the impression coping in the implant, and applying a dental impression material to at least an area adjacent the impression coping seated in the implant to cover the impression coping to obtain a negative impression of the area, and releasing the impression coping from the implant, and removing the impression material from the area adjacent the impression coping with the impression coping embedded in the impression material. In this method, engaging flanges of the impression coping with the protrusions on the implant may produce an audible sound, indicating that the impression coping has been properly seated in the implant. In a specific embodiment, a bore extends through the impression coping, the bore configured to allow the passage of an impression coping securing screw through the impression coping. In an embodiment, seating the impression coping in the implant may include passing an impression coping securing screw through the bore in the impression coping and engaging the screw in an internal cavity of the implant in a closely fitted engagement. In an embodiment, the impression coping securing screw may be a heat labile plastic, or silicone configured to cooperatively engage the implant. In an embodiment, releasing the impression coping from the implant may include activating the heat labile plastic or silicone portion of the impression coping securing screw to dissolve or soften sufficiently

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the plastic or silicone material to allow removal of the impression coping securing screw from the implant without unscrewing the impression coping securing screw. These methods may also include sending the impression material and impression coping to a dental lab to form a dental cast model.

Another aspect of the present disclosure provides a multi-component dental implant system including at least one non-cylindrical dental implant, at least one implant abutment configured to detachably join at least one non-cylindrical dental implant. The multi-component dental implant system may also include a set of standard surgical tools prepared for the dental professional to choose from. The at least one non-cylindrical dental implant may include a set of standard shaped implants of varying size. The at least one implant abutment may include a set of standard shaped abutments of varying size. The non-cylindrical implant may be configured to replace a tooth selected from a bicuspid, a molar, a canine, and an incisor. The multi-component dental implant system may also include at least one dental surgical instrument selected from a drill guide, a reamer, a drill bit, a surgical fixation screw, and a bone screw insertion tool. The multi-component dental implant system may also include a healing abutment. Such healing abutment need not be removed during an impression taking procedure. The multi-component dental implant system may also include an implant coding system that facilitates selection or identification of a non-cylindrical dental implant by the dental professional.

The present disclosure provides a dental implant adapted to be embedded within a patient's jawbone, wherein the dental implant has an apical end adapted to engage the jaw bone, and a top end, opposite the apical end. The top end has an abutment or prosthesis receiving portion comprising a cavity formed within the implant to receive an abutment, or other dental prosthetic structure. The abutment or prosthesis receiving portion has a substantially pentagonal shape, and at least the apical end of the dental implant has a non-cylindrical shape. In one embodiment, the abutment-receiving portion of the dental implant further comprises a circular opening in the apical end adapted for receiving a fixation screw that will pass through the circular opening in the abutment-receiving portion and extend below the apical end of the implant, and into a jawbone.

This Summary of the Disclosure is neither intended nor should it be construed as being representative of the full extent and scope of the present disclosure. Moreover, references made herein to "the present disclosure," or aspects thereof, should be understood to mean certain embodiments of the present disclosure and should not necessarily be construed as limiting all embodiments to a particular description. The

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present disclosure is set forth in various levels of detail in this Summary of the Disclosure as well as in the attached drawings and the Description of Embodiments, and no limitation as to the scope of the present disclosure is intended by either the inclusion or non-inclusion of elements, components, etc. in this Summary of the Disclosure. Additional aspects of the present disclosure will become more readily apparent from the Description of Embodiments, particularly when taken together with the drawings.

BRIEF DESCRIPTION OF DRAWINGS

Figure 1 depicts parts of a standard dental implant of the prior art, including an implant, an abutment, and a crown, both separate and assembled.

Figure 2 depicts the assembled dental implant of figure 1 implanted in the jaw of a patient, between two natural teeth.

Figure 3 is a mesial-distal view of an implant of the present disclosure.

Figure 4 is a top view of the implant of Figure 3.

Figure 5 is an apical view of one implant of the present disclosure, having a substantially hourglass shape.

Figure 6 is a top view of an implant of the present disclosure.

Figure 7 is a mesial-distal view of an implant of the present disclosure.

Figure 8 is a top view of the implant of Figure 7.

Figure 9 is a side view of an abutment of the present disclosure positioned above an implant of the present disclosure.

Figure 10 depicts a surgical guide disposed on a patient's gum line between two natural teeth.

Figure 11 is a side view of an impression coping according to one embodiment of the present disclosure.

Figure 12 is a partial cross-sectional view of an impression coping engaged with an implant according to an embodiment of the present disclosure.

Figure 13 is a side view of an impression coping securing screw, according to an embodiment of the present disclosure.

DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

Non-Cylindrical Dental Implant

This disclosure provides dental implants for fixed and removable prosthetic devices and certain fixed and removable prosthetic devices, including implants suitable for single tooth replacement (e.g., caps and crowns), multiple tooth replacements using one or more implants (e.g., bridges), and multiple implants for full and partial prosthetic devices.

Embodiments of dental implants of the present disclosure may be installed in single or multiple root tooth locations.

Implants according to the present disclosure are non-cylindrical, which better facilitates the restoration by providing a more anatomically correct emergence profile, thereby improving form, function and aesthetics of the restoration. This also facilitates immediate restoration when an abutment is mated with an implant of the present disclosure, because the abutment can be tightened to the implant without any danger that the implant will rotate within the implantation site in the patient's jawbone. These non-cylindrical implants of the present disclosure will have an increased size and increased surface area compared to conventional dental implants. This increased size and surface area will improve case selection and lower the need for sinus lifts and the number of areas in which nerve proximity would be a consideration in the placement of a dental implant.

Implants according to the present disclosure can be constructed from any non-corrosive material compatible with the abutment and prosthesis and the surrounding tissues within the patient's mouth without producing immunologic reactions effecting rejection by the body. Suitable materials include titanium or titanium alloys, gold alloys, zirconium, ceramic and the like, which are machined and milled to the requisite shape.

Implants of the present disclosure may have a smooth or rough surface texture. Mechanical surface treatments may be used to significantly alter the topography, while the surface chemistry remains substantially unchanged. Thus, the implants of the present disclosure may be treated to create a suitable roughness of the implant surface giving a mechanical interlocking between bone and implant. Alternatively, or additionally, coating the surface of the implant with certain materials may improve the healing process around the bone-implant (referred to as "osseointegration"). Thus, the implants of the present disclosure may be treated to include a surface coating with materials such as, but not limited to, an artificial hydroxyapatite, bisphosphonate(s), platelet rich plasma ("PRP") and/or a PRP-bone matrix mix (PRP may be formed by taking a blood sample from the patient, and then centrifuging the blood to create the PRP), or the like. The surface treatment and/or the coating(s) of the implants of the present disclosure may be uniform throughout the external surfaces of the implants, or may be applied to only a portion of the external surfaces of the implants. In specific embodiments of this disclosure, the surface treatment and/or coatings are applied to any portion of the external surface of the implant that will reside below the gum line in the surrounding tissues within the patient's mouth. In specific embodiments of this disclosure, the surface treatment and/or coatings are absent in

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a portion of the external surface of the implant that will reside above the gum line in the surrounding tissues within the patient's mouth. In specific embodiments of this disclosure, the external surface of the implant that will reside above the gum line in the surrounding tissues within the patient's mouth is smooth and free of surface coatings to form a smooth, hygienic transition area or connection with a dental prosthetic formed on the implant, in an embrasure space in the patient's mouth.

As shown in Figures 3 and 4, a dental implant 100 of the present disclosure comprises an apical end 110 adapted to engage a patient's jaw bone, a top end 120 opposite the apical end 110, the top end 120 having an abutment or prosthesis receiving portion 130, accessible from the top end 120 of the dental implant 100. The abutment-receiving portion 130 can be adapted to receive a prosthesis, such as a crown or a bridge or other dental fixture, with or without the use of an abutment. Also, an abutment or other device for receiving a crown or other dental fixture may be formed integrally with the implant 100, in which case no abutment receiving-portion 130 is present. The apical end 110 of the implant 100 has a non-cylindrical shape such that, following implantation in the jaw of a patient, the implant will not rotate within the implantation site. In specific embodiments, the apical end of the implant may have a shape substantially consistent with a square, an oval, a rectangle, a pentagon, a hexagon, or the like. In a specific embodiment, the implant as a pentagonal shape.

In a specific embodiment shown in the apical view of the implant depicted in Figure 5, the implant 500 has an hourglass shape in the mesial-distal plane, having two wider portions 510, or lobes, and a narrower center portion 520.

In specific embodiments of the implants of the present disclosure, as depicted in Figure 4, the abutment-receiving portion of the implant may comprise a cavity 130 formed within the implant 100 to receive an abutment, or other dental prosthetic structure. The abutment-receiving portion 130 of the implant 100 comprises a plurality of projections 140 formed on the interior wall 150 of the cavity comprising the abutment-receiving portion 130 of the implant 100. The projections 140 extend from the interior wall 150 into the cavity comprising the abutment-receiving portion 130 of the implant 100. In specific embodiments, the projections 140 are of a size and/or shape to engage with an abutment in a manner that will prevent rotation of the abutment disposed in the abutment-receiving portion 130 of the implant 100. In specific embodiments, the projections 140 are located about the cavity comprising the abutment receiving portion 130 of the implant 100 in a non-symmetrical pattern that will prevent rotation of an abutment disposed in the

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abutment-receiving portion 130 of the implant 100. In specific embodiments, the projections 140 comprise both a shape, and a location about the cavity comprising the abutment receiving portion 130 of the implant 100 to prevent the rotation of an abutment disposed in the abutment-receiving portion 130 of the implant 100.

A preferred embodiment is the implant of the present disclosure depicted in Figure 6. Figure 6 depicts the top end of an implant, comprising an abutment-receiving portion 630, having a substantially pentagonal shape, which will mate with a corresponding pentagonal abutment, thereby preventing rotation of the abutment disposed in the pentagonally-shaped abutment receiving portion 630 of the implant 600, without the need for specific projections residing on the interior wall 650 of the cavity comprising the abutment receiving portion 630. In related embodiments, the abutment receiving portion of the implant may have a substantially non-cylindrical shape, such as a square, an oval, a rectangle, a hexagon, an hourglass shape, or the like.

In specific embodiments of the implants of the present disclosure, the abutment-receiving portion of the implant comprises a cavity formed within the implant to receive an abutment, or other dental prosthetic structure, and the cavity further comprises a hole configured for receiving a fixation implant screw that will secure the non-cylindrical implant of the present disclosure into a jawbone of the patient. In one preferred embodiment depicted in Figure 7, the implant 700 of the present disclosure comprises an apical end 710 adapted to engage the jaw bone of a patient, a top end 720 opposite the apical end 710, the top end 720 having an abutment-receiving portion accessible from the top end 720 of the dental implant 700. The implant 700 has a circular opening in the apical end 710 adapted for receiving a fixation screw 725 that will pass through the abutment-receiving portion 720 and extend below the apical end of the implant 700, along dashed line A, and into the jawbone of the patient to further secure the implant 700 within the jawbone of a patient, while retaining the non-cylindrical, non-rotatable characteristics of the implant 700. Thus, the implant 700 retains the non-cylindrical shape of the implants of the present disclosure such that, following implantation in the jawbone of a patient, including the placement of the fixation screw 725, the implant will not rotate within the implantation site. In one embodiment, the circular hole in the apical end 710 of the implant 700 is a countersunk central opening adapted to fit a countersink head on the fixation screw 725.

Figure 8 depicts the view of the top end 720 of the implant 700 of Figure 7. The circular fixation hole 730 can be seen at the bottom of the cavity comprising the abutment-

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receiving portion 730 in the top end 720 of the implant 700. In this embodiment depicted in Figure 8, the abutment-receiving portion 730 in the top end 720 of the implant 700 has a substantially circular shape. In one preferred embodiment, the abutment-receiving portion in the top end of the implant 700 has a substantially pentagonal shape.

Anatomical Abutment

The present disclosure also provides implant abutments intended to take a dental prosthesis surmounted with a crown, or other dental fixture, cemented, glued, screwed, or otherwise affixed to the abutment, adapted for use with a dental implant of the present disclosure. The abutments of the present disclosure may be made of titanium, zirconium, or the like.

As shown in Figure 9, an abutment 900 of the present disclosure, which secures a prosthesis to an implant 901 of the present disclosure, includes an implant insertion portion 920 and a prosthesis receiving portion 930. The implant insertion portion 920 of abutment 900 is configured to mate with an abutment-receiving portion of implant 901 of the present disclosure. In one embodiment, the implant insertion portion 920 has a pentagonal shape that will mate with a corresponding pentagonal-shaped abutment-receiving portion of implant 901, when the abutment-receiving portion of the implant 901 is mated with implant insertion portion 920 of abutment 900 along line B.

In specific embodiments, the implant insertion portion may have a shape substantially consistent with a square, an oval, a rectangle, a pentagon, a hexagon, or the like. In a specific embodiment, the implant insertion portion as an hourglass shape. In these embodiments, the abutment-receiving portion of the implant 901 is shaped to receive and mate with an abutment 900 having an implant insertion portion 920 having any one of the shapes described above.

In a specific embodiment of the implant of the present disclosure depicted in Figure 4, the abutment-receiving portion 130 of the implant 100 comprises a plurality of projections 140 formed on the interior wall 150 of the cavity comprising the abutment-receiving portion 130 of the implant 100. The projections 140 extend from the interior wall 150 into the cavity comprising the abutment-receiving portion 130 of the implant 100. Similarly, in a specific embodiment of the abutment of the present disclosure, the implant insertion portion has a substantially cylindrical shape comprising a plurality of indentations having a size, shape and location configured to mate with the projections 140

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formed on the interior wall 150 of the cavity comprising the abutment-receiving portion 130 of the implant 100.

In these embodiments of the abutment of the present disclosure, engaging the abutment receiving portion of the implant with the correspondingly shaped implant insertion portion of the abutment prevents rotation of the abutment disposed in the implant. This also increases the ease of placing the abutment into the implant during the restoration procedure and simplifies the implantation of the dental system for the dental surgeon. Additionally, this configuration, which prevents rotation of the abutment on top of the implant, facilitates immediate restoration of a missing tooth when the abutment is mated with the implant, because the non-cylindrical implant will not rotate in the socket, such that full osseointegration is not necessary and the time to osseointegration is greatly reduced.

In these embodiments of the implants and the abutments of the present disclosure, after the abutment is mated with the implant, the abutment may be secured to the implant by any of the methods well known to those of skill in the art including, for example, cementation, or one or more screws disposed within the interior portion of the abutment and received and secured within the interior portion of the implant. Locking engagement between the complementary shaped surfaces of the implant and the abutment can be achieved through a tapping or threading operation. Some patients find the use of tapping action to seat the abutment onto the implant uncomfortable, and as an alternative, a dental implant system of the present disclosure which utilizes a threaded fastener to seat the abutment onto the implant may be used.

The interlocking non-cylindrical implant and abutment of the present disclosure are designed to overcome an aesthetic limitation of the prior art wherein, in many cases, it is possible to see some of the implant between the crown and the gum line. In the use of such prior art devices, patients and dentists often complain about food impacting and accumulating around and beneath the prosthesis portion of the implant in the enlarged periodontal gap between the implant and the adjacent teeth.

Using the non-cylindrical implants of the present disclosure (which are generally wider and provide better anatomical fit than implants and abutments of the prior art) allows for a more anatomical emergence profile than is often available with prior art reconstruction systems. The broader top of the dental implants of the present disclosure allows for a more anatomical emergence profile than is often available with prior art reconstructions systems, and this enhances the aesthetic appearance of the reconstruction,

and avoids many hygienic problems, as well as the accumulation of food in the periodontal gap, as described above. The wider implant and matching abutment of the present disclosure better distributes load on the jawbone, thereby allowing the prosthesis to have more upright peripheral sidewalls, so that embrasures, or periodontal gaps, between the bottom portion of the crown and adjacent teeth are substantially reduced, and so that both food impaction and collection are also substantially reduced. The matching abutment of the present disclosure also provides a smooth transition between the prosthesis and the implant fixture, which results in good soft tissue adaptation.

Dental Implant Procedure

This disclosure also provides a dental implant process that reduces surgical time and the cost of an implant operation, resulting in the formation of a restoration with a wider, anatomical implant shape having a more ideal emergence profile, providing better support for crowns, especially ceramic crowns, and improved hygienic embrasure spaces. The dental implant processes of the present disclosure reduce the time period that is customarily required between tooth extraction and the placement of a false tooth or prosthesis on the implants of the present disclosure. Additionally, these dental implant processes of the present disclosure may allow the implant to be inserted or set within the tooth cavity immediately after extraction.

The dental implant procedures of the present disclosure generally include the following steps. Initially, the restoration site is identified and cleaned and sufficient gum is removed from the jawbone to allow an implant of the present disclosure to seat directly on the exposed jawbone. In one embodiment, placing the implant in the jawbone includes first drilling one or more pilot holes in the jawbone, removing additional gum from the jawbone, as needed. A surgical drill guide can be secured about the extraction site to guide the formation of drill holes. Figure 10 depicts a surgical drill guide 1000 of the present disclosure located at the apical surface of a patient's gum 1020 at an extraction site, between two natural teeth 1010. The surgical drill guide 1000 includes a plurality of holes 1050 of various sizes and spatial arrangements that will guide a dental drill into the jawbone to form patterns of drill holes, which may be positioned and enlarged to accept an implant of the present disclosure. Once the pilot holes have been created using the surgical drill guide, the dental surgeon prepares an eccentric site for accepting the implant using an osteotome to expand the extraction cavity to fit the chosen implant. The implant cavity is reamed to shape and contour the extraction cavity to accept the selected implant.

After reaming and forming a clean and open implant cavity, a non-cylindrical implant of the present disclosure is firmly set into the reamed extraction cavity. Optionally, the non-cylindrical implant of the present disclosure may be anchored within the alveolar bone using a fixation screw extending from the apical end of the non-cylindrical implant, as described above.

After the implant has been set, the implant site may be closed in order to heal the site for a period of time. A temporary cap can be used, but in most cases it is preferred that the gingival flap be returned across the top of the implant so as to close the implant site. Thereafter, a process of osseointegration occurs, wherein the bone structure remodels and heals in intimate contact with the implant. The time for healing can vary from approximately 3 to 12 months depending on the age of the patient and other factors. After integration has been achieved, the dental professional can then secure a false tooth or other dental prosthesis to the top of the implant.

After osseointegration occurs, the gum around the implant disposed in the jawbone is positioned and maintained. A dental prosthesis is modeled in a form sized to fit on the implant or an abutment attached to the implant. The prosthesis is sized and formed to appropriately fill the open space between the adjacent teeth. Finally, the molded prosthesis is affixed to the implant of the present disclosure, which is anchored in the jawbone of the patient.

In some instances, an impression can be taken and the prosthetic device made prior to installation of the dental implant. In such cases, a non-cylindrical implant of the present disclosure and the appropriate prosthetic device can be installed in the same visit. In cases where the prosthetic device is to be installed in a visit subsequent to installation of the implant, a temporary prosthetic device (e.g., a conventional temporary cap) may be installed using a cement to temporarily secure the temporary cap to the dental implant. It is postulated that in the instance where implanting takes place immediately after extraction, there is quicker healing and osseointegration because the alveolar bone has not been subjected to the trauma of drilling that takes place in cases where the implanted site has healed and closed.

Although the steps described above are presented in a specific order, the technology presented herein can be performed in any variation of this order. Furthermore, additional steps may be executed between the steps described above.

Impression Coping and Related Materials and Kits and Methods of Using the Same

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In dental implant procedures, an impression coping (also referred to as a transfer coping) is attached to the implant, or an abutment attached to the implant, to transfer the position of the implant in the patient to a working model, which is used in a dental laboratory where the permanent dental prosthesis is prepared.

During the surgical procedure, the impression coping is attached to the implant or abutment while the impression is made. This attachment is typically made with a separate securing screw, which attaches to internal threading on the implant to hold the impression coping in place on the implant. An impression of the patient's dental structure surrounding the site of the implant is then made using an impression material, such as a polymeric material. The impression material is then removed and sent to a dental laboratory, where the permanent dental prosthesis is fabricated. In this way, the ultimate position of the implant in the patient's mouth is identified and set by the position of the impression coping within the impression material.

Conventional open and closed tray techniques both use screws to secure the impression coping to the implant. In the closed tray technique of making dental impressions, the impression coping is engaged with the implant or abutment using the securing screw and an impression material is injected around the coping. The impression is then removed, leaving the impression coping in place. This limits the accuracy of the model of the patient's dentitia based on the impression as the impression coping must be reassembled, and the impression sent to the dental laboratory, such that the impression coping may not be properly re-oriented into the impression after removal from the patient's mouth.

Conversely, in open tray techniques, the securing screw is loosened and the impression coping is picked up with the impression material as the material is removed. This technique may also lead to inaccuracies in the model of the patient's dentitia because the angle and height of the impression coping may be altered when the screw is loosened/removed prior to removal of the impression material from the patient's mouth.

Accuracy in the location of the impression coping (particularly height and angle) within the impression is important to ensure that the prepared prosthesis fits properly in the implant and relative to the patient's existing teeth and gumline. Failure to accurately position the prosthesis could result in patient discomfort and/or failure of the restoration or implant. Thus, there is a need for an impression coping that may accurately and reliably identify the position of dental implants in patients. Moreover, there is a need for an impression coping that facilitates the impression process, requiring less manipulation by a

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dentist or dental technician, and that reduces the chances of having to retro-fit the impression coping back into the impression material after removal from the implant.

The present disclosure provides an impression coping that can be used to identify the position of an implant in a patient. The impression coping according to various embodiments of the present disclosure may attach to an implant or abutment, such as a dental implant, without the use of a screw. In other embodiments, the impression coping according to various embodiments of the present disclosure may be secured to an implant or abutment using a screw. In at least one embodiment, the impression coping may be an implant level impression coping, which may allow the impression coping to be used without an abutment.

Impression copings in accordance with various embodiments of the present disclosure also may comprise an impression material contact portion. Once the impression coping is attached to the dental implant, an impression can be taken, for example with a closed dental tray, well known to those of skill in the art. The impression material surrounds the impression material contact portion of the impression coping and securely attaches the impression to the impression coping once the impression material has cured.

The impression coping according to embodiments of the present disclosure may comprise a material chosen from metal, ceramic, plastic (which may be disposable), and/or combinations thereof. In at least one exemplary embodiment, the impression coping comprises a material chosen from stainless steel, titanium, and titanium alloys. In at least one embodiment of the present disclosure, the impression coping comprises a material that is radiopaque. A radiopaque impression coping may be observable using an X-ray, which may aid in locating the implant in the patient's mouth and the position of the impression coping in the impression, and/or aid in the confirmation of the engagement between the dental implant and the impression coping.

After the impression material has cured, the impression material, with the impression coping attached or embedded therein, is removed. The impression material and the impression coping may be removed by pulling the impression coping off the dental implant, by moving the impression coping in a direction generally along the longitudinal axis of the dental implant and away from the dental implant. The impression may then be sent to a dental laboratory where the permanent tooth is fabricated.

An impression coping according to one embodiment of the present disclosure is illustrated in Figure 11. In Figure 11 the impression coping 1100 comprises an implant mating portion 1110 and an impression material contact portion 1150, and a top 1160. The

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impression material contact portion 1150 is generally cylindrical. In some embodiments, impression material contact portion 1150 further comprises projections or surface texturing, roughening and/or other surface features, and/or other configurations to enhance contact and retention in an impression material. Those having ordinary skill in the art will readily understand that the configuration of such projections or surface treatments may be utilized without departing from the scope of the present disclosure.

As shown in Figure 11, the impression coping 1100 is configured with an implant mating portion 1110 configured to be received by, and mate with, an implant. In accordance with various embodiments, the implant mating portion 1110 may be configured to engage with the interior portion of a variety of implants, including, for example, the various implants of the present disclosure described above, including any dental implant with an indented feature, such as a groove or ledge, configured to permit a mating fit (e.g., snap-fit) with a cooperating protrusion, such as the implant mating portion 1110 of the impression coping of Figure 11.

As depicted in Figure 11, the implant mating portion 1110 comprises a plurality of flanges 1110 situated around the base of impression material contact portion 1150, opposite the top 1160. Flanges 1110 may be spaced regularly around the generally cylindrical impression material contact portion 1150. Flanges 1110 are configured to engage with implants having openings that hook or retain the flanges to provide an anti-rotational engagement of the impression coping with the implant. For example, Figure 12 shows a partial cross-section of the impression coping 1100 of Figure 11 engaged with a dental implant 1220 set in the jawbone 1230 of a patient. As noted above, impression coping 1100 comprises a plurality of flanges 1110 situated around the base of impression material contact portion 1150. Implant 1220 includes a plurality of protrusions 1216. As shown in Figure 12, the protrusions 1216 matingly-engage flanges 1110 on the impression coping 1100. In at least one embodiment, a snap-fit engagement may be possible by positioning and sizing the protrusions 1216 in a way that they contact flanges 1110 on the impression coping 1100 and elastically deflect the flanges 1110. Once the flanges 1110 extend beneath protrusions 1216 as the impression coping 1100 is seated in the implant 1220, the fianges 1116 spring back to their undeflected state. An audible sound may be produced when the flanges 1116 spring back to their undeflected state, which may provide an indication that the impression coping 1100 has been properly seated in the implant 1220. The impression coping 1100 is held properly seated in the implant 1220.

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Conventional dental implants generally comprise a threaded exterior portion that attaches to the jawbone of a patient and interior threads designed to receive restorations or other fixtures, such as an impression coping. Those of skill in the art would be familiar with the various conventional dental implant configurations and features useful with the transfer copings of the present teachings. Similar to a conventional implant with internal threading, in at least one embodiment of the present disclosure, the implant 1220 may contain internal threading that allows a securing screw to pass through impression coping top 1160 and engage threads near the base 1240 of implant 1220. Thus, a related embodiment of the disclosure is an impression coping securing screw for securing an impression coping to an implant. The impression coping securing screw may be made of metal or other suitable hard material, while the threads of the impression coping securing screw are made of a heat labile plastic, or silicone.

One such impression coping securing screw 1300 of this disclosure is depicted in Figure 13. Threads 1310 may be composed of a heat labile plastic, or silicone. In related embodiments, threads 1310 may be made of metal or other suitable hard material, and coated with a heat labile plastic, or silicone. In use, the impression coping securing screw 1300 is threaded into the internal threading in a dental implant by exerting a rotational force on the impression coping securing screw. At the time of removal, the heat labile plastic, or silicone (or heat labile plastic, or silicone-coated threads) are activated to allow the impression coping secured by the impression coping securing screw 1300 to be disengaged from the implant and removed with the impression of the patient's dentitia.

Another embodiment of the present disclosure is a dental implant system comprising an implant member, and an impression coping member and an impression coping securing screw comprising a heat labile plastic, or silicone (or heat labile plastic, or silicone-coated threads) configured to cooperatively engage the implant and the impression coping structures for ensuring proper alignment and orientation of an abutment or other dental prosthesis assembled on the implant and for preparing an accurate dental impression and mold which represents the implantation site and its relationship to adjacent teeth structures.

Another embodiment of the present disclosure is a method of impression making and dental reconstruction utilizing the components of the dental implant system of the present disclosure. In at least one such embodiment, an impression coping includes a screw access channel in the impression coping to allow a dental professional to use an impression coping securing screw to secure the impression coping onto a dental implant,

followed by removal of the impression coping securing screw at the time of removing the impression. In a specific embodiment, the impression coping securing screw is removed immediately after the threaded portion of the impression coping securing screw comprising a heat liable plastic or silicone is activated to dissolve or soften sufficiently to allow the removal of the impression coping securing screw from the implant without unscrewing the impression coping securing screw.

Another embodiment of the present disclosure provides a method for obtaining an accurate translation of an orientation and position of an implant. With reference to Figure 12, one embodiment of this method comprises providing a dental implant of this disclosure, having a plurality of protrusions 1216 internal to an interior cavity of the implant, which protrusions 1216 matingly engage flanges 1110 on an impression coping 1100 in a snap-fit engagement when the flanges 1110 extend beneath protrusions 1216 as the impression coping 1100 is seated in the implant 1220, the flanges 1116 spring back to their undeflected state, which may produce an audible sound indicating that the impression coping 1100 has been properly seated in the implant 1220. In a preferred embodiment, a bore extends through the impression coping 1100, allowing the passage of an impression coping securing screw through the impression coping 1100, seating the impression coping onto the implant, and engaging corresponding threading in the internal cavity of the implant in a closely fitted engagement. The impression coping securing screw comprises heat labile plastic, or silicone (or heat labile plastic, or silicone-coated threads) configured to cooperatively engage the implant. A dental impression material is then applied to at least an area adjacent the impression coping so as to cover the impression coping to obtain a negative impression of the area. After the impression material has set, the heat labile plastic or silicone portion of the impression coping securing screw is then activated to dissolve or soften sufficiently to allow the removal of the impression coping securing screw from the implant without unscrewing the impression coping securing screw, and then the impression material is removed from the patient's mouth with the impression coping embedded in the impression material. The impression material, including the impression coping, may be sent to a dental lab, where a molding material is poured into the negative impression formed in the impression material to form a dental cast model, and a dental prosthetic is fabricated on an implant analog to match the surrounding dentitia of the patient. This method accurately positions the dental implant installed in the patient's mouth, based on the model created in the method described above, however, it will be apparent to one of ordinary skill in the art that other embodiments, or variations on this

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methodology are also possible in which various steps are added, combined, modified, substituted, automated or omitted.

To simplify impressions for both dentist and patient, a special impression coping screw would be utilized. This impression method is used instead of currently-available impression coping methods wherein the impression coping is screwed in and must either be unscrewed prior to removing the impression (open-tray method, which is considered more accurate), or after removing the impression, the impression coping is re-inserted into the impression (closed-tray method).

This new impression coping method of this disclosure is easier for the dentist and more comfortable for the patient. The impression coping is shorter in height which creates a more stable platform when taking impressions. It is further stabilized by screwing it into the internal part of the implant. By using a screw that is metal with flexible or heat labile plastic threads that are large enough to be screwed into the implant, but are able to be pulled out without much force, the impression coping is then used in a closed tray method, which is easier for the dentist and more comfortable for the patient. But the dentist would have the benefit of accuracy of the traditional open-tray method in which the implant coping is unscrewed prior to impression removal. The threading and/or sleeve coating of the impression coping securing screw is preferably a plastic or silicone material with enough flexibility to be pulled out of the implant with low resistance such that it is not difficult for the dental professional and does not cause pain or stress to the patient. The head and body of the screw may be made of titanium or a rigid but less expensive material. In one embodiment, the impression coping securing screw having a heat labile or pliable material is configured as a single-use product, which is more hygienic and safer for the patient. In this embodiment, the metal or hard plastic portions of the impression coping securing screw could be re-sterilized and reused after association with the heat labile or pliable material.

Dental Implant System Kit

Another aspect of the present disclosure provides a multi-component dental implant system comprising at least one non-cylindrical dental implant and an implant abutment of the present disclosure, with at least one implant and the abutment being configured to detachably join to one another with an improved assembly designed to prevent rotation of the abutment about the implant.

In one embodiment, the multi-component dental implant systems of the present disclosure may include an implant comprising an abutment-receiving portion having a

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substantially pentagonal shape, which will mate with a corresponding pentagonal abutment, thereby preventing rotation of the abutment disposed in the pentagonally-shaped abutment receiving portion of the implant. In related embodiments, the abutment receiving portion of the implant(s) in the multi-component dental implant systems of the present disclosure may have a substantially non-cylindrical shape, such as a square, an oval, a rectangle, a hexagon, an hourglass shape, or the like.

The multi-component dental implant system of the present disclosure may further include a set of standard shaped devices and standard surgical tools prepared for the dental professional to choose from. For example, the dental implant system may have variously shaped non-cylindrical implants configured to replace bicuspids, molars, canines, and incisors, and different sizes for each shape. From this dental implant system, the dental professional chooses the parts that are appropriate for the particular restoration.

As an alternative, the dental professional may have the prostheses portions custom made, after analyzing the patient. In this alternative embodiment, the professional may have the prostheses prepared with the aid of a CAD milling machine or powder metallurgy, among other known methods of forming parts. As examples of how to select the proper parts, the parts may be matched to the shape of an extracted tooth, if one is available, or to an impression of the teeth and gums surrounding the site of the implant. In one embodiment of the multi-component dental implant system of the present disclosure, it is contemplated that a series of differently sized, standard implants would be available. Such a kit of standard, non-cylindrical implants may vary in length and shape. Once the appropriate implant has been selected from the group of standard implants, the dental professional selects corresponding or matching surgical tools, including, for example, a surgical drill guide, a reamer from a reamer set, conventional drill bits from a set of drill bits used in dentistry for the installation of dental implants, a surgical fixation screw(s), bone screw insertion tool(s), a healing abutment that need not be removed during an impression taking procedure, and an implant coding system that facilitates selection and identification of a non-cylindrical dental implant of the present disclosure. Thus, the multi-component dental implant system of the present disclosure may include any one or all of these additional restoration components and/or surgical tools or subsets or combinations thereof, that useful in practicing the methods of the present disclosure.

The foregoing description of the present disclosure has been presented for purposes of illustration and description. Furthermore, the description is not intended to limit the disclosure to the form disclosed herein. Consequently, variations and modifications

commensurate with the above teachings, and the skill or knowledge of the relevant art, are within the scope of the present disclosure. The embodiments described hereinabove are further intended to explain the best mode known for practicing the disclosure and to enable others skilled in the art to utilize the disclosure in such, or other, embodiments and with various modifications required by the particular applications or uses of the present disclosure. It is intended that the appended claims be construed to include alternative embodiments to the extent permitted by the prior art.

