plastic, for example. Thus, a completely metal-free construction of the dental prosthesis arrangement 1 can be realized.

The implant body inner bore 21 can have a polygonal, preferably a triangular, cross section. The threaded sleeve 3 in turn has a matching, preferably hexagonal, external cross-section of the support flanks 34 of the threaded sleeve 3 and a lower part 54 of the abutment 5 engaging between the support flanks 34 are likewise adapted to one another, preferably in the form of a triangular channel. This polygonal construction, in the final state, secures the abutment 5 against rotation about the longitudinal axis 10 in the implant body 2. Moreover, during insertion, it enables a rotational positioning of the abutment 5. With the preferred three edges or hexagons, it is possible, analogously to the known ZABAMEX ® structure, to have six positions which are rotated by 60° with respect to one another. Of course, rotational symmetries with other rotational symmetry angles and also non-rotationally symmetrical arrangements are possible.

Above the locking means 4, a cylindrical abutment post 53 is inserted precisely in a cylindrical part of the implant body inner bore 21, and this ensures a good hold in the radial direction. By adapting the tolerances of the abutment post 54, micro-movements can be minimized. In order for no blood and saliva to enter the implant body inner bore 21, a flexible sealing compound (not shown) can be applied to the upper edge 24 of the implant body 2. The sealing compound additionally absorbs and dampens micro-movements.

FIGS. 7-11 show five different embodiments of the locking component 4, as is required for the dental prosthesis arrangement 1 according to the invention according to FIGS. 1-6. The locking component 4 can consist of steel, titanium, plastic or ceramic.

The one-piece locking component 4 of FIG. 7 consists essentially of three wings 42.1-42.3 which are arranged rotationally symmetrically in a plane perpendicular to the longitudinal axis 10 and are held together by an elastic ring 43 surrounding the bore 41. As a result of the above-described penetration of the conical end 32 of the threaded sleeve 3 into the bore 41, the ring 43 is stretched and the wings 42.1-42.3 are pressed outwards into the annular groove 23

In the embodiment of FIG. 8, the three wings of the locking component 4 are formed as separate sector-like parts, of which only one wing 42.1 is shown in FIG. 8, and are held together by a stretchable, preferably elastic ring (not shown) which is inserted into grooves 44

The embodiment of FIG. 9 is formed in one piece. The three wings 42.1-42.3 are connected to one another by means of expandable connecting elements 43.1-43.3 which are designed in such a way that they allow removal of the wings 42.1-42.3 from the longitudinal axis 10 and from one another.

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In the embodiment of FIG. 10, the three hills 42.1-42.3 of the locking component 4 are again designed as separate sector-like parts and each have two hooks 44. An expandable, for example annular connecting element (not shown) can be placed on the adjacent hooks 44 of two wings in order to hold the wings 42.1-42.3 together.

The locking component 4 of FIG. 11 is in the form of a ring, which has a radial slot 45 at one point, so that the locking component 4 can be spread outwards.

A second embodiment of the dental prosthesis arrangement 1 according to the invention or parts thereof are represented in FIGS. 12-14, and analogous elements are denoted by the same reference numerals as in FIGS. 1-6 and need not be explained again here.

Im Unterschied zur ersten Ausführungsform der Figuren 1-11 wird hier nicht ein separates Verriegelungsmittel eingesetzt Vielmehr wird das Verriegelungsmittel 4 durch die äussere Form der Gewindehülse 3 selbst gebildet, nämlich durch zwei einander gegenüber liegende Flügel 42. 1, 42. FIG. 2, which preferably extends in the axial direction over the entire length of the threaded sleeve 3. The implant body inner bore 21 has two opposing projections 25. 1, 25.2, which are adapted to the wings 42.1, 42.2 or longitudinal grooves 46.1, 46.2 lying between the wings 42.1, 42.2 on the outer wall of the threaded sleeve 4 in such a way that the threaded sleeve 4 can be inserted into the implant body inner shell 21. After insertion, the threaded sleeve 4 is rotated in the implant body inner bore 21 about the longitudinal axis 10 until it assumes a position in which it is anchored in a form-fitting manner by interaction of the wings 42.1, 42.2 with the projections 25.1, 25.2 In the example of FIGS. 12 and 13, the threaded sleeve 3 for anchoring is rotated through 90° about the longitudinal axis 10 In order to allow the rotation, the implant body inner bore 21 has at least in the lower part, which receives the threaded sleeve, a circular cross section and is preferably cylindrical, in this embodiment the threaded sleeve 3 is thus anchored in the implant body 2 by means of a type of bayonet closure

The threaded sleeve 3 anchored in the axial direction must still be secured against rotation about the longitudinal axis 10. This can take place, for example, by inserting two securing elements 7.1, 7.2 into the free-standing longitudinal grooves 46.1, 46.2. Such securing elements 7.1, 7.2 are shown in FIG. 14 in a plan view and in the inserted state project beyond the threaded sleeve 4 in the axial direction and are supported on the projections 25.1, 25.2. For an even better anchoring, a plurality of projections can be arranged one above the other, ie offset in the axial direction, the outer wall of the threaded sleeve 3 having to be correspondingly adapted. Other rotational symmetries or non-rotationally symmetrical arrangements are also possible in this embodiment.

In an alternative to the second embodiment of FIGS. 12-14, not shown here, the locking means can be designed as wings attached to the threaded sleeve, which extend only over part of the

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length of the threaded sleeve. Analogously to the first embodiment of FIGS. 1-6, they can engage in an annular groove in the inner bore of the implant body for the purpose of positive anchoring. In order to allow the insertion of the threaded sleeve, the upper part of the implant body inner bore has longitudinal grooves into which the wings fit. When the threaded sleeve has reached its final axial position, it is again rotated about the longitudinal axis such that the wings engage in the annular groove. Thereafter, the threaded sleeve must still be secured against rotation about the longitudinal axis, which can be carried out analogously to the embodiment of FIGS. 12-14 or in another suitable manner. A type of bayonet closure is thus also used in this alternative.

A further embodiment of the dental prosthesis arrangement 100 according to the invention or parts thereof are shown in FIGS. 15 to 17 in various views and sectional drawings

The dental prosthesis assembly 100 includes an endosseous implant body 102 for anchoring the dental prosthesis assembly 100 in a jaw bone (not shown here). In its upper (distal) region, the implant body 102 has a non-continuous inner bore 121, which runs substantially coaxially with a longitudinal axis 110 of the implant body 102 or of the tooth replacement arrangement 100. The implant body 102 preferably in turn consists of a ceramic material (for example ZERAMEX ®) or a biocompatible metal such as titanium.

The inner bore 121 of the implant body serves to anchor a threaded sleeve 103, the function of which will be discussed further below. The threaded sleeve 103 can consist, for example, of steel, titanium or a plastic.

Furthermore, the dental prosthesis arrangement 100 includes an abutment 105 for receiving a superstructure (not shown here), for example a crown or a bridge. The abutment 105 can consist, for example, of a zirconium oxide ceramic. It has a continuous inner bore 151, which runs substantially coaxially with the longitudinal axis 110 of the abutment or tooth replacement arrangement 100

The abutment inner bore 151 in turn receives a head screw 106 for connecting the abutment 105 to the implant body 102. As already described above, a head 161 of the head screw 106 is supported in the abutment inner bore 151 in a form-fitting manner , for example on a circumferential shoulder 15.2 attached in the interior of the abutment inner bore 151 A threaded part 162 of the head screw 106 with an external thread engages in a corresponding internal thread 131 of the threaded sleeve 103. The head screw 106 can consist, for example, of steel, titanium, a plastic or a ceramic material.

In the proximal region, the threaded sleeve 103 has a plurality of tongues 140, which are spaced apart from one another by incisions in the threaded sleeve 103 guided parallel to the longitudinal axis. Radial ribs 104 are used as the actual locking means, which are directed

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radially outwards in the proximal region of the tongues 140 and can engage in a corresponding radial groove 123 on the basis of the implant body inner bore 121. In the embodiment according to FIGS . 15 to 17, the locking means is designed as a plurality of locking ribs 104 connected in one piece to the threaded sleeve 103. The threaded sleeve 103 with the locking ribs 104 is designed such that, in an insertion state in which it is introduced into the implant body inner bore 21, its maximum radial extent of the ribs is smaller than a diameter of the implant body inner bore, so that it can be inserted through an upper (distal) opening 122 into the implant body inner bore 121. In an end state shown in FIGS. 17 (a) and 17 (b), the locking ribs 104 engage a maximum radial extent greater than the diameter of the implant body inner bore 121 into the annular groove 123. Thus, a form fit and possibly also a force fit between the locking 104 of the threaded sleeve 103 and the annular groove 123 occurs.

The insertion, ie the insertion and the fastening of the abutment 105 in the already inserted implant body 102, is described below. The head screw 106 is inserted from above into the abutment inner bore 151 so that its lower threaded part 161 protrudes from a lower (proximal) opening out of the abutment 105 From below, the threaded sleeve 103 is screwed onto the abutment stem 154 from below by means of form-fitting means 150 and is partially screwed onto the threaded part 162. The head screw 6 is then screwed into the threaded sleeve so far that the proximal region with the tongues remains free, or in its insertion state, the elements 103, 105 and 106 held together in this way are now introduced into the implant body inner bore 121 from above, in which the ribs on the flexible tongues can spring radially inwards. When they have reached their end position in the inner bore 121 of the implant body, the head screw 106 is completely screwed in and tightened. As a result, the threaded part 162 penetrates between the tongues and fixes the latter and thus the ribs in the locking position. Depending on the configuration of the tongues, these can also additionally be spread out from the screw to the outside into the annular groove 123. The locked end state is shown in longitudinal section according to FIG. 17(b)

The threaded sleeve 103 with its ribs 104 engages in the annular groove 123 and is anchored in the inner implant bore 121. The abutment 105 is pulled against an upper edge 124 of the implant body 102 and against the threaded sleeve supported in the implant body 102 by an axial force defined by the tightening of the head screw 106.

With knowledge of the invention, a person skilled in the art is able to derive further embodiments which are likewise part of the present invention.

Claims

1. The invention relates to a dental prosthesis arrangement (1, 100), comprising an endosseous implant body (2, 102) for anchoring the tooth arrangement (1, 102) in a jaw bone, wherein the

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implant body (2,) has an inner bore (21, 121), a threaded sleeve (3,) anchored in the inner bore (21, 121) of the implant body, an abutment (5, 105) for receiving a superstructure, soft abutment (5,) (105) and an abutment internal bore (51, 151). (51,) and a threaded part (62, 162) of the head screw (6, 106) engages in the threaded sleeve (3, 103), characterized in that the threaded sleeve (3, 103) can be anchored in a form-fitting manner in the inner bore (21, 121) of the implant body by means of locking means (4, 104)

2. A dental prosthesis assembly (1, 100) according to claim 1, wherein the locking means (4, 104) engage and are supported in an annular groove (23, 123) mounted in a wall of the implant body inner bore (21, 121)

3. The tooth replacement arrangement (1) according to claim 2, wherein the locking means are formed from a locking component (4) which can be spread outwards in the radial direction and can be introduced into the implant body inner bore (21) in an unfolded state and engages in the annular groove (23) in a spread state

4. A dental prosthesis assembly (1) according to claim 3, wherein the locking member (4) comprises at least two wing-like planes perpendicular to a longitudinal axis (10) Arranged sectors (42.1-42.3) which are connected to one another by stretchable, preferably elastic connecting means (43).

5. Tooth replacement arrangement (1) according to claim 3 or 4, wherein the locking component (4) has a bore (41) into which a conical end (32) of the threaded sleeve (3) penetrates in order to spread the locking component (4) outwards.

6. Tooth replacement arrangement (1) according to one of the preceding claims, wherein the implant body inner bore (21), an outer wall of the threaded sleeve (3), the locking means (4) and/or an end (54) of abutments (5) engaging in the implant body inner bore (21) are designed to be rotationally symmetrical and the rotational symmetry angle is preferably 120° or 60°

7. A dental prosthesis arrangement (100) according to claim 2, wherein a plurality of locking means are arranged in the proximal region of the threaded sleeve (103) as portions of an

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outwardly projecting radial rib (104) on respective individual flexible tongues (140) which are spaced apart from one another.

8. The dental prosthesis assembly (1, 100) according to any one of the preceding claims, wherein the implant body (2,) (102) is made of a ceramic material or a biocompatible metal such as titanium, the threaded sleeve (3, 103) is steel, titanium, a plastic or a ceramic material, the locking means (4, 104) are made of steel, titanium. plastic or a ceramic material, the abutment (5, 105) consists of a zirconium oxide ceramic and/or the head screw (6, 106) is made of steel, titanium, a plastic or a ceramic material

9. Locking component (4) for a dental prosthesis arrangement (1) according to Claim 2, characterized in that it differs from an insertion state in which it has a first lateral Extension can be converted into an end state in which it has a second lateral extent which is greater than the first lateral extent.

10. Locking component (4) according to claim 9, wherein the locking component (4) comprises at least two wing-like sectors (42.1-42.3) which are arranged in a plane perpendicular to a longitudinal axis (10) and which are connected to one another by stretchable, preferably elastic connecting means (43).

1 The first locking component (4) according to claim 9 or 10, wherein the locking component (4) has a bore (41) and, as a result of a penetration of a conical object (32) into the bore (41), can be spread outwards

12. The method of constructing a dental prosthesis assembly (1) according to claim 6, wherein the head screw (6) is inserted from a distal side into the abutment internal bore (51) such that its threaded portion (62) protrudes from the abutment (5) on a proximal side,

the locking component (4) is placed with its bore (41) onto the threaded part (62) and secured to the threaded sleeve (3),

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the elements (3-6) held together in this way are introduced into the implant channel bore (21),

the head screw (6) is tightened so that the conical end (32) of the threaded sleeve (3) is pressed into the locking component bore (41), and the locking component (4) is spread outwardly into the annular groove (23) by the penetration of the conical end (32) of the threaded sleeve (3).

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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/827,656	**01/11/2025 07:41:17 PM Z ET**	**SDC013**

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 #	2702	FILED BY	Daniel Whittle
PATENT CENTER #	68698159	AUTHORIZED BY	-
CUSTOMER #	112823	FILING DATE	09/06/2024
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Brandon Dale Kofford

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 5436	**E20251AJ42457704**	**Daniel Whittle**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
2806	SUBMISSION OF AN INFORMATION DISCLOSURE STATEMENT	104.00	1	104.00
			TOTAL AMOUNT:	**$104.00**

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.

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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/827,656	**03/29/2025 11:43:18 PM Z ET**	**SDC013**

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 #	2702	FILED BY	Daniel Whittle
PATENT CENTER #	69793686	FILING DATE	09/06/2024
CUSTOMER #	112823	FIRST NAMED INVENTOR	Brandon Dale Kofford
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	-

Documents

TOTAL DOCUMENTS: 1

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
SDC013responsefinal-APP.TEXT.docx	42	Application body structured text document	1502 KB

Warning: Bookmarks were found and have been removed. The claims appear to contain duplicate claim numbering. Please review and revise if necessary. At least one claim number appears to be missing or out of order. Please review and revise if necessary. The claims appear to contain an improper dependency with at least one claim that depends on itself. Please review and revise if necessary. The automatic document description has been replaced. Bookmarks were found and have been removed. The claims appear to contain duplicate claim numbering. Please review and revise if necessary. At least one claim number appears to be missing or out of order. Please review and revise if necessary. The claims appear to contain an improper dependency with at least one claim that depends on itself. Please review and revise if necessary.

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
SDC013responsefinal-APP.TEXT.docx	0EADE16FDFE46C0D347A4DB14DE2A890FE7BD6225C8802C881021E0CFC78D041212CDA3397D063DDF38D3B2ED179D1C89EDA41D8F47C00DB6AD1469013EB28DA

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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/827,656	**03/29/2025 11:43:18 PM Z ET**	**SDC013**

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 #	-
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PATENT CENTER #	69793686	AUTHORIZED BY	-
CUSTOMER #	112823	FILING DATE	09/06/2024
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Brandon Dale Kofford

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 5436	**E20253SN47435402**	**Daniel Whittle**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
2830	PROCESSING FEE, EXCEPT IN PROVISIONAL APPLICATIONS	60.00	1	60.00
2252	EXTENSION FOR RESPONSE WITHIN SECOND MONTH, EXCEPT PROVISIONAL APPLICATIONS	276.00	1	276.00
2202	EACH CLAIM IN EXCESS OF 20	80.00	3	240.00
			TOTAL AMOUNT:	**$576.00**

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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

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Docket No. SDC013 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re: Kofford et al. Confirmation No. 2702
Application No.: 18/827,656 Group Art Unit: 3772
Filing Date: September 6, 2024 Examiner: Courtney Nguyen Huynh
For: **SCREW-ATTACHED PICK-UP DENTAL COPING SYSTEM AND METHODS**

Date: March 29, 2025

Commissioner for Patents
Box 1450
Alexandria, VA 22313-1450

RESPONSE AFTER NON-FINAL REJECTION

Madam:

This response is submitted in reply to the Office Action dated October 30, 2024 ("the Action").

The applicant herewith petitions the Director of the United States Patent and Trademark Office to extend the time for reply to the Office action dated October 30, 2024 for 2 months from January 30, 2025 to March 30, 2025. Submitted herewith is an electronic payment for $276.00 to cover the cost of the extension.

Amendments to the Claims are reflected in the Listing of Claims, which begins on page 2 of this document.

Remarks begin on page 11 of this document.

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CLAIMS

The Listing of Claims:

1. (Currently Amended) A dental system comprising:

a coping having a proximal end with an aperture;

an implant abutment having threads, wherein the implant abutment threads extend distally from a most proximal thread position;

a definitive screw having a proximal head end having a tool interface and a distal post portion having threads configured for securing the coping to the threads of the implant abutment through rotary engagement to a predetermined definitive fixation torque, wherein the distal post portion is sized and configured to extend through the aperture of the coping; and

a temporary fastener having a longitudinal axis with a length measured along the longitudinal axis and a lateral dimension providing different widths along the longitudinal axis measured perpendicular to the longitudinal axis, the temporary fastener comprising a shaft comprising a distal shaft portion sized and configured for rotary engagement with the implant abutment threads,

wherein the shaft of the temporary fastener is configured to extend through the aperture of the coping and the distal shaft portion is configured to engage the implant abutment threads through an engagement depth measured axially between a most distal contact position with the implant abutment threads and the most proximal thread position of the implant abutment threads and is configured so that a portion of the temporary fastener holds the coping in alignment with the implant abutment prior to attachment of the definitive screw,

wherein the distal shaft portion of the temporary fastener is configured to rotate to couple to the implant abutment through the engagement depth and to a predetermined temporary holding torque whereby the temporary fastener holds the coping into alignment against the implant abutment,

wherein the temporary fastener is configured to release at least a portion of the temporary fastener and the coping from the implant abutment as a unit when an axial release force is applied in a proximal direction to the temporary fastener,

wherein the distal shaft portion of the temporary fastener is sized and configured to make contact with the implant abutment threads over a first thread contact area to hold the coping

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against the implant abutment, wherein, after removal of the temporary fastener, the distal post portion of the definitive screw is sized and configured to make contact with the implant abutment threads over a second thread contact area to hold the coping against the implant abutment, and wherein the first thread contact area is less than the second thread contact area.

2. (Original) The dental system of Claim 1 wherein the threads of the implant abutment comprise female threads, wherein the female threads have a radial extent bounded by a female thread minor diameter and a female thread major diameter, and wherein the female thread minor diameter is located closer to the longitudinal axis than the female thread major diameter.
3. (Withdrawn, Currently amended) The dental system of Claim 2 wherein a maximal width of the distal post portion of the definitive screw having threads is larger than the female thread minor diameter of the implant abutment threads, and wherein a maximal width of the distal shaft portion of the temporary [[screw]]fastener sized and configured to make contact with the implant abutment threads is smaller than the width of the distal post portion of the definitive screw having threads.
4. (Original) The dental system of Claim 2 wherein the distal shaft portion of the temporary fastener is configured to have a temporary fastener engagement volume extending radially beyond the female thread minor diameter and axially over the engagement depth, wherein the definitive screw is configured to have a definitive screw engagement volume extending radially beyond the female thread minor diameter and axially over the engagement depth, and wherein the definitive screw engagement volume is greater than the temporary fastener engagement volume.
5. (Original) The dental system of Claim 1 wherein the distal shaft portion of the temporary fastener is configured to have discontinuous contact with the implant abutment threads throughout the engagement depth.
6. (Currently amended) The dental system of Claim 1 wherein the [[axial release force is configured to be applied]] temporary fastener is configured to release at least a portion of the temporary fastener and the coping from the implant abutment as a unit when an axial release force is applied in a proximal direction to the temporary fastener in a pick-up

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process further comprising a dental prothesis bonded and/or adhered to the coping with the temporary fastener coupled to the implant abutment to hold the coping into alignment with the implant abutment, wherein the temporary fastener is configured to release, as a unit, at least a portion of the temporary fastener, the coping and the dental prosthesis bonded and/or adhered to the coping from the implant abutment in response to the axial release force in the proximal direction.

7. (Withdrawn) The dental system of Claim 1 wherein the shaft of the temporary fastener includes a portion that has a smaller width than the distal shaft portion sized and configured for rotary engagement with the implant abutment threads, and wherein the portion with the smaller width is located proximally from the distal shaft portion sized and configured for rotary engagement.
8. (Original) The dental system of Claim 1 wherein the threads of the distal post portion of the definitive screw are configured to continuously engage the implant abutment threads.
9. (Original) The dental system of Claim 1 wherein the distal shaft portion of the temporary fastener is configured to deform and disengage the implant abutment threads to release the coping and the temporary fastener as a unit as a result of the axial release force.
10. (Withdrawn, Currently amended) A dental system comprising:

an implant abutment having threads and an implant abutment longitudinal axis;

a coping having a proximal end with a central aperture merging into a central open channel of greater width than the central aperture;

a definitive screw having a proximal head end having a tool interface and a distal post portion having threads configured for securing the coping to the threads of the implant abutment, wherein the distal post portion having threads is sized to extend through the aperture of the coping into the central open channel;

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

a head with a proximal end having a drive tool interface configured for rotating the temporary fastener to a predetermined temporary holding torque, and

a shaft coupled to or integral with the head and configured to extend through the

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central aperture of the coping, wherein the shaft has a distal portion having an outer surface comprising threads, wherein a maximal width of the distal portion with the threads is smaller than a maximal width of the distal post portion of the definitive screw with the threads,

wherein the temporary fastener is configured so that, in position and engaged with the threads of the implant abutment at [[a]] the predetermined temporary holding torque, the temporary fastener cooperates with the coping to align the coping into position with the implant abutment, and wherein the temporary fastener is configured so that in response to application of an axial release force above a predefined value in a proximal direction, the coping and at least a portion of the temporary fastener are released as a unit from the implant abutment without rotation.

11. (Withdrawn, Currently Amended) The dental system of Claim 10 wherein the distal portion of the shaft of the temporary fastener is configured to deform in response to the application of the axial release force above [[a]] the predefined value in [[a]]the proximal direction.

12. (Withdrawn) The dental system of Claim 10 wherein the temporary fastener is configured to move axially in response to the axial release force without rotation.

13. (Withdrawn,Currently Amended) The dental system of Claim 10 wherein the threads of the shaft of the temporary fastener are configured to have discontinuous contact with the threads of the implant abutment at the[[predefined]] predetermined temporary holding torque.

14. (Withdrawn ,Currently Amended) The dental system of Claim 10 wherein the shaft of the temporary fastener has a portion located proximally of the distal portion comprising threads having a width smaller than the maximal width of the distal portion comprising the threads.

Straumann USA Exhibit 1023

15. (Currently Amended) A dental system comprising:

a coping having a proximal end with an aperture and a distal end with a coping seating surface; and

an implant abutment having a longitudinal axis comprising:

female threading, wherein the female threading resides proximate a proximal end of the implant abutment and extends distally thereof, and

an outer wall surrounding the female threading, the outer wall comprising an implant abutment seating surface;

a temporary fastener having an axis with a length measured along the axis and a lateral dimension providing different widths along the axis measured perpendicular to the axis, the temporary fastener comprising:

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

a shaft comprising a distal shaft portion configured for rotary engagement with the implant abutment female threading,

wherein the shaft of the temporary fastener is sized to extend through the aperture of the coping, and wherein the distal shaft portion of the temporary fastener is configured to rotatably engage the female threading of the implant abutment <u>at a predetermined temporary holding torque</u> to an engagement depth sufficient to hold the coping seating surface aligned with and <u>against</u> [[adjacent]] the implant abutment seating surface, and

wherein the temporary fastener is configured to release at least a portion of the temporary fastener and the coping from the implant abutment as a unit as a result of an axial release force in a proximal direction, and

wherein the distal shaft portion of the temporary fastener[[does not continuously contact]] <u>discontinuously engages</u> the female threading of the implant abutment between a most distal engagement position and a proximate end of the female threading of the implant abutment.

16. (Currently amended) The dental system of Claim 15, wherein the <u>temporary fastener is configured to release at least a portion of the temporary fastener and the coping from the implant abutment as a unit as a result of an</u> axial release force <u>in a proximal direction</u> [[is]] applied in a pick-up process after adhesive bonding of the coping to a prosthesis or

Straumann USA Exhibit 1023

in a closed tray impression process, further comprising a dental prothesis bonded and/or adhered to the coping with the temporary fastener coupled to the implant abutment to hold the coping into alignment with the implant abutment, wherein the temporary fastener is configured to release, as a unit, the at least a portion of the temporary fastener, the coping and the dental prosthesis bonded and/or adhered to the coping from the implant abutment in response to the axial release force in the proximal direction whereby a closed tray impression process provides the axial release force in the proximal direction.

17. (Currently amended) The dental system of Claim 15, wherein the axial release force in the proximal direction releases[[an entire]] the temporary fastener, intact and in its entirety, and the coping from the implant abutment as a unit.
18. (Original) The dental system of Claim 15, wherein the temporary fastener comprises a polymeric material.
19. (Currently amended) The dental system of Claim 15, further comprising a definitive screw with a longitudinal axis and a width measured perpendicular to the longitudinal axis, the definitive screw comprising:

a head with a proximal end having a drive tool interface, wherein, after removal of the temporary fastener, the head is configured to be in contact with a proximal surface of the coping proximate the aperture of the coping, and

a shaft that has a width configured to extend through the aperture of the coping, the shaft comprising:

a distal portion having an outer surface comprising male threading configured to engage the female threading of the implant abutment, wherein the distal portion of the definitive screw is configured to rotatably engage the female threading of the implant abutment to a predefined definitive fixation torque to position the coping seating surface [[adjacent to]]against the implant abutment seating surface.

20. (Original) The dental system of Claim 19, wherein the male threading of the definitive screw is configured to make continuous contact with the implant abutment female threading.
21. (Withdrawn) The dental system of Claim 19, wherein the male threading of the distal

Straumann USA Exhibit 1023

portion of the definitive screw has a greater engagement depth with the female threading of the implant abutment than the engagement depth of the temporary fastener and/or the male threading of the distal portion of the definitive screw has a longitudinal extent that is greater than a longitudinal extent of the distal shaft portion of the temporary fastener.

22. (Withdrawn) The dental system of Claim 19, wherein a maximum width of the distal portion of the definitive screw comprising the male threading is greater than a maximum width of the distal shaft portion of the temporary fastener configured to rotatably engage the implant abutment female threading.

23. (Withdrawn, Currently amended) A method of installing a dental prosthesis according to the dental system of Claim 1, comprising:

~~providing a coping comprising an aperture and a temporary fastener comprising threads wherein the temporary fastener is configured to extend at least partially through the aperture of the coping;~~

attaching the temporary fastener to the implant abutment threads of the implant abutment while the coping extends about the temporary fastener in axial alignment with the implant abutment;

processing the coping using a pick-up process or closed tray impression process while the temporary fastener is attached to the implant abutment;

releasing the coping attached to at least part of the temporary fastener as a unit in response to [[an]]the axial release force applied from the processing;

drilling at least one hole through a dental prosthesis aligned with the aperture of the released coping;

aligning the dental prosthesis coupled to the released coping with the implant abutment; and

attaching the dental prosthesis with the released coping to the implant abutment using [[a]] the definitive screw inserted through a respective at least one hole of the dental prosthesis wherein the definitive screw has threads with a maximal width that is greater than [[the]] a maximal width of the [[threads]]distal shaft portion of the temporary fastener[[screw]].

Straumann USA Exhibit 1023

24. (Withdrawn, Currently Amended) The method of Claim 23, wherein the releasing is carried out so that the temporary fastener is entirely removed while attached to the coping providing the unit.

25. (Withdrawn, Currently Amended) The method of Claim 23, wherein the method further comprises, before the step of attaching the temporary fastener, providing a tool that is configured to at least partially surround the coping while the temporary fastener extends through the aperture of the coping and aligning the tool with the coping and temporary fastener with the implant abutment.

26. (Cancelled)

27. (Withdrawn, New) The method of Claim 23 wherein the temporary fastener threads are attached to the implant abutment threads at the predetermined temporary holding torque, wherein the definitive screw is attached to the implant abutment threads at the predetermined definitive fixation torque, and wherein the predetermined definitive fixation torque is greater than the predetermined temporary holding torque.

28. (New) The dental system of Claim 1 wherein the predetermined definitive fixation torque is greater than the predetermined temporary holding torque.

29. (Withdrawn, New) The dental system of Claim 10 wherein the definitive screw is configured for rotational engagement with the implant abutment threads to a predetermined definitive fixation torque that exceeds the predetermined temporary holding torque.

30. (Withdrawn, New) The dental system of Claim 10 wherein the threads of the distal post portion having threads of the definitive screw comprise a helical thread portion characterized by a first thread pitch, wherein the threads of the distal shaft portion of the temporary fastener comprise a helical thread portion characterized by a second thread pitch, and wherein the second thread pitch is essentially the same as the first thread pitch.