What is claimed is:

1. A dental implant adapted to be embedded within a patient's jawbone comprising:

an apical end adapted to engage the jaw bone,

a top end, opposite the apical end, the top end having an abutment or prosthesis receiving portion;

wherein at least the apical end of the dental implant has a non-cylindrical shape.

2. The dental implant of claim 1, wherein at least the apical end of the dental implant has a shape substantially consistent with a shape selected from a square, an oval, a rectangle, a pentagon, and a hexagon.

3. The dental implant of claim 1, wherein at least the apical end of the dental implant has a shape substantially consistent with a rectangle.

4. The dental implant of claim 1, wherein at least the apical end of the dental implant has a shape substantially consistent with an hourglass in the mesial-distal plane, having two wider lobes, and a narrower, center portion between the two lobes.

5. The dental implant of any one of claims 1 to 4, wherein the dental implant comprises at least one material selected from the group consisting of titanium or titanium alloys, gold alloys, zirconium, and a ceramic.

6. The dental implant of any one of claims 1 to 4, wherein the dental implant has a smooth surface texture.

7. The dental implant of any one of claims 1 to 4, wherein the dental implant has a rough surface texture.

8. The dental implant of any one of claims 1 to 4, wherein the dental implant has at least one surface portion having a rough surface texture, and at least one surface portion having a smooth surface texture.

9. The dental implant of any one of claims 1 to 8, wherein the dental implant comprises a surface coating with materials selected from the group consisting of an artificial hydroxyapatite, a bisphosphonate, a platelet rich plasma (PRP), a PRP-bone matrix mix, and combinations thereof.

10. The dental implant of claim 9, wherein the surface coating is uniformly applied throughout the external surface of the implant.

11. The dental implant of claim 9, wherein the surface coating is applied to only a portion of an external surface of the implant.

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12. The dental implant of claim 9, wherein the surface coating is applied to a portion of an external surface of the implant that resides below the gum line in the surrounding tissues within the patient's mouth following implantation of the implant.

13. The dental implant of claim 9, wherein the surface coating is absent in a portion of the external surface of the implant that will reside above the gum line in the surrounding tissues within the patient's mouth following implantation of the implant.

14. The dental implant of claim 9, wherein an external surface of the implant that will reside above the gum line in the surrounding tissues within the patient's mouth is smooth and free of surface coatings.

15. The dental implant of any one of claims 1-8, wherein the top end is adapted to receive a prosthesis without the use of an abutment.

16. The dental implant of any one of claims 1-8, wherein the top end comprises a dental fixture integrally formed with the implant.

17. The dental implant of any one of claims 1-8, wherein the top end is adapted to receive an abutment.

18. The dental implant of Claim 17, wherein the abutment-receiving portion of the implant comprises a cavity formed within the implant to receive an abutment, or other dental prosthetic structure.

19. The dental implant of Claim 18, wherein the abutment-receiving portion of the implant comprises a plurality of projections formed on an interior wall of the cavity comprising the abutment-receiving portion of the implant.

20. The dental implant of Claim 19, wherein the projections extend from the interior wall into the cavity comprising the abutment-receiving portion of the implant.

21. The dental implant of Claim 20, wherein the projections are of a size and/or shape to engage with an abutment in a manner that will prevent rotation of an abutment disposed in the abutment-receiving portion of the implant.

22. The dental implant of Claim 21, wherein the projections are located in the cavity comprising the abutment receiving portion of the implant in a non-symmetrical pattern that will prevent rotation of an abutment disposed in the abutment-receiving portion of the implant.

23. The dental implant of Claim 21, wherein the projections have a shape to prevent the rotation of an abutment disposed in the abutment-receiving portion of the implant.

24. The dental implant of claim 17, wherein the abutment-receiving portion has a substantially pentagonal shape.

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25. The dental implant of claim 17, wherein the abutment receiving portion of the implant has a substantially non-cylindrical shape selected from the group consisting of a square, an oval, a rectangle, a hexagon, and an hourglass shape.

26. The dental implant of claim 17, wherein the abutment-receiving portion of the implant comprises a cavity formed within the implant to receive an abutment, or other dental prosthetic structure, the cavity further comprising a hole configured for receiving a fixation implant screw that will secure the implant into a jawbone.

27. The dental implant of Claim 26, comprising a circular opening in the apical end adapted for receiving a fixation screw that will pass through the circular opening in the abutment-receiving portion and extend below the apical end of the implant, and into a jawbone.

28. The dental implant of Claim 26, wherein the circular hole in the apical end of the implant has a countersunk central opening adapted to fit a countersink head on the fixation screw.

29. A dental implant abutment adapted to receive a dental prosthesis surmounted with a crown, or other dental fixture, comprising an implant insertion portion and prosthesis receiving portion opposite the implant insertion portion.

30. The dental implant abutment of Claim 29, comprising a material including titanium, zirconium, or a combination thereof.

31. The dental implant abutment of Claim 29, wherein the implant insertion portion has a substantially pentagonal shape.

32. The dental implant abutment of Claim 29, wherein the implant insertion portion has a shape substantially consistent with a square, an oval, a rectangle, a pentagon, a hexagon, or an hourglass shape.

33. The dental implant abutment of Claim 29, wherein the implant insertion portion has a substantially cylindrical shape comprising a plurality of indentations configured to mate with projections on an abutment-receiving portion of a dental implant.

34. A surgical drill guide adapted to guide the formation of drill holes in a jawbone comprising a metal guide comprising a plurality of holes of varying sizes and spatial arrangements that will guide a dental drill into the jawbone to form patterns of drill holes.

35. A method for securing a dental prosthesis to a patient's jawbone, comprising:

drilling at least one pilot hole in the jawbone to form an extraction cavity,

expanding the extraction cavity to accept a non-cylindrical implant,

setting a non-cylindrical implant into the extraction cavity,

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affixing a dental prosthesis on the non-cylindrical implant.

36. The method of claim 35, wherein the drilling is conducted using a surgical drill guide secured about an extraction site to guide the formation of pilot holes.

37. The method of claim 36, wherein the surgical drill guide includes a plurality of holes of various sizes and spatial arrangements configured to guide a dental drill into the jawbone to form patterns of drill holes.

38. The method of claim 35, wherein the expanding step comprises using an osteotome to expand the extraction cavity to fit the chosen implant.

39. The method of claim 35, wherein the expanding step comprises reaming to shape and contour the extraction cavity to accept the selected implant.

40. The method of claim 35, wherein the affixing step comprises anchoring the non-cylindrical implant to the jawbone with a fixation screw extending from an apical end of the non-cylindrical implant.

41. The method of claim 35, further comprising closing the implant site after setting the non-cylindrical implant into the extraction cavity prior to affixing a dental prosthesis on the non-cylindrical implant.

42. The method of claim 41, further comprising attaching a temporary cap to the non-cylindrical implant after setting the non-cylindrical implant into the extraction site.

43. The method of claim 41, wherein the implant site is closed by placing a gingival flap across the non-cylindrical implant.

44. The methods of any one of claims 41-43, wherein the affixing step is conducted about 3 months to about 12 months after setting a non-cylindrical implant into the extraction cavity.

45. The method of claim 35, wherein the affixing step comprises securing a false tooth to the implant.

46. The method of claim 35, wherein the affixing step comprises securing an abutment to the implant.

47. The method of claim 35, further comprising forming an impression of the non-cylindrical implant in the extraction cavity including surrounding dentitia.

48. An impression coping comprising an implant mating portion and an impression material contact portion, and a top.

49. The impression coping of claim 48, wherein the impression material contact portion is substantially cylindrical.

50. The impression coping of claim 48, wherein the impression material contact portion comprises at least one of surface projections, surface texturing, roughening, to enhance contact and retention in an impression material.

51. The impression coping of claim 48, wherein the implant mating portion is configured to be received by and mate with an interior portion of a dental implant with an indented feature configured to permit a mating fit with a cooperating protrusion.

52. The impression coping of claim 51, wherein the implant mating portion comprises a plurality of flanges situated around the impression material contact portion, opposite the top of the impression coping.

53. The impression coping of claim 52, wherein flanges may be spaced regularly around the generally cylindrical impression material contact portion.

54. An impression coping securing screw for securing an impression coping to an implant comprising at least one material selected from a heat labile plastic and silicone.

55. The impression coping securing screw of claim 54, wherein the impression coping securing screw comprises threads made of metal or plastic and coated with a heat labile plastic or silicone.

56. A method of removing an impression coping securing screw threaded into the internal threading in a dental implant comprising activating heat-labile plastic, or silicone threads, or heat labile plastic-coated or silicone-coated threads, to allow the impression coping secured by the impression coping securing screw to be disengaged from the implant and removed with the impression of the patient's dentitia.

57. A dental implant system comprising a dental implant and an impression coping member and an impression coping securing screw comprising a heat labile plastic or silicone material configured to cooperatively engage the dental implant and the impression coping member for ensuring proper alignment and orientation of a dental prosthesis assembled on the implant.

58. A method of impression making and dental reconstruction comprising:

providing an impression coping including a screw access channel in the impression coping configured to receive an impression coping securing screw

securing the impression coping on a dental implant set in a jawbone by passing an impression coping securing screw through the screw access channel and mating an end of the impression coping securing screw with the dental implant,

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activating a heat liable plastic or silicone on the impression coping securing screw to dissolve or soften sufficiently to allow removal of the impression coping securing screw from the implant without unscrewing the impression coping securing screw, and

removing the impression coping securing screw from the implant.

59. The method of claim 58, wherein an impression material is used to form an impression of the implant and surrounding dentitia before the step of removing the impression coping securing screw from the implant.

60. A method for obtaining an accurate translation of an orientation and position of an implant, comprising:

securing a dental implant in a jawbone, wherein the dental implant has a plurality of protrusions internal to an interior cavity of the implant, which protrusions are configured to matingly engage flanges on an impression coping in a snap-fit engagement when the flanges extend beneath the protrusions;

seating an impression coping comprising flanges that engage two or more of the protrusions internal to the interior cavity of the implant by deflecting and springing back to an un-deflected state upon seating of the impression coping in the implant;

applying a dental impression material to at least an area adjacent the impression coping seated in the implant to cover the impression coping to obtain a negative impression of the area;

releasing the impression coping from the implant;

removing the impression material from the area adjacent the impression coping with the impression coping embedded in the impression material.

61. The method of claim 60, wherein engaging flanges of the impression coping with the protrusions on the implant produces an audible sound indicating that the impression coping has been properly seated in the implant.

62. The method of claim 60, wherein a bore extends through the impression coping, the bore configured to allow the passage of an impression coping securing screw through the impression coping.

63. The method of claim 62, wherein seating the impression coping in the implant comprises passing an impression coping securing screw through the bore in the impression coping and engaging the screw in an internal cavity of the implant in a closely fitted engagement.

64. The method of claim 63, wherein the impression coping securing screw comprises a heat labile plastic or silicone configured to cooperatively engage the implant.

65. The method of claim 64, wherein releasing the impression coping from the implant comprises activating the heat labile plastic or silicone portion of the impression coping securing screw to dissolve or soften sufficiently to allow removal of the impression coping securing screw from the implant without unscrewing the impression coping securing screw.

66. The method of claim 60, further comprising sending the impression material and impression coping to a dental lab to form a dental cast model.

67. A multi-component dental implant system comprising:

at least one non-cylindrical dental implant;

at least one implant abutment configured to detachably join at least one non-cylindrical dental implant.

68. The multi-component dental implant system of claim 67, further comprising: a set of standard surgical tools prepared for the dental professional to choose from.

69. The multi-component dental implant system of claim 67, wherein the at least one non-cylindrical dental implant comprises a set of standard shaped implants of varying size.

70. The multi-component dental implant system of claim 67, wherein the at least one implant abutment comprises a set of standard shaped abutments of varying size.

71. The multi-component dental implant system of claim 67, wherein the at least one non-cylindrical dental implant comprises at least one non-cylindrical implant configured to replace a tooth selected from a bicuspid, a molar, a canine, and an incisor.

72. The multi-component dental implant system of claim 67, further comprising: at least one dental surgical instrument selected from a drill guide, a reamer, a drill bit, a surgical fixation screw, and a bone screw insertion tool.

73. The multi-component dental implant system of claim 67, further comprising: a healing abutment.

74. The multi-component dental implant system of claim 73, wherein the healing abutment need not be removed during an impression taking procedure.

75. The multi-component dental implant system of claim 67, further comprising: an implant coding system that facilitates selection or identification of a non-cylindrical dental implant by the dental professional.

76. A dental implant adapted to be embedded within a patient's jawbone comprising:

an apical end adapted to engage the jaw bone,

a top end, opposite the apical end, the top end having an abutment or prosthesis receiving portion,

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the abutment or prosthesis receiving portion comprising a cavity formed within the implant to receive an abutment, or other dental prosthetic structure,

wherein the abutment or prosthesis receiving portion has a substantially pentagonal shape, and

wherein at least the apical end of the dental implant has a non-cylindrical shape.

77. The dental implant of claim 76, wherein the abutment-receiving portion of the implant further comprises a circular opening in the apical end adapted for receiving a fixation screw that will pass through the circular opening in the abutment-receiving portion and extend below the apical end of the implant, and into a jawbone.

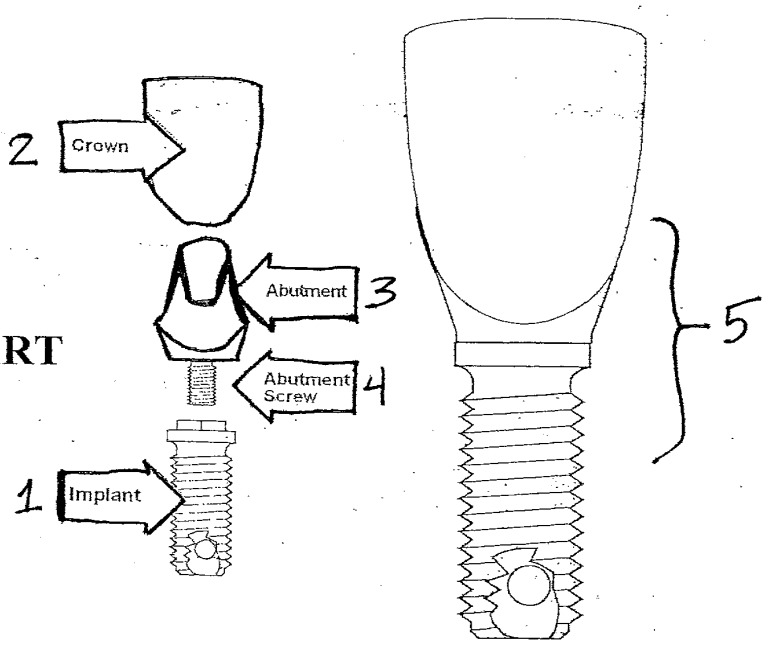


FIG. 1
PRIOR ART

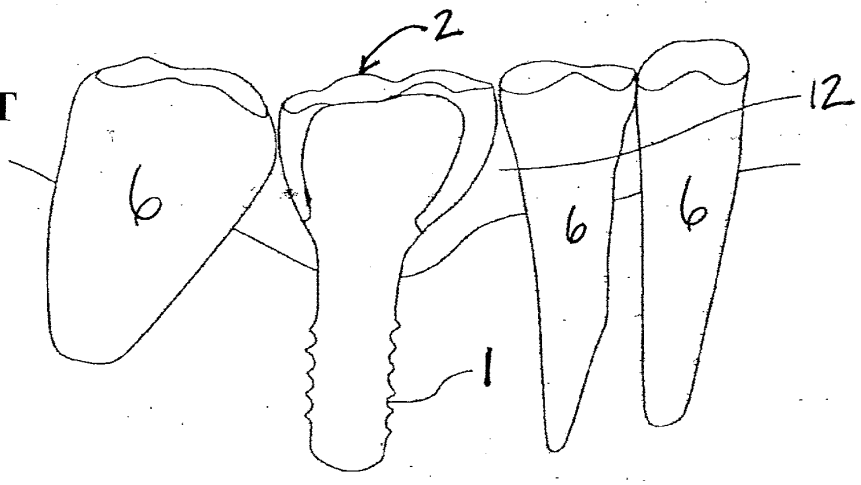


FIG 2.
PRIOR ART

FIG. 3

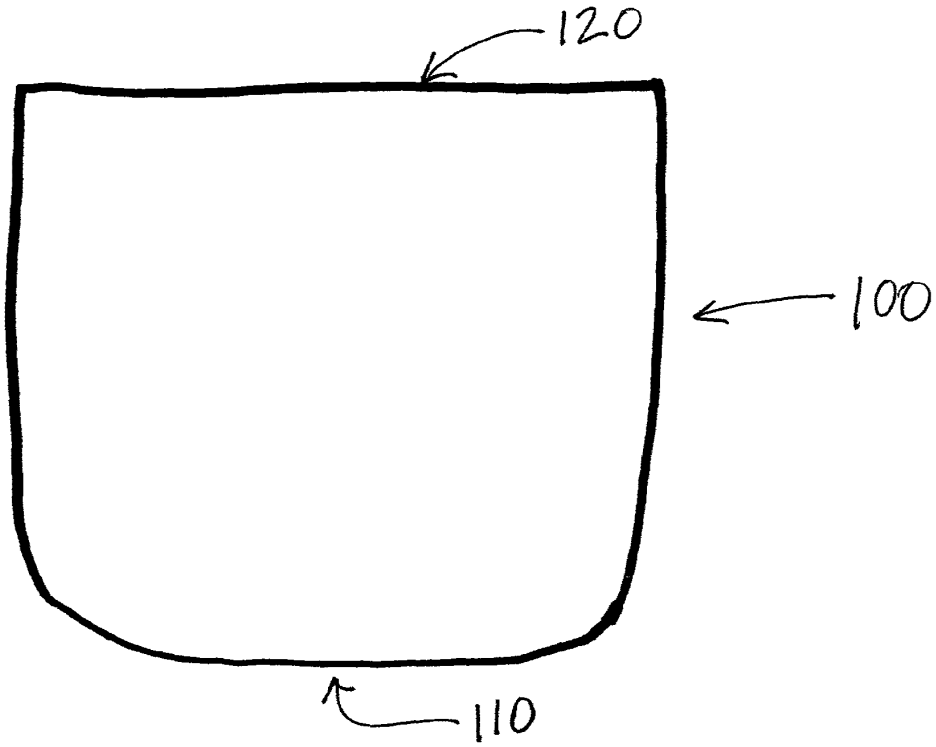
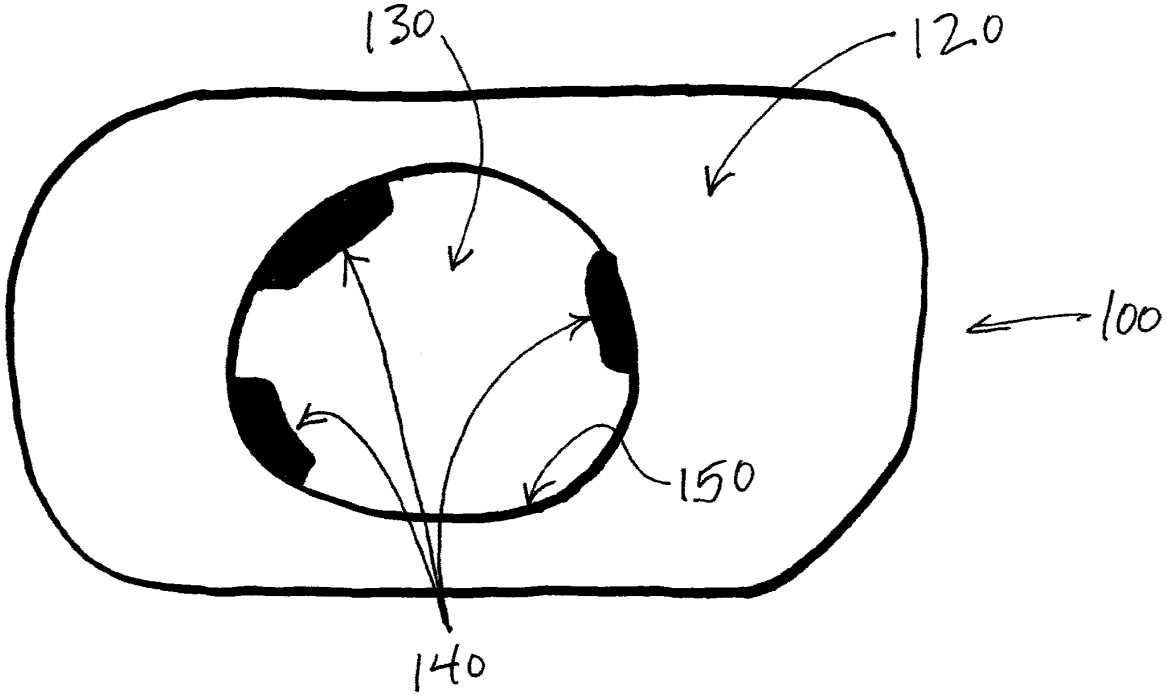


FIG. 4



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FIG. 5

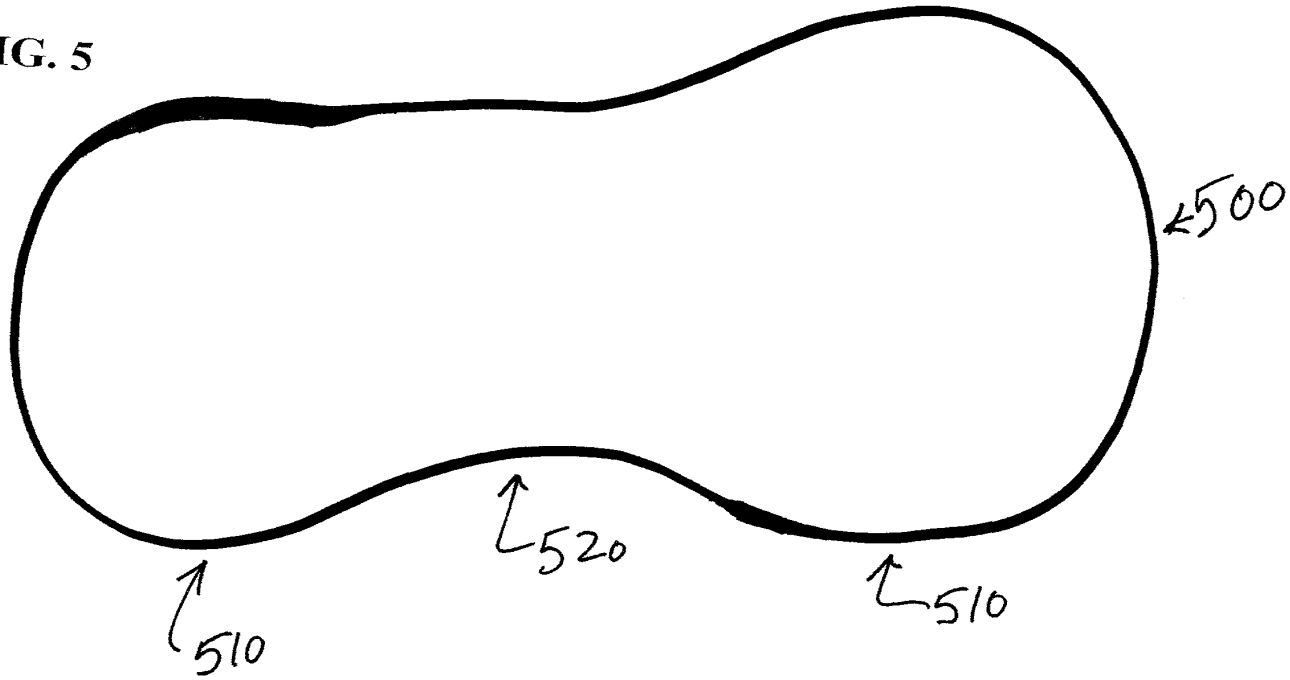
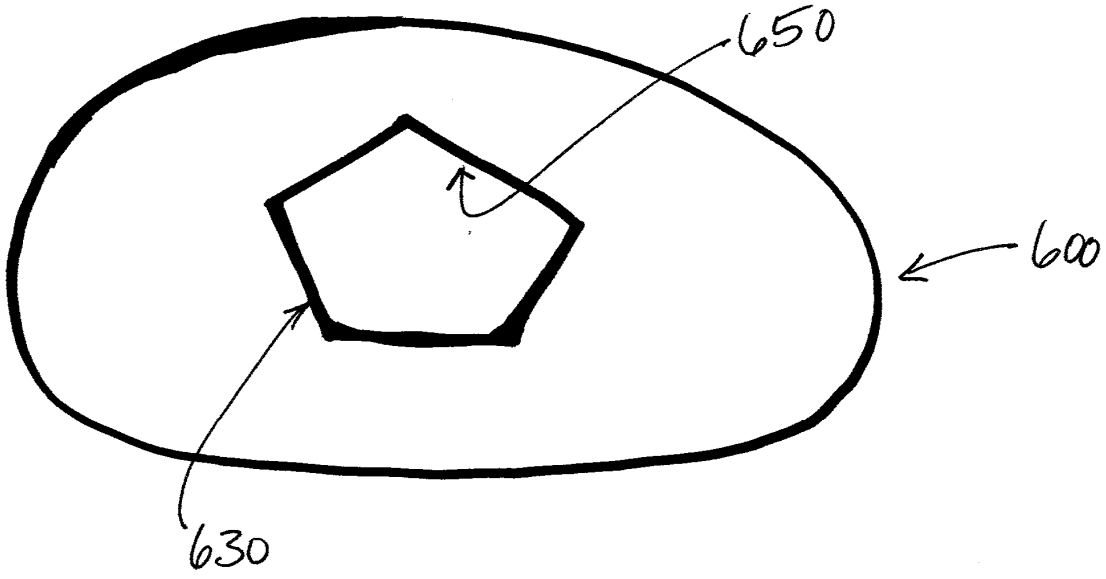


FIG. 6



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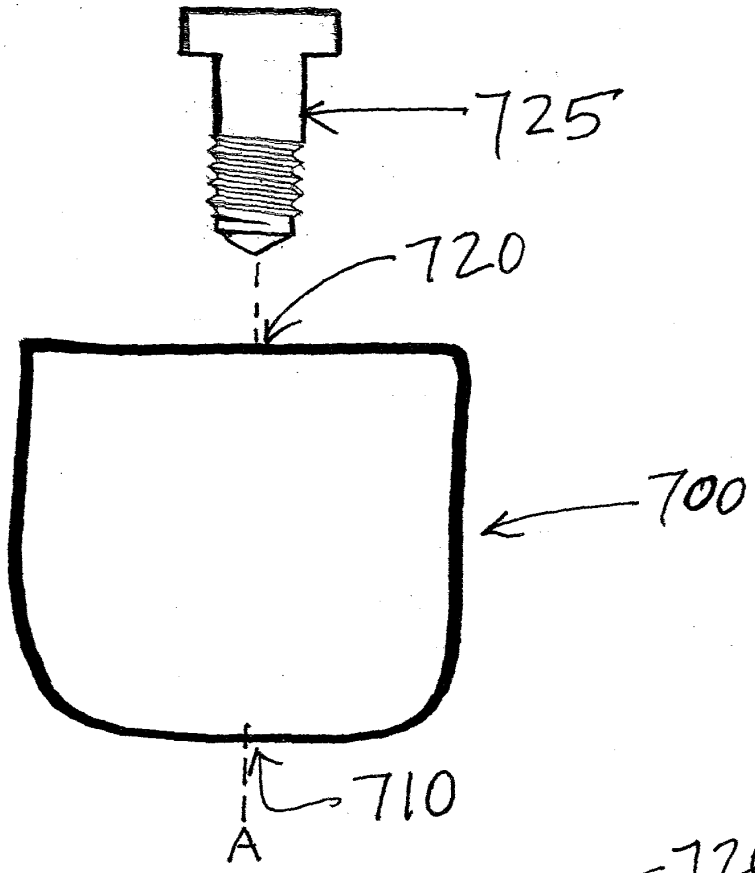


FIG. 7

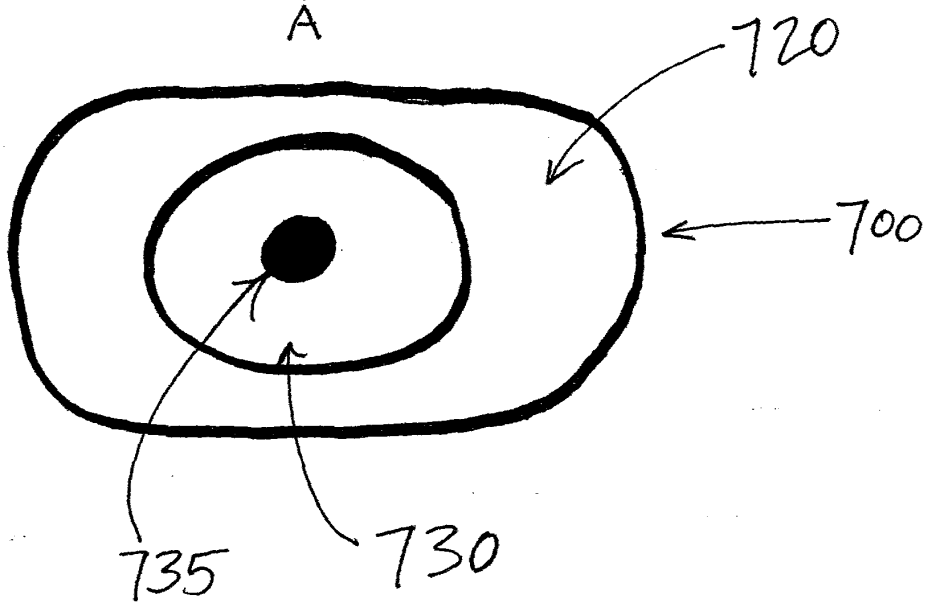


FIG. 8

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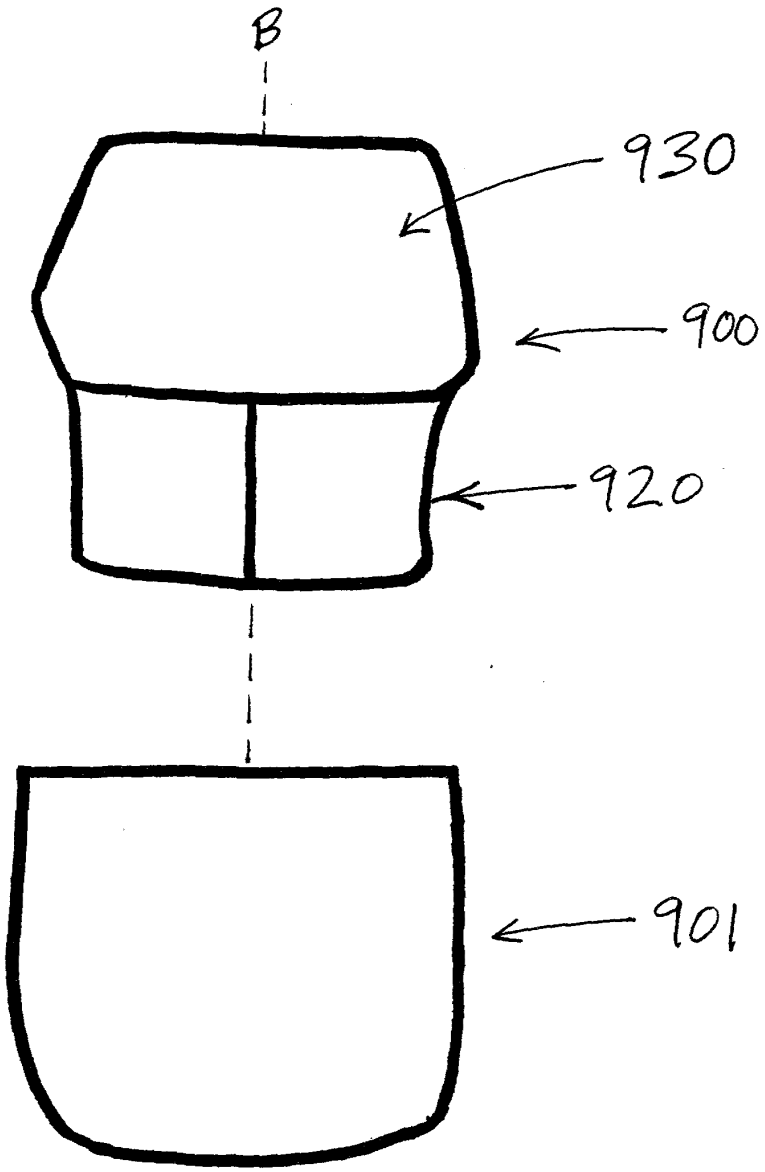
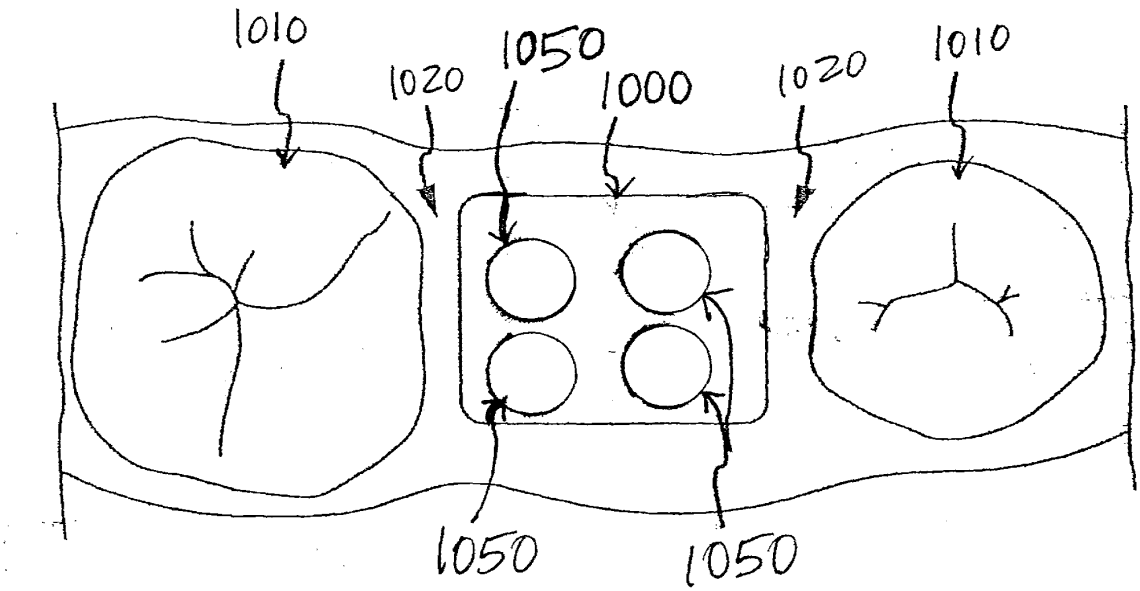