Straumann USA Exhibit 1023

REMARKS

Election/Restrictions

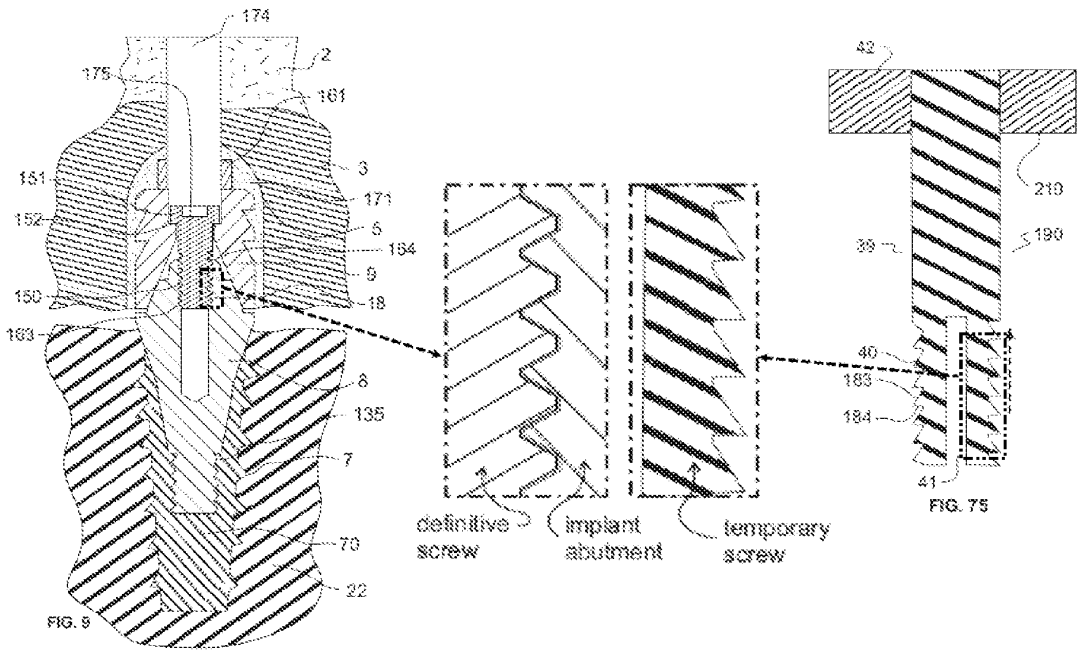
Applicant appreciates the courtesy of the Examiner in a telephonic request to provide an election of the invention and species to be examined. Applicant confirms the election of the product/apparatus of Group I, claims 1-22, Species Q, Figure 75 without traverse. Applicant agrees that it was appropriate to withdrawal the process claims 23-26 of Group II as originally presented. As noted by the Examiner in the Office Action mailed October 30, 2024 ("the Office Action", process claims may be considered for rejoinder if they include all the limitations of allowable product/apparatus claims. Claims 23-25 have been amended to depend from Claim 1 to maintain the possibility of rejoinder.

The Examiner has withdrawn Claims 3, 7, 10-14, and 21-22 as being drawn to a non-elected invention. Applicant respectfully submits that these claims are covered by or not excluded by the election of Species Q/FIG. 75 for the reasons described below.

As to Claim 3, the Office Action states that the limitation of a maximal width of the distal shaft portion of the temporary screw is less than the width of the distal post portion of the definitive screw having threads has not been disclosed or shown for the elected species of FIG. 75. Applicant respectfully disagrees for the reasons provided below.

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 fastener of FIG. 75 for side-by-side comparison.

Straumann USA Exhibit 1023



As shown in FIG. 9, the male definitive screw threads (callout 150) essentially fill the female implant abutment threads (callout 18). When engaged, the profile of the temporary fastener threading 40 fits within the profile of the implant 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. In certain embodiments, 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 above 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 size and pitch as the definitive screw male threading 150. Thus, as shown in FIG. 9, the male definitive screw threads 150 mateably, threadably engage the female implant abutment threads 18. That is, in the cross-

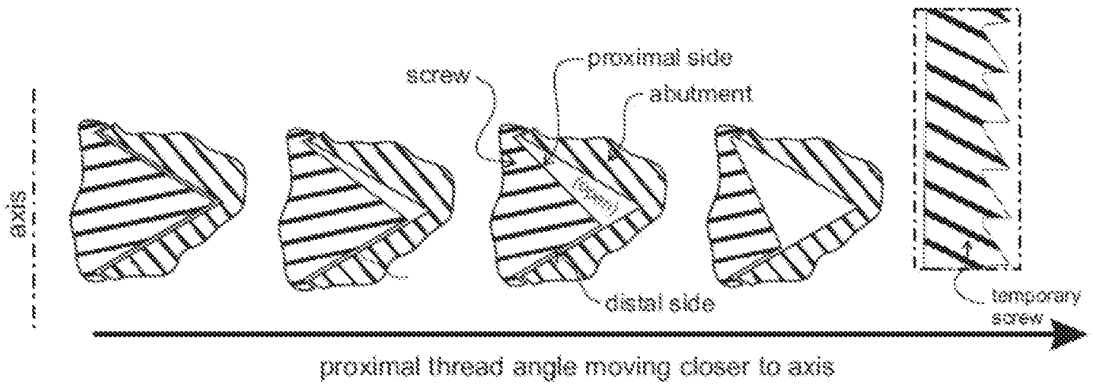
sectional view of FIG. 9, the crest of one thread essentially fills the root of the other thread and vice versa.

In contrast, the thread profile 40 of the temporary fastener of FIG. 75 is not the same as the illustrated profile (enlarged in box from FIG. 9 shown above) of the definitive screw threading. Both the definitive screw profile cross-section and the temporary fastener profile cross-section share essentially V-shaped profiles having straight line sides. However, the angles between sides are different. As shown in FIG. 75, the proximal side or flank of at least some of the respective threads of the temporary fastener (toward the head portion 42), labeled as feature 183, 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) 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 rotationally engaged, the profile of the temporary fastener threading 40 fits within and advances within the same abutment threading 18 as the definitive screw. Each complete revolution of the definitive screw 175 or the temporary fastener 190 when engaged in the implant abutment 8 results in an axial distance advancement equal to their shared thread pitch.

If the definitive screw male threading illustrated fills the female implant abutment threading, then the definitive screw represents a maximum threading material size and shape that can engage the female threading. (Practical parts tolerances can reduce the degree of fill and remove sharp vertexes from thread profiles. The magnitude of these effects is too small to invalidate the basic analysis for the significantly different thread profiles shown above. Their impact will be discussed later.)

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. The final illustration has a proximal side angle about the same as that of FIG. 75 excerpt provided. Changing an angle of the male thread profile does not change the pitch of the thread. That is, as the shape of the thread is altered by removing material, the number of crests per unit length is

preserved. The altered male thread will still longitudinally advance the same distance for the same angle of rotation of the screw since the thread pitch is preserved.



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 the axis with the increasingly smaller proximal angle. Since the width of the distal shaft portion of the temporary fastener is determined by twice the distance of this male thread vertex from the screw axis, the width of the screw becomes smaller as the proximal angle is reduced from the original angle of the female threading. This sequence represents the material removal in fabricating the shape of a temporary fastener with a smaller side profile proximal angle from a definitive screw. 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 and may be considered to be the minimum width of male threading having engagement. The widest male threading width possible is the width of threading of the definitive screw. Temporary fastener threading with a proximal side profile at an angle closer to the axis that engages the female implant abutment threading will have a width within these limits. 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

Straumann USA Exhibit 1023

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. The schematic illustration above includes sharp vertices for both the male and female threading which ignores tolerancing and the flattened profile shown in FIG. 9 or the ISO 68-1 standard basic metric thread screw profile. For relatively small proximal side angle changes towards the screw axis, it is possible that there is reduction in the axial extent of this flattened male thread crest without any change in screw width. When the angle change moves beyond the flattened male thread crest, the screw width will decrease as the angle increases. However, even the smallest angular change illustrated in the sequence above is sufficient to reduce the width of the definitive screw threading in FIG. 9 or ISO 68-1. The angle of the proximal flank of the temporary fastener thread profile in FIG. 75 is much closer to the screw axis than the smallest angle change illustrated above. As a result, tolerances and male thread profiles near the crest may be ignored for this width comparison of the definitive screw threading of FIG. 9 and the temporary fastener threading of FIG. 75. As a result of the open space from the different thread profile of the temporary fastener compared to the definitive screw in FIG. 9, the temporary fastener threading illustrated in FIG. 75 has a smaller radial extent or width than the definitive screw. For this reason, Applicant respectfully disagrees that Claim 3 should be withdrawn according to 37 CFR 1.142(b) as being drawn to a non-elected invention of FIG. 75 and requests that this claim be examined.

By the same reasoning regarding smaller widths of temporary fastener distal shaft portions being shown for the elected species for Claim 3, Applicant respectfully disagrees with the withdrawal of Claims 10 and 22 and requests that they be examined. Applicant also respectfully suggests that dependent Claims 11-13 which depend upon Claim 10 are also drawn to the elected invention of FIG. 75 and requests that they be examined.

Straumann USA Exhibit 1023

Claim 7 was withdrawn by the Examiner as being drawn to a non-elected species. Claim 7 includes the limitation of a portion of the shaft of the temporary fastener that has a smaller width than the distal shaft portion which is sized and configured for rotary engagement. The specification allows for the combination of various features of different embodiments:

> "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." (Kofford [0032])
>
> ---
>
> "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." (Kofford [0206])

The subject limitation of Claim 7 is described and shown for FIG. 67 (non-elected species I). This feature facilitates lateral movement during pick-up processing. It is not disclosed specifically for the elected species Q of FIG. 75, but is not excluded from being used with the elected species. As a result, Applicant requests rejoinder of Claim 7 if base Claim 1 is found patentable.

Claim 14 includes the limitation of the shaft of the temporary fastener has a portion located proximally of the distal portion comprising threads having a width smaller than the maximal width of the distal portion comprising threads. Claim 14 was withdrawn by the Examiner as a result of dependency on Claim 10. Claim 10 was interpreted as not being applicable to the elected species of FIG. 75, but Applicant has provided reasoning above on how

Straumann USA Exhibit 1023

Claim 10 reads on the elected species. However, Claim 14 also includes a similar limitation to that of Claim 7 which is not excluded from being used with the elected species. Applicant requests rejoinder of Claim 14 if base Claim 10 is found patentable.

Claim 21 includes the limitation of the male threading of the distal portion of the definitive screw has a greater engagement depth with the female threading of the implant abutment than the engagement depth of the temporary fastener and/or the male threading of the distal portion of the definitive screw has a longitudinal extent that is greater than a longitudinal extent of the distal shaft portion of the temporary fastener. This limitation is not specifically disclosed for the elected species of FIG. 75, but is not excluded from use with the elected species. This limitation is enabled by comparing the number of temporary fastener thread crests on post 101 of FIG. 34 (species D) to the number of definitive screw thread crests 150 that are engaged with implant abutment threading 18 in FIG. 9. Applicant requests rejoinder of Claim 21 if base Claim 15 is found patentable.

Originally filed Claims 23-26 were drawn to non-elected Group II, directed toward a method of installing a dental prosthesis. As noted by the Examiner in the Office Action, these may be considered for rejoinder if they include all the limitations of an allowable product/apparatus claim. Claims 23-25 have been amended to require the apparatus of Claim 1. Claim 25 includes a tool such as that of non-elected species related to FIG. 90 which is not precluded from use with the elected species of FIG. 75. Applicant requests rejoinder of Claims 23-25 if base Claim 1 is found patentable. Claim 26 is cancelled.

Claim Objections

Claim 17 was objected to because of informalities. Applicant appreciates the suggested amendments provided by the Examiner and has amended Claim 17 accordingly.

Straumann USA Exhibit 1023

Claim Rejections – 35 USC §112

Claims 6 and 16 were rejected due to uncertainty on "the axial release force" in these claims. Applicant has amended these claims to clarify this phrase to overcome the rejection.

Claim 19 was rejected due to uncertainty of the positioning of the definitive screw and coping. Applicant appreciates the specificity provided by the Examiner on how the claim would be interpreted for examination as written. This claim has been amended appropriately to overcome the rejection.

Claim Rejections – 35 USC §103

Claims 1-2, 4-6, 8-9, 15-17, and 19-20 were rejected under 35 U.S.C. 103 as being unpatentable over Aldecoa et al. (U.S. Pubs 2008/0227057 A1, hereinafter "Aledecoa") in view of Berrevoets et at (U.S. Patent No. 6,517,543 B1, hereinafter "Berrevoets"). Applicant respectfully disagrees.

Briefly, Aldecoa discloses a narrow dental implant, abutment and coping system for screw-attached dental prosthesis in which tightening a prosthesis retention screw fixes a gold cylinder in alignment to a threaded implant abutment assembly (Aldecoa FIG. 18). This corresponds to the basic functionality of the definitive prosthetic screw, coping and implant abutment, such as illustrated in FIG. 9 of the current disclosure. Aldecoa discloses an impression coping attached to a threaded implant abutment by tightening an impression coping screw (Aldecoa FIG. 22). This corresponds with the functionality of screw-attached pick-up coping systems using elongated impression screws for open-tray pick-up processing as described in the prior art discussion in [0008] of the current disclosure. Annotated figures of Aldecoa FIGs. and 8 included in the Office Action are reproduced below.

Straumann USA Exhibit 1023

Aldecoa stresses several mechanical relationships in the fitting of these parts together.

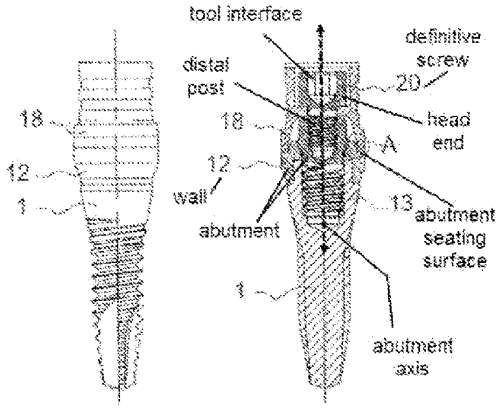


FIG. 18 (Aldecoa, annotated)

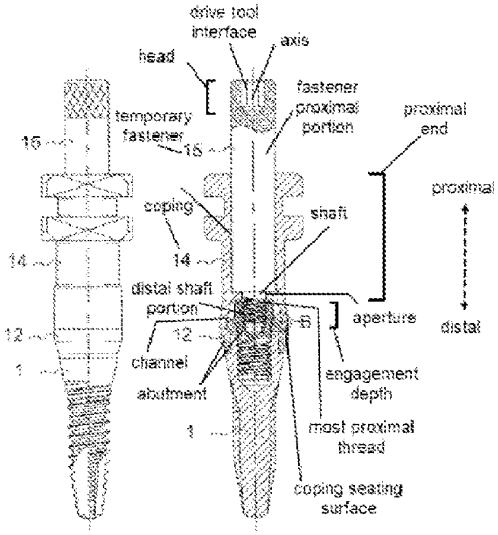


FIG. 22 (Aldecoa, annotated)

[0038] The screw with which the gold cylinder is secured to the aforementioned first screw is adapted so that it can be connected to said first screw. It presents a threaded part provided with between 4 and 6 turns of thread, with an internal diameter of between 1.0 and 1.2 mm and an external diameter of between 1.9 and 2.1 mm. (emphasis added)

[0039] The gold cylinder has a hole designed to house the upper part of the transephitelial abutment and the hexagonal protuberance of the first screw, said hole thus presenting a height of between 1.7 and 1.9 mm. Besides, the hole of the gold cylinder comprises a cylindrical part with a diameter of between 3.3 and 3.5 mm and a height of 0.4 mm. Said height is optimal for ensuring a correct connection/disconnection of the cylinder to/from the transephitelial abutment in the case of varied angulations. The height value is complemented by the fact that when the gold cylinder is connected to the transephitelial abutment, they come into contact with each other only in the cylindrical part of the hole of the gold cylinder, and not in the rest of said hole. (emphasis added).

[0040] Additionally, the invention discloses an transephitelial impression coping and a screw of the transephitelial impression coping, which are connected to the implant and the transephitelial abutment before making an impression of the patient's mouth. The

> impression coping comprises a hole in which the conical and cylindrical parts of the upper part of the transephitelial abutment are housed. One of the fundamental characteristics of the impression coping is that its hollowed interior enables angulation problems to be solved. This hole has the same characteristics as those of the hole of the gold cylinder, with the same measurements and also comprising a cylindrical part that is the only part of the hole that comes into contact with the transephitelial abutment when the transephitelial abutment and the impression coping are connected together. In turn, the screw of the impression coping features a threaded area that comprises between 4 and 6 turns of thread and that has an internal diameter of between 1.0 and 1.2 mm and an external diameter of between 1.9 and 2.1 mm. (Aldecoa col. 4A line 44 – col 4B line 14, emphasis added)

The gold cylinder (coping) 18 and the implant abutment assembly (12,13) are shown in more detail in FIGs. 16 and 17. The impression coping 14 and impression screw 15 are shown in more detail in FIGs. 20 and 21. An enlargement of the seating interfaces between copings and the implant abutment are shown in FIGs. 19 and 23. These are included below with annotations.

Straumann USA Exhibit 1023

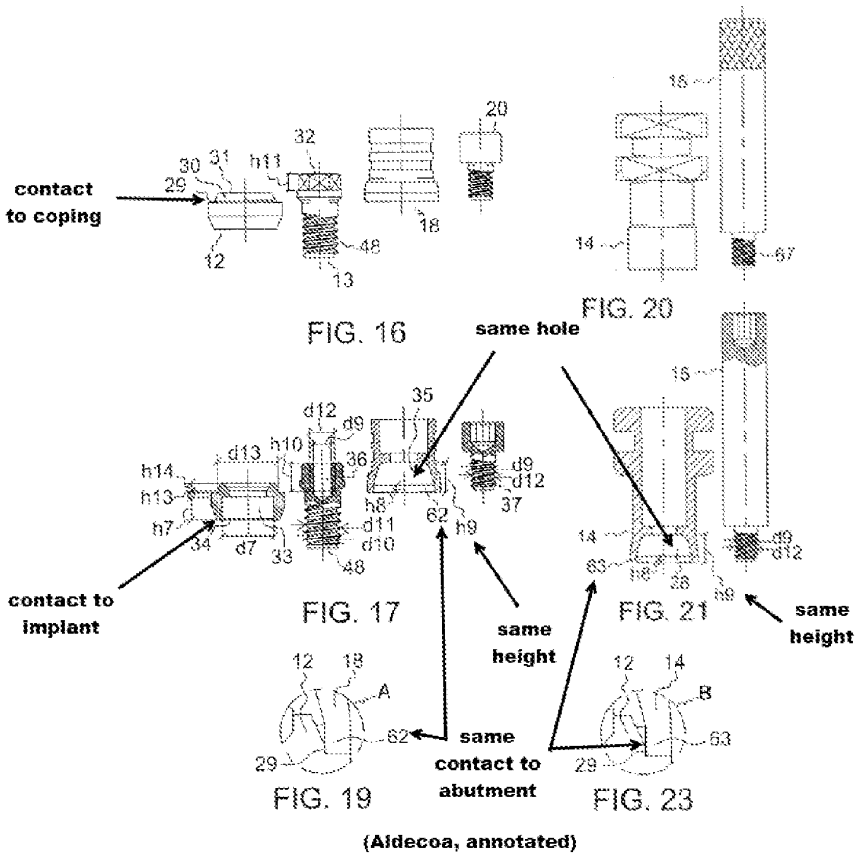


FIG. 16 FIG. 20 FIG. 17 FIG. 21 FIG. 19 FIG. 23

The enlargements of FIGs. 19 and 23 are described in the following excerpts:

[0098] The gold cylinder (18) presents a hole (35) designed to house the upper part (31) of the transephitelial abutment (12) and the hexagonal protuberance (32) of the first screw (13), for which reason said hole (35) presents a height (h9) of between 1.7 and 1.9 mm. Additionally, hole (35) comprises a cylindrical part (62) with a diameter of between 3.3 and 3.5 mm and a height (h8) of 0.4 mm. A correct connection/disconnection of the gold cylinder (18) to/from the transephitelial abutment (12) in the case of varied angulations is ensured thanks to two features: first, said height (h8) being optimal; second, the fact that when the gold cylinder (18) is connected to the transephitelial abutment (12), both come into contact with each other only in the cylindrical part (62) of the hole (35) of the gold cylinder (18), and not in the rest of said hole (35). This last

> characteristic is enlarged in FIG. 19, showing zone A of FIG. 18. It can be seen how the adjustment between the transephitelial abutment (12) and the gold cylinder (18) takes place only where its cylindrical parts (29, 62) come into contact and become adjusted. (Aldecoa col. 7B line 21 – line 39, emphasis added)

> [0101] FIG. 23 shows an enlarged view of zone B of FIG. 22, that is just as that shown in FIG. 19. In other words, the adjustment between the transephitelial abutment (12) and the transephitelial impression coping (14) is based on the contact and adjustment only of its cylindrical parts (29, 63). (Aldecoa col. 8A line 1 – line 5, emphasis added)

Contact is made between 29 and 62 and between 29 and 63 in the enlargements. Note that this implant abutment contact 29 extends axially over a small fraction of the cylindrical surface axial wall (62, 63) height (h8) at the bottom of the gold cylinder 18 and impression coping 14. These axial walls are intentionally small (0.4mm). The screw 20 in FIG. 18 and the screw 15 in FIG. 22 are rotationally engaged to force the copings 18 and 14 into proper alignment with the abutment 12 to ensure this contact.

The description of the threading portions (37, 67) of both the definitive screw 20 and the impression screw 15 are identical. These match the description for the female threading of the implant abutment.

> A blind threaded hole (36) opens up from this hexagonal protuberance (32), said blind threaded hole (36) containing between 4 and 6 turns of thread and having a height (h10) of between 1.55 and 2.15 mm. The blind threaded hole (36) also has an internal diameter (d9) of between 1.0 and 1.2 mm and an external diameter (d12) of between 1.9 and 2.1 mm. (Aldecoa col. 7B line 10 – line 16, emphasis added)

Aldecoa describes the precision desired in the fitting of the abutment onto the implant in the following section:

> Said hole (33) has cylindrical dimensions that fit the hexagonal protuberance (6) of the implant (1) but that allow the transephitelial abutment (12) to rotate in relation to the

> implant (1), the transephitelial abutment (12) remaining centred in relation to the implant (1) at all times. Furthermore, in order to help fit the transephitelial abutment (12) onto the implant (1), said hole (33) ends in its lowest area in a widened section (34), in the form of a bevel or rounded area. In the event that the widened section (34) is in the form of a rounded area, the radius of the rounded area is preferably 20 micron. (Aldecoa col. 7A line 50 – line 59, emphasis added)

Aldecoa recognizes that differences in the oral geometry of patients requires variation in the length of different system components.

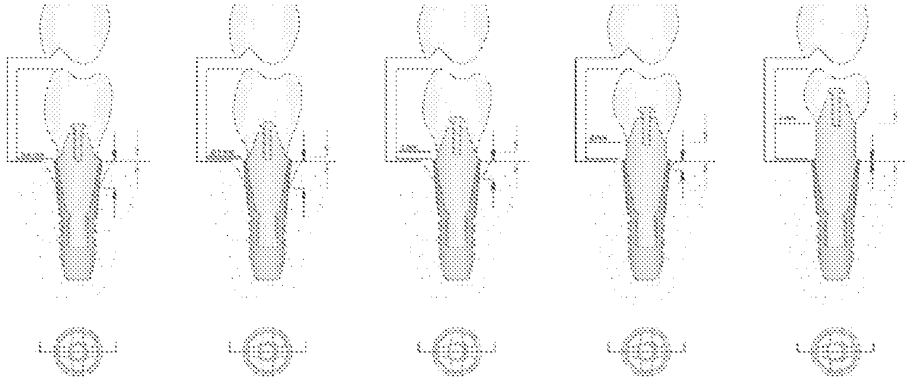
> The invention contemplates the provision of narrow dental implants of different lengths, preferably with implant lengths of between 7.0 and 20.0 mm (where the length is calculated as the sum of the lengths of all its parts except the hexagonal protuberance). Of course, the invention does not discard using other lengths not comprised in this preferred range. (Aldecoa col. 3 line 1 – line 7, emphasis added)

> Transephitelial abutments of different sizes are contemplated, although preferred transephitelial abutments will have a total height of 1.5, 2.0. 3.0, 4.0, 5.0, 5.5 or 6.0 mm. (Aldecoa col. 4 line 18 – line 21, emphasis added)

Changing the height of the abutment to accommodate different patients without changing the critical dimensions at the interface between the implant abutment and the implant and at the interface of the coping to the implant abutment was well known at the time of Aldecoa's disclosure. The following review article excerpt references a 2002 study and includes a diagram of different implant abutment heights—note that the geometry at both ends of the implant abutment is unchanged.

Collaert and De Bruyn (2002) proposed a relationship between prosthetic abutment height and 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

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.



greater influence on the MBL than did the internal or external implant connection (Galindo-Moreno et al., 2014b).

(Galindo-Moreno P, León-Cano A, Ortega-Oller I, Monje A, Suárez F, ÓValle F, Spinato S, Catena A. Prosthetic Abutment Height is a Key Factor in Peri-implant Marginal Bone Loss. J Dent Res. 2014 Jul;93(7 Suppl):80S-85S, page 80S col. 3 line 28 – page 81S col. 1 line 4 and FIG. 1)

The dental system of Aldecoa prescribes very specific mechanical interfaces for "correct connection" of the coping to the implant abutment as noted for FIG. 19. PHOSITA at the time of Aldecoa's disclosure would understand that precision machining and intimate contact between discrete components of dental implant assemblies is essential for adequate sealing to prevent microgaps. Microgaps have been known for decades to cause problems in harboring bacterial colonies inside implant/abutment assemblies.

Early bacterial colonization around implants by microorganisms associated with periodontitis was reported, and this colonization of implant surfaces and peri-implant tissues can occur within minutes after implant placement.

> 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 and set up a bacterial reservoir, resulting in an area of inflamed soft tissue facing the fixture–abutment junction. (Tesmer M, Wallet S, Koutouzis T, Lundgren T. Bacterial colonization of the dental implant fixture-abutment interface: an in vitro study. J Periodontol. 2009 Dec;80(12):1991-7., page 1991, col. 2, lines 12-26)

The motivation provided for combining the threading of the distal shaft portion of Berrevoets with the temporary screw of Aldecoa was "in order to allow the distal shaft portion 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."

Applicant respectfully disagrees. Dental professionals would avoid the potential for dental hardware misfit using a temporary fastener with the flexibility allegedly provided by Aldecoa modified by Berrevoets to prevent unnecessary gaps and to ensure proper alignment and positioning transfer for the definitive screw to provide long-term mechanical stability and avoid bacterial growth problems.

Applicant submits that the Action fails to make a prima facie case for obviousness of these claims.

The title of Berrevoets is "Bone connector system with anti-rotational feature". Prior art must be considered in its entirety according to MPEP 2141.02.

> This application relates to bone fixation and fusion systems, for example for the fusing together of toe bones or the like, by <u>firmly locking them in abutting relation</u> to permit good healing. (Berrevoets col. 1 lines 16-19 emphasis added)

The office action references FIG. 1 with annotations in the rejection. This is reproduced below.

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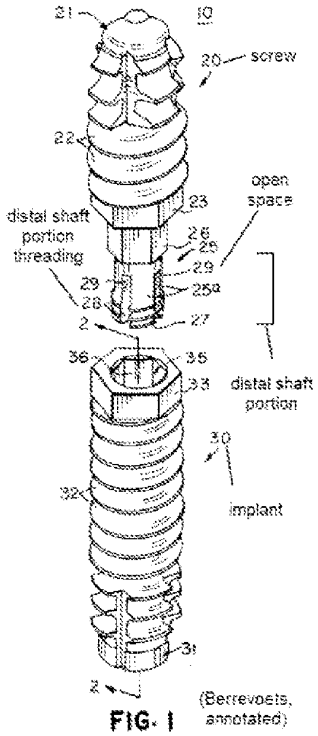


FIG. 1 (Berrevoets, annotated)

The final connection between the two parts is made by applying an axial force by inserting boss 25 into bore 36.

> The bore 35 is provided adjacent to an outer end with a peripheral engagement portion 36 which is non-circular in shape, being shaped and dimensioned for mating engagement with the engagement surface 26 of the connector member 20. (Berrevoets col. 3 line 18 – line 22 emphasis added)
>
> Then, the connector members 20 and 30 are secured together by inserting the boss 25 into the bore 35. This insertion may be accomplished without relative rotation of the parts, because the fingers 25a of the boss 25 have radial flexibility sufficient to permit them to be deflected inwardly so that the loops or convolutions of the external screw thread 28 on the boss 25 can be snapped past the loops or convolutions of the internal screw thread 38 in the bore 35 in a camming action. The boss 25 is in inserted in the bore 35 until the hexagonal engagement surface 26 enters the hexagonal engagement portion 36 of the bore 35. In this regard, it will be appreciated that, when the connector members 20 and 30

> are respectively inserted in the bones 12 and 14, they will be rotated to positions wherein the engagement surface 26 and the engagement portion 36 align with each other. It will also be appreciated that the boss 25 may be inserted into the bore 35 to a variety of different depths, limited by the axial extent of the hexagonal engagement portion 36 of the bore 35, so that the overall length of the bone connector system 10 may be finely adjustable. Once the engagement surface 26 is mateably engaged with the engagement portion 36, the connector members 20 and 30 are non-rotatable relative to each other. While the invention has been described with respect to fusing of toe bones or bone parts, it will be appreciated that the bones 12 and 14 may be other types of bones, such as finger bones, adjacent vertebrae or any other adjacent bones which need to be fused together. If only one of the connector members 20 and 30 is mounted in a bone, it will be appreciated that, in joining the other connector member to it, the other connector member may initially be rotated to screw the parts together until the engagement surface 26 is about to enter the engagement portion 36, whereupon continued joinder is accomplished by an axial movement. (Berrevoets col. 3 line 26 – col. 4 line 6 emphasis added)

An alternate embodiment is shown in FIG. 5 having a different matching shape of the boss and bore portions to increase retention.