FIG. 9

FIG. 10



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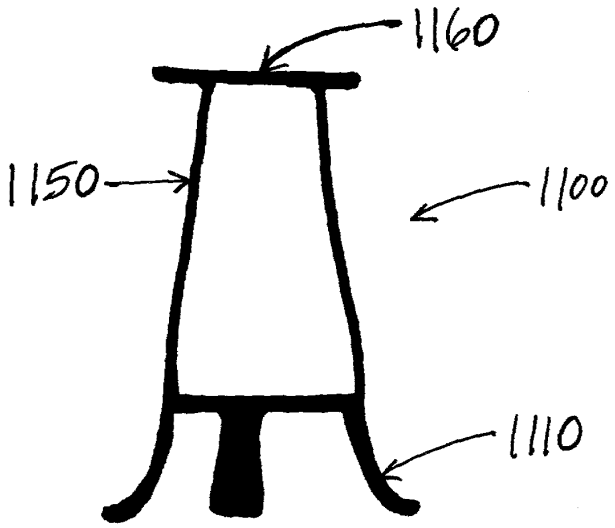

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FIG. 11

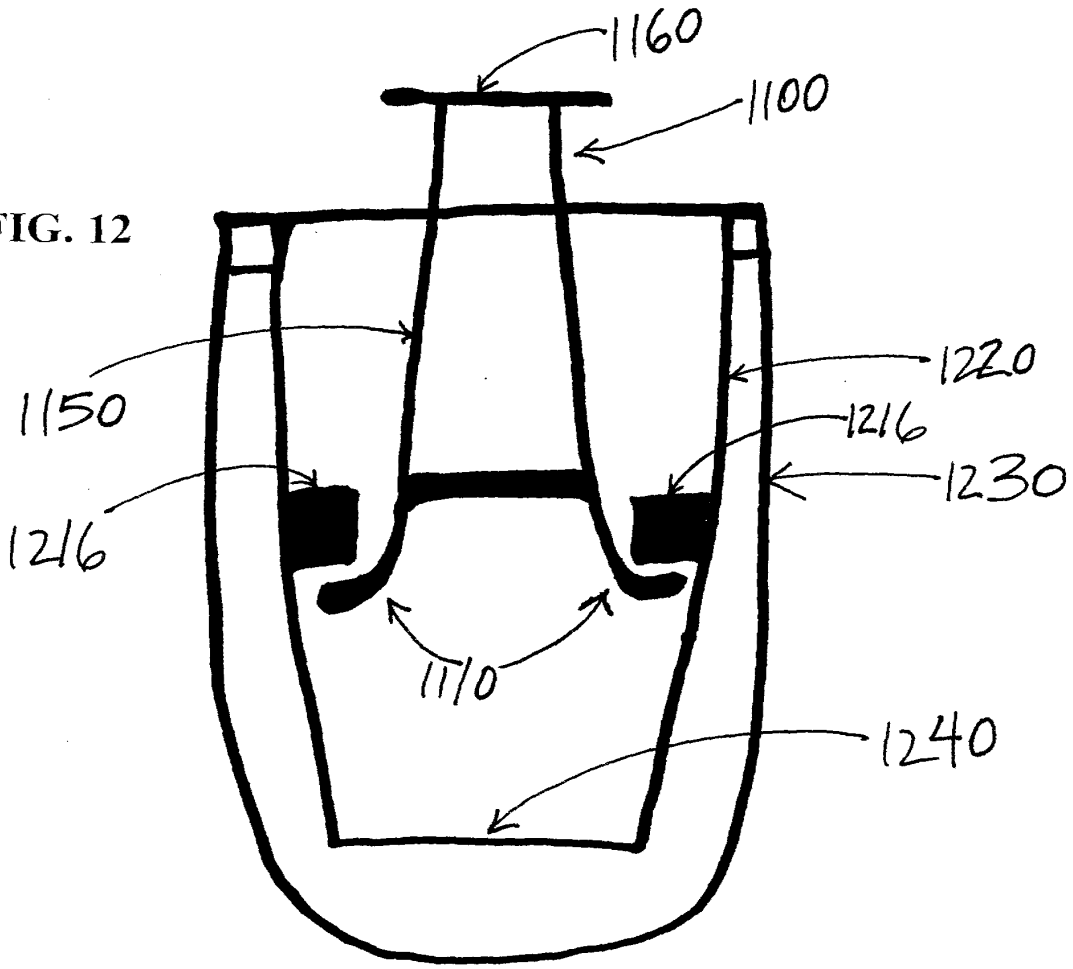
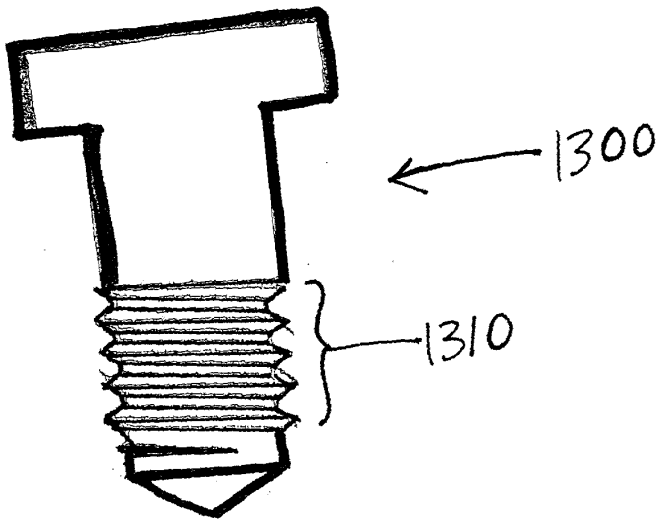

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1216
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1240

FIG. 12

FIG. 13



PRACTICE

8

IN BRIEF

- Impressions of teeth and implants are differentiated.
- Accuracy of different impression copings and methods are discussed.
- Methods to transfer peri implant soft tissues are illustrated.

Impression techniques for implant dentistry

W. Chee[1] and S. Jivraj[2]

The object of making an impression in implant dentistry is to accurately relate an analogue of the implant or implant abutment to the other structures in the dental arch. This is affected by use of an impression coping which is attached to the implant or implant abutment. This impression coping is incorporated in an impression – much as a metal framework is 'picked up' in a remount impression for fixed prosthodontics. With implant copings the coping is usually attached to the implant or abutment with screws. The impression material used is usually an elastomeric impression material; the two types most widely used and shown to be the most appropriate are polyether and polyvinyl siloxane impression materials.[1]

IMPLANTS

1. Rationale for dental implants
2. Treatment planning of implants in posterior quadrants
3. Treatment planning of implants in the aesthetic zone
4. Surgical guidelines for dental implant placement
5. Immediate implant placement: treatment planning and surgical steps for successful outcomes
6. Treatment planning of the edentulous maxilla
7. Treatment planning of the edentulous mandible
8. Impression techniques for implant dentistry
9. Screw versus cemented implant supported restorations
10. Designing abutments for cement retained implant supported restorations
11. Connecting implants to teeth
12. Transitioning a patient from teeth to implants
13. The role of orthodontics in implant dentistry
14. Interdisciplinary approach to implant dentistry
15. Factors that affect individual tooth prognosis and choices in contemporary treatment planning
16. Maintenance and failures

The impression coping takes two general forms, one type is retained in the mouth when the set impression is removed – this type of impression coping is known as the transfer type impression coping. The other type is incorporated in the impression and is removed from the mouth together with the set impression and is known as a pick up type impression coping.

Characteristics or the transfer type impression coping are that they remain in the mouth on removal of the set impression, the analogue is attached to the impression coping after removal from the mouth and this assembly is replaced in the indentation left on the set impression. No custom tray is required for this type of impression.

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Characteristics of the pick up type impression coping are that they are removed from the mouth together with the set impression. They require access to the retaining screw to allow release of the screw prior to removal of the impression coping – impression assembly, the analogues are attached to the impression copings while they are embedded in the impression tray. A custom tray with access to the impression coping screws is required.

Some precautions to take are:

- Making a radiograph when the impression coping/implant or impression coping/abutment is below the level of the mucosa to insure seating of the impression copings.
- Using vinyl gloves when a polyvinyl siloxane impression is used to prevent retardation of setting of the impression material from the interaction of latex gloves with the material.[2,3]
- It has been shown that the pick up type impression coping is the more accurate type of impression as errors occur on removal and replacement of the transfer type impression copings, especially in the occluso-gingival direction.[4–7]

However, there are indications to use of the transfer type impression coping. When there is limited mouth opening they can be used as there may not be sufficient space for access to the screws retaining pick up type impression

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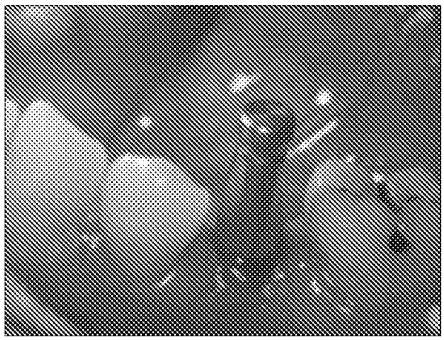


Fig. 1 Intra oral view of transfer impression coping in place.

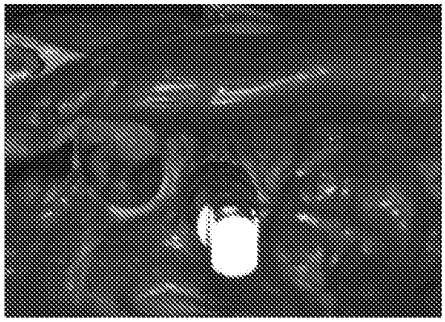


Fig. 2 Transfer impression – analogue assembly placed into elastormeric impression.

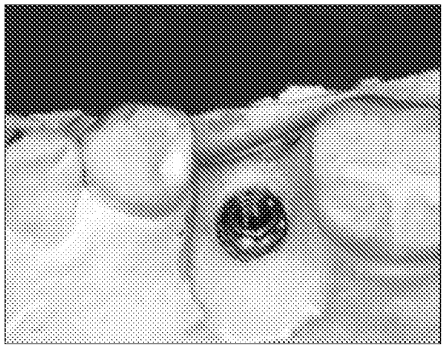


Fig. 3 Cast of implant analogue with soft tissue cast removed – allowing the technician access to the fit surface of the implant analogue.

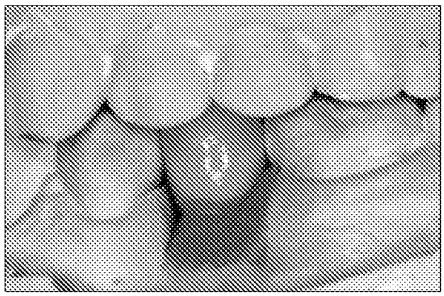


Fig. 4 Completed restoration in occlusion on working casts.

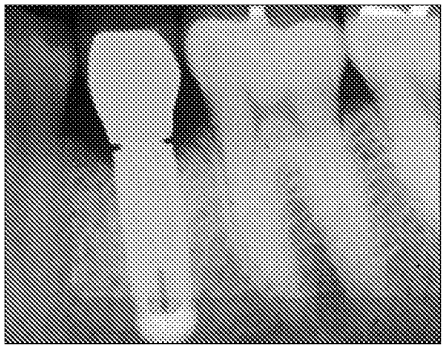


Fig. 5 Radiograph of restoration indicating poor seating due to interference of inter proximal contacts.

copings with the impression in place and in patients with an exaggerated gag reflex, when the impression has to be removed as quickly as possible.

The fidelity of the impression with respect to dimensional stability is critical; small discrepancies can lead to difficulty when the restoration is fabricated and delivered. Figures 1 to 7 illustrate a situation where a transfer type impression coping was used, showing that a slight error resulted in poor seating of the restoration due to interference with the proximal contacts. The impression was repeated with a pick up type impression and the contacts refined to allow more efficient delivery of the finished restoration with minimal adjustments to the interproximal contacts. These errors are more obvious when compared to conventional fixed prosthodontics due to the precise machine fit of implant components and to the rigid connection of implant to bone. Any discrepancy of the working cast to the mouth will manifest itself (Figs 1-7).

When impressions are required for multi implant restorations the precision of the impression is even more critical. This is because frameworks will be constructed from the master cast and mis-fit in the frameworks can lead to stress applied to the implants on screwing down the framework. Bone loss and even loss of integration has been attributed to this misfit.

Many articles have been written and many *in vivo* studies have been carried out to improve the fidelity of impressions over the use of pick up type impression copings alone. Some advocate connecting the impression copings together intra orally prior to impression making with acrylic resin.[8] These studies indicate that there is not statistically significant improvement when splinting impression copings with acrylic, however, the deviation of these impressions from the standardised cast is smaller. Others advocate use of impression plaster to connect the impression copings.[9] Manufacturers have developed impression copings with 'metal wings' that can be connected with acrylic resin to reduce the bulk of shrinking acrylic to further improve dimensional stability of the impression in order to obtain a passive framework.[10] Yet others have advocated corrected impression techniques where impression copings are connected then with only one impression coping related to the cast the other analogues are retrofitted to the cast to compensate for distortions of the impression material and the distortions of the setting die master cast material. Other authors have demonstrated that none of the above procedures are likely to improve the fidelity of the impression over use of a rigid custom tray and pick up type impression copings with an elastomeric impression material.[11-14]

Based on the above, the authors' suggestion is to use a an open custom tray which is rigid, to allow access to the retaining screws of pick up impression copings, to use a polyvinyl siloxane

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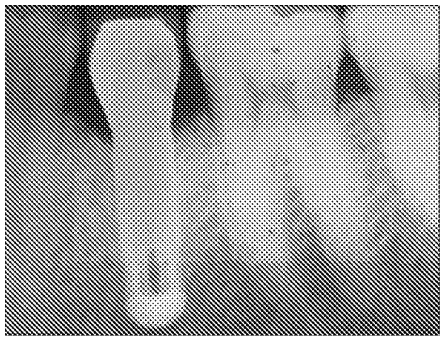


Fig. 6 Radiograph of restoration indicating seating after contacts are adjusted.

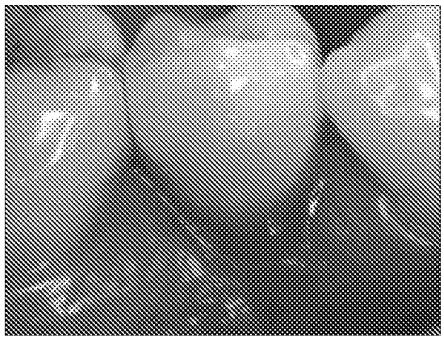


Fig. 7 Intra oral view of seated restoration.

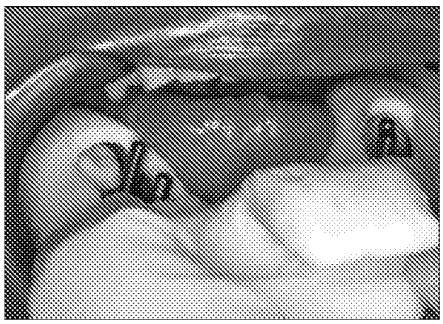


Fig. 8 Intra oral view of pick up impression copings and custom tray.

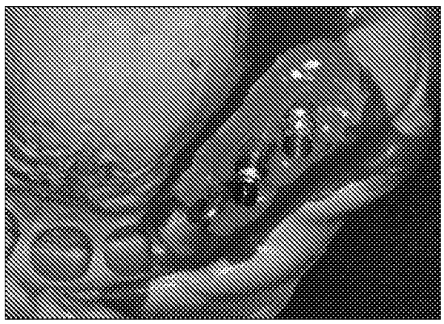


Fig. 9 Impression in Figure 8 with implant analogues assembled and soft tissue cast poured.

impression material with adhesive applied to the custom tray and poly ether as a soft tissue cast material (Figs 8-10).[15-18]

The above describes only making an impression which as accurately as possible positions the implant or abutment analogues in the master cast. This only provides the technician with part of the information he or she needs to fabricate the restoration. Other information that the technician will require about the soft tissue contours, that will frame the restoration and provide much of the aesthetics, will come from transfer of the contours surrounding the implant and also pontic areas.[19] Several methods are available to capture this information on the master cast and they will be discussed as follows:

1. fabricating a custom impression coping which is adapted to the soft tissue contours
2. replacing the provisional restoration on the master cast and forming the soft tissue around the sub muscosal areas of the provisional restoration
3. incorporating the provisional restoration into the impression.

Manufacturer supplied impression copings do not take into account soft tissue morphology formed by provisional restorations. Impressions using manufacturer supplied impression copings merely relate the implant or implant abutment to oral structures. Customised impression copings that accurately record the soft tissue can be made by attaching an analogue to the provisional restoration and placing some impression material around the sub mucosal portion of the provisional restoration. On setting of the impression material the provisional restoration can be returned to the patient. An impression coping is attached to the analogue and the space around the impression coping formed by the provisional restoration is filled with acrylic resin. The customised impression coping is then used in the impression making process. A soft tissue cast is poured around the customised impression coping producing a cast with the implant position and soft tissue representing the intra oral conditions.[20,21]

Instead of making customised impression copings, the provisional restoration can be seated on the master cast that is made routinely and the existing soft tissue cast can be removed. The provisional restorations are removed from the patient and placed onto the master cast and impression material is extruded around the provisional restoration to form the soft tissue contours presenting intra orally.[22]

Another method of transferring soft tissue information is incorporating the provisional restoration into the impression. When screw retained restorations are used, the provisional restoration itself can be used as a pick up type impression coping. A soft tissue cast is poured around the exposed provisional after an impression coping is attached, yielding a soft tissue cast which is identical to the soft tissue form intra orally. This allows communication of some vital information to the technician fabricating the definitive restorations (Figs 11-12).[23,24]

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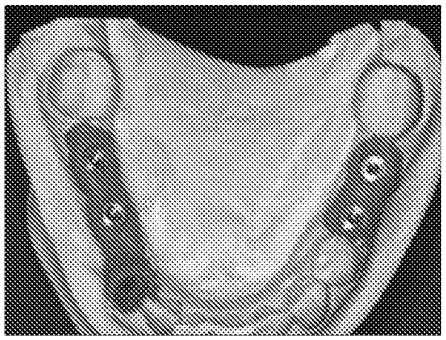


Fig. 10 Occlusal view of hard and soft tissue cast recovered from impression.

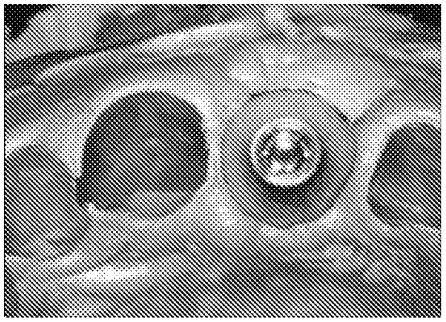


Fig. 11 Impression incorporating provisional restoration – note the sub mucosal portion of the provisional restoration.

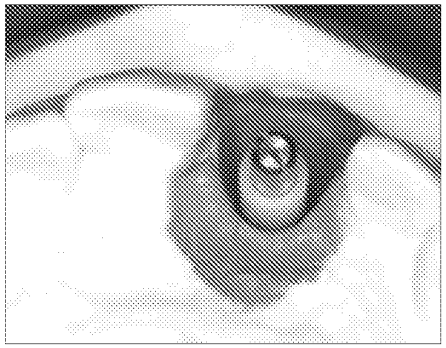


Fig. 12 Cast recovered from impression in Figure 11 with restorative cylinder in place – note the soft tissue information communicated to the laboratory technician.

DISCUSSION

A review of the literature concerning impression making in implant dentistry was presented along with suggestions for a predictable implant impression technique, when esthetics is of concern methods of transferring the soft tissue information formed by provisional restorations to the master cast were also described.

CONCLUSION

With the predictable integration of implants the emphasis is shifted toward more precision with restorative techniques and the creation of tooth like replacements for missing teeth. With careful planning dental implants can be placed in ideal restorative positions. Furthermore, with careful soft tissue management the soft tissue contours can be enhanced with early use provisional restorations. These efforts must be translated to the master cast to allow the technician to fabricate definitive restorations that have individualised peri implant soft tissue contours that will be identical to the soft tissue contours present intra orally. Using the modified impression techniques described, information regarding soft tissues can be transferred to the master cast.

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THE JOURNAL OF PROSTHETIC DENTISTRY

RESEARCH AND EDUCATION

Fatigue performance of prosthetic screws used in dental implant restorations: Rolled versus cut threads

Mikel Armentia, MSc,[a] Mikel Abasolo, PhD,[b] Ibai Coria, PhD,[c] Joseba Albizuri, PhD,[d] and Josu Aguirrebeitia, PhD[e]

ABSTRACT

Statement of problem. Cold rolling is widely used for screw thread manufacturing in industry but is less common in implant dentistry, where cutting is the preferred manufacturing method.

Purpose. The purpose of this in vitro study was to compare the surface finish and mechanical performance of a specific model of prosthetic screw used for direct restorations manufactured by thread rolling and cutting.

Material and methods. The thread profiles were measured in an optical measuring machine, the residual stresses in an X-ray diffractometer, the surface finish in a scanning electron microscope, and then fatigue and static load tests were carried out in a direct stress test bench according to the International Organization for Standardization (ISO) 14801. Finally, linear regression models and 95% interval confidence bands were calculated and compared through ANCOVA for fatigue tests while the *t* test was used for statistical comparisons (α=.05).

Results. The surface finish was smoother, and compressive residual stresses were higher for the roll-threaded screws. Linear regression models showed a fatigue life 9 times higher for roll-threaded screws (P=1) without affecting static behavior, which showed statistically similar static strengths (P=.54). However, the thread profile in the roll-threaded screws was not accurately reproduced, but this should be easily corrected in future prototypes.

Conclusions. Rolling was demonstrated to be a better thread-manufacturing process for prosthetic screws, producing improved surface quality and fatigue behavior. (J Prosthet Dent 2021;126:406.e1-e8)

Dental implants are widely used to replace missing teeth.[1] In direct-to-implant restorations, implant and abutment are joined by the preload obtained through the tightening torque applied to the prosthetic screw[2] as illustrated in Figure 1, providing the necessary structural integrity to the restoration.[3-8] The recommended torque value is provided by manufacturers based on different implant design factors.[9]

Clinical studies suggest that the failure of implant restorations is often induced by fatigue because of the variable load conditions during their life span.[10-12] These failures typically occur in the prosthetic screw, with abutment or implant failures being less common.[13,14] The screw fracture is usually located at the first thread engaged with the implant.[15,16] Under given loading conditions, the number of cycles to fatigue failure depends on several parameters, including component dimensions, screw metric, material, manufacturing processes, and preload level.[17] Most prosthetic screws are made of pure or alloyed titanium, as these are less expensive than gold alloy screws while having excellent biocompatibility, corrosion resistance, machinability, and desirable physical and mechanical properties.[18,19] Two processes are widely used for screw thread manufacturing in industry: cutting and cold rolling. In thread cutting, material is removed from a cylindrical blank by machining, and in thread rolling, a matched set of dies displaces material of the manufacturing part to produce external threads on the

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Clinical Implications

Thread rolling is a suitable manufacturing process for prosthetic screw threads that significantly enhances the fatigue performance of dental restorations.

cylindrical blank in a cold forming operation with no material losses.[20]

Thread rolling offers many benefits in terms of manufacturing and mechanical behavior. The rolling process is less time-consuming because the thread may be obtained in a single pass[21,22] with no need for secondary operations,[23] which significantly increases productivity[23] and reduces unit product cost.[24] Regarding mechanical behavior, the thread rolling process introduces compressive residual stresses[25] on the thread surface, increasing hardness from strain hardening.[26] Furthermore, as no material is removed, good grain flow is obtained,[23,27] improving surface quality.[22,28] Consequently, rolled threads have been reported to provide better fatigue results than cut threads.[22,29-31]

Even though rolled threads are widely used in general industry,[21,23,25] they are less common in threaded prosthetic components, possibly because of the small screw sizes. The purpose of the present work was to compare both manufacturing techniques in a direct restoration prosthetic screw in terms of thread profile, residual stresses, surface finish, and fatigue and static mechanical behavior. The hypothesis of this study was that rolled threads would provide better mechanical response than cut threads.

MATERIAL AND METHODS

The retaining screw studied (INTTUH; BTI Biotechnology Institute) has been commonly used by the dental implant manufacturer BTI (BTI Biotechnology Institute), with a 1.8-mm metric thread and with a tungsten carbide surface treatment (Ti Black; BTI Biotechnology Institute) to reduce the friction coefficient and maximize the preload for a given tightening torque. Two batches of INTTUH prosthetic screws were manufactured: one with cut threads and the other with rolled threads. Most machining operations were the same for both batches, except for the diameter of blank material before threading, the turning speed, the feed rate, and the number of passes during the thread-manufacturing process. For the cut threads, a Ø1.8-mm blank was used, and 20 passes were made at 5000 rpm with a 1750-mm/min feed rate. For the rolled threads, a Ø1.5-mm blank was used, and the final profile was obtained by 1 pass at 200 rpm with a 70-mm/min feed rate. In both operations, the same commercially available lubricant was used (Blasomill 10; Blaser Swisslube). For the measurements of the thread profile, surface roughness, and compressive residual stress, the coating was not added. Then, the prosthetic screw was mounted in an implant (IIPSCA4513; BTI Biotechnology Institute) with a Ø4.5-mm body, a Ø4.1-mm universal platform, and a titanium abutment (IN-PPTU44; BTI Biotechnology Institute), as used for directly attached implant-supported restorations, all provided by the manufacturer. The static and fatigue failure tests were carried out with a coated (Ti Black; BTI Biotechnology Institute) screw. Figure 2 shows the assembly where, following the recommendation of the manufacturer, a tightening torque of 35 Ncm was applied to the screw. The retaining screw was made of Ti 6Al 4V ELI (Ti GR5), while the implant and the abutment were made of Ti CP4, the chemical composition of which is provided in Table 1.

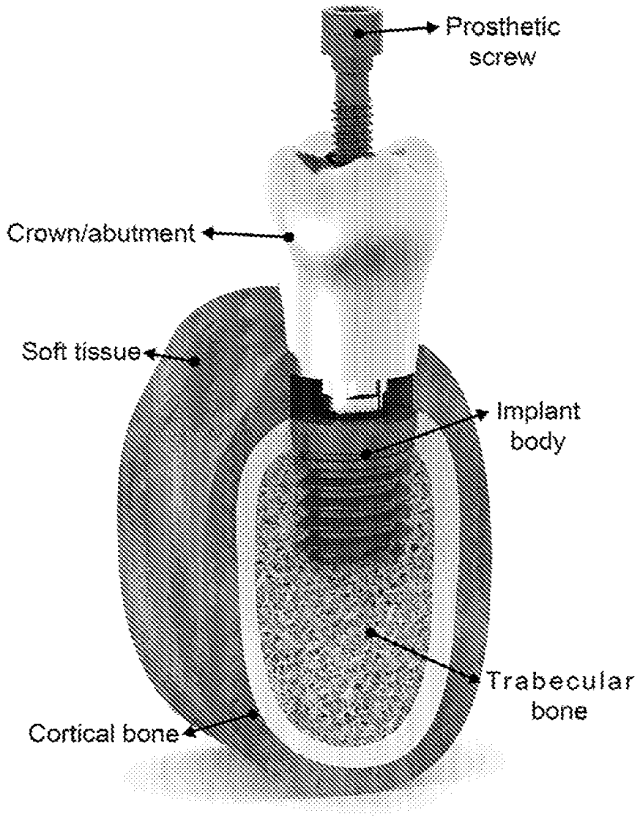


Figure 1. Assembly of single dental implant restoration.[17]

Cutting and rolling operations may cause slight dimensional differences in the thread profile. Therefore, a multisensor measuring machine (Zeiss O-Inspect 322; Carl Zeiss Iberia, S.L.) was used to examine both thread profiles and measure the thread parameters, including the internal diameter, external diameter, pitch, and thread angle for 1 specimen of each batch of thread rolled and cut screws.

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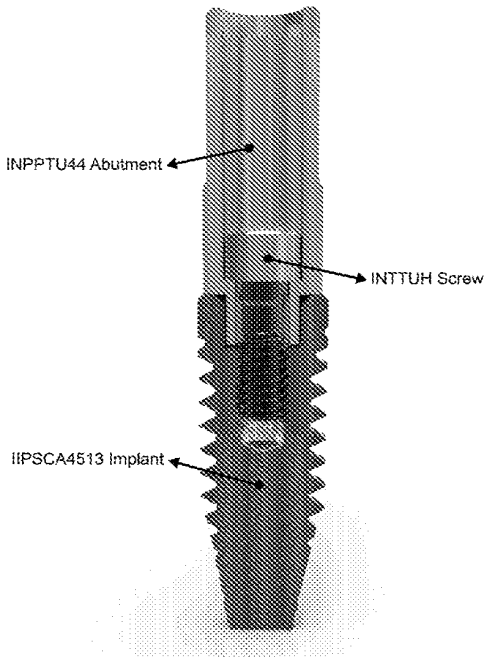


Figure 2. Dental implant assembly: implant body, prosthetic screw, and abutment.[37]

The surface roughness of 1 specimen of each batch was measured with a scanning electron microscope (Thermo Scientific Phenom ProX; ThermoFisher Scientific/Paralab). Surface analyses were performed for a field of view of 53.7 μm, and the results were provided after Gaussian filtering (microroughness filter λ_s=20 nm and waviness filter λ_c=20 μm).

The residual compressive stresses in the screw thread surface were measured in 3 specimens for each manufacturing technique (thread rolling and cutting) by using a diffractometer (Bruker D8 Discover; Bruker) equipped with a Chromium Point or Line Focus X-ray tube, V filter (λ=2.2911 Å), PolyCapTM (1-μm single crystal cylinders) system for parallel beam generation (divergence of 0.25 degrees), and a 1-D detector (LynxEye; Bruker) with active length in 2θ 2.7 degrees. The twist X-ray tubes allowed for the quick selection change between point and line focus.[33,34] The prosthetic screws were mounted on an Eulerian Cradle with an automatically controlled X-Y-Z stage. Data were collected from 59 to 64.2 degrees 2θ (step size=0.05 and time per step=7.5 seconds). Strain values in side inclination mode were recorded for different specimen tilt angles (0, 18.4, 26.6, 33.2, 39.2, 45.0, 50.8, and 56.8 degrees) at constant azimuth angles phi. Strain-Sin2 ψ was plotted to estimate the stress values. In order to acquire a complete evaluation, at least 6 measurements were needed on the Strain-Sin2 ψ plot by using 3 different values of phi, and 0, 45, and 90 degrees were chosen in negative and positive values. Stress was evaluated from strain values by using

Table 1. Chemical composition of materials used in implant and prosthetic components

Ti 6Al 4V ELI (Ti GR5)		Ti CP4	
Composition	**Wt. %**	**Composition**	**Wt. %**
Al	5.5–6.5	N(max)	0.05
V	3.5–4.5	C(max)	0.08
Fe(max)	0.25	Fe(max)	0.5
O(max)	0.13	O(max)	0.4
C(max)	0.08	H(max)	0.0125
N(max)	0.05	-	-
H(max)	0.012	-	-

Wt. %, weight percentage.

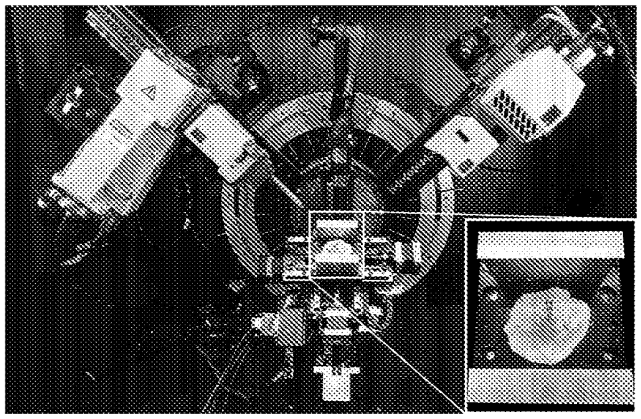


Figure 3. Diffractometer: general view and detail of specimen.

the Young modulus E (111 982 MPa) and Poisson ratio ν (0.330) and by taking into consideration the elastic constants s1 (-2.947×10^{-6}) and ½ s2 (1.188×10^{-5}) of the material. A single peak (101), available at 61.4 value of 2θ, was used for the analysis. The obtained results were adjusted by using a software program (Leptos 7.03; Bruker AXS GmbH). The data were corrected for absorption, background (5 points at edges), polarization, smoothness, and K alpha2 subtraction, and the peak evaluation was fitted by the Pearson VII function. The determined values were obtained by using a biaxial mode with the Psi splitting function because of the shear stress components. Figure 3 shows the experimental design.