> The angle β of these flanks is relatively large, preferably approximately 90° , so separation of the connector members 50 and 70 by pulling the boss 55 axially back out of the bore 75 will be extremely difficult, if not impossible, without damage to or destruction of the parts. (Berrevoets col. 5 line 18 – line 22 emphasis added)

From the descriptions above, Applicant respectfully submits that it is clear that the intended use of the Berrevoets connection is for a one-time connection preventing any movement to hold bones in a fixed position in order to fuse together. This emphasizes Berrevoets teaching is for a permanent connection by axial insertion, not the reversible screw connections essential for the intended use of the primary prior art of Aldecoa. The Office Action does not include an explanation as to why an inventor seeking to allow coping alignment and axial release with a

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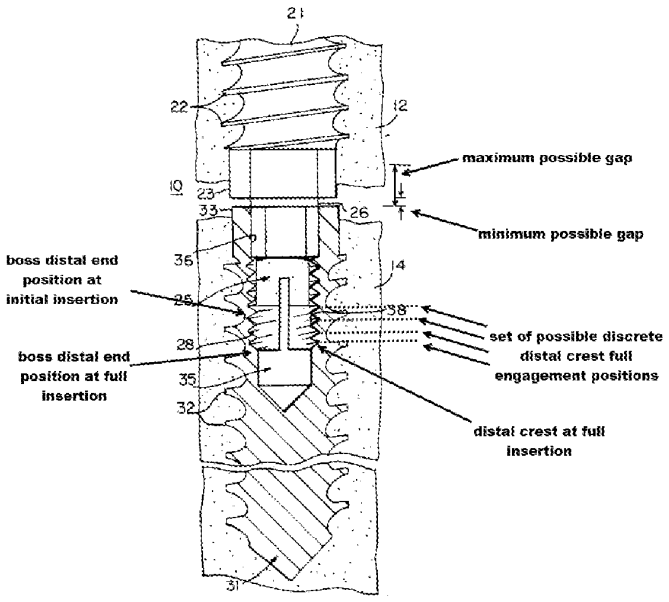
threaded fastener (in a closed tray process) would have looked to a reference for permanent fixation.

If not used to fuse two constrained bones together, an initial rotation may be used for relative axial alignment before engagement is accomplished by axial movement. A series of circular grooves could also be used for his female axial connection, but would be more difficult to machine.

> While the flanges on the boss 25 and the grooves in the bore 35 are respectively formed by helical threads 28 and 38, they could be discrete, annular flanges and grooves, but threads are less expensive to form. (Berrevoets col. 4 line 7 – line 10, emphasis added)

Berrevoets does not use relative rotation of parts to change length or apply an axial tension through a torquing action. Berrevoets teaches using axial motion alone to change engagement length.

FIG. 3 of Berrevoets shows the parts of FIG. 1 inserted to the maximum depth. This is annotated below. As illustrated, the boss 25 is fully inserted as far as possible into bore 35. All crests of the boss fully fill the matching grooves of the bore in this figure and there is no more distal open groove available. At this point the overall length will be the minimum possible of the two assembled parts. The annotations show the most distal end position of the boss and the most distal crest at full insertion. There is a minimum gap indicated separating the two parts between 23 and 33. When the boss is initially inserted into the bore, the overall length of the assembly will be longer. There is a maximum gap that is determined by the first position in which the crests of the boss become fully engaged in the grooves of the bore. There are discrete stable engagement positions between these extremes as indicated.



Berrevoets FIG. 3, annotated

This range of discrete stable engagement positions determines the set of length variation possibilities taught by Berrevoets. That is, as the boss is pushed into the bore, the crests will "be snapped past the loops or convolutions of the internal screw thread 38 in the bore 35 in a camming action" (Berrevoets col. 3 line 40 – line 41 emphasis added) to click into engagement position with the grooves of the bore. In particular, if a crest is positioned midway between any adjacent grooves, it is unstable and may relax back into the previously engaged groove or move forward if not constrained. When fully aligned with a groove, a crest is stable in that it is not subject to an axial force from misalignment. In addition, any axial compression in the connector coming from the resistance to insertion will also relax when the insertion force is removed. This is similar to the springing back of a piece of rubber noodle that is axially pressed or rotated into a smaller hole than the noodle's diameter which is impractical to reliably rotate to a torque for engagement depth.

As shown in the annotation of FIG. 3 above, Berrevoets' disclosure does "allow for the distal shaft portion to be installed at a variety of different depths" which is provided as a motivation to combine in the rejection provided by the Office Action. As shown in the annotations above, the distal shaft portion as illustrated in FIG. 3 is inserted to the maximum engagement depth into the abutment. At the maximum engagement depth, there is the minimum gap between the screw head and the abutment. If the screw is axially inserted to a lesser distance into the abutment, the gap at the screw head will be larger. The overall length and the screw head gap are adjustable in discrete steps by the "snapping action" of the connection. Looking at the figure, Applicant submits that it is clear that the size of these steps is equal to the pitch of the screw threading or the spacing of annular grooves. The overall length variation in steps will be determined by the total number of abutment female grooves minus the minimum number of male crests needed for engagement. This discrete stepping also means that due to mechanical tolerances in the parts, the uncertainty in final position could approach one step. That is, if the crests are not fully engaged by the axial insertion at a desired length, it could relax back to increase the gap at the previous discrete step position. If there is any compression in the shaft of the connector due to resistance to insertion, this will relax to increase the gap shown in the annotations.

Note also that the connection of Berrevoets is not torqued through rotary motion. It "may initially be rotated to screw the parts together until the engagement surface 26 is about to enter the engagement portion 36, whereupon continued joinder is accomplished by an axial movement." (Berrevoets col. 4 lines 4-6 emphasis added)

This initial connection helps align the two parts to align the anti-rotation capability included in the title of Berrevoets patent but does not allow them to be tightened by rotational torque to create a controllable force for intimate seating alignment. The intentional lack of rotation is beneficial in a bone fusion application, but it reduces axial length and connection force control. The specification of the pending patent application notes:

> 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. (Kofford [0204] lines 1-6)

The reason this is not preferred is the lack of continuous axial alignment positioning and contact force control from "snapping" in place leading to imprecise coping abutment contact and resulting microgaps.

Thus, one of ordinary skill in the art before the effective filing date of the claimed invention would not have been motivated to modify the temporary distal screw shaft portion of Aldecoa to allow for the distal shaft portion to be installed at a variety of different depths, so that the overall length of the system is adjustable to different patients and mouth locations. Aldecoa already describes how to do this without changing the critical mating interfaces of components in line with accepted industry practice.

For this application, variable length of the type provided by Berrevoets is not an advantage and would not be motivation to combine. There are two fundamental reasons for this:

> A coping held by the head of the screw on the implant abutment would not be held tightly against the implant abutment during the pick-up process. The longer the overall length of the assembly, the more uncertain is the position of the coping held between the screw head and the implant abutment. The coping's position when fixed in the prostheses will not be properly aligned for subsequent definitive screw attachment due to these potentially macroscopic gaps. Copings cannot be held in place by soft gum tissue.
>
> Even for a single design length assembly, the discrete steps in attachment length will not provide satisfactory seating and sealing of the coping on the abutment due to microscopic gaps for the pick-up process. Gaps in the pick-up process would be transferred to the definitive screw attachment.

The first reason above concerns essential mechanical functionality, and the second concerns functionality and mechanical precision discussed by Aldecoa above. Aldecoa already

has variable length with sealing, so a PHOSITA would not be motivated to look for variable length alternatives, particularly ones that introduce pain for patients by bearing on soft tissue, inaccurate transfer of misaligned coping pick-up and potential long-term problems from microgaps.

Aldecoa provides sufficient information to calculate a range of screw thread pitches of the definitive and temporary fasteners. The blind threaded hole 36 in FIG. 17 above is the implant abutment portion that receives these screws.

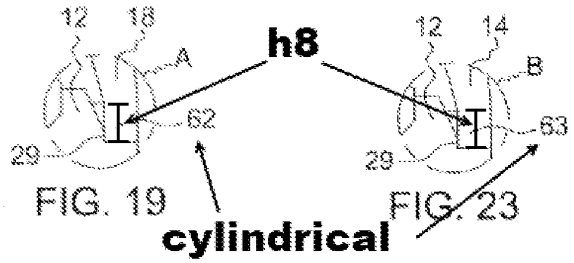
> A blind threaded hole (36) opens up from this hexagonal protuberance (32), said blind threaded hole (36) containing between 4 and 6 turns of thread and having a height (h10) of between 1.55 and 2.15 mm. (Aldecoa col. 7B line 10 – line 14, emphasis added)

Dividing the heights provided by the turns gives a range of pitches of about 0.3 to 0.5 mm. This is consistent with the following statement in ¶ [0134] of the present application:

"A typical screw thread size for appliances is m1.4 x 0.3."

A person having ordinary skill in the art of screw-attached dental prostheses would understand this sentence to refer to a screw with an ISO 68-1 Metric Thread Profile having a nominal outer diameter of 1.4 millimeters and a pitch of 0.3 millimeters.

This range of 0.3 to 0.5 mm represents the distance between stable engagement positions for axial engagement of Berrevoets system. This distance can be compared to the coping to



Aldecoa, annotated

implant abutment interface found in Aldecoa. Comparing this distance to the height of the cylindrical interface walls 62 and 63 at the bottom of the coping of height h8 shown in annotated enlargements FIGs. 19 and 23.

> Aldecoa describes the interface of FIG. 19 for the coping as follows:
>
> Additionally, hole (35) comprises a cylindrical part (62) with a diameter of between 3.3 and 3.5 mm and a height (h8) of 0.4 mm. A correct connection/disconnection of the gold cylinder (18) to/from the transephitelial abutment (12) in the case of varied angulations is ensured thanks to two features: first, said height (h8) being optimal; second, the fact that when the gold cylinder (18) is connected to the transephitelial abutment (12), both come into contact with each other only in the cylindrical part (62) of the hole (35) of the gold cylinder (18), and not in the rest of said hole (35). This last characteristic is enlarged in FIG. 19, showing zone A of FIG. 18. It can be seen how the adjustment between the transephitelial abutment (12) and the gold cylinder (18) takes place only where its cylindrical parts (29, 62) come into contact and become adjusted. (Aldecoa col. 7B line 25 – line 39, emphasis added)

The overall height h8 of the coping cylindrical wall provided by Aldecoa of 0.4 mm is within the range of the uncertainty in length of Berrevoets. That is, if the coping of Aldecoa is not positioned with an accuracy better than a fraction of this wall height, the coping may not be in a position to physically contact the implant abutment with a circular sealing contact. In a pick-up process, this could result in inaccurate positioning for definitive screw attachment. A PHOSITA would not be motivated to modify the screw of Aldecoa "in order to allow the distal shaft portion 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."

As a result, Applicant maintains that a prima facie case for obviousness of Claim 1 has not been made. As explained by the Federal Circuit with respect to reversal of a Patent

Trademark and Appeal Board (PTAB) IPR decision based on an alleged motivation to combine, a proper rejection using this basis of rejection must; (1) articulate a reason why a PHOSITA would combine prior art references; (2) have an adequate evidentiary basis for that finding; and (3) provide a satisfactory explanation for the motivation finding that includes an express and rational connection with the evidence presented. *See*, *In re: Nuvasive, Inc*., No. 15-1670 (Fed. Cir. 2016), emphasis added. Here, while the Office Action articulates a reason, the Office Action does not provide adequate evidentiary basis for that finding. This rejection does not satisfy the requirements for a *prima facie* rejection.

To advance prosecution, without acquiescing as to the art rejection of Claim 1, Applicant has amended Claim 1 to further recite "wherein the distal shaft portion of the temporary fastener is configured to rotate to couple to the implant abutment through the engagement depth and at a predetermined temporary holding torque whereby the temporary fastener holds the coping into alignment against the implant abutment."

Aldecoa does not provide any indication that the impression screw 15 should be applied differently than definitive screw 20 for fixing the copings 14 and 18 differently to the female threading 36 or have a different threading profile for permanent versus impression processing. The current application states:

> 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. (Kofford [0007] line 1 – line 6 emphasis added)
>
> 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. (Kofford [0015] line 8 – line 13 emphasis added)
>
> 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. (Kofford [0018] line 3 – line 5 emphasis added)

The present application provides examples of representative torques applied to temporary fasteners:

> 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. (Kofford [0134] line 6 – line 9 emphasis added)
>
> 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. (Kofford [0160] line 6 – line 8 emphasis added)

These torque values when converted to Ncm are equivalent to 0.17 Ncm and 1.3 Ncm, respectively. These predetermined temporary fastener torque values may be compared to the fixation torque values recommended by manufacturers or typically used by dental practitioners for definitive prosthetic screws.

> Bakaeen et al[9] have reported that when prosthetic gold screws were tightened to 10 N-cm according to the manufacturer's instructions… (WINKLER et al. "Implant screw mechanics and the settling effect: an overview", Journal of Oral Implantology 2003;29(5):242-5, page 244 col A line 15 – line 19)
>
> 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)… (ARMENTIA et al., "Fatigue performance of prosthetic

screws used in dental implant restorations: Rolled versus cut threads", The Journal of Prosthetic Dentistry, 126 (2021) 406-413, page 407 col B line 11- line 14)

Screws from different manufacturers with different mechanical properties from chemical compositions and design will have different torquing recommendations, but the range of 10 Ncm to 35 Ncm covers most definitive screws. These are significantly higher than the temporary fastener torques contemplated by embodiments of the pending application. Notably, alignment between the coping and the implant abutment from rotating the temporary fastener to make contact and to an engagement depth and applying a relatively small torque (smaller than the definitive screw torque) to provide a mounting pressure forcing the coping against the implant abutment seating surface provides a temporary alignment that Applicant submits is superior to the variable seating that would result from the combination of Aldecoa modified with the axial insertion relaxation characteristic of Berrevoets.

Applicant submits that even combined as alleged, the cited prior art fail to teach or suggest the claimed combination of elements recited by amended Claim 1.

In regard to Claims 2-6 and 8-9, Applicant respectfully submits that Claims 2-6 and 8-9 are patentable for depending from a patentable base claim, Claim 1. As noted earlier, as a result of dependency upon a patentable base claim, rejoinder of Claim 7 is requested upon the allowance of amended Claim 1.

In regard to Claims 3, 10, and 22, Applicant has described above why the elected species of FIG. 75 discloses a temporary fastener comprising a shaft having threads with a maximal width of the distal portion with the threads smaller than a maximal width of the distal post portion of the definitive screw with the threads and has requested this claim be examined. Although these claims were not examined in the Office Action, Applicant respectfully submits that this feature is not obvious in the combination of Aldecoa and Berrevoets. This analysis is provided in the interest of compact prosecution.

Aldecoa describes the threading of the definitive screw and the impression screw as follows:

> The screw with which the gold cylinder is secured to the aforementioned first screw is adapted so that it can be connected to said first screw. It presents a threaded part provided with between 4 and 6 turns of thread, with an internal diameter of between 1.0 and 1.2 mm and an external diameter of between 1.9 and 2.1 mm. (Aldecoa col. 4A line 44 – line 50, emphasis added)
>
> Additionally, the invention discloses an transephitelial impression coping and a screw of the transephitelial impression coping, which are connected to the implant and the transephitelial abutment before making an impression of the patient's mouth…In turn, the screw of the impression coping features a threaded area that comprises between 4 and 6 turns of thread and that has an internal diameter of between 1.0 and 1.2 mm and an external diameter of between 1.9 and 2.1 mm. (Aldecoa col. 4A line 64 – col 4B line 14, emphasis added)

The description of the threading of the two screws of Aldecoa is the same. The blind threaded hole 36 in FIG. 17 above is the implant abutment portion that receives these screws.