The dental implant assembly (Fig. 2) was tested under static and cyclic loading conditions to evaluate its mechanical strength. A direct stress fatigue test bench (E 3000 Electropuls; Instron) with a ±5-kN load range load cell (DYNACELL 2527-153; Instron) was used. Tests were carried out in accordance with the International Organization for Standardization (ISO) 14801 Standard,[35] which established the test conditions for dental implant fatigue tests. In brief, the implant was fixed in a rigid clamping device with the implant extending 3 mm from the specimen holder and with the load applied at 8 mm from the implant-abutment connection with an inclination of 30 degrees with respect to the implant axis.

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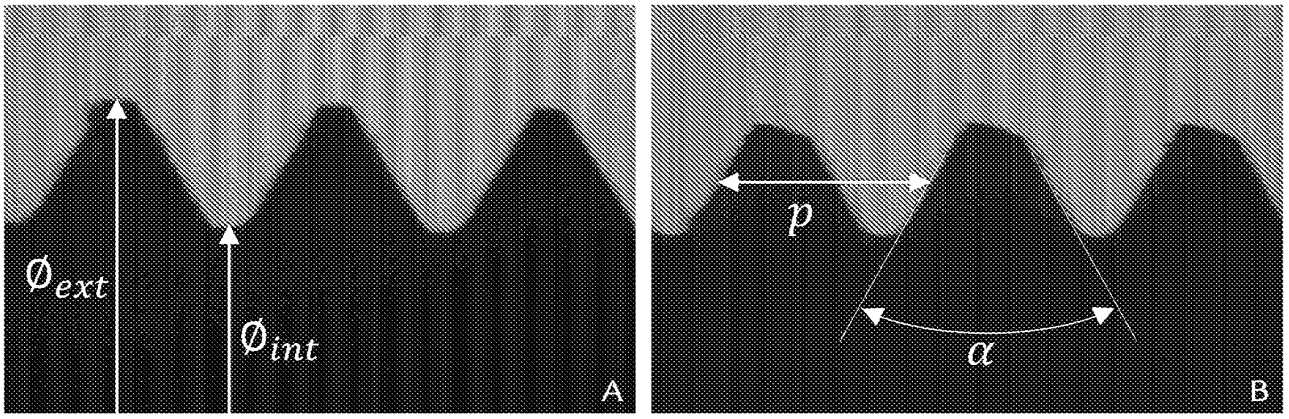


Figure 4. Thread profile. A, Cut thread. B, Rolled thread. Original magnification ×150.

For fatigue tests, the load varied sinusoidally between the test load and 10% of this value (R0.1) with a frequency not higher than 15 Hz, and the number of cycles to failure was reported. Thus, the curve that related the applied force with the number of cycles was obtained. For such purpose, a total of 24 fatigue tests were performed fulfilling ISO 14801 requirements: 9 tests at 3 different load levels (3 specimens per load level) for cut threads and 15 tests at 3 different load levels (5 specimens per load level) for rolled threads because a longer fatigue life and consequently more scatter were expected.[36] The cut thread tests had been previously published.[17] However, both tests were carried out at the same fatigue tests bench and in the same period, making the results comparable. For the static tests, the load was quasistatically incremented until collapse, and the collapse load was reported as a result. Five specimens were tested for both cut and rolled threads. For the statistical analysis of the results, ANCOVA was used to compare linear regression models from fatigue data, and a *t* test (α=.05) was used to compare static strength.

RESULTS

Figure 4 shows the profiles of the rolled and cut threads. Table 2 presents the dimensions obtained from both manufacturing processes: the external diameter $\emptyset_{ext}$, the internal diameter $\emptyset_{int}$, the pitch p, and the angle of the thread profile α. Unlike cut threads, where thread crests were parallel to the longitudinal axis of the screw, rolled thread crests showed a different shape. Thus, 2 values of the external diameter were measured in this case: maximum and minimum. The equivalent stress area A_s, which is the effective resistance area for threaded sections,[37] was calculated as in a previous study.[17] Cut threads showed an equivalent tensile stress area of 1.37 mm^2, while rolled threads showed 1.50 mm^2.

Figure 5 shows the surface roughness obtained from both manufacturing processes. The cutting process removed material, leaving transverse lines from the irregular shape of the turning insert caused by wear and the several passes used in this manufacturing process. In contrast, material flow was seen with the rolling process, indicating that material was formed rather than removed. Table 3 gives the results of the surface roughness measurements: Area roughness average S_a was obtained for the whole field of view, while roughness average R_a and mean roughness depth R_z of a path perpendicular to the cutting or rolling direction were calculated.

Table 2. Dimensions of thread profile (N=1)

Thread Type	$\emptyset_{ext}$ (mm)	$\emptyset_{int}$ (mm)	Pitch (mm)	α (degrees)
Cut thread	1.74	1.24	0.35	60.5
Rolled thread	1.69/1.60	1.30	0.35	58.8

α, angle of the thread profile; $\emptyset_{ext}$, external diameter; $\emptyset_{int}$, internal diameter.

Table 4 shows the compressive residual stresses in the longitudinal direction of the screw. The specimen geometry (screw thread) and the material absorption generated high standard errors in the measurements, a consequence of a high dispersion of the measured data. Nevertheless, the measurements confirmed, at least qualitatively, that thread rolling introduced considerably higher compressive loads than thread cutting.

As a result of the fatigue tests, a curve was obtained that related the applied cyclic load magnitude with the number of cycles to fatigue failure. The curve for a dental implant with cut-threaded screw has been previously published in a study[17] where 9 experimental tests were performed at 3 different load levels: 325, 350, and 375 N. In the present work, the same tests were carried out with roll-threaded screws. For this experiment, 15 specimens were tested (5 tests at each load level) because larger fatigue life and, consequently, more scatter were expected.[36] Figure 6 shows the experimental results along with the linear models log(F)-log(cycles) and 95% confidence bands according to the ASTM E-739 Standard.[38] Even though linear regression models were obtained

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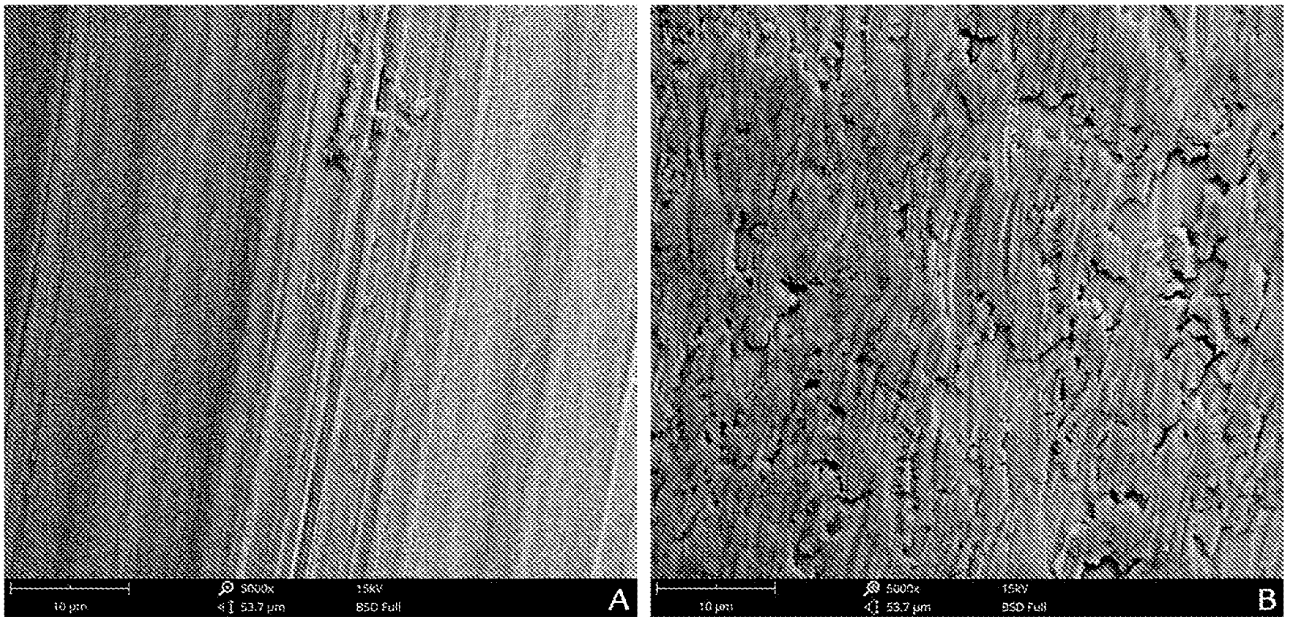


Figure 8. Surface roughness measurements. A, Cut thread. B, Rolled thread. Original magnification ×5000.

Table 3. Surface roughness parameters (N=1)

Thread Type	S_a (nm)	R_a (nm)	R_z (μm)
Cut thread	430	446	1.95
Rolled thread	333	434	1.83

R_a, roughness average; R_z, mean roughness depth; S_a, area roughness average.

Table 4. Mean values and standard errors of compressive residual stresses in threaded area

	Residual Stresses (MPa)	
N=48 (per Test)	Cut Thread	Rolled Thread
Test 1	281.5 ±136.1	569.5 ±87.7
Test 2	264.9 ±119.3	480.0 ±103.6
Test 3	297.0 ±124.8	496.0 ±87.2

from logarithmic values for both force and cycles, only the horizontal axis (cycles) is shown in log scale in Figure 6 to facilitate interpretation of the results. While the failure section in cut screws was in the first engaged thread, the failures in the rolled screws took place in the head-shank transition section (Fig. 7). ANCOVA was used to compare both linear models, accepting the first hypothesis that the slopes were equal (P=1) and rejecting the second hypothesis (P<.001); that is, the mean fatigue life was statistically different. Furthermore, once the slopes of both models had been determined to be equal, the fatigue life was calculated to be 9 times larger for roll-threaded screws (P=1).

Table 5 shows the maximum static loads before fracture of the dental implant assembly. In this case, the failure in both cut and rolled threads took place in the first engaged thread. A t test was carried out for the static loads registered in Table 5. The null hypothesis was accepted (P=.54); that is, the static load was assumed to be statistically the same for both manufacturing processes.

DISCUSSION

The hypothesis of the study was accepted as the results indicated that rolled threads had better mechanical behavior than cut threads. Even though the obtained geometries were similar and functional, the crests of the rolled thread poorly reproduced the desired geometry. This shape was obtained because of grain flow caused by the rolling process.[30,40] The small diameter of the blank may have increased the effect of this phenomenon, so the diameter of the blank should be optimized in future studies.

The rolled threads had lower surface roughness parameter values, that is, better surface finish and quality, consistent with previous studies.[25,28,41,42] The surface finish was mainly influenced by the residual compressive stresses on the thread surface by the rolling process, found to be larger than the ones left by cutting.[25,31] Using synchrotron radiation to evaluate surface properties should improve the quality of the data and allow the extrapolation of stress more accurately.[43-45]

The prosthetic screws had a significantly better fatigue response with thread rolling, consistent with roll-threaded screws used in industry.[29-31] Linear regression models showed a fatigue life 9 times higher for roll-threaded screws. In addition, roll-threaded screws failed at the head-shank transition section (Fig. 7) rather than

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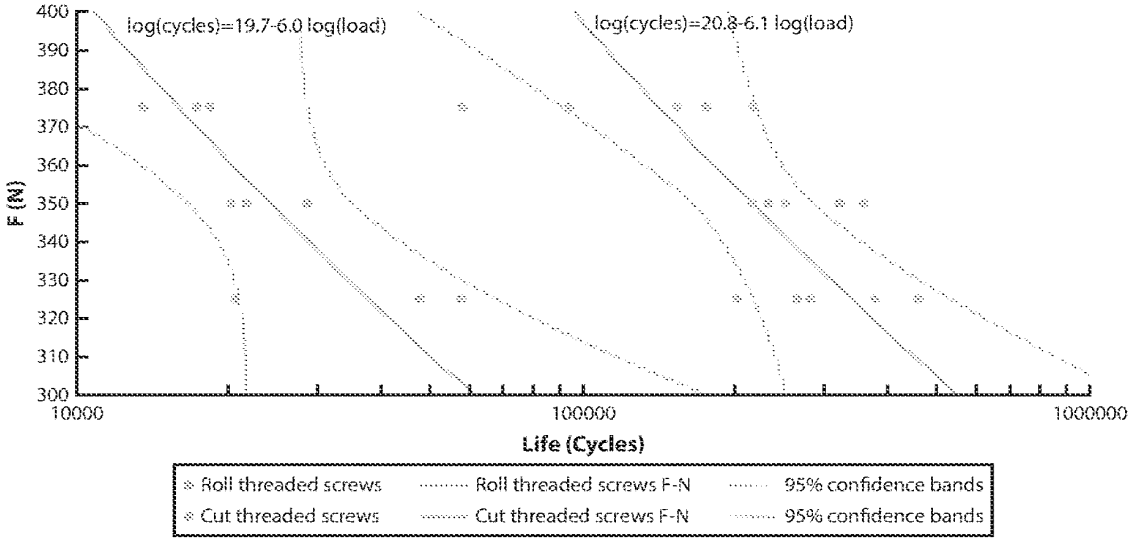


Figure 8. Fatigue data and linear models (F-N curves) for dental implant assemblies mounting cut- and roll-threaded screws. Data points and linear model for cut threads extracted from previous study.[17]

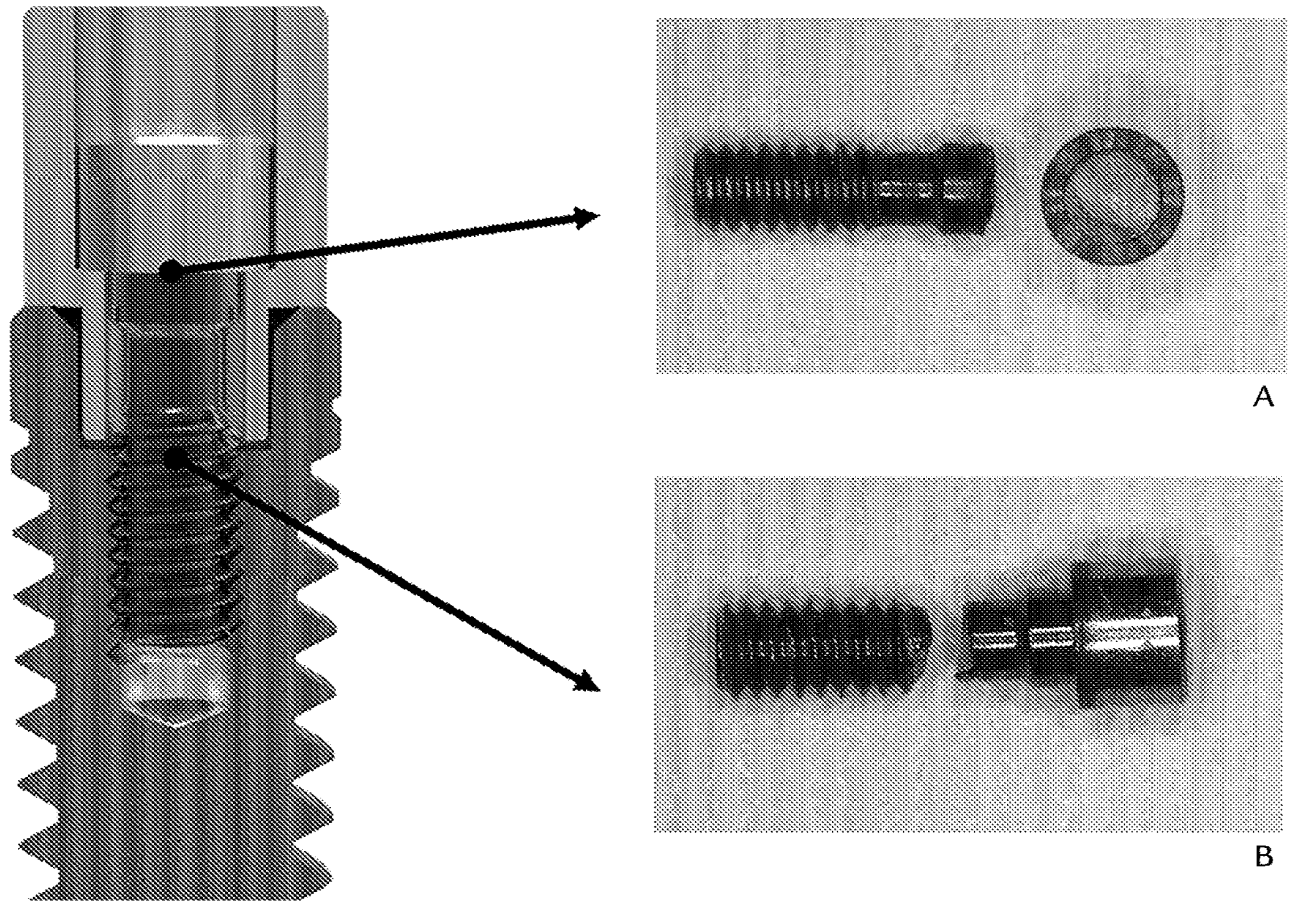


Figure 9. Fatigue failure. A, Head-shank transition section in roll-threaded screw. B, First engaged thread in cut-threaded screw.

Table 3. Maximum loads measured in static tests (N=5)

	Maximum Static Loads (N)	
	Cut Thread	**Rolled Thread**
Test 1	676	602
Test 2	622	656
Test 3	568	705
Test 4	600	593
Test 5	689	704
Mean	631	652
Standard deviation	51	54

at the first engaged thread, suggesting an increased improvement in the threaded section. Presumably, the improved fatigue behavior of rolled threads was mainly because of the larger compressive residual stresses because differences in the surface roughness and tensile stress area were small. The static load at failure was statistically similar for both manufacturing processes.

Limitations of this in vitro study included that a single-screw model with single rolled and cut thread manufacturing parameters were analyzed. Thus, further studies should evaluate different screw models and analyze the effect of alternative manufacturing variables.

CONCLUSIONS

Based on the findings of this in vitro study, the following conclusions were drawn:

1. Roll-threaded prosthetic screws had better mechanical performance than cut-threaded screws.
2. Rolling placed compressive residual stresses on the thread surface, which improved the fatigue behavior of the dental implant restoration assembly without affecting its ability to withstand static load.
3. The rolling process reproduced the geometry of the rolled thread profile poorly, but this problem might be solved by altering the manufacturing parameters.

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Mechanical Behavior and Failure Analysis of Prosthetic Retaining Screws after Long-term Use in vivo. Part 4: Failure Analysis of 10 Fractured Retaining Screws Retrieved from Three Patients

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Mechanical Behavior and Failure Analysis of Prosthetic Retaining Screws after

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Longterm Use in vivo. Part 4: Failure Analysis of 10 Fractured Retaining Screws Retrieved from Three Patients

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Abstract

Purpose: The aim of this study was to perform a failure analysis on fractured prosthetic retaining screws after long-term use in vivo. Additionally, the study addresses the commonly asked question regarding whether complex repeated functional occlusal forces initiate fatigue-type cracks in prosthetic retaining screws.

Materials and Methods: Ten fractured prosthetic retaining screws retrieved from three patients treated with fixed detachable hybrid prostheses were subjected to a failure analysis. In patients 1 and 2, the middle three retaining screws of the prostheses were found fractured at retrieval time after they had been in service for 20 and 19 months, respectively. In patient 3, the middle three and one of the posterior retaining screws were found to be fractured at retrieval after they had been in service for 18 months. Low power stereomicroscopy and high-power scanning electron microscopy (SEM) were performed to analyze the fractured surfaces of the retaining screws examining fatigue cracks in greater detail.

Results: Typical fatigue failure characterized by ratchet mark formation was revealed by light microscopy and SEM for all examined screws. Using low magnification light microscopy, ratchet marks were visible on the fracture surfaces of only two screws. SEM examination revealed all three classical stages of fatigue failure, and it was possible to see the ratchet marks on the fracture surfaces of all specimens, indicating a fatigue zone. The final catastrophic overload fracture appeared fibrous, indicating ductile fracture. The final overload ductile fracture surfaces showed equiaxed dimples, suggesting tensile

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overload in all examined screws except in two specimens that showed an elongated dimple pattern indicating shear/tearing overload forces.

Conclusions: Fracture of prosthetic retaining screws in hybrid prostheses occurs mainly through a typical fatigue mode involving mostly the middle anterior three screws. Fatigue cracks can grow in more than one prosthetic retaining screw, leading to fracture before the patient or clinician determines that any problem exists.

Although the use of implant-retained and -supported fixed detachable hybrid prostheses has become a very successful treatment for totally edentulous patients, one of the commonly encountered complications is clamped joint instability as a result of screw loosening and/or fracture.1-3 Because prosthetic retaining screws are designed to be the weakest-link component in fixed detachable hybrid prosthesis and are used as a "break-safe" mechanism, the occurrence of screw loosening and/or fracture is expected to occur more frequently than for abutment screws.4, 5 If patients and/or clinicians fail to detect loose retaining screws early on, inevitable screw fracture will occur, leading to more complicated, time consuming, and expensive repairs.

A 31% occurrence of retaining screw loosening in edentulous patients has been reported 2 weeks after insertion.6 Other studies have reported: (1) 5% loosening of all retaining screws placed in 91 patients;7 (2) 9% implant screw loosening in 56 complete and partially edentulous patients treated with implantretained and -supported prostheses with screw failure in 25% of the patients;8 and (3) 53 prosthetic retaining screw fractures as complications of implant treatment.4 A summary of various studies indicates a 1–9% occurrence of retaining screw fracture.9 Implant screw loosening and/or loss of osseointegration (mechanical and/or biological failures) have been attributed to unfavorable biomechanical factors, such as occlusal overload and/or poor stress distribution.2, 3, 10 Two studies regarding implant screw loosening and fracture11, 12 suggested the following to minimize such problems: (1) occlusal forces should be directed to the long axis of the implant by placing the implant in a favorable position in relation to the opposing occlusion; (2) cantilevers should be as short as possible in fixed detachable hybrid prostheses; (3) application of recommended preload and use of gold screws; and (4) establishing a proper and accurate occlusion.

To date, only in vitro studies have attempted to investigate the effect of functional cyclic loading on implant system components, or to explain the mechanism of implant screw loosening and characterize the mode of failure.13-17 The aim of this study was to perform a failure analysis on fractured prosthetic retaining screws after long-term use in vivo. Additionally, the study addressed the commonly asked question regarding whether complex repeated functional occlusal forces initiate fatigue-type cracks in prosthetic retaining screws.

Materials and methods

Sample collection

Ten fractured prosthetic retaining screws retrieved from three patients treated with fixed detachable hybrid prostheses were subjected to failure analysis. All three patients came to the dental office complaining of loose prostheses. The fractured retaining screws were in Groups 16, 17, and 20 in Table 1 of Part 1 of this series. In patients 1 (Group 16) and 2 (Group 17), the middle three retaining screws of the prostheses were found to be fractured at retrieval after they had been in service for 20 and 19

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months, respectively. In patient 3 (Group 20), the middle three and one of the posterior retaining screws were found to be fractured at retrieval after they had been in service for 18 months (refer to Table 1 in Part 1 of this series for more detail regarding group classification system, screw manufacturer, and inservice history). All the retaining screws were made by Sterngold (SG; Sterngold ImplaMed, Attleboro, MA) and used with the Nobel Biocare (Göteborg, Sweden) implant system. Screws were carefully handled during all stages of analysis and testing, using only plastic tweezers. Prior to testing, each screw was ultrasonically cleaned. Screws were placed individually in a glass beaker containing water/Alconox detergent powder (Alconox Inc., White Plains, NY) and ultrasonically cleaned for 10 minutes. Each screw was placed in a different glass beaker containing methanol and ultrasonically cleaned for an additional 5 minutes.

Low-power stereomicroscope examination

Low-power stereomicroscopy was used as the first-step for performing failure analysis (Meiji MZS-TR Model, Meiji Techno Co., Ltd., Saitama, Japan). A fiber optic light source was used for illumination (Lumina-I, Chiu Technical Corp., Kings Park, NY), and white paper was used to provide a neutral background. Prosthetic screws were examined and photographed within a white paper barrel that distributed the light more evenly and prevented glare. Photography was performed using an Image Analysis System comprised of a Sony CCD digital camera (DXC 151A, Sony, Tokyo, Japan) coupled to a computer with photo analysis software (Image Pro Plus 4.0 software, Media Cybernetics Inc., Bethesda, MD).

Scanning electron microscopy (SEM) examination

SEM was used to analyze the fractured surfaces of the retaining screws in more detail. A JEOL JSM 35 scanning electron microscope (JEOL USA Inc., Peabody, MA) was operated according to manufacturing instructions at 25 Kev, using secondary electron imaging.

Results

Light and scanning electron microscopy revealed typical fatigue failure on the fracture surfaces of the retrieved implant prosthetic retaining screws in Groups 16, 17, and 20. All of the middle three retaining screws from each group and one of the two posterior screws in Group 20 were fractured with moderate to severe thread wear. The remaining two posterior screws in each group were intact with mild thread wear. The fatigue fracture occurred in the shank area of all prosthetic screws, with the exception of the posterior screw in Group 20, for which fracture occurred in the threaded area (Fig 1).

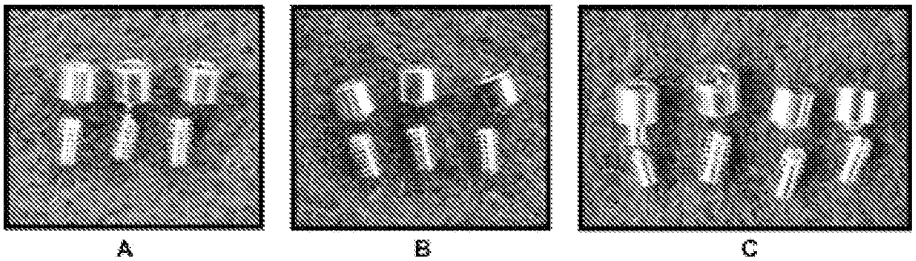


Figure 1 Fractured prosthetic retaining screws. Representative samples from groups 16 *(A)*, 17 *(B)*, and 20 *(C)*. Note that fracture occurred in the shank area for all screws except for $20B_1$, for which fracture occurrence was in the threaded segment of the screw.

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Low-magnification light microscopy of the fracture surfaces of the prosthetic retaining screws suggested that fatigue failure was the primary mode of fracture (ratchet marks were observed). Ratchet marks were visible on the fracture surfaces of specimens $16A_1$ and $17A_2$ but were not visible on the fracture surfaces of other specimens (Fig 2). Additionally, light microscope examination revealed yellow fibrous (rutted) areas on the fracture surfaces representing the areas of final fracture when the fatigue crack reached its critical length and the cross-section area was reduced to the point where it could not carry the load.

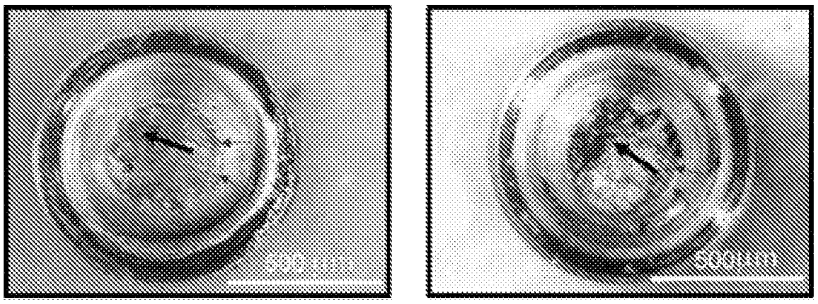


Figure 2 Light microscope photograph of fatigue fracture surfaces of prosthetic retaining screws. (A) 16A1(B) 17A2. Note the ratchet marks evenly dispersed along the periphery (blue arrows). Black arrows indicate fatigue crack propagation direction.

SEM revealed more detail of the fatigue fracture surfaces. At low magnification (×65), it was possible to see the ratchet marks on the fracture surfaces of all specimens. They were dispersed evenly along the periphery of the fatigue zone. The final catastrophic overload fracture appeared fibrous, indicating ductile fracture. The fatigue fracture surfaces of specimens $16A_1$, $17A_2$, and $20A_1$ are the best representative examples of the fatigue fracture surfaces for Groups 16, 17, and 20. Figure 3A is a lowmagnification (×65) SEM fractograph of the fatigue fracture surface of specimen $16A_1$. It illustrates a typical fatigue fracture surface characterized by ratchet marks parallel to the direction of crack propagation. The fibrous gray area indicates the final overload ductile fracture. The distinction between the area of fatigue crack propagation and that of final overload ductile fracture was very visible, whereas the distinction between the two areas was not clear for the fatigue fracture surfaces of specimens $16A_2$ and $16A_3$ at low magnification (×65). It was possible, however, to distinguish between the two areas under higher magnification, at which the fatigue crack propagation area was characterized by fatigue striations, and the final overload ductile fracture area was characterized by dimple formation. As can be seen in Figure 3A, the fatigue crack covered approximately 40% of the fracture surface as indicated by the outline in yellow, until final rapid overload fractured occurred (red area). For specimens $16A_1$, $16A_2$, and $16A_3$, the ratio of fatigue crack propagation area to the final overload ductile fracture area was 0.4:0.6, 0.6:0.4, and 0.8:0.2, respectively (Fig 3).

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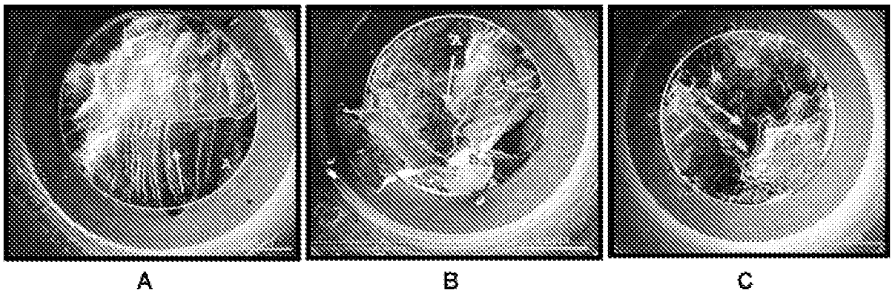


Figure 3 Scanning electron microscopy (SEM) fractograph of specimens 16A1 (A),16A2 (B), and 16A3 (C). In (A) the fracture surface shows well-formed and distinct ratchet marks (red arrow) parallel to crack propagation (yellow arrow). In both (B) and (C) fatigue fracture surfaces show fine ratchet marks on the periphery (red arrows). Region A is fatigue crack, and region B is final catastrophic overload fracture. The yellow arrow indicates the fatigue crack propagation direction.

Figure 4A is a high-magnification (×1500) SEM fractograph of one of the fatigue crack initiation sites for specimen $16A_1$. It illustrates typical fatigue striations, which are normally associated with fatigue cracks in ductile material. Figure 4B is another high-magnification (×500) SEM fractograph for specimen $16A_1$. It demonstrates the transition of the fatigue crack from the crack propagation stage (stage II) to the final overload fracture stage (stage III). Stage II shows parallel ratchet marks along the crack propagation direction and very fine fatigue striations perpendicular to the crack direction. Stage III shows dimple formation, which might be a result of a single occlusal (bite) overload force.

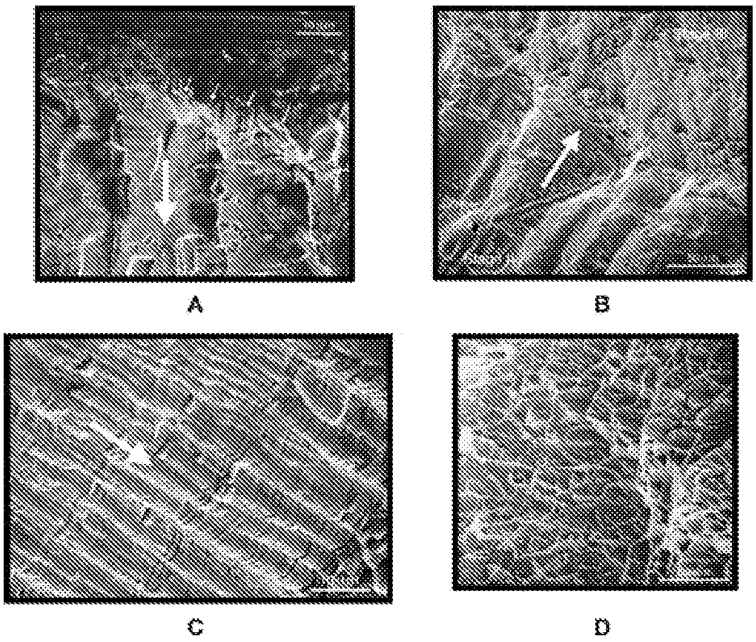


Figure 4 SEM fractograph of specimen 16A1. (A) Shows the origin of fatigue fracture as indicated by small arrows. Note fine striations within the fatigue crack propagation region. (B) Shows the transition from fatigue crack propagation stage (stage II) to final overload fracture (stage III). Stage II is characterized by ratchet marks and striations, and stage III is characterized by equiaxed dimples. Bold arrows indicate the crack propagation direction. (C) Shows the local variation of the orientation of the fatigue striations due to microstructural features. Note the variation of the striation banding or spacing (small arrows) due to varying stress

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magnitudes. Large, bold arrow in (A), (B), and (C) indicates crack propagation direction. (D) Shows equiaxed dimples indicating the final ductile overload fracture (stage III).

Figure 4C is a high-magnification (×1500) SEM fractograph of stage II for specimen 16A1. It shows two common, interesting features of fatigue striations. First, there is local variation of the orientation of the fatigue striations due to differing microstructural features through which the crack was advancing. Second, there is variation of the striation spacing due to the differing magnitudes of occlusal cyclic loading. Careful examination of the striation spacing in Figure 4C may suggest occlusal loading magnitude. The wider the striation, the higher the magnitude of occlusal forces. Figure 4D is a highmagnification (×1000) SEM fractograph of stage III for specimen 16A1. It shows equiaxed dimples, which are usually caused by tensile overload.

Figure 5B is a low-magnification (×65) SEM fractograph of the fracture surface of specimen 17A2. It shows fatigue features similar to those seen in Figure 3A. The ratchet marks, however, are visible only at the periphery of the fracture surface and start to disappear as the fatigue crack propagates. Additionally, the distinction between the area of the fatigue crack growth and that of the final overload ductile fracture was not as clear as it was in Figure 3A. Distinction between the two areas was possible under higher magnification. For specimens 17A1, 17A2, and 17A3 the ratios of the fatigue crack propagation areas to the final overload ductile fracture areas were 0.8:0.2, 0.85:0.15, and 0.7:0.3, respectively (Fig 5).

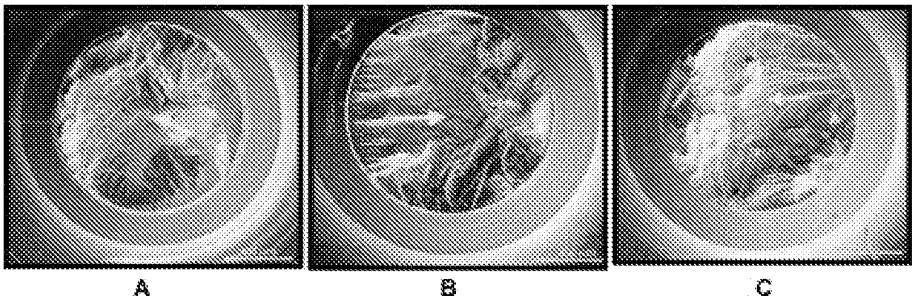


Figure 5 SEM fractograph of specimens 17A1 (A), 17A2 (B), 17A3 (C). In (A) and (B) fatigue fracture surfaces show fine ratchet marks on the periphery (red arrows), while in (C) fatigue fracture surface shows fine ratchet marks on the periphery with a very distinct band of ratchet marks in the middle (red arrows). Region A is fatigue crack propagation (stage II), and region B is final catastrophic overload fracture (stage III).Yellow arrow indicates crack propagation direction.

Figures 6A and B are high-magnification (×2000 and ×600) SEM fractographs for specimen $17A_2$. Figure 6A shows typical fatigue striations similar to those seen in Figures 4A and C, whereas Figure 6B shows an equiaxed dimple pattern of final overload ductile fracture similar to those found on the fracture surface of specimen $16A_1$ in Figures 4B and D. An elongated dimple pattern was observed on the final catastrophic overload fracture surfaces of $16A_2$ and $17A_1$, indicating shear or tearing overload forces (Figs 6C, D).

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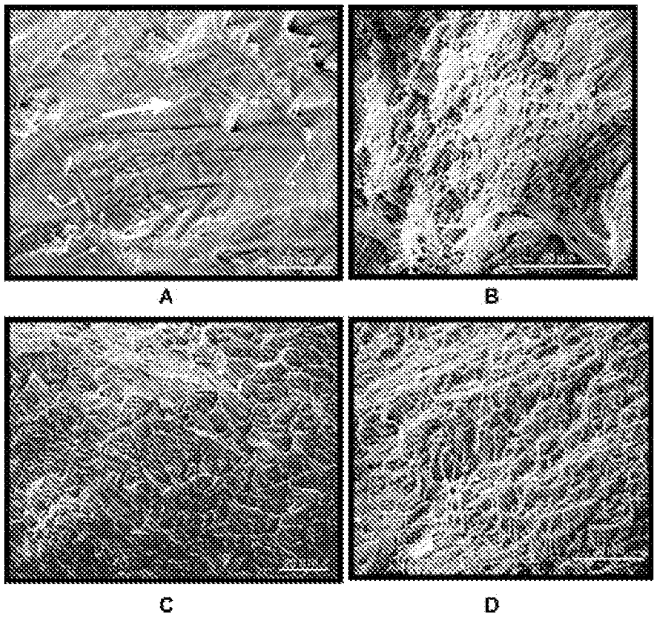


Figure 6 SEM fractograph for specimen 17A2. (A) Shows the fatigue crack propagation (stage II). Note local variation of the striation spacing (small arrows) due to repeated stress cycles. Large, bold arrow indicates crack propagation direction. (B) Demonstrates the final overload fracture (stage III), which was characterized by equiaxed dimples formation. (C) & (D) demonstrate elongated dimple pattern formation of the final overload fracture (stage III) for specimens 16A2 and 17A1, respectively.

Figure 7 shows low-magnification (×65) SEM fractographs for specimens $20A_1$, $20A_2$, $20A_3$, and $20B_1$. They show features similar to those seen in Figure 3. For specimens $20A_1$, $20A_2$, $20A_3$, and $20B_1$ the ratios of the fatigue crack propagation area to the final overload ductile fracture areas were 0.75:0.25, 0.4:0.6, 0.55:0.45, and 0.5:0.5, respectively. Figure 8A is a high-magnification (×1000) SEM fractograph of the fatigue crack initiation sites for specimen $20A_1$. It shows the first two stages (stage I and II) of fatigue crack initiation and propagation. Stage I extends inward from the surface (usually along a slip band about 45° to the tensile stress axis)18 with no associated striations. It was the only specimen for which stage I was observed on the fracture surface. Stage II, on the other hand, shows the change of orientation of crack propagation as it becomes perpendicular to the long axis of the implant screw and the tensile loads. Stage II contains typical fatigue striations similar to those seen in Figures 4A, 4C, and 6A.

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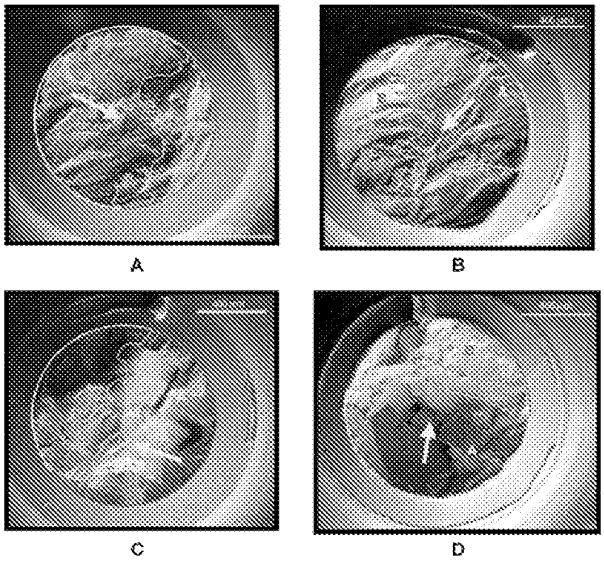


Figure 7 SEM fractograph of specimens 20A1, 20A2, 20A3, and 20A4 are shown in (A), (B), (C), and (D), respectively. Fatigue fracture surfaces show fine ratchet marks on the periphery (red arrows). Region **A** is fatigue crack propagation (stage II) and region **B** is final catastrophic overload fracture (stage III). Yellow arrow indicates crack propagation direction.

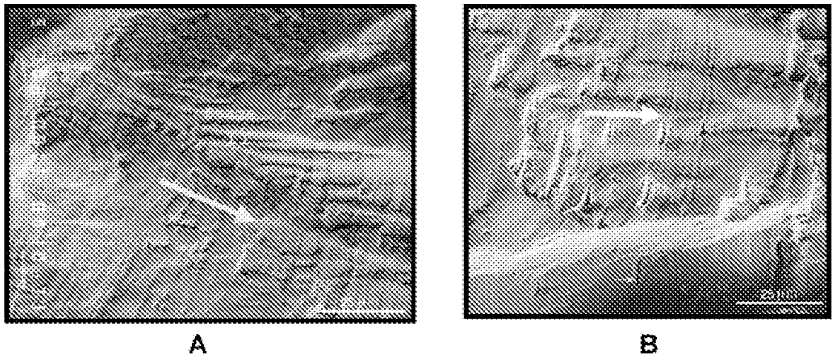


Figure 8 SEM fractograph of specimen 20A1. (A) shows the transition from stage I to stage II at the periphery of the fracture surfaces (yellow arrow indicates crack propagation direction). (B) shows stage II with secondary cracks (small arrows) associated with striations perpendicular to the fatigue crack propagation direction (large, bold arrow).

Figure 8B is another high-magnification (×1000) SEM fractograph of fatigue crack propagation from a different location for specimen $20A_1$. It illustrates typical fatigue striations with secondary crack formation.

Discussion

Metal fatigue is caused by repeated loading at stress levels above the endurance limit of a susceptible material.18 In this study, it was possible to see features of fatigue failure at both the macroscopic and microscopic level for all fracture surfaces of prosthetic retaining screws examined. Macroscopically, the

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fatigue fracture surfaces exhibited two distinct regions, a fatigue crack propagation region and a final overload ductile region. The ratio of the areas of the two regions to each other provided a better understanding of the fatigue with regard to the number of occlusal load cycles and stress level. Normally, if the stress level from occlusal (biting) forces is relatively low, it takes many cycles for the fatigue crack to propagate to a location where the remaining material would fracture catastrophically on the next (and final) occlusal load application (Fig 9).18 Thus, for lower loads, the relative amount of the fracture surface covered by fatigue crack propagation will be larger than the surface covered by final occlusal overload fracture. On the other hand, if the stress level is high, then the fatigue crack will not propagate far before final fracture occurs.18 Accordingly, in this study, failed screws with larger fatigue crack propagation areas (probably 70% or more) are most likely the ones that initiated fatigue cracking and failure. Therefore, the observed stage I propagation in Figure 8A of this study might indicate that the retaining screw was subjected to a very low stress level and was the first screw that initiated fatigue cracking and failure. Many factors can initiate or produce stage I propagation such as: (1) surface finishing micro-cracks; (2) scratches and/or deformations due to improper handling; (3) manufacturer defects; and (4) corrosion.18, 19 In this study, corrosion was not considered to be a major causative factor of fatigue failure, because the prosthetic screws were made from noble materials as determined by energy dispersive X-ray analysis in Part 2 of this series. The noble metals are resistant to corrosion.20 Retaining prosthetic screws, however, are more sensitive to the effect of surface finish and scratches/deformation due to improper handling. It was possible to see both manufacturer machining irregularities and surface damage on one of the non-fractured screws ($15B_1$; Fig 10).

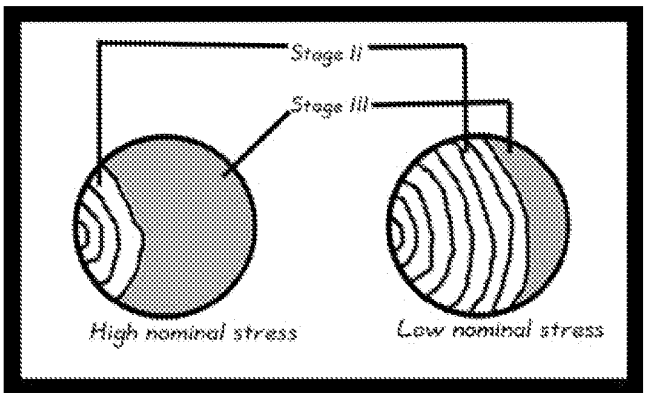


Figure 9 Schematic illustration of a fatigue fracture surface and the effect of loading conditions and stress level on the relative area covered by the fatigue crack.

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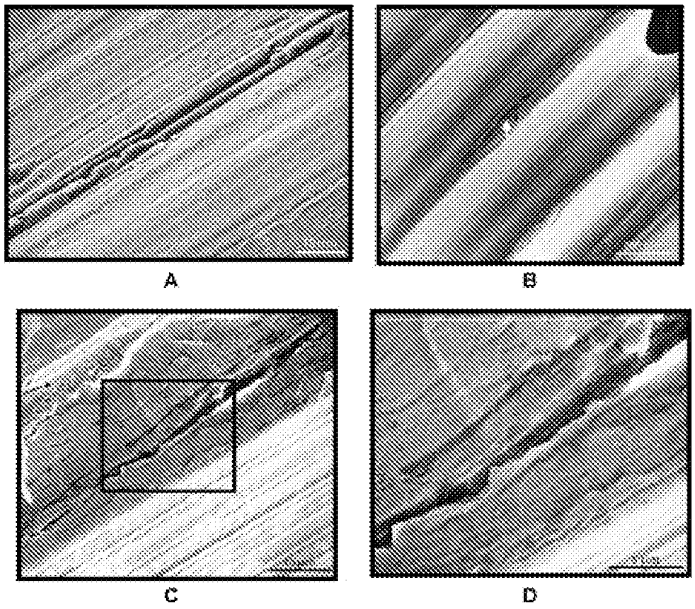


Figure 10 SEM micrograph of the15B1 prosthetic screw. Variability of machining roughness and irregularities in the head area are demonstrated in (A). (B) Localized damage to the crest of a thread (white arrow). (C) High magnification view of the area in (B) at ×2000 showing severe plastic deformation of the thread crest associated with crack/groove-like defect formation. (D) is the outlined area in (C) at ×5000.

In stage II, the fatigue propagation plane becomes normal to the maximum tensile stress, and it is usually associated with most of the fatigue crack propagation.18, 19 It has been established that each striation formed during stage II is associated with the growth of the crack during one loading cycle, but every load cycle does not necessarily produce a striation.18 Others have shown that one striation does not necessarily correspond to one load cycle; tens to thousands of load cycles may be required to obtain one striation.18 In this study, the observed fatigue striations on all fracture surfaces of prosthetic retaining screws were considered to result from single high-stress occlusal loads and/or multiple lowstress occlusal loads. An additional observation of this study was local variations of the orientation of the fatigue striations as the crack advanced (Fig 4C). This indicates that the crack propagated through various microstructural features (multiple plateaus) that were at different elevations with respect to one another.18, 19 Stage III is the final stage of fatigue failure and involves final fracture resulting from a single overload. Final fracture may be brittle, ductile, or a combination of the two.18, 19 The dimple rupture observed in this study indicates a ductile type of final fatigue fracture in all specimens.

The ductile fracture was associated with equiaxed dimple formation except for two screws (16A2 and 17A1) in which the final fracture was associated with elongated dimple formation. Equiaxed dimples are caused by tensile overload forces, and elongated dimples are caused by shear or tear overload forces. It has been suggested theoretically that the most posterior two implant screws in fixed detachable hybrid prostheses are subjected mainly to compression, while the most anterior implants are subjected mainly to tensile forces.21 This has never been proven clinically. The failure analysis in this study suggests that the most anterior prosthetic retaining screws are subjected to more occlusal overload force. This is supported from the location of the fatigue fracture and the higher thread wear on the middle three screws, observed and discussed in Part 1 of this series. Additionally, it suggests that the most anterior screws are not subjected solely to tensile force as previously proposed.21 The difference in dimple

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patterns (equiaxed and elongated) indicates that the prosthetic screws were subjected to a combination of tensile and shear/tear forces. The occlusal forces acting on the implant prosthetic screw are considered complex. In addition to the vertical forces induced by mastication, lateral forces are created by: (1) horizontal motion of the mandible during function; (2) inclination of the cusps; and (3) existence of parafunctional habits for long periods of time.21-24 Furthermore, all fatigue fractures, except for one screw, occurred in the shank area of the screws, rather than below the shank area or in the threaded part. It has been suggested that for adequately preloaded and torqued screws, the maximum stress from the cyclic tensile and transverse loading will be located on the shank area.25, 26 Therefore, the finding of fatigue fracture in the threaded area in one screw (Fig 11) indicates it was loose before fatigue crack initiation and fracture occurrence. It is not yet known why a fastener will self-loosen under cyclic loading and/or thermal cycles.25 It has been suggested that a fastener subjected to both tensile and transverse cyclic loading will have a vibratory motion along a circular path rather than a straight one. The vibration motion may loosen, tighten, or have no effect on the fastener.26 Therefore, the observation of fatigue fracture locations suggests that the fatigue cracks initiated and propagated in the middle anterior three screws first, and then the posterior screw started to self-loosen after experiencing higher cyclic occlusal loading before it fractured in the threaded area.

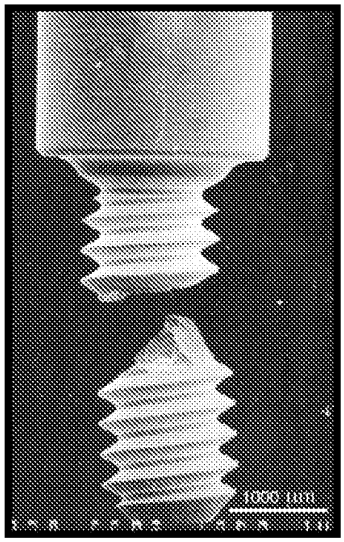


Figure 11 SEM micrograph for specimen 20B1 showing screw fracture at threaded area.

The finding of this study that the failure occurred only in retaining screws from SG after a short inservice time may be significant. The failure may be related to design incompatibility of the retaining screws from SG with the NB implant system. In Part 1 of this series, the observed unique design of the junction between the shank area and the head revealed by low-magnification SEM as wide and inclined with no head-shank fillet raised a significant concern because these screws had been considered compatible and interchangeable with the NB implant system. A retrospective assembly of one of the retrieved retaining screws from SG ($15B_1$) with NB implant components using a 3 mm gold cylinder (DCA 073–0 lot 0728A-03) and a standard abutment replica (DCB 175–0 Lot 123246) compared with a similar assembly using an NB hexed retaining screw and a standard abutment revealed an unexpected finding (Fig 12). The junction area between the head and shank of the retaining screw from SG formed a “point contact” with the gold cylinder. Such a point contact will lead to rapid and total relaxation. As the compression from the tightening torque increases, it will concentrate at a very small area, creating permanent (plastic) deformation and subsequent screw loosening. This problem can be exaggerated if a screw has lower

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hardness and higher preload. As mentioned in Part 3 of this series, SG screws had the highest preload and the lowest hardness. This observation might explain why fatigue failure occurred only in retaining screws from SG in Groups 16, 17, and 20 after a short period of in-service time. The manufacturer might argue that the retaining screw was not assembled with the SG implant system. The NB implant components were used based on claims of interchangeability and compatibility with the NB implant system.

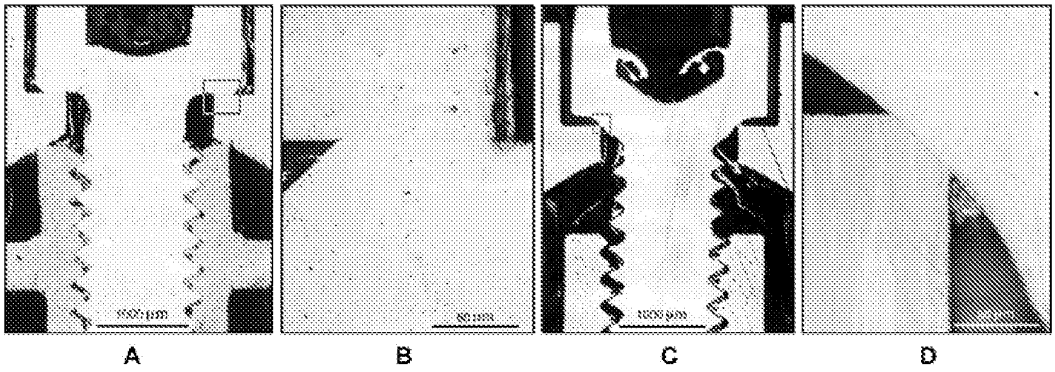


Figure 12 Light micrograph of assembled implant complex illustrating the assembly difference between the gold alloy retaining screws from NB and SG. NB is shown in (A) and (B), while SG is shown in (C) and (D). The outlined two areas in (A) and (C) at ×25 are shown in (B) and (D) at ×500. Compared to (B), the assembly in (D) formed a point contact area with the gold cylinder, which gradually will yield and deform plastically under torque preload and functional bite forces.

Clinical significance

The findings of this study and those presented in Part 1 of this series demonstrate that retaining screws from the same manufacturer and/or different manufacturers have different geometrical designs. Catastrophic failure and fatigue fracture of prosthetic retaining screws from SG may be related to design incompatibility when used with the NB gold cylinder designed for flat-headed screws. These findings support previous concerns raised by consensus of the "JOMI Current Issues Forum" in 1993[11] and a study in 1995[26] regarding interchangeable implant hardware. These emphasized that "to provide scientific proof regarding long-term survival of interchanging implant hardware between different implant system components, there is a need for long-term clinical trials." Additionally, this study reinforces previous concerns regarding the lack of written specifications for prosthetic implant components.[26] Therefore, based on the findings of this study, avoiding interchanging implant components between different implant systems is highly recommended until an accurate written specification regarding geometrical design, alloy composition, and mechanical properties of implant components becomes available. This may be the only way to ensure long-term clinical performance of the prostheses. Additionally, maintaining retaining screws within their own implant system facilitates the most accurate information and best service from the manufacturer when problems arise.

Conclusions

1) The fracture of prosthetic retaining screws in fixed detachable hybrid prostheses observed in this study suggests that failure of these types of screws occurs mainly by fatigue and involves mostly the middle anterior three screws (the screws farthest from the fulcrum).

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2) Fatigue cracks can grow in more than one prosthetic retaining screw, leading to catastrophic fracture before the patient or clinician determines that any problem exists. Annual evaluation of retaining screws using stereo-light microscopy (as a suggested maintenance protocol in Part 1 of this series) may allow early detection of fatigue cracks before catastrophic failure occurs.

3) When possible, clinicians should avoid interchanging prosthetic implant components between different implant systems.

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Open Tray Impression Technique Using the Direct Pick-Up Coping: A Case Report

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Abstract

Dental implants have become a quite successful method for restoration of fully and partially edentulous patients. Impression procedure becomes exacting in implantology as compared to fixed partial denture because of lack of periodontal ligament fibers in implants.

Traditionally, there are two different implant impression techniques for transferring the impression copings from the implant to the impression. The transfer technique uses tapered copings and a closed tray to make an impression. Conversely, the pick-up impression uses square copings and an open tray (a tray with an opening), allowing the coronal ends of the impression coping screw to be exposed.

This article describes the Pick-up implant impression procedure that is inexpensive, clean, and easy to perform with materials commonly found in a restorative dental practice and deals with its advantages and limitations.

Keywords: Implant impression; Implant direct impression, Open tray, Pick up impression coping

Introduction

The success of implant-supported restorations relies on how well the hard and soft tissue information is transferred to the laboratory [1,2]. The critical aspect is to record the three-dimensional orientation of the implant as it is present intraorally, other than reproducing fine surface detail for successful implant prosthodontic treatment [3-5]. The development of impression techniques to accurately record implant position has become more complicated and challenging. Several impression techniques have been suggested to obtain a master cast that will ensure the passive fit of prosthesis on implants [6]. In implant dentistry, the two traditional ways of making an impression are the closed tray and the open tray technique. Both impression techniques have their advantages and disadvantages [7]. A recent systematic review revealed that the open tray impression technique is more accurate than the closed tray impression technique [8,9]. It has been shown that the pickup type impression coping is the more accurate type of impression as errors occur on removal and replacement of the transfer type impression copings, especially in the occluso-gingival direction [10,11].

Characteristics of the Pick-up type impression coping are that they are removed from the mouth together with the set impression. They require access to the retaining screw to allow release of the screw prior to removal of the impression coping impression assembly, the analogues are attached to the impression copings while they are embedded in the impression tray. A custom tray with access to the impression coping screws is required [12].

Clinical Case

Open tray impression procedure



Figure 1: Removing of healing screws.

A patient consulted the Department of Fixed Prosthodontics at the Dental Clinic of Monastir to replace his bilateral terminal maxillary edentulism by implant-supported fixed prostheses. The patient had enough and rectilinear mouth opening. We decided to make him five maxillary implants. To record the spatial position of

the implants, we have chosen "Open tray Impression technique" using the direct pick-up copings. In the first time, the healing screws were removed (Figure 1). Then, the square impression copings were placed into the implants (Figure 2). The guide screws were tightened using the screwdriver. Retroalveolar X-rays were taken along the long axis of the implant to ensure that the impression copings were seated completely into the hex of the implants.

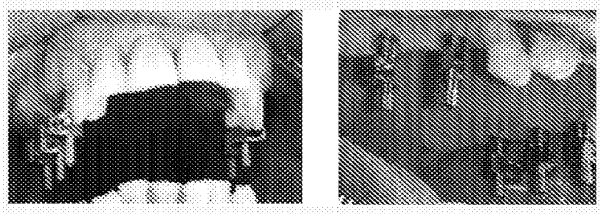


Figure 2: Impression copings were connected to each implant after removing of healing screws.

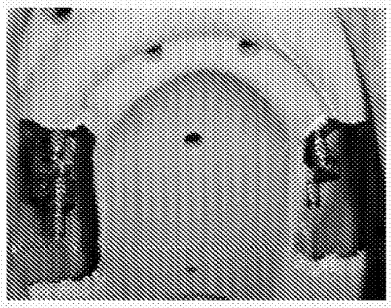


Figure 3: Intra oral view of pick up impression copings through the impression tray.

The tray was perforated in the regions where implants were placed to provide access for the pick-up copings (Figure 3). The impression tray was coated with manufacturer recommended impression adhesive 5 minutes before each impression was made. Tray adhesive was applied thinly and evenly over the inner surface of each tray and extended approximately 3mm onto the outer surface of the tray along periphery. The adhesive could dry for 15 minutes before impression. The tray was removed from the mouth and two sections of boxing wax (Dentsply Intl) were adapted over the openings in the tray and sealed to the tray using a hot instrument (Figure 4).

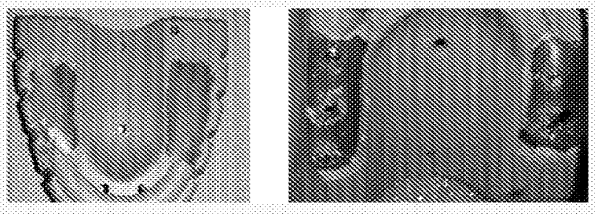


Figure 4: Two sections of boxing wax (Dentsply Intl) were adapted over the openings in the tray.

Other open-tray impression protocols recommend wiping off the excess impression material that extrudes through the hole in the tray with a gloved finger or injecting impression plaster through the hole(s) in the tray to fill the remaining void. This may be messy to accomplish. Additionally, the powder on some gloves may inhibit the polymerization of vinyl polysiloxane (VPS) impression materials Wax placed over the hole in the tray prevents contact of the impression material with the gloves [13].

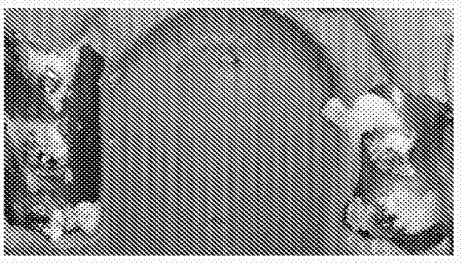


Figure 5: Open tray impression.

The heavy consistency polyvinylsiloxane impression material was loaded inside the impression tray and light consistency polyvinylsiloxane impression material was meticulously syringed around the impression copings to ensure complete coverage of the copings (Figure 5). The screwdriver was used to loosen the guide screw within the impression post (Figure 6).

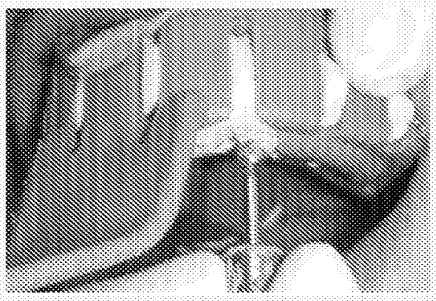


Figure 6: The copings screws are unscrewed to be removed along with the impression.

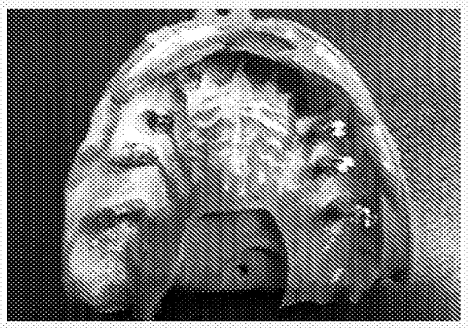


Figure 7: Impression with coping analog assembly

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The impression was taken out from the patient's mouth. The corresponding analog was selected, and the impression post was placed into the implant analog and the guide screw was tightened by using the screwdriver (Figure 7). The healing abutments were replaced immediately to prevent soft tissue collapse over the implant (Figure 8). Before screwing in, implant analog should be placed in line with the grooves of impression coping to achieve accurate passively fitting prosthesis. The impression was now ready to be used to create a model (Figure 9).

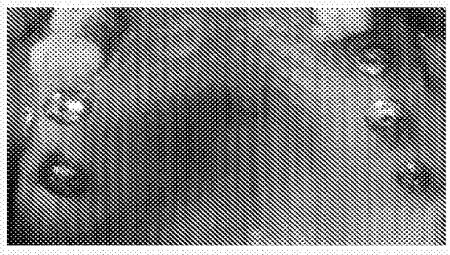


Figure 8: The healing abutments were replaced immediately.

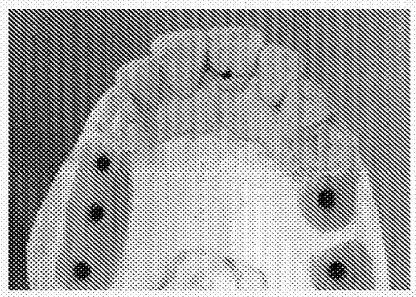


Figure 9: Occlusal view of hard and soft tissue cast recovered from impression.

Discussion

Indirect technique, the impression coping lies within the impression. Advantages of direct technique are minimization of dimensional changes in impression upon removal from patient's mouth, no need to screw in coping again as it comes along with the impression and useful in patients with angulated implants [14]. When impressions are required for multi implant restorations the precision of the impression is even more critical. This is because frameworks will be constructed from the master cast and mis-fit in the frameworks can lead to stress applied to the implants on screwing down the framework [12].

For situations in which there were three or fewer implants, most studies showed no difference between the pick-up and transfer techniques, whereas for situations in which there were 4 or more implants, more studies showed more accurate impressions with the pick-up technique (open tray) than the transfer technique (closed tray) [6].

Fourteen studies compared the accuracy of pick-up and transfer impression techniques [15,16]. Of the 14 studies, five showed more accurate impressions with the non-splinted pick-up technique [17], two with the transfer technique, and three showed no difference between them [8,18].

Closed tray (transfer, indirect) technique using tapered impression copings is an easy and simple technique ideal for single implant impressions and multiple parallel implants in patients with limited mouth opening [14]. When there is limited mouth opening they can be used as there may not be enough space for access to the screws retaining pick up type impression copings with the impression in place and in patients with an exaggerated gag reflex, when the impression must be removed as quickly as possible [12]. The clinical situations which indicate the use of the closed tray technique are when the patient has limited inter arch space, tendency to gag, or if it is too difficult to access an implant in the posterior region of the mouth [10].

Polyether and VPS were the recommended materials for the implant impressions. Results indicated that the 2-step VPS impression was significantly less accurate than the 1-step putty and light-body VPS combination impression, the medium body VPS monophase impression, and the medium-body polyether monophase impression [5].

Conclusion

Several impression techniques have been advocated for implant impressions to obtain a definitive cast. Different impression techniques have some advantages and some limitations, but selection of technique depends upon operator choice and various clinical situations. Open tray (pick-up, direct) technique using square impression copings is more accurate method usually preferred in multiple implants with different angulations.

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Article 3

Continuing Education

The Combination Implant Crown: A Cement- and Screw-Retained Restoration

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Learning Objectives

After reading this article the reader should be able to:

- discuss the indications for single-tooth implant restorations.
- describe the requirements for single-tooth implant crowns.
- compare the cement- and screw-retention options for implant crowns.
- present the clinical and laboratory procedures for single-tooth restorations using the Integral Omniloc® Dental Implant and a Combination Implant Crown.
- contrast the advantages of this new system with those of other available single-tooth implant techniques.

Dental implant systems have provided predictable long-term function in the prosthetic rehabilitation of totally edentulous patients.[1-3] Adequate evidence also exists that indicates that implant success rates reach similarly high levels in partially edentulous patients.[2,3] Although there are a few promising initial reports,[4-11] single-tooth implants have been included in only one longitudinal retrospective study.[3]

Single implants to restore missing teeth offer an attractive option for the patient and dentist. However, this procedure requires careful implant placement and precise control of all prosthetic components.[10] Single-tooth restorations supported by implants may be indicated in the following situations: (1) in patients with otherwise intact dentition[5]; (2) in dentition with spaces that would be more complicated to treat with conventional fixed prosthodontics[5]; (3) in distally missing teeth, when cantilevers or removable partial dentures are not indicated; (4) when the patient desires treatment that will closely mimic a missing natural tooth.

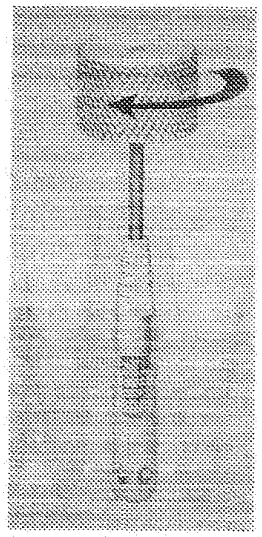


Figure 1—The abutment is screwed in.

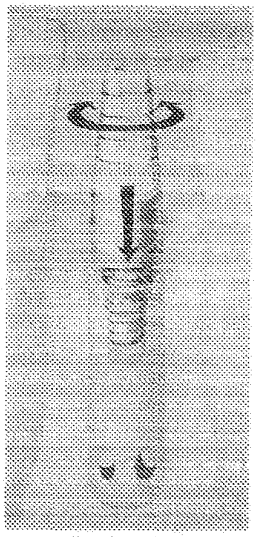


Figure 2—The abutment is then rotated to engage the octagon.