> A blind threaded hole (36) opens up from this hexagonal protuberance (32), said blind threaded hole (36) containing between 4 and 6 turns of thread and having a height (h10) of between 1.55 and 2.15 mm. The blind threaded hole (36) also has an internal diameter (d9) of between 1.0 and 1.2 mm and an external diameter (d12) of between 1.9 and 2.1 mm. (Aldecoa col. 7B line 10 – line 14, emphasis added)

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In Aldecoa, the description of the dimensions of the female threading of the implant abutment matches the male threading of what has been identified as the definitive screw and the temporary fastener. Berrevoets does not provide important dimensions like Aldecoa. Two different full connector engagements are provided by Berrevoets, FIG. 3 and FIG. 5, reproduced below. Note that the crests of the boss match and fully fill the grooves of the bore in both figures like the definitive screw in the implant abutment of Kofford discussed above. Berrevoets does not suggest mixing shapes or reducing the width of the crests of the boss.

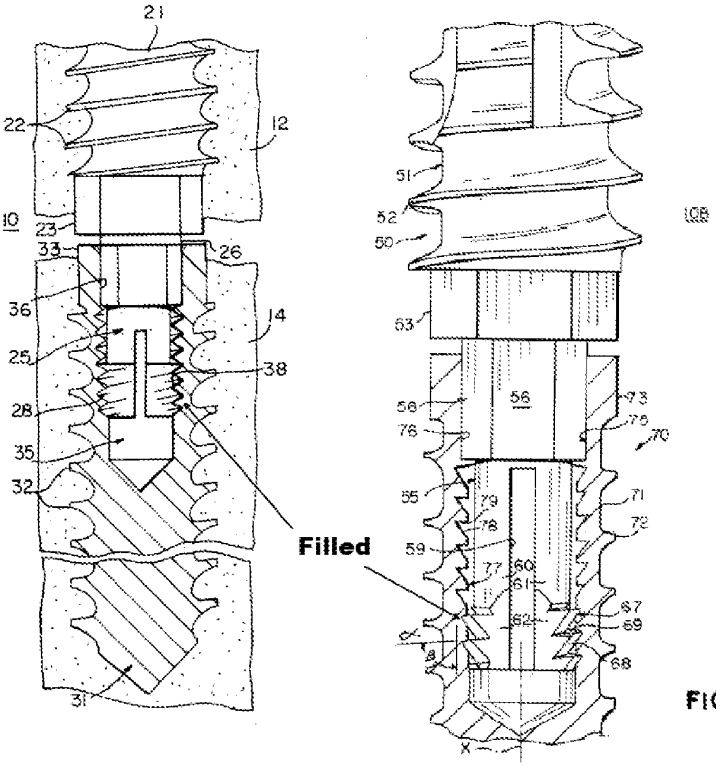


FIG. 3 FIG. 5

Berrevoets, annotated

At least for this reasoning, Applicant respectfully submits that the dental system of Claim 3 "wherein a maximal width of the distal post portion of the definitive screw having threads is larger than the female thread minor diameter of the implant abutment threads, and wherein a maximal width of the distal shaft portion of the temporary screw sized and configured to make contact with the implant abutment threads is smaller than the width of the distal post portion of the definitive screw having threads" is not obvious from the combination of Aldecoa in view of

Berrevoets cited for other claims in the Office Action. Applicant respectfully submits that Claim 3 is patentable for this reason alone in addition to being dependent upon allowable Claim 1. At least for this reasoning, Applicant respectfully submits that the dental system of Claim 10 comprising a temporary fastener comprising "a shaft coupled to or integral with the head configured to extend through the central aperture of the coping, wherein the shaft has a distal portion having an outer surface comprising threads, wherein a maximal width of the distal portion with the threads is smaller than a maximal width of the distal post portion of the definitive screw with the threads" is not obvious from the combination of Aldecoa in view of Berrevoets cited for other claims in the Office Action. As Claims 11-13 depend upon Claim 10 and apply to the elected species, Applicant respectfully submits that they are patentable if Claim 10 is allowed.

At least for this reasoning, Applicant respectfully submits that the dental system of Claim 22 "wherein a maximum width of the distal portion of the definitive screw comprising the male threading is greater than a maximum width of the distal shaft portion of the temporary fastener configured to rotatably engage the implant abutment female threading" applies to the elected species and is not obvious from the combination of Aldecoa in view of Berrevoets cited for other claims in the Office Action.

Claim 15 was rejected under 35 U.S.C. 103 as being unpatentable over Aldecoa in view of Berrevoets. Applicant respectfully disagrees. The motivation to have modified the distal shaft portion of the temporary fastener of Aldecoa by specifying it is sized and configured so that it does not continuously make contact with the threading as taught by Berrevoets was "in order to allow the distal shaft portion 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."

This is the same reasoning as Claim 1 discussed above. For the same reasons as above, Applicant respectfully suggests that someone of ordinary skill in the art before the date of the claimed invention would not have been motivated to modify the distal shaft portion of the

temporary fastener of Aldecoa by the teaching of Berrevoets. As a result, Applicant maintains that a prima facie case for obviousness of Claim 15 has not been made.

Without acquiescing as to the art rejection of Claim 15, Applicant has amended Claim 15 to further recite "wherein the shaft of the temporary fastener is sized to extend through the aperture of the coping, and wherein the distal shaft portion of the temporary fastener is configured to rotatably engage the female threading of the implant abutment to an engagement depth and with a predetermined temporary holding torque sufficient to hold the coping seating surface aligned with and against [[adjacent]] the implant abutment seating surface".

As discussed above regarding Claim 1, alignment between the coping and the implant abutment from rotating the temporary fastener to make contact and then applying even a relatively small torque to provide a predetermined mounting pressure positively forces them together to provide a temporary alignment that is superior to the uncertain seating resulting from the combination of Aldecoa with the axial insertion relaxation characteristic of Berrevoets.

Applicant submits that even combined as alleged, the cited prior art fail to teach or suggest the claimed combination of elements recited by amended Claim 15. Applicant respectfully submits that Claim 15 is patentable over the cited prior art.

Applicant respectfully submits that Claims 16-20, and 22 dependent from Claim 15 are patentable over the cited prior art for at least depending from a patentable base claim.

As to withdrawn Claim 21, Applicant requests rejoinder upon the allowance of Claim 15 upon which it depends.

As to Claim 22, Applicant has shown above for the discussion of Claims 3 and 10 how the elected species discloses "a maximum width of the distal portion of the definitive screw comprising the male threading is greater than a maximum width of the distal shaft portion of the temporary fastener configured to rotatably engage the implant abutment female threading". Applicant submits Claim 22 is patentable over the cited prior art for the same reasoning as for Claims 3 and 10 in addition to being allowable for depending upon Claim 15.

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Claims 23-26 were withdrawn as being directed to a non-elected Group II, directed toward a method of installing a dental prosthesis. Claim 23 has been amended to require all the limitations of product/apparatus Claim 1. Original Claims 24-25 require the limitations of Claim 1 through dependency. Claim 26 has been cancelled.

New claims

New method Claim 27 also is dependent upon Claim 23. It provides for "wherein the temporary fastener threads are attached to the implant abutment threads at a predetermined temporary holding torque, wherein the definitive screw is attached to the implant abutment threads at a predetermined definitive fixation torque, and wherein the predetermined definitive fixation torque is greater than the predetermined temporary holding torque" as discussed above.

Applicant respectfully requests rejoinder of Claims 23-25, and 27 upon allowance of Claim 1.

New Claim 28 is dependent upon Claim 1 and provides for "wherein the predetermined definitive fixation torque is greater than the predetermined temporary holding torque."

New Claim 29 is dependent upon Claim 10 and provides for "wherein the definitive screw is configured for rotational engagement with the implant abutment threads to a predetermined definitive fixation torque that exceeds the predetermined temporary holding torque."

New Claim 30 is dependent upon Claim 10 and provides for "wherein the threads of the distal post portion having threads of the definitive screw comprise a helical thread portion characterized by a first thread pitch, wherein the threads of the distal shaft portion of the temporary fastener comprise a helical thread portion characterized by a second thread pitch, and wherein the second thread pitch is essentially the same as the first thread pitch."

Applicant submits that Claims 28-30 are enabled by the specification of the present application and not disclosed by the combination of the prior art cited in the Office Action. Applicant submits they are at least allowable for being dependent upon allowable Claims 1 and 10, respectively.

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Previously 26 claims were pending in the Application including 4 independent claims. As a result of this amendment, 29 claims are pending including 3 independent claims.

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/

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ENTITY: ☐ LARGE ☑ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $40 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $ 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).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

AMENDMENT	03/29/2025	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 29	Minus	** 26	= 3		x $ 80 =	240
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 4	= 0		x $ 240 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	240

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $ 0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $ 0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/ANGELONA D JONES/
*** 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 number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. 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 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.

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

NOTICE OF ALLOWANCE AND FEE(S) DUE

112823 7590 07/09/2025

Daniel J Whittle
1229 Modoc Dr
Bellingham, WA 98229

EXAMINER	
HUYNH, COURTNEY NGUYEN	
ART UNIT	PAPER NUMBER
3772	

DATE MAILED: 07/09/2025

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/827,656	09/06/2024	Brandon Dale Kofford	SDC013	2702

TITLE OF INVENTION: Screw-attached Pick-up Dental Coping System and Methods

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$516	$0.00	$0.00	$516	10/09/2025

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 40% the amount of undiscounted fees, and micro entity fees are 20% the amount of undiscounted fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PTOL-85 (Rev. 11/23)

Straumann USA Exhibit 1023

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via the USPTO patent electronic filing system.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications. **Because electronic patent issuance may occur shortly after issue fee payment, any desired continuing application should preferably be filed prior to payment of this issue fee in order not to jeopardize copendency.**

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

112823 7590 07/09/2025

Daniel J Whittle
1229 Modoc Dr
Bellingham, WA 98229

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via the USPTO patent electronic filing system or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/827,656	09/06/2024	Brandon Dale Kofford	SDC013	2702

TITLE OF INVENTION: Screw-attached Pick-up Dental Coping System and Methods

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$516	$0.00	$0.00	$516	10/09/2025

EXAMINER	ART UNIT	CLASS-SUBCLASS
HUYNH, COURTNEY NGUYEN	3772	433-173000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/AIA/122 or PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/AIA/47 or PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑ Issue Fee ❑ Publication Fee (if required)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via the USPTO patent electronic filing system ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

❑ Applicant asserting small entity status. See 37 CFR 1.27

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

❑ Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

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 NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/827,656	09/06/2024	Brandon Dale Kofford	SDC013	2702

112823 7590 07/09/2025

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1229 Modoc Dr
Bellingham, WA 98229

EXAMINER	
HUYNH, COURTNEY NGUYEN	
ART UNIT	PAPER NUMBER
3772	

DATE MAILED: 07/09/2025

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. 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 30 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, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. 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.

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. The United States Patent and Trademark Office (USPTO) collects the information in this record under authority of 35 U.S.C. 2. The USPTO's system of records is used to manage all applicant and owner information including name, citizenship, residence, post office address, and other information with respect to inventors and their legal representatives pertaining to the applicant's/owner's activities in connection with the invention for which a patent is sought or has been granted. The applicable Privacy Act System of Records Notice for the information collected in this form is COMMERCE/PAT-TM-7 Patent Application Files, available in the Federal Register at 78 FR 19243 (March 29, 2013).
https://www.govinfo.gov/content/pkg/FR-2013-03-29/pdf/2013-07341.pdf

Routine uses of the information in this record may include disclosure to:

1) law enforcement, in the event that the system of records indicates a violation or potential violation of law;
2) a federal, state, local, or international agency, in response to its request;
3) a contractor of the USPTO having need for the information in order to perform a contract;
4) the Department of Justice for determination of whether the Freedom of Information Act (FOIA) requires disclosure of the record;
5) a Member of Congress submitting a request involving an individual to whom the record pertains, when the individual has requested the Member's assistance with respect to the subject matter of the record;
6) a court, magistrate, or administrative tribunal, in the course of presenting evidence, including disclosures to opposing counsel in the course of settlement negotiations;
7) the Administrator, General Services Administration (GSA), or their designee, during an inspection of records conducted by GSA under authority of 44 U.S.C. 2904 and 2906, in accordance with the GSA regulations and any other relevant (i.e., GSA or Commerce) directive, where such disclosure shall not be used to make determinations about individuals;
8) 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));
9) the Office of Personnel Management (OPM) for personnel research purposes; and
10) the Office of Management and Budget (OMB) for legislative coordination and clearance.

If you do not furnish the information requested on this form, the USPTO may not be able to process and/or examine your submission, which may result in termination of proceedings, abandonment of the application, and/or expiration of the patent.

Notice of Allowability	Application No. 18/827,656	Applicant(s) Kofford et al.	
	Examiner COURTNEY N HUYNH	Art Unit 3772	AIA (First Inventor to File) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to the response filed 39 March 2025.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ 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.

3. ☑ The allowed claim(s) is/are 1-25 and 27-30 . As a result of the allowed claim(s), 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.**

4. ☐ 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)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☑ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/COURTNEY N HUYNH/ Examiner, Art Unit 3772	/ERIC J ROSEN/ Supervisory Patent Examiner, Art Unit 3772

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. Claims 1-2, 4-6, 8-9, 15-20, and 28 are directed to an allowable product. Pursuant to the procedures set forth in MPEP § 821.04(B), claim 23, directed to the process of making or using an allowable product, previously withdrawn from consideration as a result of a restriction requirement, claims 3, 7, 10-14, 21-25, 27, 29-30 are hereby rejoined and fully examined for patentability under 37 CFR 1.104.

Because all claims previously withdrawn from consideration under 37 CFR 1.142 have been rejoined, **the restriction requirement as set forth in the Office action mailed on 30 October 2024 is hereby withdrawn**. In view of the withdrawal of the restriction requirement as to the rejoined inventions, applicant(s) are advised that if any claim presented in a divisional application is anticipated by, or includes all the limitations of, a claim that is allowable in the present application, such claim may be subject to provisional statutory and/or nonstatutory double patenting rejections over the claims of the instant application. Once the restriction requirement is withdrawn, the provisions of 35 U.S.C. 121 are no longer applicable. See *In re Ziegler*, 443 F.2d 1211, 1215, 170 USPQ 129, 131-32 (CCPA 1971). See also MPEP § 804.01.

Information Disclosure Statement

3. In the IDS of 11 January 2025, the Foreign patent with Citation No. 13 and applicant/patentee of cited document Toboso Romon with the patent number 0985209 appears to have an incorrect patent number, as the attached copy of the Foreign patent with applicant/patentee of cited document Toboso Romon has the patent number

0**6**85209.

Reasons for Allowance

1. Claims 1-25 and 27-30 are allowed.

2. The following is an examiner's statement of reasons for allowance:

4. In regard to independent claim 1, the prior art of record fails to teach or fairly suggest a dental system comprising: a coping having a proximal end; an implant abutment having threads extending distally; a definitive screw having a distal post portion having threads configured for securing the coping to the implant abutment threads through rotary engagement to a predetermined definitive fixation torque; and a temporary fastener comprising a shaft comprising a distal shaft portion sized and configured for rotary engagement with the implant abutment threads, wherein the distal shaft portion is configured to engage the implant abutment threads through an engagement depth of the implant abutment threads and is configured so that a portion of the temporary fastener holds the coping in alignment with the implant abutment, wherein the temporary fastener distal shaft portion is configured to rotate to couple to the implant abutment through the engagement depth and to a predetermined temporary holding torque whereby the temporary fastener holds the coping into alignment against the implant abutment, wherein the temporary fastener is configured to release at least a portion of the temporary fastener and the coping from the implant abutment as a unit when an axial release force is applied in a proximal direction to the temporary fastener, wherein the temporary fastener distal shaft portion is sized and configured to make contact with the implant abutment threads over a first thread contact area to hold the coping against the implant abutment, and the definitive screw distal post portion is sized and configured to make contact with the implant abutment threads over a second thread contact area to hold the coping against the implant abutment, and wherein the first thread contact area is less than the second thread contact area, and in combination with other limitations set forth in the claim.

3. In regard to independent claim 10, the prior art of record fails to teach or fairly suggest a dental system comprising: an implant abutment having threads; a coping having a proximal end with a central aperture merging into a wider central open channel; a definitive screw having a distal post portion having threads configured for securing the coping to the implant abutment threads, wherein the distal post portion having threads is sized to extend through the coping aperture into the central open channel; a temporary fastener comprising: a head with a proximal end having a drive tool interface configured for rotating the temporary fastener to a predetermined temporary holding torque, and a shaft coupled to or integral with the head and configured to extend through the central aperture of the coping, wherein the shaft has a distal portion having an outer surface comprising threads, wherein a maximal width of the distal portion with the threads is smaller than a maximal width of the distal post portion of the definitive screw with the threads, wherein the temporary fastener is configured so that, in position and engaged with the threads of the implant abutment at the predetermined temporary holding torque, the temporary fastener cooperates with the coping to align the coping into position with the implant abutment, and wherein the temporary fastener is configured so that in response to application of an axial release force above a predefined value in a proximal direction, the coping and at least a portion of the temporary fastener are released as a unit from the implant abutment without rotation, and in combination with other limitations set forth in the claim.

4. In regard to independent claim 15, the prior art of record fails to teach or fairly suggest a dental system comprising: a coping having a proximal end with an aperture and a distal end with a coping seating surface; and an implant abutment comprising: female threading, wherein the female threading resides proximate a proximal end of the implant abutment and extends distally thereof, and an outer wall surrounding the female threading, the outer wall comprising an implant abutment seating surface; a temporary fastener comprising: a proximal portion with a width larger than the coping aperture; and a shaft comprising a distal shaft portion configured for rotary engagement with the implant abutment female threading, wherein the shaft of the

temporary fastener is sized to extend through the coping aperture, and wherein the temporary fastener distal shaft portion is configured to rotatably engage the implant abutment female threading at a predetermined temporary holding torque to an engagement depth sufficient to hold the coping seating surface aligned with and against the implant abutment seating surface, and wherein the temporary fastener is configured to release at least a portion of the temporary fastener and the coping from the implant abutment as a unit as a result of an axial release force in a proximal direction, and wherein the temporary fastener distal shaft portion discontinuously engages the female threading of the implant abutment between a most distal engagement position and a proximate end of the implant abutment female threading and in combination with other limitations set forth in the claim.

5. The closest prior art is the following:

6. Aldecoa (US 20080227057 A1) discloses a dental system comprising: a coping having a proximal end; an implant abutment having threads extending distally; a definitive screw a distal post portion having threads capable of securing the coping to the threads of the implant abutment through rotary engagement; and a temporary fastener comprising a shaft comprising a distal shaft portion sized and capable of rotary engagement with the implant abutment threads, wherein the shaft of the temporary fastener is capable of extending through the aperture of the coping and the distal shaft portion is capable of engaging the implant abutment threads through an engagement depth measured axially between a most distal contact position with the implant abutment threads and the most proximal thread position of the implant abutment threads and is configured so that a portion of the temporary fastener holds the coping in alignment with the implant abutment prior to attachment of the definitive screw, wherein the temporary fastener is capable of releasing at least a portion of the temporary fastener and the coping from the implant abutment as a unit when an axial release force is applied in a proximal direction to the temporary fastener, wherein the distal shaft portion of the temporary fastener is sized and capable of making contact with the implant abutment threads over a first thread

contact area to hold the coping against the implant abutment, wherein, after removal of the temporary fastener, the distal post portion of the definitive screw is sized and capable of making contact with the implant abutment threads over a second thread contact area to hold the coping against the implant abutment. Aldecoa is silent to a predetermined definitive fixation torque, wherein the first thread contact area is less than the second thread contact area, wherein the distal shaft portion of the temporary fastener is configured to rotate to couple to the implant abutment through the engagement depth and to a predetermined temporary holding torque whereby the temporary fastener holds the coping into alignment against the implant abutment, wherein the distal shaft portion of the temporary fastener is configured to have discontinuous contact with the implant abutment threads throughout the engagement depth.

7. Berrevoets (US 6517543 B1) discloses an implant having threads and a screw having a distal shaft portion wherein the distal shaft portion is sized and configured to make contact with the threads over a first thread contact area, wherein the distal shaft portion is capable of having discontinuous contact with the threads throughout an engagement depth. Berrevoets is silent to a dental system comprising a coping and a temporary fastener, wherein the distal shaft portion of the temporary fastener is configured to rotate to couple to the implant abutment through the engagement depth and to a predetermined temporary holding torque.

8. Klardie (US 20030211445 A1) discloses a dental system wherein a component of the dental pick-up process system is polymeric. Klardie is silent to wherein the distal shaft portion of the temporary fastener is configured to rotate to couple to the implant abutment through the engagement depth and to a predetermined temporary holding torque whereby the temporary fastener holds the coping into alignment against the implant abutment, wherein the distal shaft portion of the temporary fastener is configured to have discontinuous contact with the implant abutment threads throughout the engagement depth.

9. Derey (WO 2013030839 A1) discloses a distal shaft portion sized and configured to make contact with threads over a first thread contact area where the apparatus is capable of

releasing at least a portion of the fastener when an axial release force is applied in a proximal direction to the fastener. Derey is silent to wherein the distal shaft portion of the temporary fastener is configured to rotate to couple to the implant abutment through the engagement depth and to a predetermined temporary holding torque whereby the temporary fastener holds the coping into alignment against the implant abutment, wherein the distal shaft portion of the temporary fastener is configured to have discontinuous contact with the implant abutment threads throughout the engagement depth.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

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, Eric Rosen can be reached at (571) 270-7855. 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:

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/COURTNEY N HUYNH/
Examiner, Art Unit 3772

/ERIC J ROSEN/
Supervisory Patent Examiner, Art Unit 3772

Notice of References Cited	Application/Control No. 18/827,656	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 YYYY-MM-DD	Name	CPC Classification	US Classification
*	A	US-6517543-B1	2003-02-11	Berrevoets; Greg A.	A61B17/68	411/419
*	B	US-20030211445-A1	2003-11-13	Klardie, Michael R.	A61C8/0001	433/172
*	C	US-20080227057-A1	2008-09-18	Anitua Aldecoa; Eduardo	A61C8/0001	433/174
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date YYYY-MM-DD	Country	Name	CPC Classification
	N	WO-2013030839-A1	2013-03-07	WO	DEREY OFER	A61C8/0057
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title, Date, Publisher, Edition or Volume, Pertinent Pages
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in YYYY-MM-DD format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/827,656	Kofford et al.
	Examiner	Art Unit
	COURTNEY N HUYNH	3772

CPC - Searched*		
Symbol	**Date**	**Examiner**
A61C8/0001	10/24/2024	CNH
A61C8/0001	06/20/2025	CNH

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**
411	419, 414	10/24/2024	CNH
411	419, 414	06/20/2025	CNH

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/827,656	Kofford et al.
	Examiner	Art Unit
	COURTNEY N HUYNH	3772

Search Notes		
Search Notes	**Date**	**Examiner**
Search patent family in Global Dossier, Espacenet, Patentscope	10/22/2024	CNH
Inventor name search in PE2E and PDP/DAV	10/22/2024	CNH
PE2E- CPC and text search	10/22/2024	CNH
PE2E- CPC and text search -A61C2201/00, A61C2008/0084, A61C13/225,2255,265,2656,275, A61C11/088, F16B37/14, F16B35/06,041, F16B33/02, A61C8/0066,0068,00,005,008,0007,0082,0087,0066,0074,0078, USPC 411/396,397,411, 433/173 - see attached search history	10/24/2024	CNH
Search in IP.com	10/24/2024	CNH
Updated patent family search in Global Dossier, Espacenet, Patentscope	06/20/2025	CNH
Updated Inventor name search in PE2E and PDP/DAV	06/20/2025	CNH
PE2E- CPC and text search -A61C2201/00, A61C2008/0084, A61C13/225,2255,265,2656,275, A61C11/088, F16B37/14, F16B35/06,041, F16B33/02, A61C8/0066,0068,00,005,008,0007,0082,0087,0066,0074,0078, USPC 411/396,397,411, 433/173 - see attached search history	06/20/2025	CNH
PGR2025-00054 Reviewed Petition for Post Grant Review of U.S. Patent No. 12,156,781, Papers 1-5, Exhibits 1001-1021	06/20/2025	CNH
IPR2025-00956 Reviewed Petition for Inter Partes Review of U.S. Patent No. 11,937,992, Papers 1-6, Exhibits 1001-1027	06/20/2025	CNH
Consulted with Primary Examiner Ed Moran regarding allowability	06/25/2025	CNH

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
	See attached search notes	06/25/2025	CNH

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/827,656	Kofford et al.
	Examiner	**Art Unit**
	COURTNEY N HUYNH	3772

CPC						
Symbol					**Type**	**Version**
A61C	/	8	/	0068	F	2013-01-01
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A61C	/	8	/	0001	I	2013-01-01
A61C	/	8	/	0078	I	2013-01-01
A61C	/	8	/	0074	I	2013-01-01
A61C	/	2201	/	00	A	2013-01-01
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CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
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(Assistant Examiner)	(Date)	29	
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	COURTNEY N HUYNH	3772

INTERNATIONAL CLASSIFICATION					
CLAIMED					
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NON-CLAIMED					
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US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

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(Primary Examiner)	(Date)	1	75

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	18/827,656	Kofford et al.
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☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	10	23	19	14	28	21								
2	2	11	24	20	29	29	22								
3	3	12	25	21	30										
4	4	13	27	22	15										
5	5	14	28	23	16										
6	6	15	10	24	17										
7	7	16	11	25	18										
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9	9	18	13	27	20										

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RULE			

APPLICANTS

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CONTINUING DATA

This application is a CON of 18424696 01/26/2024 PAT 12156781

This application is a CON of 18328730 06/03/2023 PAT 11937992

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This application has PRO of 62742942 10/09/2018

FOREIGN APPLICATIONS

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[Continued on nextpage]

(54) **Title:** A METHOD FOR ATTACHING AND DETACHING DENTAL CONSTRUCTIONS AND A DEVICE THEREOF

(57) **Abstract:** The present invention relates to a flexible holding device for connecting a construction to an implant in a ridge of a mouth comprising: (a) a head for holding the construction from the inside of said construction; (b) more than one leg for holding the internal thread of said implant from the inside; and (c) a body, attached to said head and attached to said legs, for attaching said construe - tion to said implant.

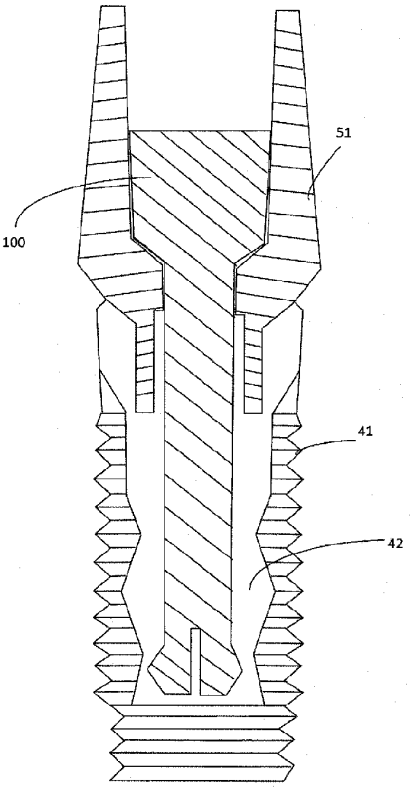


Fig. 6

WO 2013/030839 A1

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SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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A METHOD FOR ATTACHING AND DETACHING DENTAL CONSTRUCTIONS AND A DEVICE THEREOF

Field of the Invention

The present invention relates to the field of dentistry. More particularly, the invention relates to dental restoration systems.

Background of the Invention

The loss of permanent teeth creates the need for a denture, i.e. a dental restoration system, to replace the natural teeth. Conventional dentures rest on implants which are implanted in the gingival tissue of the ridge of the mouth. These dentures, where possible, may also be anchored to existing natural teeth. In cases where all of the teeth have been extracted from either the upper or lower jaw, or both, a full denture can be utilized.

One type of denture, used today, utilizes a prosthetic tooth, which connects to an abutment on a dental implant. After a dental implant is implanted, in the gingival tissue of the ridge, a construction, e.g. an abutment, is attached on top of the implant. The abutment is a metal cylinder that the prosthetic tooth is built onto. There are many types of abutments and they vary in length, width, angle, shape and color. On the abutment a prosthetic tooth is fastened and it should look, and function, just like any other tooth in the mouth.

A patient with a multiple implant restoration goes through the same process and the final prosthetic teeth can vary between multiple single teeth or several teeth connected by a bridge or even a partial fixed denture, based on the planning of the dentist and the needs of the patient.

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Another type of denture used today, utilizes a construction such as an overdenture bar. This dental reconstruction system comprises a conventional acrylic overdenture retained by suitable attachments, such as clips, to an implant supported cast bar otherwise known as an overdenture bar, e.g. a Dolder bar. The overdenture bar is attached to the implants, in the patient's ridge, using designated screws.

In any case, after fitting the construction(s) on the implant(s), the dentist is required to take an impression of the ridge, with the attached construction(s). The impression is taken by filling a standard form with a solidifying substance such as polyvinylsiloxane and pressing it inside the mouth of the patient. Once this is completed the dentist will send the impression out to the laboratory for building a model of the mouth. In the laboratory, after receiving the impression, a solidifying material, such as plaster of Paris, is then poured into the impression for creating the model. The model is then separated from the impression. Thus, the model sculpts the patient's alveolar, ridge, implants and the construction. However, since the model is used to create a prosthetic for a patient, the model has to be accurate enough in order to provide that the created prosthetic has a precise fit to the ridge of the patient. An inaccurate prosthetic can cause subsequent inconvenience, or even injuries, to the patient. Finally, the created prosthetic is seated in the mouth of the patient. However, this kind of procedure is time consuming, problematic, and may create inconveniences to the patient.