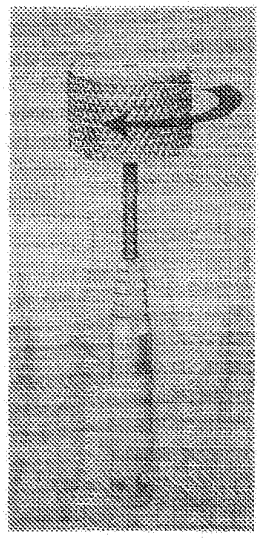


Figure 3—The abutment is tightened completely.

Initially, osseointegrated implant systems were developed for prosthetic reconstruction of totally edentulous patients. For single-tooth replacements, a refinement of components must be

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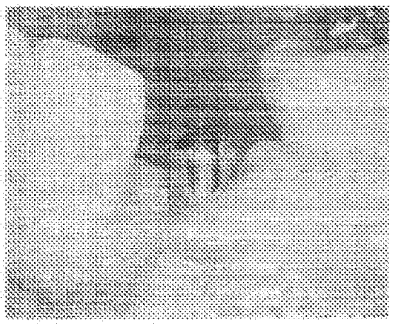


Figure 4—Tissue healing 2 weeks after implant uncovery.

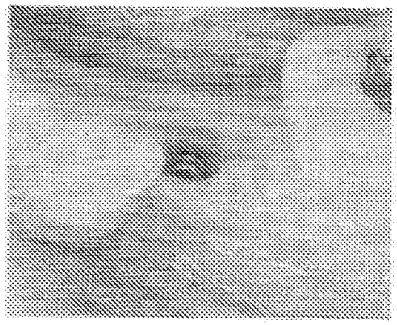


Figure 5—Tissue appearance after removal of the abutment. The tissue healed sufficiently to select the correct abutment.

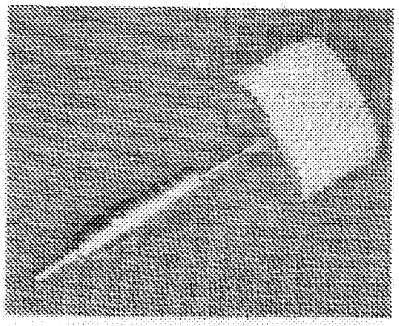


Figure 6—Selected abutment attached to the hex drive.

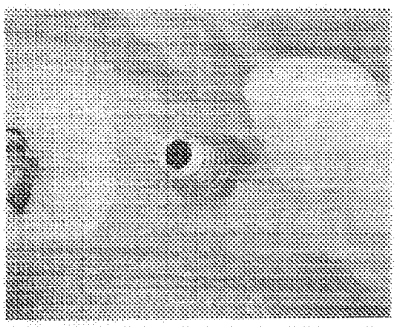


Figure 7—Fixed abutment placed in the mouth.

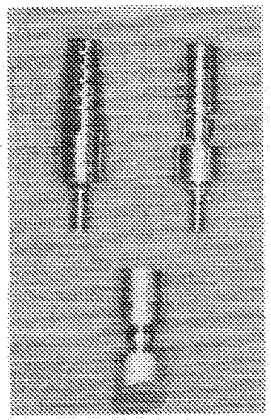


Figure 8—Integral Omniloc® fixed abutment (left), impression post (right), and implant body analogue (bottom).

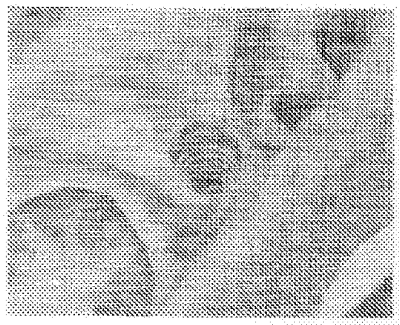


Figure 9—Impression removed from the mouth. Note that the flat side of the abutment is visible in the impression.

accomplished to address special problems.[6,7,10] The requirements for single implant crowns are: (1) esthetics, especially when a visible metal collar from the abutment is unacceptable; (2) antirotation, to avoid component loosening and allow accurate transfer of angle corrections; (3) biocompatability, to ensure hard- and soft-tissue health; (4) simplicity, to minimize the amount of components used; (5) accessibility, so the patient can maintain optimum oral hygiene; (6) variability, so the clinician can easily control the height, diameter, and angulation of the implant restoration; and (7) retrievability, to facilitate necessary future alterations.

Several systems have been developed to comply with the demands of the single-tooth replacement.[5,7] It is generally accepted that components should not be directly cemented into the implant body. However, the implant crowns may be either cement- or screw-retained. The advantages and disadvantages of these two options will be discussed.

Cement- vs Screw-Retained Crowns

The cement implant crown is luted to a screw-retained abutment. Zinc-phosphate, glass ionomer, and composite cements have all been suggested for this purpose. Retrievability of the implant restoration is ordinarily not considered when permanent cement is used. The use of a provisional cement has been recommended as an alternative. However, as Chiche stated,[12] "Unpredictability of the agents used in luting may result in either difficult retrieval or premature loosening." Simplicity is the major advantage of cement-retained restorations.[12] In addition, cementing can allow minor angle corrections to compensate for discrepancies between the implant inclination and the facial crown contour. Resistance to rotation can also be assisted by crown cementation; however, the abutment screw must also incorporate an antirotational feature.

The screw-retained crown is fastened either to the abutment or directly to the implant. The main advantage of this restoration is retrievability. Retrievability allows for crown removal, which can facilitate soft-tissue evaluation, calculus debridement, and any necessary contour modification. Additionally, future treatment considerations may be made more easily and are less costly if implant restorations are retrievable. However, it is important in screw-retained restorations that the access hole comes through the occlusal table of posterior teeth or the lingual surface of the anterior teeth. Forces can then be directed in the long axis of the implant and optimum esthetics can be more easily achieved. This alternative requires an ideal surgical implant location, which is not always possible due to anatomic limitations. A primary disadvantage of screw-retained implant restoration is that the screws may loosen during function.[13] Many techniques for main-

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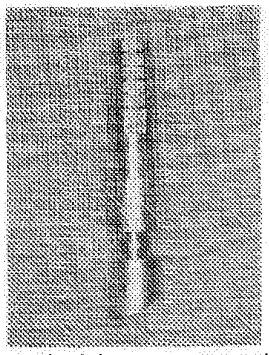


Figure 10—Fixed abutment connected to the implant body analogue.

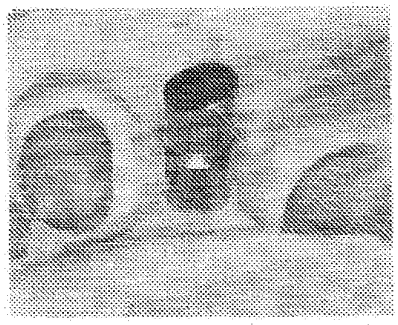


Figure 11—Abutment-analogue complex placed into the impression.



Figure 12—Soft-tissue material is injected around the analogue before pouring.

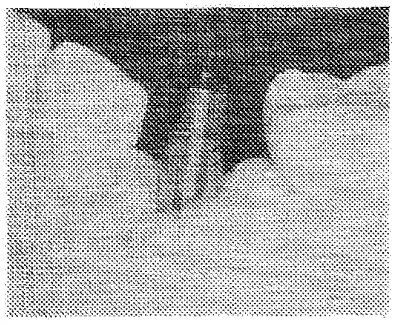


Figure 13—Soft-tissue master cast. Note that the abutment selected has supergingival cuff height. The soft-tissue cast allows for changing to a shorter abutment before preparation.

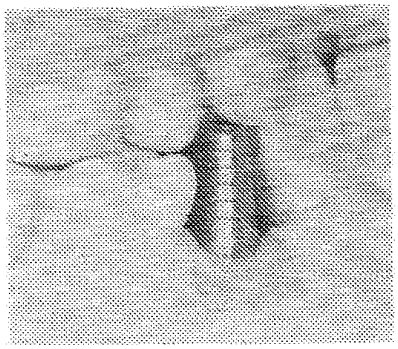


Figure 14—Lingual view of the abutment mounted on a semi-adjustable articulator.

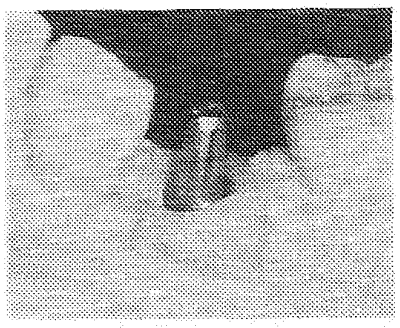


Figure 15—The abutment is first prepared out of the mouth. Note: Do not prepare below taper.

taining a tight screw connection have been reported. Direct mechanical interlocks appear to be the most effective.

The objective of this article is to present the clinical and laboratory procedures for single-tooth restorations using the unique features of the Integral Omniloc®,[a] Dental Implant to complete a restoration that is both cemented on the abutment and screw retained. This type of restoration may incorporate the advantages of a cement-retained restoration while being antirotational and retrievable. Because of these combined advantages, the authors have chosen the term "Combination Implant Crown" to describe this type of restoration.

The Integral Omniloc® Implant System

The Integral Omniloc® Implant System is a cylinder made out of a titanium alloy with a hydroxyapatite coating. It is available in two diameters: 3.25 and 4.00 mm. The system incorporates a retrievable locking device to prevent abutment rotation. The inside of the implant body has a recessed octagon. The fastening screw is encapsulated in the abutment, but can "float" and rotate independently of the abutment. The abutment has a protruding octagon. A hex driver is used to engage the abutment-fastening screw to the implant. The screw is tightened until the abutment base is nearly touching the implant surface (Figure 1). Then the abutment is rotated to align its projected octagon base with the octagon in the implant (Figure 2). The abutment is then dropped into place and the screw is tightened completely (Figure 3). The procedures will be described for using the Integral Omniloc® Implant for the completion of a combination cement- and screw-retained restoration.

Combination Implant Crown: Clinical and Laboratory Procedures

Two weeks after stage 2 surgery, soft-tissue healing around the temporary gingival cuff should be evaluated (Figure 4). The tissue should be healed sufficiently to accurately gauge definitive tissue thickness (Figure 5). The "straight fixed abutment" with the appropriate cuff height should then be selected. There are four available cuff heights: 2.0, 3.0, 4.0, and 5.0 mm. The abutment is engaged to the implant using the hex driver (Figures 6 and 7) as previously described. Final impressions can then be made with a rigid impression material using the fixed abutment or the Integral Omniloc® impression post (Figure 8). It is critical that the impression post incorporate a flat side to properly orient the octagon in the analogue. Because both the fixed abutment and the Integral Omniloc® impression post have this feature, they can be used interchangeably to make the transfer impression.

After the impression is removed from the mouth (Figure 9), the abutment or impression post is also removed and connected to an implant

[a] Calcitek, Inc, Carlsbad, CA 92008

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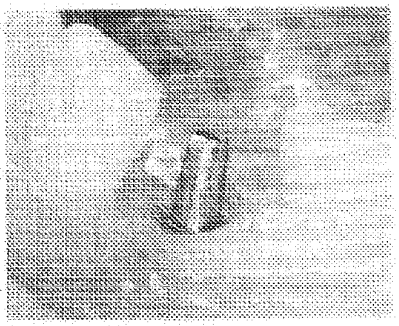


Figure 16—Prepared abutment tried intraorally. The clinician should check placement of the finish line and occlusal reduction.

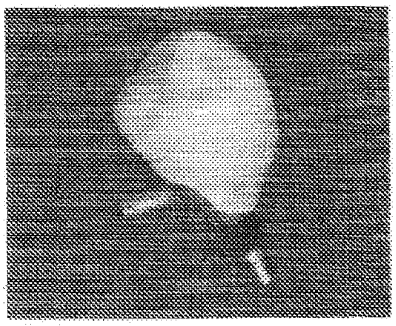


Figure 17—Unglazed crown, fit to the abutment, and ready for try-in.

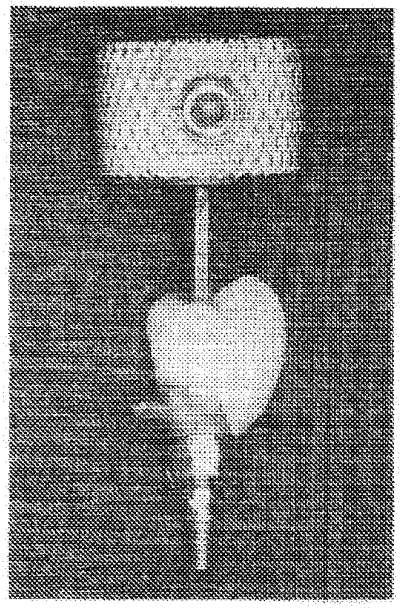


Figure 18—Screw access hole opened to allow access to floating screws.

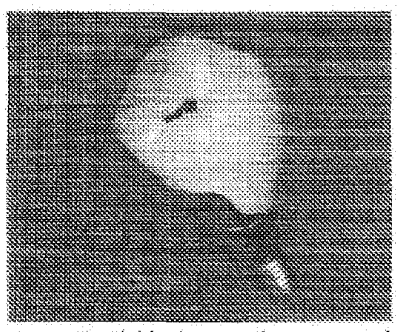


Figure 19—Finished restoration, cemented onto abutment and ready for insertion.

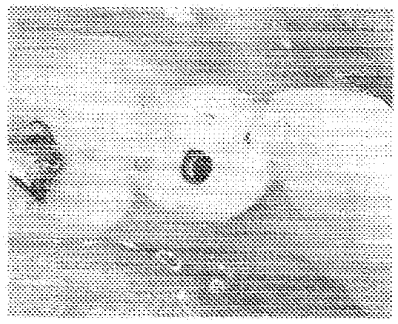


Figure 20—Final occlusion check after fastening the combination crown intraorally.

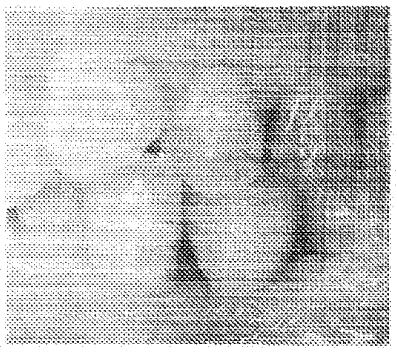


Figure 21—Facial view of the finished restoration.

analogue (Figure 10). These components are then placed back into the impression (Figure 11). A soft-tissue master cast can be generated by injecting a soft material (eg, Vestogum®[b] gingival modeling material) around the abutment and analogue before pouring the impression in type VI die-stone (Figure 12). The resulting master cast will have transferred the orientation of the implant octagon (Figure 13). The soft-tissue cast will allow easy removal of the abutment without altering the representation of the gingiva. The mandibular and maxillary casts should then be mounted on an appropriate articulator and the abutment should be examined for available space to complete the final metal-ceramic restoration (Figure 14).

After occlusal reduction, a chamfer or shoulder with rounded internal angles should be prepared approximately 0.5 mm subgingivally (Figure 15). The prepared abutment should then be tried back in the mouth (Figure 16). Preparation of the abutment below the cuff line should be carefully avoided because it may weaken the abutment. Likewise, the axial reduction should not be excessive. The abutment should never be prepared in the mouth, because heat would be transferred to the implant.

A final contour wax-up can then be completed, followed by cut-back and casting. The casting should be adjusted on the abutment and porcelain fired using the selected shade. The restoration should then be tried intraorally and the interproximal and occlusal contacts should be adjusted. At this point, an access hole can be opened with a diamond bur occlusally, making it possible to reach the fastening screw from the occlusal surface (Figures 17 and 18).

The crown can be stained, glazed, polished, and then cemented onto the fixed abutment using a permanent cement (Figure 19). The "combination crown" is then fastened to the implant via the floating-abutment screw. The occlusal contacts should be checked again at this point (Figure 20). The access hole can be filled with a low-viscosity polyvinyl-siloxane[14] and completed with a composite resin material (Figures 21, 22, and 23). Similar restorations can also be completed for anterior restorations when the implant is appropriately placed (Figures 24 and 25).

Discussion

The Combination Implant Crown has some advantages that may establish it as an alternative treatment modality for single-tooth restorations. The implant restorations are totally retrievable and the crown-abutment complex can be easily removed. An esthetic result can be achieved because a custom-

[b] ESPE GmbH, Germany. Distributed by ESPE-Premier, Norristown, PA 19404

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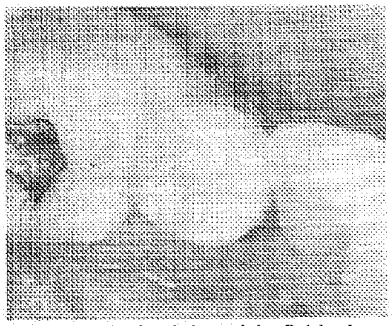


Figure 22—Occlusal view of the finished restoration.

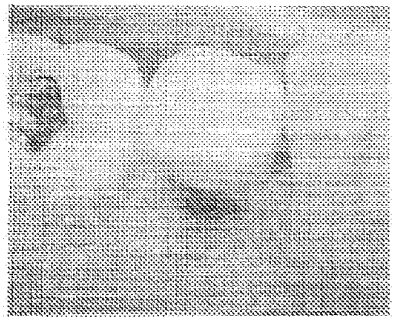
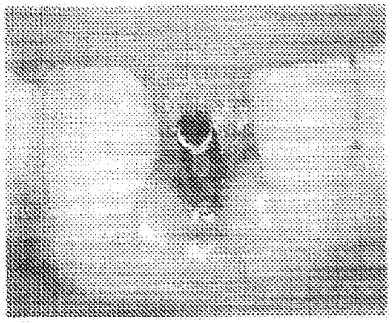
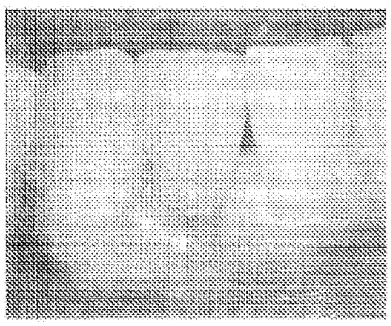


Figure 23—Lingual view of the finished restoration





Figures 24 and 25—Combination Implant Crown used to restore a mandibular lateral incisor.

ized finish line may be placed subgingivally. Antirotation is addressed by the octagon engagement of the abutment and the cementation of the crown. Additionally, there are a minimum number of components used.

The Combination Implant Crown is a technique similar to the original Nobelpharma[c] single-tooth crown developed by Jemt.[5] The major difference is that the access hole for the fastening screw is considerably larger in the Nobelpharma system because the entire fastening screw must be placed independently. In the Integral Omniloc® Implant System, the access hole need only be slightly larger than the diameter of the hex driver because the floating screw is not removed. Therefore, anterior teeth and teeth with smaller occlusal tables can be restored more effectively. Additionally, the Integral Omniloc® abutment is machined to fit to the implant, in contrast to the custom-cast abutments or prefabricated plastic pattern such as the UCLA abutment. Therefore, fit tolerances should improve and contact of two dissimilar metals at the implant level is avoided, reducing the chance for potential problems due to corrosion.[5]

Conclusion

A technique for completing single-tooth restorations on a relatively new implant system has been described. Clinical observations suggest it is possible for fabricated, uncomplicated, esthetic restorations that do not rotate. However, long-term clinical trials on this type of crown should be completed.

[c] Nobelpharma USA, Chicago, IL 60632

Acknowledgment

Figures 1-3 courtesy of Calcitek, Inc.

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(54) **Title:** AN IMPLANT SYSTEM

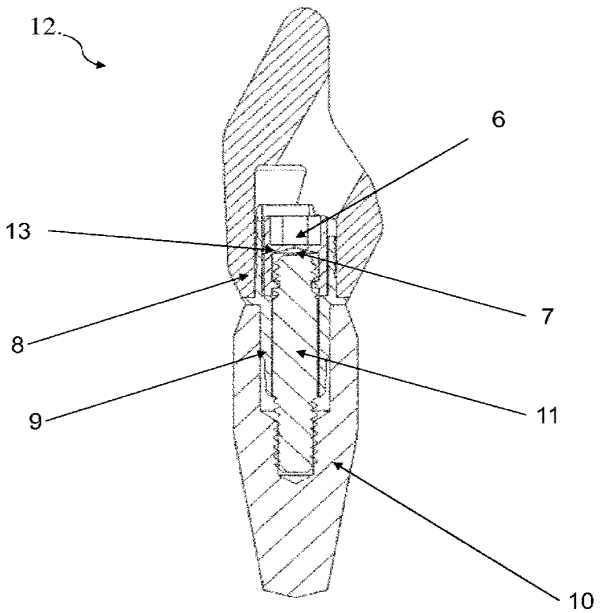


FIG. 4

(57) **Abstract:** The present invention relates to an implant system for fixing an abutment to an implant, such as a dental implant, comprising a threaded bolt having a top threaded portion configured to engage with a nut and an end threaded portion configured to be inserted in an implant.

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AN IMPLANT SYSTEM

FIELD OF THE INVENTION

The present invention relates to an implant system for fixing an abutment to an implant, such as a dental implant, comprising a threaded bolt having a top threaded portion configured to engage with a nut and an end threaded portion configured to be inserted in an implant.

BACKGROUND OF THE INVENTION

Existing implant solutions requires large hollow spaces above the implant to allow for removal of lengthy screw elements necessary to fasten the dental abutment to the implant.

This disadvantage may lead to damages on the tooth restoration during removal as the screw element need to be almost entirely pulled out of the implant before being titled to be removed.

Current solutions employ bridges elements between the abutment and the implant adding complexity due to the presence of several parts that need to be fasten. The use of several elements has also the drawback of increasing the risk of bacterial infections.

Hence, an improved dental assembly system would be advantageous, and in particular, a more reliable dental assembly system that is easier to unscrew and to remove and has a reduced amount of elements would be advantageous.

OBJECT OF THE INVENTION

It is an object of the present invention to wholly or partly overcome the above disadvantages and drawbacks of the prior art in removing an abutment, such as a dental abutment, from an implant, such as a dental implant. More specifically, it may be seen as an object of the invention to provide a dental assembly system providing solutions for fastening a dental abutment to a dental implant, which are easy to be unfasten for temporary removal.

A further object of the present invention is to provide an alternative to the prior art.

In particular, it may be seen as a further object of the present invention to provide a dental assembly system that solves the above mentioned problems of the prior art by employing a threaded bolt having a top portion configured to engage with a nut and an end threaded portion configured to be inserted in an implant.

SUMMARY OF THE INVENTION

Thus, the above described object and several other objects are intended to be obtained in a first aspect of the invention by providing a dental implant system comprising : a bolt having a top portion a central portion and an end portion, wherein the end portion is configured to engage with an interior bore of an implant; a nut having a hole, the hole having an area configured to engage with the top portion of the bolt, wherein the nut comprises one or more engaging surfaces opposite to the hole, the engaging surfaces adapted to mate with protuberances or recesses of a tightening tool.

The above described object and several other objects are intended to be obtained in a second aspect of the invention by providing a dental implant system comprising : a threaded bolt having a top portion a central portion and an end threaded portion, wherein the end threaded portion is configured to engage threads of an interior bore of an implant; a nut having a hole, the hole having an area configured to engage with the top portion of the threaded bolt, wherein the nut comprises one or more engaging surfaces opposite to the hole, the engaging surfaces adapted to mate with protuberances or recesses of a tightening tool.

The threaded element or bolt is an elongated element having threads in one end. In some embodiments, the central portion may be also threaded. Thus, the threaded bold may be an elongated element, such as a rod, having threads over 2/3 of its longitudinal axis.

The top and end portion of the threaded element may have different sizes, cross sections, diameters or pitches.

The nut may be any type of fastener with a hole. The nut according to the invention is used in conjunction with the mating threaded bolt to fasten an abutment to a dental implant.

Engagement or connection between the top portion of the threaded bolt and the area of the hole of the nut may occur in between the two mating part by different means.
For example, engagement or connection between the top portion of the threaded bolt and the area of the hole of the nut may occur by interference fit or press fit.

The top portion may be configured to engage with the nut via a bayonet connection.

In some embodiments, the connection between the top portion of the threaded bolt and the area of the hole of the nut may also occur via a bayonet mount or bayonet connector.
In this case the top portion of the male threaded bolt may have pins aligned with slots, such as L-shaped slots on the female nut. When pushed together the pins reaches the bottom of the slot and the nut may be rotated so as that the pins slide and are no longer free to rotate.

In some other embodiments the top portion of the threaded bolt comprises the L-shaped slots while the nut comprises pins in the internal area of the hole so that upon insertion and rotation according the pins reaches the bottom of the slot on the threaeded bolt and upon rotation slide and are no longer free to rotate.

In some other embodiments, the threaded bolt is a double threaded bolt.

The top portion may be a top threaded portion.

The area of the hole configured to engage with the top portion is at least partially threaded and is configured to engage with threads of the top threaded portion.

Thus, the above described object and several other objects are intended to be obtained in an aspect of the invention by providing a dental implant system comprising : a double threaded bolt having a top threaded portion, a central portion and an end threaded portion, wherein the end threaded portion is configured to engage threads of an interior bore of an implant; a nut having a hole having an area at least partially threaded and configured to engage threads of the top threaded portion, wherein the nut comprises one or more engaging surfaces opposite to the hole, the engaging surface adapted to mate with protuberances or recesses of a tightening tool.

The double threaded element or bolt is an elongated element having threads in both ends.

In some embodiments, the central portion may be also threaded. Thus, the double threaded bold may be an elongated element, such as a rod, having threads all along the longitudinal axis.

The top and end portion of the double threaded element may have different sizes, cross sections, diameters or pitches.

The nut may be any type of fastener with a threaded hole. The nut according to the invention is used in conjunction with the mating double threaded bolt to fasten an abutment to a dental implant. The nut and the double threaded bolt are kept together by a combination of their threads' friction, eventually with slight elastic deformation a slight stretching of the double threaded bolt and compression of the parts to be held together.

In some embodiments, the nut is a blind nut, the one or more engaging surfaces are a recess or protrusion and the hole is a cavity.

Thus the invention relates in one aspect to an implant system comprising : a double threaded bolt having a top threaded portion a central portion and an end threaded portion, wherein the end threaded portion, is configured to engage threads of an interior bore of an implant; a blind nut having a cavity internally threaded and configured to engage threads of the top threaded portion, wherein

the blind nut comprises a recess or protrusion opposite to the cavity, the recess or protrusion adapted to mate with protuberances or recesses of a tightening tool.

In some embodiments, the blind nut comprises a recess in its head, which is located in a position opposite to the cavity. The recess has a geometry, shape or structure that is adapted to mate with protuberance or recess of a tightening tool. For example, the recess may have element structures that are complementary to element structures on the tightening tool.

The blind nut may be a cap nut, an acron nut, a crown hex nut or domed cap nut, characterized by a domed top covering the threads.

The domed top or head may comprise an internal or external torque transferring interface for a tightening tool.

The domed top or head of the blind nut may present openings, such as openings having a width or diameter, smaller than the width or diameter of the threaded bolt.
The openings on the domed top or head of the blind nut may thus not be through going openings for the threaded bolt.

In some embodiments the one or more engaging surfaces are located above the area of the hole configured to engage with the top portion.

In some other embodiments, the one or more engaging surfaces are located above the at least partially threaded area of the hole.

The positioning of the one or more engaging surfaces above the area of the hole configured to engage with the top portion or the at least partially threaded area of the hole prevent the contact between the protuberances or recess of a tightening tool and the underneath areas or threads. In this way, the area of the hole configured to engage with the top portion or at least partially threaded area of the hole and the top portion or the threads of the top threaded portion are protected from unintentional rubbing while operating the tightening tool.

In some embodiments, the implant system further comprises an implant for installation in a bone, the implant having : a proximal end located near an exterior surface of a bone; an interior bore, internally threaded, extending distally from the proximal end; and an externally threaded exterior surface.

The end threaded portion of the double threaded bolt is configured to engage threads of the interior bore of the implant.

The proximal end is located near an exterior surface of the bone and can also referred to a gingival end portion.

The implant has a threaded exterior surface to be fastened to the bone.

In some embodiments, the double threaded bolt is pre-assembled with the dental implant.

In some other embodiments, the implant system further comprises an abutment for use in a dental implant comprising a prosthetic portion configured to support a prosthesis having a supragingival region protruding beyond gingiva adjacent to the dental implant, the prosthetic portion having a passageway extending therethrough; an end portion having a central opening, the end portion configured to be inserted in the dental implant; the double threaded bolt being insertable in the dental implant through the passageway in the prosthetic portion and the central opening in the end portion.

The supragingival region or supragingival end is the area carrying the prosthetic or dental restoration.

The end portion or insert extends into the passageway and engage the subgingival end of the prosthetic portion.

When the abutment has to be fasten to the dental implant, the end portion is inserted in the dental implant. The threaded bolt is then inserted in the dental implant through the passageway in the prosthetic portion and the central opening in the end portion.

The blind nut is then used to fasten the abutment to the implant by engaging the threads of the top threaded portion of the double threaded bolt.

The dental implant system when in place comprises a dental implant, an abutment, a double threaded bolt and a nut.

In some further embodiments, the central portion is externally threaded.

The central portion may also be threaded, thus the bolt may be threaded from the top to the end. Top, central and end portion may have a thread having the same or different pitch.

For example, the top threaded portion may have a first pitch and the end threaded portion may have a second pitch, the first pitch being different form the second pitch.

In some further embodiments, the top threaded portion and the end threaded portion have a same first pitch.

In some other embodiments, the implant system further comprises a hollow interface element for facilitating fixing of the abutment to the implant. The hollow interface may be a bridge structure between the abutment and the implant for improving fastening between the abutment and the implant.

The interface element may comprise a proximal section adapted to favour fastening and a distal section adapted to be inserted into the implant.

The first and other aspect and embodiments of the present invention may each be combined with any of the other aspects or embodiments. These and other aspects and embodiments of the invention will be apparent from and elucidated with reference to the embodiments described hereinafter.

BRIEF DESCRIPTION OF THE FIGURES

The implant system according to the invention will now be described in more detail with regard to the accompanying figures. The figures show one way of implementing the present invention and is not to be construed as being limiting to other possible embodiments falling within the scope of the attached claim set.

Figure 1 and figure 2 show an implant system according to the prior art showing one of the problem addressed by the invention.

Figure 3 shows an implant system having an interface element between the abutment and the implant.

Figure 4 shows an implant system according to some embodiments of the invention.

Figure 5 and figure 6 show a 3D representation of a nut and a double threaded bolt, respectively, according to some embodiments of the invention.

Figure 7 and figure 8 show a cross section and a front view of a nut, according to some embodiments of the invention.

Figure 9 and figure 10 show a cross section and a front view of a nut, according to some other embodiments of the invention.

Figure 11 and figure 12 show a 3D representation and a cross section of a double threaded bolt pre-assembled in an implant, according to some embodiments of the invention.

Figure 13 shows a 3D representation of an implant having a threaded rod extending longitudinally out of a top surface of the implant.

Figure 14 and figure 15 show a 3D representation of a threaded bolt and a nut, according to some embodiments of the invention.

Figure 16 shows a technical drawing of a cross section of a threaded bolt and a nut assembled in an implant, according to some embodiments of the invention.

Figure 17 and 18 show a 3D representation and a cross section of a threaded bolt and a nut assembled in an implant, characterized by the presence of a bayonet connection according to some embodiments of the invention.

DETAILED DESCRIPTION OF AN EMBODIMENT

Figure 1 and figure 2 show an implant system according to the prior art showing one of the problem addressed by the invention.

The implant system of figure 2 comprises an abutment that is fasten to a dental implant by means of a screw. Due to the length of the screw existing implant solutions requires large hollow space above the implant, so that if removal is necessary this can be done without damaging the dental restoration.

Figure 1 shows damages to the dental restoration due to the difficulty of removal of a lengthy screw element in a limited hollow space.

Figure 3 shows an implant system having an interface element between the abutment and the implant.

The abutment is fasten to the implant via an interface element or bridge located in between the fastening screw and the implant.

In this case, the screw is shorter thus allowing for removal also in case of limited hollow space above the implant. Removal of the screw may occur via an angulated tightening tool, such as an angulated screw driver.

Figure 4 shows an implant system 12 according to some embodiments of the invention.

The dental implant system of figure 4 shows a double threaded bolt 11 inserted into a dental implant 10. The abutment having a prosthetic portion 8 supporting a dental restoration and an end portion 9 inserted into the implant 10 is fasten to the implant by means of nut 13. The nut 13 shown in figure 4 is a blind nut having a cavity 7 internally threaded and configured to engage threads of the top threaded portion of the double threaded bolt. The blind nut comprises also a recess 6 opposite to the cavity 7, which is adapted to mate with protuberances of a tightening tool, thus can be tightened or loosen by, e.g. an angulated screwdriver.

Figure 5 and figure 6 show a nut 1 and a double threaded bolt 2 according to some embodiments of the invention.

The double threaded bolt 2 has a top threaded portion 5, a central portion 3 and an end threaded portion 4. The central portion 3 may be threaded as well (not shown). The end threaded portion 4 is configured to engage threads of an interior bore of an implant, while the top threaded portion 5 is configured to engage with threads of the at least partially threaded area of the hole of nut 1.

The nut 1 as shown in figure 5 may be an open nut or blind nut.
The one or more engaging surfaces 6 adapted to mate with protuberances or recesses of a tightening tool are located above the at least partially threaded area of the hole or the cavity.

Figure 7 and figure 8 show a cross section and a front view of nut 14 having as engaging surfaces 15 adapted to mate with protuberances or recesses of a tightening tool an internal torque transferring interface.
The torques transferring interface is located above the at least partially threaded area of the hole, i.e. the threaded internal area.

Figure 9 and figure 10 show a cross section and a front view of nut 16 having as engaging surfaces 17 adapted to mate with protuberances or recesses of a tightening tool an external torque transferring interface.
The torques transferring interface is located above the at least partially threaded area of the hole, i.e. the threaded internal area.

Figure 11 and figure 12 show a 3D representation and a cross section of a double threaded bolt pre-assembled in an implant, according to some embodiments of the invention.

Figure 13 shows a 3D representation of an implant having a threaded rod extending longitudinally out of a top surface of the implant.
Thus in one aspect the invention relates to an implant comprising a rod at least partially threaded extending longitudinally out of a surface, such as a top surface of the implant.
The thread rod has the function of the top threaded portion of the double threaded bolt, i.e. it is configured to engage with threads of the at least partially threaded area of the hole on the nut.
Figure 14 and figure 15 show a 3D representation of a threaded bolt 18 and a nut 19, in the engagement or connection between the top portion of the threaded bolt and the area of the hole of the nut occur via a bayonet mount.
The threaded bolt 18 comprises L-shaped slots 21 located on opposite correspondent areas along the shaft of the bolt, which can be aligned with pins 22 located in the hole or cavity of the nut 19.

As shown in figure 16, the end portion of the threaded bolt is designed to be inserted in a dental implant 20.

The connection between the top portion of the threaded bolt and the nut is realized by aligning the pins 22 with the slots 21 and by pushing the nut until the pins reaches the bottom of the slot. Upon rotation of the nut the pins slides into the L-shaped area and are thus are no longer free to rotate.

Figure 17 and 18 show a 3D representation and a cross section of a threaded bolt and a nut assembled in an implant, characterized by the presence of a bayonet connection according to some embodiments of the invention.

The connection between the top portion of the threaded bolt and the area of the hole of the nut may occur via a bayonet mount or bayonet connector.

As shown in figure 17 and figure 18 the top portion 23 of a male threaded bolt has pins 24 aligned with slots 25, such as L-shaped slots on a female nut. When pushed together the pins reaches the bottom of the slot and the nut may be rotated so as that the pins slide into the slot and are no longer free to rotate.

Although the present invention has been described in connection with the specified embodiments, it should not be construed as being in any way limited to the presented examples. The scope of the present invention is set out by the accompanying claim set. In the context of the claims, the terms "comprising" or "comprises" do not exclude other possible elements or steps. In addition, the mentioning of references such as "a" or "an" etc. should not be construed as excluding a plurality. The use of reference signs in the claims with respect to elements indicated in the figures shall also not be construed as limiting the scope of the invention. Furthermore, individual features mentioned in different claims, may possibly be advantageously combined, and the mentioning of these features in different claims does not exclude that a combination of features is not possible and advantageous.

CLAIMS

1. A dental implant system comprising :

- a threaded bolt (2) having a top portion (5) a central portion (3) and an end threaded portion (4), wherein said end threaded portion is configured to engage threads of an interior bore of an implant;

- a nut (1) having a hole (7) said hole having an area configured to engage with said top portion of said threaded bolt, wherein said nut comprises one or more engaging surfaces (6) opposite to said hole, said engaging surfaces adapted to mate with protuberances or recesses of a tightening tool, wherein said one or more engaging surfaces are located above said area of said hole configured to engage with said top portion.

2. A dental implant system according to claim 1, wherein said threaded bolt is a double threaded bolt.

3. A dental implant system according to any of the preceding claims, wherein said top portion is a top threaded portion.

4. A dental implant system according to any of the preceding claims, wherein said area of said hole is at least partially threaded and is configured to engage with threads of said top threaded portion.

5. A dental implant system according to any of the preceding claims, wherein said nut is a blind nut, said one or more engaging surfaces are a recess or protrusion and said hole is a cavity.

6. A dental implant system according to any of the preceding claims, further comprising an implant (10) for installation in a bone, said implant having :

- a proximal end located near an exterior surface of a bone;

- an interior bore, internally threaded, extending distally from the proximal end; and

- an externally threaded exterior surface.

7. A dental implant system according any of the preceding claims, further comprising an abutment for use in a dental implant comprising :

- a prosthetic portion (8) configured to support a prosthesis having a supragingival region protruding beyond gingiva adjacent to the dental implant, said prosthetic portion having a passageway extending therethrough;
- an end portion (9) having a central opening, said end portion configured to be inserted in said dental implant;

said threaded bolt being insertable in said dental implant through said passageway in said prosthetic portion and said central opening in said end portion.

8. A dental implant system according to any of the preceding claims, wherein said central portion is externally threaded.

9. A dental implant system according to any of the preceding claims, further comprising a hollow interface element for facilitating fixing of said abutment to said implant.

10. A dental implant system according to any of the preceding claims 3-9, wherein said top threaded portion has a first pitch and said end threaded portion has a second pitch, said first pitch being different form said second pitch.

11. A dental implant system according to any of the preceding claims 3-9, wherein said top threaded portion and said end threaded portion have a same first pitch.

12. A dental implant system according to claim 1, wherein said top portion of said threaded bolt is configured to engage with said nut via a bayonet connection.

13. A dental implant system according to claim 12, wherein said area configured to engage with said top portion comprises pins aligned with slots on said top portion of said threaded bolt.

14. A dental implant system according to claim 12, wherein said top portion of said threaded bolt comprises pins aligned with slots in said area configured to engage with said top portion.

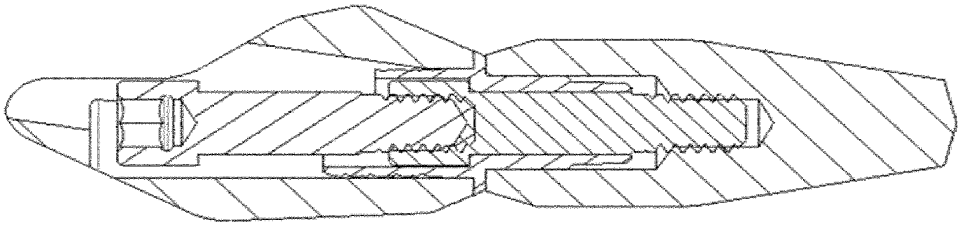


FIG. 2

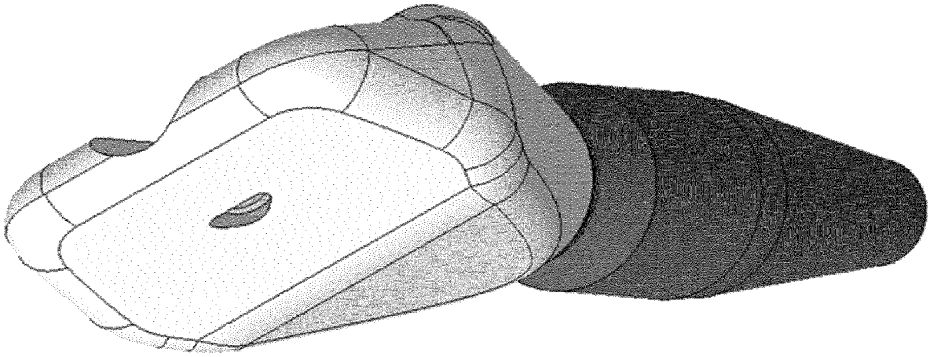


FIG. 1 (PRIOR ART)

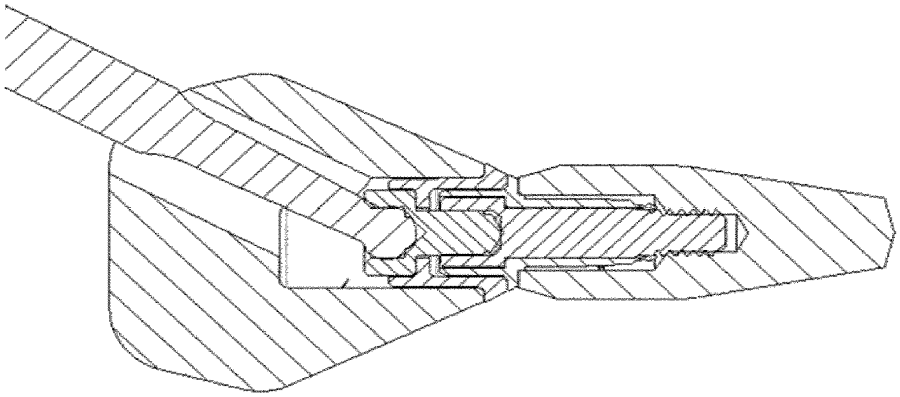


FIG. 3

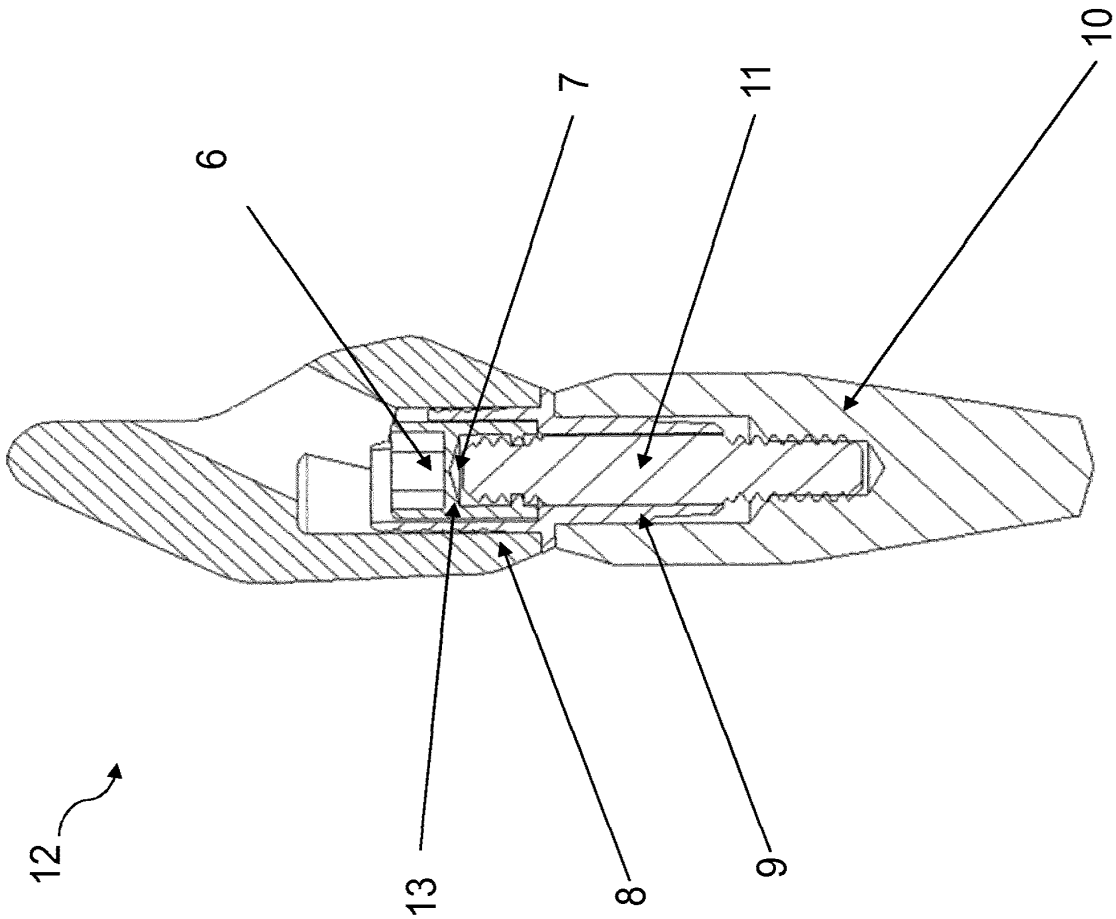


FIG. 4

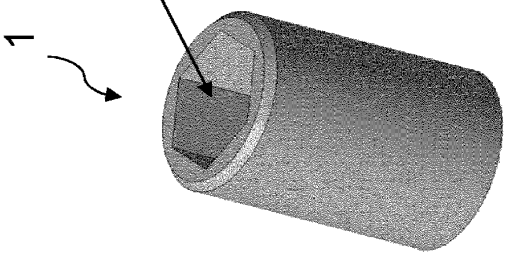


FIG. 5

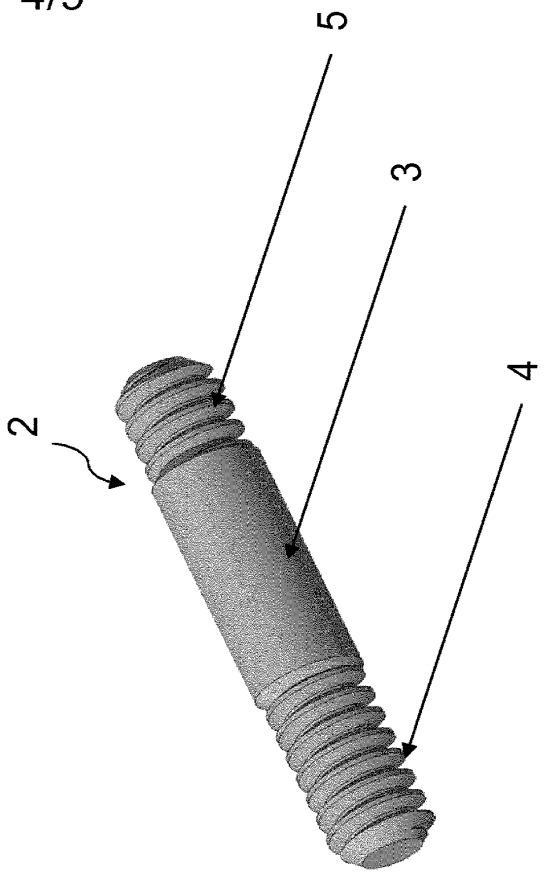


FIG. 6

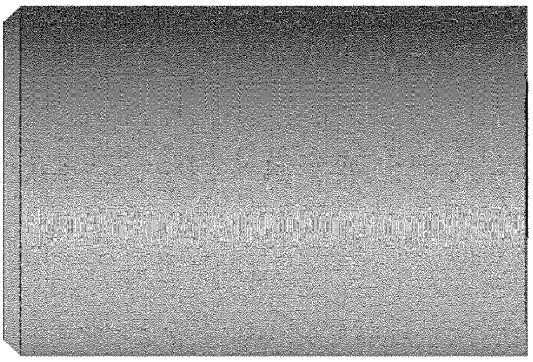


FIG. 8

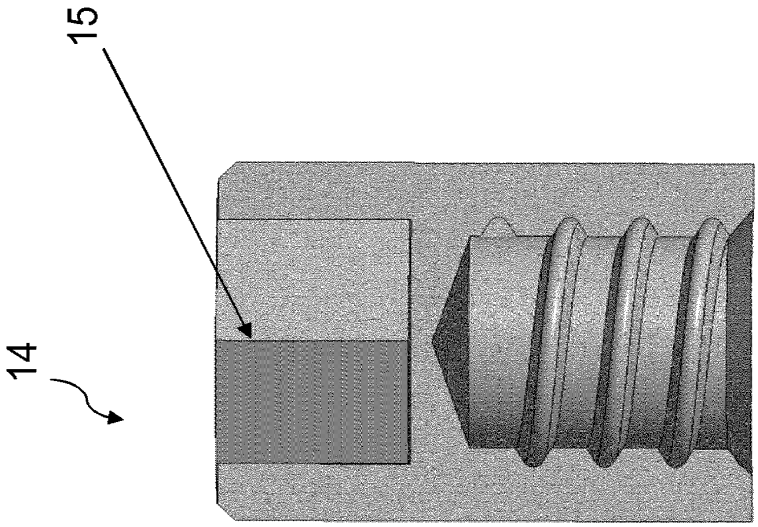


FIG. 7

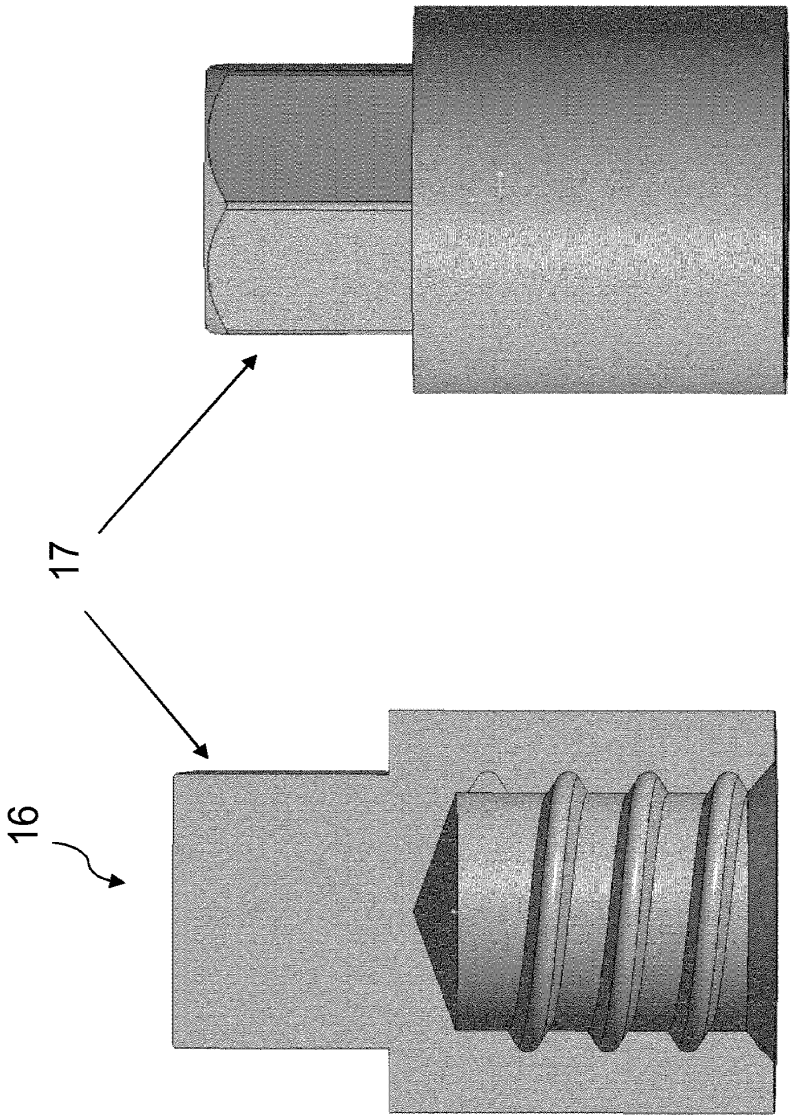


FIG. 10

FIG. 9

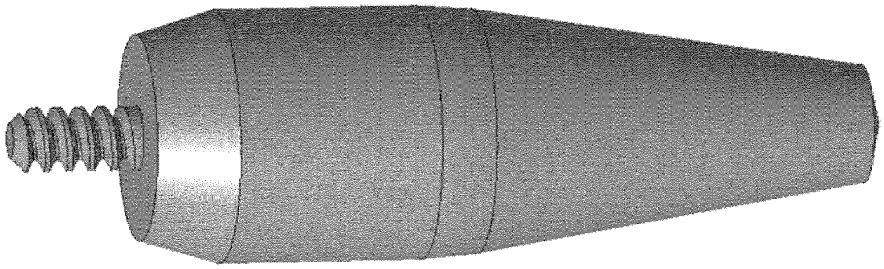


FIG. 13

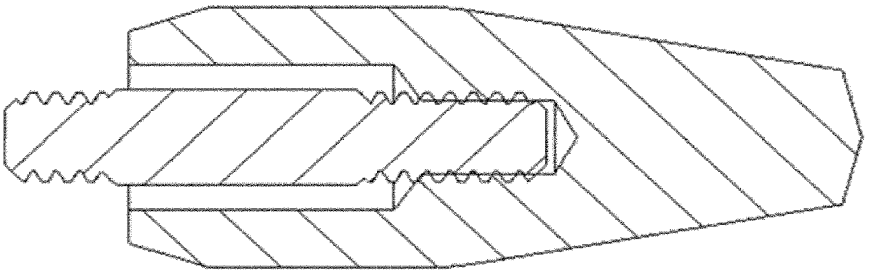


FIG. 12

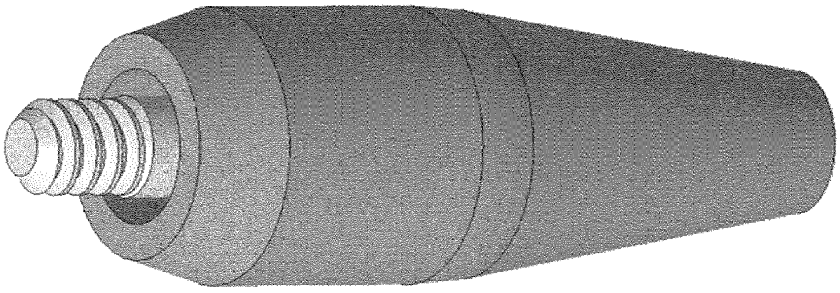


FIG. 11

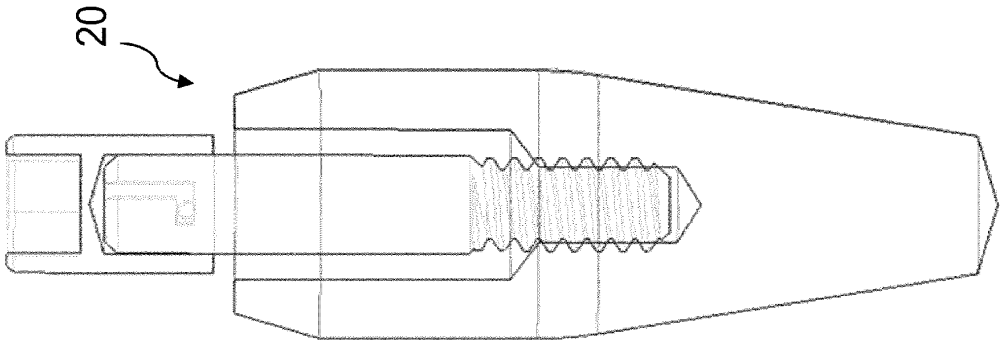


FIG. 16

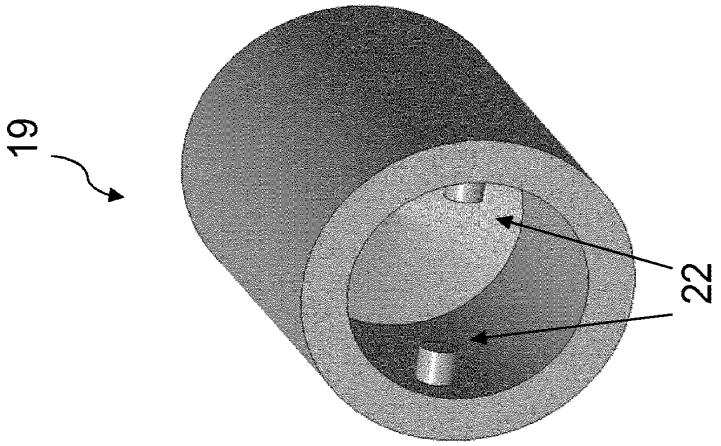


FIG. 15

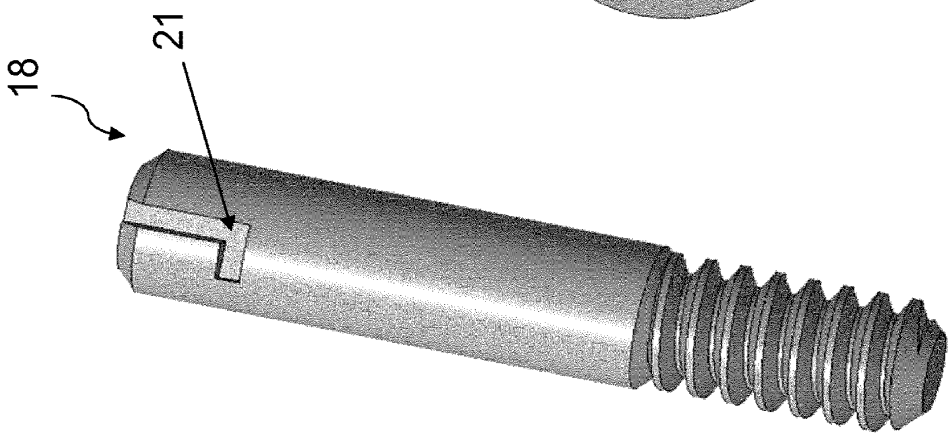


FIG. 14

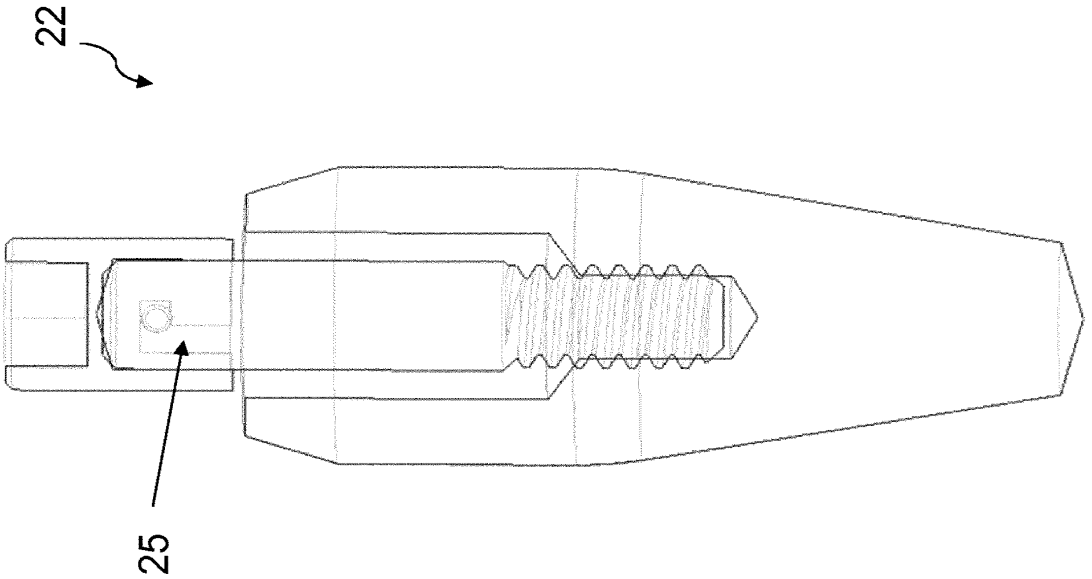


FIG. 18

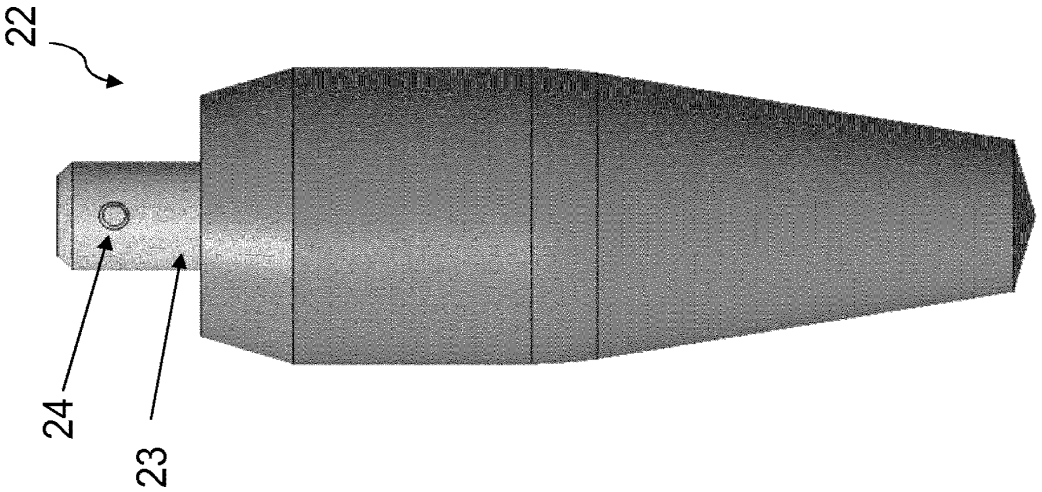


FIG. 17

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/067661

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61C8/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A61C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal , WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 938 693 A (BULAKIEV GEORGI K [BG]) 3 July 1990 (1990-07-03) column 1, line 54 - column 2, line 43 figure	1-4,6-14
X	EP 1 972 297 A1 (STRAUMANN HOLDING AG [CH]) 24 September 2008 (2008-09-24)	1-7 ,9-11
A	paragraph [0017] - paragraph [0020] paragraph [0021] figures 1,2 figures 3A-3D	8, 12-14
A	US 5 733 122 A (GORDON BASIL [US]) 31 March 1998 (1998-03-31) column 9, lines 3-22 column 6, line 10 - column 6, line 67 figures 6-8 figure 17	1-4, 12-14

-/- .

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" documentwhich may throw doubts on priority claim(s) orwhich is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
30 August 2018	12/09/2018

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Fortune, Bruce

3

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2018/067661

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 687 450 A1 (REGENT LTD [KY]) 20 December 1995 (1995-12-20) column 2, line 23 - column 3, line 17 figures 1,2	1-14
A	JP 4 898950 B1 (HISAKAKAI ; HISAKA MITSUHIRO) 21 March 2012 (2012-03-21) the whole document	1-14
A	US 5 209 659 A (FRIEDMAN KURT E [US] ET AL) 11 May 1993 (1993-05-11) figures	1-14

3

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2018/067661

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4938693 A	03-07-1990	BG 47523 A1	15-08-1990
		EP 0312935 A1	26-04-1989
		JP H01236048 A	20-09-1989
		US 4938693 A	03-07-1990
EP 1972297 A1	24-09-2008	EP 1972297 A1	24-09-2008
		ES 2557555 T3	27-01-2016
		US 2008233538 A1	25-09-2008
US 5733122 A	31-03-1998	NONE	
EP 0687450 A1	20-12-1995	DE 69420258 D1	30-09-1999
		DE 69420258 T2	31-08-2000
		EP 0687450 A1	20-12-1995
		ES 2136141 T3	16-11-1999
JP 4898950 B1	21-03-2012	JP 4898950 B1	21-03-2012
		JP 2012090676 A	17-05-2012
US 5209659 A	11-05-1993	NONE	

Form PCT/ISA/210 (patent family annex) (April 2005)

Straumann USA Exhibit 1015

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 104 284**
A1

(12) **EUROPEAN PATENT APPLICATION**

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(22) Date of filing: **28.09.82**

(51) Int. Cl.³: **A 61 C 5/08**
A 61 C 3/02, F 16 B 25/00

(43) Date of publication of application:
04.04.84 Bulletin 84/14

(84) Designated Contracting States:
CH DE FR GB LI SE

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(54) **Combined dental drill and anchor pin.**

(57) A dental device which comprises a drill (30), an integrally-connected anchoring pin (20), stop means (35) positioned on the anchoring pin, and a trailing shank (15), at the other end from the drill, which can be attached to a powerful dental hand piece. The trailing shank may comprise a frangible connection (40) which breaks when, on drilling, the stop means comes into contact with the drilling tooth; the protruding portion then serves as an anchoring pin for subsequent dental work on the tooth.

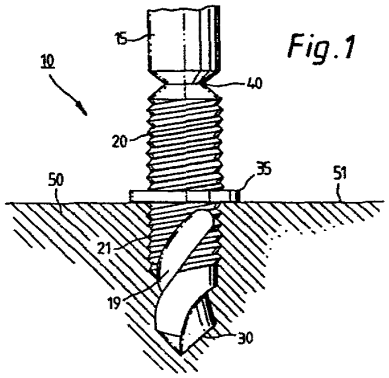


Fig.1

EP 0 104 284 A1

Croydon Printing Company Ltd.

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COMBINED DENTAL DRILL AND ANCHOR PIN

The present invention relates to a novel dental appliance. More particularly the invention pertains to a combined dental drill and anchor pin for use in teeth restoration and orthodontic procedures.

In conventional dentistry procedures it is customary to install one or more pins into broken-down teeth or into teeth to which orthodontic appliances are being applied. The treatment of broken-down teeth is of course more prevalent, and the present invention will be discussed primarily in conjunction with restorative techniques for treating teeth where the nerve is still alive. It will be understood, however, that the invention is also applicable to orthodontic techniques or to non-vital teeth.

As is well known, the conventional procedure is to initially drill one or more relatively deep holes in the dentin portion of the tooth undergoing repair. The drilling can be carried out, for example, by utilizing a typical dental twist drill. The dentist then screws in a small, screw-threaded anchor into each of the holes, leaving a portion of the screw-threaded pin sticking out of the hole. The remainder of the screw-threaded pin is retained in the dentin as the anchor.

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Illustrative U.S. patents pertaining to anchor retention pins include the following:

Baker	3,364,575
Tieche	4,142,293
Chan	4,187,611
Smith	4,189,834
Weissman	4,202,101
Carse	4,219,620

A commercially available screw pin is sold by Pulpdent Corporation of America as "Stabilok" screw-pins under U.S. Patent No. 4,189,834.

A number of commercially available dental drills have been employed for making the holes or channels in the dentin which are required for the anchor pins.

In accordance with present day practices, therefore, two instruments are needed: a drill, e.g. a twist drill; and a diameter-coordinated screw pin. After the twist drill digs its deep hole or channel, the path of insertion must again be found in order to screw in the screw-threaded anchor pin. Since the drilled hole is very tiny, in general being of the order of 0.53 mm, plus or minus a few 100 or 10 nm units, in diameter. If the screw-threaded

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pin is not inserted with its long axis exactly parallel and in line with the orifice and the long axis of the hole, it is difficult, if not impossible, to successfully screw the pin into the hole. Moreover, sometimes the drilled hole or opening is in a difficult location for good accessibility or visibility. At times, the drilled hole or channel is obfuscated by debris or saliva.

According to the invention, a drill and an anchor pin are combined in one structure. In general, the overall instrument or device of this invention has at its end a short drill, e.g. a twist drill, immediately followed by an anchor pin section, a major portion of which will generally protrude above the surface of the dentin and which will serve as the retaining or reinforcing device for enhancing the attachment of an amalgam filling or other restorative material to the tooth. In order to limit the drilling depth, a stop means is positioned on the shank carrying the drill bit and the anchor pin. Furthermore, the device is provided with a weakened point, i.e. a frangible reduced portion or shearing joint positioned on the shank immediately following the desired protruding length of anchor pin.

The invention will be more fully understood by reference to the accompanying drawings in which:

Fig. 1 is a partly cut-away side-view showing a combined drill and anchor pin device according to the present invention.

Fig. 2 is a partly cut-away side-view showing several variations on the combined drill and anchor pin device according to the present invention.

Fig. 3 is an end view of the single fluted drill illustrated in Fig. 2.

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Referring now to the drawings and more specifically to Fig. 1, the present invention comprises a combined drill and anchor pin structure 10, which may be a latch type or straight hand piece bur shank made of stainless steel, plated cast iron or any material harder than dentin and suitable for making a drill therefrom; has a trailing shank portion 15, an anchor pin 20, a screw-threaded portion 21, a groove 19 for debris removal and a drill 30. A stop 35, which may be a part of anchor pin 20, is positioned so that it separates the drill 30 and a portion of the screw-threaded pin from the protruding portion of the anchor pin 20. After drill 30 has pierced the dentin section 50 of the tooth to the desired depth, the stop 35 will come to rest on the top surface 51 of dentin 50 and further drilling will cease.

The drill 30 used in the instrument of this invention may be any kind of deep drilling end such as a single flute, or twist drill, suitable for drilling deep pin holes. For many purposes the drill 30 can be a conventional twist drill type. Fig. 1 shows a twist drill while a single flute drill is illustrated in Fig. 2. Portion 21 of the anchor pin secures the anchor pin to the tooth and portion 21 must have a screw thread for the present purposes.

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The protruding section or portion of anchor pin 20 can be screw-threaded as shown in Fig. 1 or can be a straight shank that has been scored or provided with grooves 42 to enhance its functioning as a retention or reinforcing pin. In general, the anchor pin section of the present instrument is screw-threaded, and it will have an overall length of from about 3 to 6 mm. For most restorative dental work, the segment of the anchor pin extending above or protruding from dentin surface 51 will range from about 1.5 to 4 mm. The outside diameter or lands or anchor screw portion 21 must be slightly larger than the diameter of drill 30, while the grooves of the anchor screw pin 21 must be slightly smaller than the diameter of drill 30. Useful diameters of the anchor pin and the drill will range from about 0.43 to 0.71 mm. It will be understood, however, that for some purposes the diameter of that portion of the anchor pin protruding from the dentinal surface may be less or greater than the diameter of the drill 30.

As also shown in Fig. 1, the trailing shank 15 has a reduced diameter or shearing joint 40 positioned on the upper end of the anchor pin 20 so as to provide a fracture or shear point. When rotation continues following abutment of the stop 35 against the upper dentin surface 51, shearing joint 40 severs under continuing torsional forces leaving the drill 30 and anchor pin portion 21 securely affixed in dentin 50, and that portion of the anchor pin 20 below shearing joint 40 protruding from dentin surface 51.

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In Fig. 3, the centerpoint 25 and the cutting edge 26 of the drill are shown. The drill may have single or multiple blades, as desired.

Although the use of an instrument having a shearing joint 40 is preferred under the invention, it will be understood that other arrangements are also possible. Thus, the trailing shank may be cooperatively attached to an elongated circular-cylindrical shank (not shown) which in turn is attached to a latching-type dental hand piece (not shown). In such a structure, the trailing shank, which can also function as a part of the protruding anchor pin, is detached from the dental handpiece (not shown) when stop 35 is in abutment with the upper dentinal surface 51. It will also be understood that the free end of the trailing shank may have a variety of shapes to cooperate with some locking means on a dental handpiece so that the essential structure of the present invention is locked to a powered dental handpiece.

As will be comprehended by those skilled in the art, the combined drill and pin instrument of this invention may be used in a variety of orientations at various inclinations and inverted from the position shown in the drawings, so that certain positional terms in the foregoing description are used to describe the relative portions of the combined structure without limitation to their orientation with respect to a horizontal plane.

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CLAIMS

1. A dental device characterised in that it comprises a drill (30), an integrally-connected anchoring pin (20), stop means (35) positioned on the anchoring pin, and a trailing shank (15), at the other end from the drill, which can be attached to a powered dental hand piece.

2. A device according to claim 1, wherein the anchoring pin is screw-threaded.

3. A device according to claim 1 or claim 2, wherein that portion of the anchoring pin which, when drilled into a tooth, protrudes from the dentinal surface, is scored or grooved.

4. A device according to any preceding claim, wherein the drill is a twist drill.

5. A device according to any preceding claim, wherein the drill is a single or multiple-fluted end cutting drill.

6. A device according to any preceding claim, wherein the trailing shank is provided with a shearing point.

7. A device according to any preceding claim, wherein the stop means is positioned between a screw retention section on the drill and a section of the anchoring pin, which section protrudes from a tooth when the device is drilled into that tooth.

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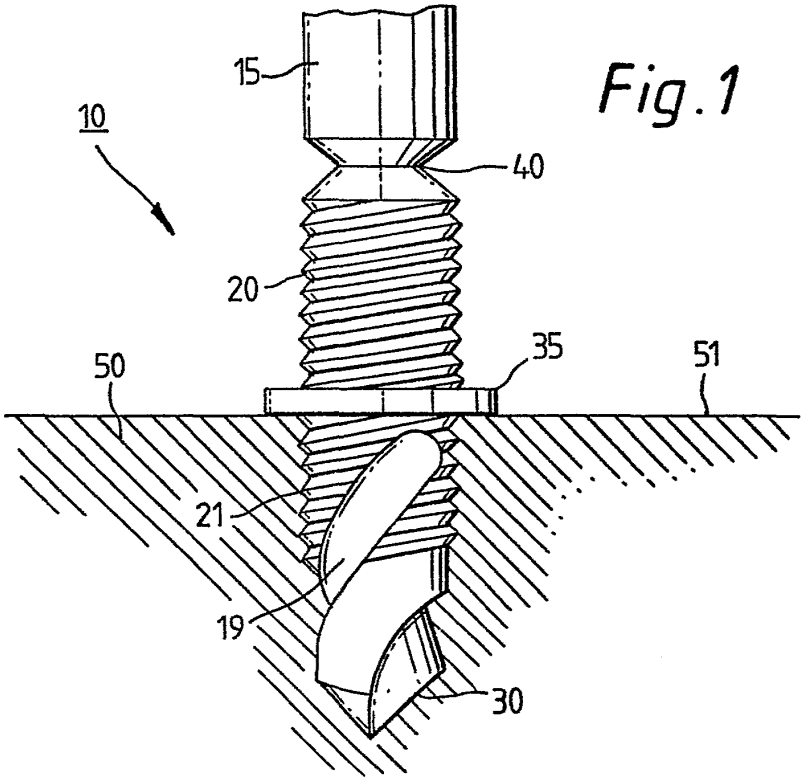


Fig.1

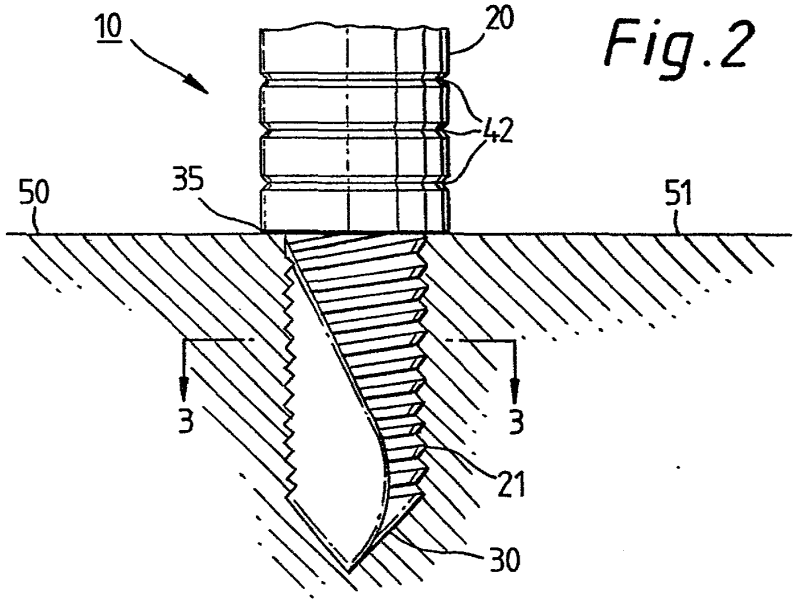


Fig.2

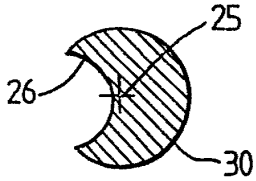


Fig.3

European Patent Office

EUROPEAN SEARCH REPORT

Application number

EP 82 30 5105

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)
X	DE-C- 665 805 (SZABO) * Whole document *	1,4	A 61 C 5/08 A 61 C 3/02 F 16 B 25/00
X	US-A-1 698 951 (HOLMES) * Whole document *	1,5	
A	US-A-2 823 574 (ROSAN) * Whole document *	2,7	
A	US-A-2 740 315 (GOUVERNEUR) * Whole document *	6	
A	CH-A- 562 605 (SPANG) * Whole document *	3	

TECHNICAL FIELDS SEARCHED (Int. Cl. ³)

A 61 C
F 16 B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23-05-1983	VAN BOGAERT J.A.M.M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO Form 1503. 03.82

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CLINICAL INVESTIGATIONS

Prosthetic Abutment Height is a Key Factor in Peri-implant Marginal Bone Loss

P. Galindo-Moreno[1]*, A. León-Cano[1], I. Ortega-Oller[1], A. Monje[2], F. Suárez[2], F. O'Valle[3], S. Spinato[4], and A. Catena[5]

Abstract: *In this study, we analyzed the influence of prosthetic abutment height on marginal bone loss (MBL) around implants in the posterior maxilla. In this retrospective cohort study, the radiographically determined MBL was related to the height of the abutments of internal conical connection implants at 6 and 18 months post-loading. Data were gathered on age, sex, bone substratum, smoking habit, history of periodontitis, and prosthetic features, among other variables. A linear mixed model was used for statistical analysis. The study included 131 patients receiving 315 implants. MBL rates at 6 and 18 months were mainly affected by the abutment height but were also significantly influenced by the bone substratum, periodontitis, and smoking habit. MBL rates were higher for prosthetic abutment < 2 mm* vs. *≥ 2 mm, for periodontal* vs. *non-periodontal patients, for grafted* vs. *pristine bone, and for a heavier smoking habit. The abutment height is a key factor in MBL. MBL rates followed a non-linear trend, with a greater MBL rate during the first 6 months post-loading than during the next 12 months.*

Key Words: sinus augmentation, peri-implantitis, dental implant, dental implant-abutment connection.

Introduction

Various etiologies have been proposed for marginal bone loss (MBL). It has been attributed to inflammation from biomechanical stress due to an incorrect occlusal prosthesis design (Rungsiyakull *et al.*, 2011) or from a foreign-body reaction to cement in the soft tissues around cemented-retained prostheses (Qian *et al.*, 2012). MBL may also be increased by the presence of pathogenic microflora that promote peri-implant inflammation, increasing pocket depth and bone resorption (Lindhe and Meyle, 2008). It has been observed that resorption is reduced with greater distance between the bone and the area of inflammation induced by bacteria in the implant-crown micro-gap (Piattelli *et al.*, 2003).

The bone level around dental implants is significantly affected by clinical decisions about the biologic width (Hermann *et al.*, 2000, 2001). It has been observed that post-implantation wound healing consistently entails bone resorption and, therefore, the establishment of an angular bone defect at sites in which the mucosa is thinner than 2 mm before the abutment connection and remains similar over time (Berglundh and Lindhe, 1996). Significantly greater peri-implant bone loss was also reported when this tissue was thinner than 2 mm, regardless of the position of the micro-gap (Linkevicius *et al.*, 2009). A subsequent study found a similar magnitude of initial marginal bone loss between implants applied with a "platform-switching" or traditional implant/abutment approach in areas with mucosal thickness of 2 mm or less (Linkevicius *et al.*, 2010). These observations indicate that mucosal thickness has a major influence on the degree of early peri-implant bone loss (Wennström and Derks, 2012).

However, some authors found a higher MBL rate with a shorter prosthetics abutment, compressing the initial mucosa thickness, possibly due to a re-establishment of the biological width (Vervaeke *et al.*, 2014). Collaert and De Bruyn (2002) proposed a relationship between prosthetic abutment height and

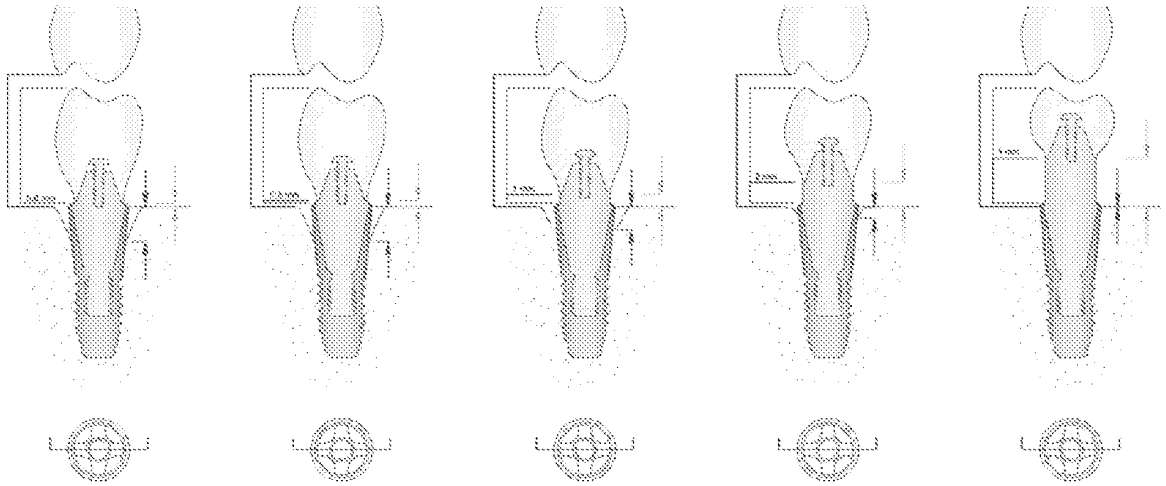
DOI: 10.1177/0022034513519800. [1]Oral Surgery and Implant Dentistry Department, School of Dentistry, University of Granada, Granada, Spain; [2]Department of Periodontics and Oral Medicine, School of Dentistry, University of Michigan, Ann Arbor, USA; [3]Department of Pathology, School of Medicine & IBIMER, University of Granada, Granada, Spain; [4]Unit of Periodontology and Implantology, School of Dentistry, University of Bologna, Bologna, Italy; and [5]Department of Experimental Psychology, School of Psychology, University of Granada, Granada, Spain; *corresponding author, pgalindo@ugr.es

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Figure 1.
Diagram depicting the marginal bone loss (MBL) in relation to the height of the prosthetic abutment. Note that the distance between the antagonist tooth and the bone remains the same in all clinical situations but is comprised of different abutment and crown heights.



peri-implant bone loss, although the absence of statistical analysis prevented meaningful conclusions from being drawn (Collaert and De Bruyn, 2002). Similar results were observed in another study, in which the prosthetic abutment height had an even greater influence on the MBL than did the internal or external implant connection (Galindo-Moreno *et al.*, 2014b).

Hence, according to the above data, MBL around healthy implants can be attributed to the biologic width establishment or to inflammation induced by bacteria present in the micro-gap formed around the crown-implant connection, regardless of the soft-tissue width. In theory, the use of higher abutments to connect the crown to the implant would provide more space for soft-tissue adaptation and would diminish bacteria-promoted inflammation, reducing the bone resorption mediated by these mechanisms.

The main objective of this study was to test the hypothesis that the peri-implant MBL would be reduced with higher abutments, due to the greater distance between crown and bone. Secondary objectives were to evaluate the influence of tobacco consumption, history of periodontitis, and bone substratum type on the MBL around implants in the posterior maxilla and to estimate the optimal distance from the prosthetic crown to the bone surface for minimizing bone resorption.

Materials & Methods

Study Design

The eligible population for this retrospective correlational study was comprised of consecutive patients at 2 private practices who underwent functional restoration of the posterior maxilla between September 2008 and July 2010. Study inclusion criteria were: 18 to 85 yr of age, placement in the posterior maxilla of at least 2 implants splinted in the same screwed prosthetic structure, the presence of at least 5 mm of remnant crestal bone (Wang and Katranji, 2008), and performance of the surgery by the lead author (P.G.-M.). The study protocol was approved by the human research ethical committee of the University of Granada. The same implant system (Astra Tech AB, Mölndal, Sweden) was used in all patients, and all implants were surgically inserted at bone level.

Clinical Variables

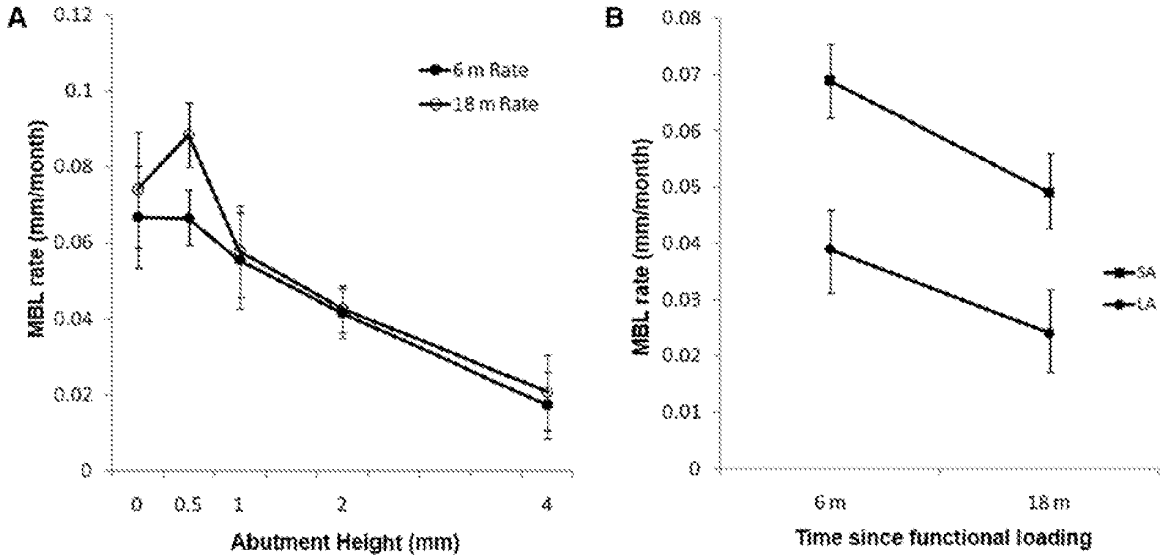
Data were gathered for each patient on their age, sex, smoking habit, history of periodontal disease, implant features, height of prosthetic abutment, and type of restoration. The smoking habit of the patients at the time of the surgery was recorded, classifying them as non-smokers (0 cig/day), mild smokers (0-10 cig/day), or heavy smokers (>10 cig/day). The history of periodontal disease was determined by assessment of the clinical attachment loss (CAL) with a Michigan O probe (Hu-Friedy, Chicago, IL, USA), defining periodontal disease as the presence of at least 4 sites with CAL ≥ 3 mm. The height of uni-abutment used to fix the crown to the implant body was 0 mm, 0.5 mm, 1 mm, 2 mm, or 4 mm, as indicated by the manufacturer (Astra Tech AB, Mölndal, Sweden) (Fig. 1). The restoration type was defined as full-arch rehabilitation, fixed partial denture, or overdenture.

Radiographic Evaluation of MBL

Standardized digital panoramic radiographs (Kodak ACR-2000, Eastman Kodak Company, Rochester, NY, USA) taken at the surgical implant installation, at the time of final restoration delivery (baseline), and at 6 and 18 mos after the functional loading were obtained from medical records. They were analyzed by a single independent calibrated examiner using Dent-A-View v1.0 software (DigiDent, DIT, Nesher, Israel). The MBL

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Figure 2.
Marginal bone loss (MBL) rates in mm/month (**A**) in relation to prosthetic abutment height as a continuous variable and (**B**) as a function of the time since functional loading and the abutment height, classified as short (< 2 mm) or long (≥ 2 mm). Vertical bars are 95% confidence intervals.



was determined by linear measurements taken from the most mesial and distal points of the implant platform to the crestal bone on each panoramic radiograph, corrected according to the known height and width of each implant.

Statistical Analysis

Descriptive statistics, analysis of variance, the exact chi-square test, and the linear mixed model were used to examine and determine the effect of the abutment height (primary predictor) on the MBL rates (primary outcome) at 2 peri-implant sites (mesial and distal, secondary predictor) in 2 time frames (6 and 18 mos after functional loading, secondary predictor). We controlled for the following potential confounders: age, sex, smoking habit, periodontal status, restoration type, bone substratum type, and implant width and length. MBL rates were computed for the mesial and distal rates as the difference between MBL at 18 mos and 6 mos divided by the elapsed time in mos (mm/mo). The initial loss rate (in mos) was calculated as the MBL at 6 mos minus the MBL at baseline (*i.e.*, at the functional loading) divided by 6. These 2 rates were compared to determine whether the MBL rate was constant across time. When no significant difference was found between aspects (mesial/distal) or times (6 and 18 mos), mean rates were used to examine the effect of abutment height. The abutment height was treated both as a continuous variable and in 2 categories: short abutment (SA), < 2.00 mm in height; and long abutment (LA), ≥ 2.00 mm in height. A scaled-identity repeated-covariance matrix was used in all cases, following Schwarz's Bayesian information criterion. Analysis of variance and the exact chi-square test were used to analyze the potential associations of abutment height with patient characteristics and clinical features. The Bonferroni correction for multiple comparisons was applied when required.

Results

The study included 131 patients in whom 315 implants were placed. Seven implants from three patients were excluded because data were missing, Out of the final sample of 308 implants, 137 (44.5%) were LA implants (abutment ≥ 2.00 mm) and 171 (55.5%) were SA implants. Table 1 displays the socio-demographic, clinical, and peri-implant variables of the patients. Table 2 gives the MBL values (in mm) for mesial and distal aspects, and the linear mixed-model estimates for MBL rates (in mm/mo).

Appendix Table 1 exhibits the mean values with standard error for the patients' characteristics and clinical features as a function of the abutment height (SA or LA). Results of the analysis of variance (age, implant width, and implant height) and the exact chi-square test (sex, smoking, periodontal status, prosthesis, and bone substratum) indicated that an overdenture was significantly more frequent in SA *vs.* LA implants ($p = .01$), and that the implant was slightly wider in LA *vs.* SA implants ($p = .01$).

Appendix Table 2 shows the results of the linear mixed models for the effects of patient characteristics and clinical variables on MBL rates. MBL rates were higher for grafted *vs.* pristine bone ($p = .013$), for men *vs.* women ($p = .044$), for smokers *vs.* non-smokers ($p < .001$), and for periodontal *vs.* non-periodontal patients ($p < .001$). Bonferroni-corrected

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Table 1.
Clinical, Socio-demographic, and Implant-related Variables of the Study Sample

Variable	Level	N	%
Sex	Males	67	52.3
	Females	61	47.7
Smoking	Smokers	45	35.2
	Non-smokers	83	65.6
Alcohol	No	122	95.3
	Yes	6	4.7
Periodontitis	Yes	80	62.5
	No	48	37.5
Plaque	0	2	0.7
	1	155	50.3
	2	107	34.7
	3	44	14.3
Laterality	Right	146	47.4
	Left	162	52.6
Bone type	Graft	163	52.9
	Pristine	145	47.1
Implant diameter (mm)	3.5	21	6.8
	4	53	17.2
	4.5	186	60.4
	5	48	15.6
Implant length (mm)	11	20	6.5
	13	137	44.5
	15	151	49.0
Abutment height (mm)	0	20	6.5
	0.5	114	37.0
	1	37	12.0
	2	120	39.0
	4	17	5.5
Restoration type	FR	140	45.5
	FPD	138	44.8
	OD	30	9.7

Note: Imp, implant; FR, full-arch rehabilitation; FPD, fixed partial denture; OD, overdenture.

comparisons indicated that MBL rates were lower for full-arch rehabilitations than for fixed partial dentures or overdentures and were lower for fixed partial dentures than for overdentures. A significantly lower MBL rate was observed in wider implants ($p = .05$).

Mixed linear analysis of the mesial and distal rates (Table 2) yielded significant effects of abutment height, $F(1,1216) = 58.25$, $p < .01$, time, $F(1,126) = 23.53$, $p < .01$, bone type, $F(1,1216) = 6.69$, $p = .01$, smoking, $F(1,1216) = 19.30$, $p < .01$, and periodontitis, $F(1,1216) = 6.42$, $p = .01$. The abutment x time interaction was not significant, $F(1,1216) = 0.64$, $p > .4$. As shown in Table 2, MBL rates were higher for SA *vs.* LA implants, for the first time period studied (from implant loading to 6 mos post-loading) *vs.* the second (from 6 to 18 mos post loading; Fig. 2B), for periodontal (0.051 mm/mo) *vs.* non-periodontal patients (0.040 mm/mo), for a heavier smoking habit (0.0009 mm/mo), and for grafted (0.050 mm/mo) *vs.* pristine (0.040 mm/mo) bone. As observed in Appendix Table 3, the effect of the abutment height was also significant when considered as a continuous predictor ($p < .001$; Fig 2A).

Discussion

The aim of this study was to determine the influence of prosthetic abutment height on peri-implant marginal bone loss. We hypothesized that a reduced MBL would result from a greater distance between crown and bone and therefore from the utilization of a higher abutment. We found a significantly ($p < .001$) greater MBL in shorter prosthetic abutments (from 0 to 4 mm), in agreement with the finding by Vervaeke *et al.* (2014) of greater bone level changes in implants with short abutments [abutment height < 2 mm (1.17 mm at 1 yr, 1.23 mm at 2 yr); 2 mm, (0.86 mm, 1.03 mm, respectively), or 3 mm (0.38 mm; 0.41 mm)] *vs.* long (≥ 4 mm) abutments at 1 and 2 yr, respectively. In the present study, the abutment height was the variable with most influence on the MBL at both 6 and 18 mos, confirming the desirability of maximizing the distance between crown and bone to obtain a more predictable bone preservation outcome.

The MBL rates at 6 and 18 mos were also influenced by the bone substratum, smoking habit, and periodontal status of our patients. Tobacco consumption is known to promote increased marginal bone loss around implants (Galindo-Moreno *et al.*, 2005), and the present findings suggest that it exerts its effect at early stages of wound healing, possibly by reducing vascularization of the tissues or altering their homeostasis. It has also been shown that, regardless of its etiology, MBL is greater in patients with periodontitis than in those without (Cho-Yan Lee *et al.*, 2012). Increased MBL has also been reported around implants with external *vs.* internal connection (Peñarrocha-Diago *et al.*, 2013), which was reported to have the most influence

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Table 2.
Mean Marginal Bone Loss (in mm) at Mesial and Distal Aspects and Mean Marginal Bone Loss Rates (in mm/month) between 0 and 6 Months and between 6 and 12 Months Post-loading as a Function of the Main Predictor and Clinical Variables (standard error in parentheses)

	Aspect	6 months	12 months	Effect	p
	MBL				
SA	Mesial	0.180 (0.025)	0.565 (0.043)	SA *vs.* LA	< .01
	Distal	0.224 (0.028)	0.704 (0.053)	Time	< .01
LA	Mesial	0.063 (0.014)	0.295 (0.043)	Aspect	< .01
	Distal	0.073 (0.015)	0.312 (0.042)	Abut x Time	< .01
	MBL rates (mm/month)				
Abutment	SA	0.069 (0.004)	0.049 (0.004)	SA *vs.* LA	< .01
	LA	0.039 (0.005)	0.024 (0.005)	Time	< .01
Bone	Grafted	0.062 (0.004)	0.045 (0.004)	G *vs.* P	< .01
	Pristine	0.053 (0.004)	0.035 (0.004)		
Periodontitis	No PD	0.043 (0.004)	0.026 (0.0.04)	No PD *vs.* PD	< .01
	PD	0.065 (0.003)	0.048 (0.003)		
Smoking		0.001 (0.0003)	0.0008 (0.0002)	Slope (mm/y)	< .01

Note: SA, short abutment (< 2 mm); LA, long abutment (≥ 2 mm); Abut, abutment; G, grafted bone; P, pristine bone; No PD, no history of periodontitis; PD, history of periodontitis.

on MBL of any variable with the exception of abutment height (Galindo-Moreno *et al.*, 2014a,b).

An important secondary aim in our study was to estimate the optimal distance from the prosthetic crown to the bone surface for minimizing bone resorption. Our results demonstrated that this distance is 2 mm. According to Linkevicius and co-workers (2009, 2010), the width of the keratinized mucosa may be the key factor in maintaining peri-implant marginal bone, with 2 mm being the minimum width of keratinized tissue to preserve the marginal bone around implants, independently of the implant features. However, regardless of the keratinized tissue width, the mucosa can be compressed, as suggested by Collaert and De Bruyn (2002), through the selection of a shorter abutment. Our results indicate that the choice of a shorter abutment may increase MBL and that the keratinized tissue width is not the critical factor. For instance, if the remnant mucosa width is 3 mm after tissue healing in the second surgical stage, we can select a prosthetic abutment of 0 mm, 0.5 mm, 1 mm, or 2 mm. All of these heights will give an esthetic emergence profile, but, as demonstrated in our study, the MBL will differ according to our important clinical decision on the abutment height.

The MBL rate was elevated during the first 6 mos post-loading and decreased thereafter (Table 2). This non-linear trend in MBL progression after functional loading is consistent with the finding by Vervaeke *et al.* (2014) of no significant increase in MBL between 12 and 24 mos post-loading, based on the cumulative percentage of bone level changes after 12 mos. In fact, there is a tendency for consensus and success criteria to assume that MBL takes place largely during the first year.

The present study differs in some important respects from the very few previous studies on the influence of abutment height on MBL. Thus, unlike the studies by Collaert and De Bruyn (2002) and Vervaeke and co-workers (2014), we studied maxillary implants. Mandibular and maxillary bones differ in their stiffness and hardness because of their distinct macro- and micro-architecture. The difference in bone types between mandible (types 1 and 2) and maxilla (types 3 and 4) is known to influence the osseointegration process and the pattern of resorption around the implant neck (Davies, 2003). We studied implants placed in the posterior maxilla, which has a larger amount of keratinized tissue in comparison with that in the edentulous anterior mandible (Romanos *et al.*, 2010). It has been questioned whether the mucosal lining has the capability to function as a proper barrier tissue (Warrer *et al.*, 1995), and it is widely considered that an "adequate" area of keratinized mucosa is desirable around dental implants to prevent soft-tissue recession and to facilitate oral hygiene measures (Wennstrom and Derks, 2012). Finally, Romanos *et al.* (2010) found a greater biologic width in maxillary *vs.* mandibular sites.

A further difference from previous studies is that we compared outcomes between implants in pristine and grafted bone. Our results confirmed previous findings by our group of slight but significant increases in the MBL around implants placed in grafted *vs.* pristine bone (Galindo-Moreno *et al.*, 2014a).

We studied patients with distinct types of prosthetic rehabilitation, observing less

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MBL around implants supporting a fixed partial denture than around those supporting an overdenture, which can be explained by differences in load distribution and biomechanics (Kitamura *et al.*, 2004). In the study by Vervaeke *et al.* (2014), all patients carried an overdenture supported by 2 implants.

Our study had some limitations. Being a retrospective study, it was not possible to homogenize the sample, although our statistical methodology minimized this drawback. We also used panoramic radiography, which is less sensitive than periapical techniques for MBL measurement but provides data on features of the posterior maxilla that can influence implant behavior (*e.g.*, bone type). Moreover, periapical radiography at this localization requires utilization of the bisector technique, and resulting differences in angulation may alter MBL measurements.

The height of the prosthetic abutment was the variable with the most influence on MBL, which was greater around implants with shorter abutments. This parameter must be taken into consideration for adequate maintenance of the bone level around implants over time. MBL rates around dental implants appear to follow a non-linear trend, with a faster bone loss during the first 6 mos post-loading than during the following 12 mos.

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(54) Title: PROVISIONAL PROSTHETIC SYSTEMS AND METHODS OF USING SAME

(57) Abstract: Provisional prosthetic systems and methods of coupling such provisional prosthetic systems to a dental implant are disclosed. The provisional prosthetic system can include at least one dental component having a provisional connection feature and a prosthesis. A clinician can couple the prosthesis to the dental component using a bonding agent. The clinician can then drill a hole through the prosthesis. The hole can be configured to receive a fastener to securely fasten the prosthesis and dental component to the implant.

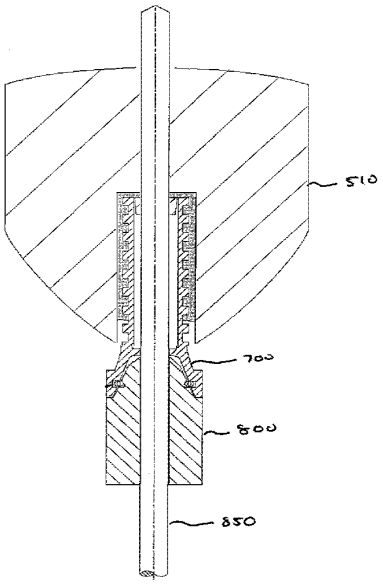


Figure 11

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GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

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