US 6,488,501 discloses a transfer jig for implant, in a dental surgery, which uses a tubular post and a tubular coping which is attachable and detachable from the post by a snap-fit attachment. The described post has a hexagonal portion for location in a hexagonal socket in an implant and a frusto-conical portion which is a seat for the coping. The coping has a diametrically opposed pair of slots in its end that seats on the post to receive a diametrically opposed pair of pins with a snap-fit, the pins being mounted on the post so that the coping is precisely located relative to the hexagonal portions. The coping also has apertures formed through its tubular wall through which dental

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impression material is forced to form structural links when a dental impression is taken. Nevertheless, the described mechanism is complicated and requires a number of specially-designed tight-fitting parts for applying the described method.

It would therefore be desired to propose a system void of the problems discussed above.

Summary of the Invention

It is an object of the present invention to provide a method for creating an accurate impression of the mouth ridge.

It is another object of the present invention to provide a method for creating comfortable and accurate dental restorations.

It is still another object of the present invention to provide a method for attaching and detaching dental constructions for measurements.

It is still another object of the present invention to provide a flexible device, for firmly holding a dental restoration construction in its place, over the implants in the ridge, and for allowing an easy detachment of the construction from the implants in the ridge when detaching the impression.

It is still another object of the present invention to provide a flexible device for firmly holding the dental restoration construction in its place over the implants in the ridge, even if the implants are not parallel to one another.

Other objects and advantages of the invention will become apparent as the description proceeds.

The present invention relates to a method for attaching and detaching a construction to an implant in a ridge of a mouth comprising the steps of: (a) inserting at least one flexible holding device into said construction, where said flexible holding device head is held inside said construction; (b) attaching said construction to said implant by fastening the legs of said holding device into said implant; and (c) detaching said construction by applying a pulling force, in an opposite direction to the implant, on said construction.

Preferably, the detaching is done by applying a pulling force on the form with an impression which engulfs the construction.

In one embodiment, the method is used for connecting and detaching an abutment.

In one embodiment, the method is used for connecting and detaching an overdenture bar. In one embodiment, the method is used for connecting the overdenture bar to a number of implants which are not parallel to one another in the ridge of the mouth.

The present invention also relates to a flexible holding device for connecting a construction to an implant in a ridge of a mouth comprising: (a) a head for holding the construction from the inside of said construction; (b) more than one leg for holding the internal thread of said implant from the inside; and (c) a body, attached to said head and attached to said legs, for attaching said construction to said implant.

Preferably, the device is made of Polyacetal.

Preferably, the device has two legs.

In one embodiment, the device is used instead of a transfer.

Brief Description of the Drawings

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Some embodiments of the invention are 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 embodiments of the invention. In this regard, the description and the drawings make apparent to those skilled in the art how embodiments of the invention may be practiced.

In the drawings:

- Fig. 1 is a schematic diagram of the different dental parts of a prior art prosthetic tooth.
- Fig. 2 is a diagram of a mouth of a patient with an abutment secured, in a prior art fashion, in the mouth.
- Fig. 3 is a diagram of an impression taken, in a prior art fashion, in a mouth of a patient.
- Fig. 4 is a schematic diagram of an overdenture bar above the ridge of a mouth, before attaching the overdenture bar to the dental implant analogues, according to a prior art process.
- Fig. 5 is a schematic diagram of a flexible holding device, according to an embodiment of the invention.
- Fig. 6 is a schematic diagram of the flexible holding device attaching a construction to a typical dental implant analogue, according to an embodiment of the invention.

Detailed Description of Preferred Embodiments

The term "ridge" refers to the alveolar ridge which comprises gingival tissue and contains the sockets, i.e. alveoli, of the teeth.

The terms "implant analogue(s)" and "implant(s)" are used throughout the description intermittingly and are meant to include any device which is inserted into the ridge for supporting a denture.

The terms "bar" "cast bar", "denture bar", "overdenture bar", "Perci bar", and "Dolder bar" are used throughout the description intermittingly and are meant to include any bar which supports the prosthetic overdenture.

The term "construction(s)" is meant to include any dental device which can be attached to the implant, such as, an abutment, a bridge, or an overdenture bar.

The term "denture(s)" is meant to include any prosthetic device for replacing the natural teeth, such as a prosthetic tooth or a prosthetic overdenture.

Fig. 1 is a schematic diagram of the different dental parts of a prior art prosthetic tooth. At first a dental implant 41 is implanted in the gingival tissue of the ridge 44. Then, an abutment 31 is fastened to the implant 41 using a prior art screw 200. After the abutment 31 has been attached and fastened to the implant 41, the dentist is required to take an impression of the ridge and the attached abutment 31, for casting a model of the ridge with its attached abutment 31. Since the model is used afterwards to create the prosthetic tooth 30, the model needs to be as accurate as possible. Any inaccuracy in the model may result in an inaccuracy of the prosthetic tooth which in turn may cause inconvenience to the patient. In some of the cases, due to the inaccuracies, the dentist may be required to amend and smooth the tooth in the mouth of the patient, after attaching the prosthetic tooth, a feat which is not easy to the dentist and inconvenient to the patient.

Fig. 2 is a diagram of a mouth of a patient with an abutment secured, in a prior art fashion, in the mouth. The abutment 31, as describe in relations to fig. 1, is secured, using a screw, prior to taking an impression. The abutment 31, of the prior art, is designed to be

taller than the other teeth of the mouth in order to allow the dentist to unfasten the screw of the abutment 31 and pull the abutment 31.

Fig. 3 is a diagram of an impression taken, in a prior art fashion, in a mouth of a patient. In the prior art process, a hole is cut in the standard form 33 in order to equip the abutment 31. The abutment 31, as described in relations to Fig. 1 and 2, sticks out from the ridge and therefore the standard form 33 is first cut in order to take the impression with the abutment 31. The cut is made in the corresponding place of abutment 31 and then the form 33 is filled with the solidifying material such as such as a combination of Zhermack's Hydrorise silicon and Hydroise putty. This cut form 33, with its solidifying material, is then pressed onto the ridge of the patient and held in place until it solidifies. After which the dentist first unscrews the abutment 31 and then lifts the form and sends it the lab for casting a model of the ridge.

Fig. 4 is a schematic diagram of an overdenture bar above the ridge of a mouth, before attaching the overdenture bar to the dental implant analogues, according to a prior art process. The overdenture bar 20 comprises poles, such as pole 21, connected between them by interconnecting bars, such as bar 22. The overdenture bar 20 may have any number of poles, and interconnecting bars, according to the needs of the patient and his ridge. In this embodiment the ridge 44 has four implants, such as implant 41, for supporting the overdenture bar 20, which has four poles. The poles of the overdenture bar 20 are attached to the implants by screws such as screw 200. The top part of the screw 200 which is inside the pole 21 is depicted in silhouette. In the prior art process, after attaching the overdenture bar with screws to the implants of the ridge an impression is taken.

However, since the construction is fastened by screws to the implants, any impression of the ridge and the construction is distorted by the construction. For example when the impression material, which may be any solidifying material such as a combination of Zhermack's Hydrorise silicon and Hydroise putty, is first poured on the ridge and the

construction, the material flows around the construction, and in the spaces between the construction and the ridge, and solidifies. This however makes the task, of removing the impression intact and undamaged, time consuming and fairly difficult, since the construction is fastened with screws to the abutments of the implants in the ridge. In many cases it is almost impossible to detach the impression from the mouth of the patient without it being ripped or torn, due to the fact that the construction is secured to the ridge of the mouth and due to the fact that there is a space between the construction and the ridge and due to the fact that the impression material has solidified. In many cases the ripped and distorted impression hinders the ability to create an accurate model of the mouth of the patient which in turn may prevent the lab from creating a fitting prosthetic, whether the prosthetic is a prosthetic tooth or a prosthetic overdenture, or any other kind of construction.

Therefore, a device is proposed which can hold the construction in place when pouring the impression material, over the construction and ridge, and can easily detach from the ridge, when the impression solidifies, thus allowing the impression to keep engulfing the construction when lifted. Thus the impression, which includes the construction, may be used for casting the model of the ridge of the patient, after which the construction may be extracted from the impression and fastened to the model, effectively creating a more accurate model of the ridge and the construction of the patient. These flexible devices are designed to be used instead of the screws used for attaching the construction to the implants.

The described device may also spare the use of a transfer since it may be used as a transfer, even in cases where the implants are not implemented in the ridge in parallel.

Fig. 5 is a schematic diagram of a flexible holding device, according to an embodiment of the invention. The device 100 is designed as a flexible holding device having a head 11, a body 12, and two extended legs 13. The body 12 is designed to be slimmer than the head 11, in other words, the body 12 is designed to have a shorter circumference than the head

11. A typical dental construction is designed with a tunnel running through its axis, where the end of the tunnel is slightly slimmer in order to hold the head of the screw. The device 100 is designed to fit in a construction, instead of the designated screw. Thus the device 100 may be inserted into the construction, legs 13 first - head 11 last, and pushed to the limit, i.e. until the head 11 gets stuck close to the end of the construction, above the lower opening, and the legs 13 dangle out. The legs 13, which are designed for insertion and gripping, can then be inserted into the inside of an implant, where the legs 13 can grip the internal thread of the implant from within, due to the legs 13 elastic repelling force which repels the legs form one another. Typically, the construction can be attached to the implant by applying force on the top of the head 11 of device 100, which is in the tunnel of the construction, to force the legs 13 into the implant and gripping it from within, while the lower opening of the tunnel of the construction is on, or substantially close, to the implant.

Likewise the construction may be detached by pulling the construction from the ridge, thus forcing the legs 13 of device 100 to surrender their grip on the inner thread of the implant. The holding device 100 may be composed of Polyacetal or any other flexible and rigid material such as Toarplast POM.

In one embodiment, the wider part of legs 13, as described in relations to Fig 5, is designed as having an angle which sticks out of the device. In another embodiment the legs 13 may have their wider part rounded. Other embodiments are possible as well as long as the legs are designed to grip the internal thread of the implant from within.

In one of the embodiments, the device 100, as described in relations to Fig. 5, has more than two legs. There may be any number of legs to device 100 as long as they are designed to grip the internal thread of the implant from within.

In one embodiment the device 100, as described in relations to Fig. 5, is 10mm long, where the head 11 may be 2mm long, the body 12 may be 7mm long, and the legs 13

wider part may be 1mm long. In this embodiment the head 11 may have a diameter of 2mm, the body 12 may have a diameter of 1mm, and the legs 13 wider part may have a diameter of 2mm, when they are not pressed together. In one embodiment the legs 13 may be 2mm long. Other embodiments and other measurements are possible as well.

Fig. 6 is a schematic diagram of the flexible holding device attaching a construction to a typical dental implant analogue, according to an embodiment of the invention. The device 100, as described in relations to Fig. 5, is inserted in the construction 51 and into the implant 41. The head of device 100 secures the construction 51, and the legs, of device 100, grip the internal thread 42 of the implant 41 from within. Thus the construction 51 is held by device 100 to the implants 41. However, if an upper pulling force is applied to the construction 51, the legs of device 100 will surrender their grip and the construction 51 can be easily detached from the implant 41.

Due to the features of the described flexible holding device, it may be used for holding the constructions over implants where the implants are not parallel. Meaning, that even in cases where a number of implants are implanted in the ridge of the patient at different angles, the construction(s) may be held by a number of the described flexible devices, e.g. one for each implant, to the implants, and pulled away when necessary.

The device of the present invention is beneficial to the dental surgeon who performs the implant surgery, the dental laboratory which creates the dentures, and the patient who receives the denture. The dental surgeon can make an impression much easier since the construction is removed from the ridge along with the impression. With a securely attached construction, difficulty always is encountered with the impression material becoming lodged between the construction and the sutured gingival tissue. Since the construction is removed with the impression, no such difficulties are encountered taking the impression. Next, the dental laboratory can fashion a denture which is much tighter fitting since the construction is present in the laboratory during the denture manufacturing operation. This results in a better fit of the denture for the patient. Installation of the

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construction, for usage, is accomplished easily by attaching the construction extracted from the impression into the implants in the ridge, prior to the patient being finally fitted with the custom-manufactured denture prosthetic.

While some embodiments of the invention have been described by way of illustration, it will be apparent that the invention can be carried into practice with many modifications, variations and adaptations, and with the use of numerous equivalents or alternative solutions that are within the scope of persons skilled in the art, without departing from the invention or exceeding the scope of claims.

Claims

1. A flexible holding device for connecting a construction to an implant in a ridge of a mouth comprising:
    a. a head for holding the construction from the inside of said construction;
    b. more than one leg for holding the internal thread of said implant from the inside; and
    c. a body, attached to said head and attached to said legs, for attaching said construction to said implant.
2. A device according to claim 1, where the device is made of Polyacetal.
3. A device according to claim 1, where the device has two legs.
4. A device according to claim 1, where the device is used for connecting an abutment.
5. A device according to claim 1, where the device is used for connecting an overdenture bar.
6. A device according to claim 5, where the device is used for connecting the overdenture bar to a number of implants which are not parallel to one another in the ridge of the mouth.
7. A device according to claim 1, where the device is used instead of a transfer.
8. A method for attaching and detaching a construction to an implant in a ridge of a mouth comprising the steps of:
    a. inserting at least one flexible holding device into said construction, where said flexible holding device head is held inside said construction;
    b. attaching said construction to said implant by fastening the legs of said holding device into said implant; and
    c. detaching said construction by applying a pulling force, in an opposite direction to the implant, on said construction.
9. A method according to claim 8, where the detaching is done by applying a pulling force on the form with an impression which engulfs the construction.

Straumann USA Exhibit 1023

10. A method according to claim 8, where the method is used for connecting and detaching an abutment.

11. A method according to claim 8, where the method is used for connecting and detaching an overdenture bar.

12. A method according to claim 11, where the method is used for connecting the overdenture bar to a number of implants which are not parallel to one another in the ridge of the mouth.

Straumann USA Exhibit 1023

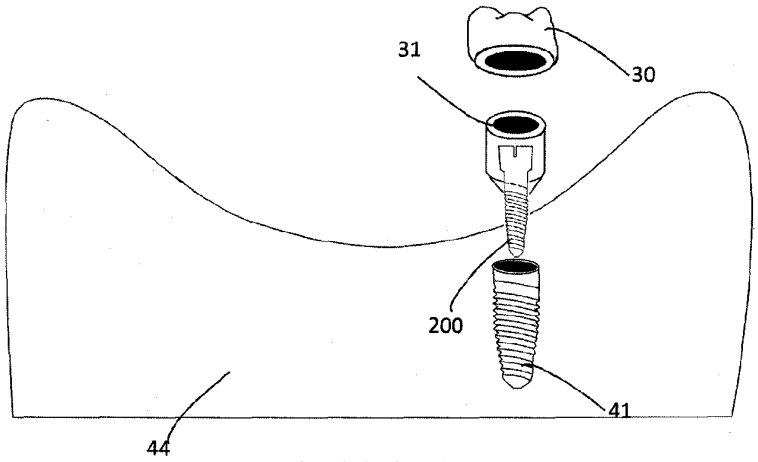


Fig. 1 (Prior Art)

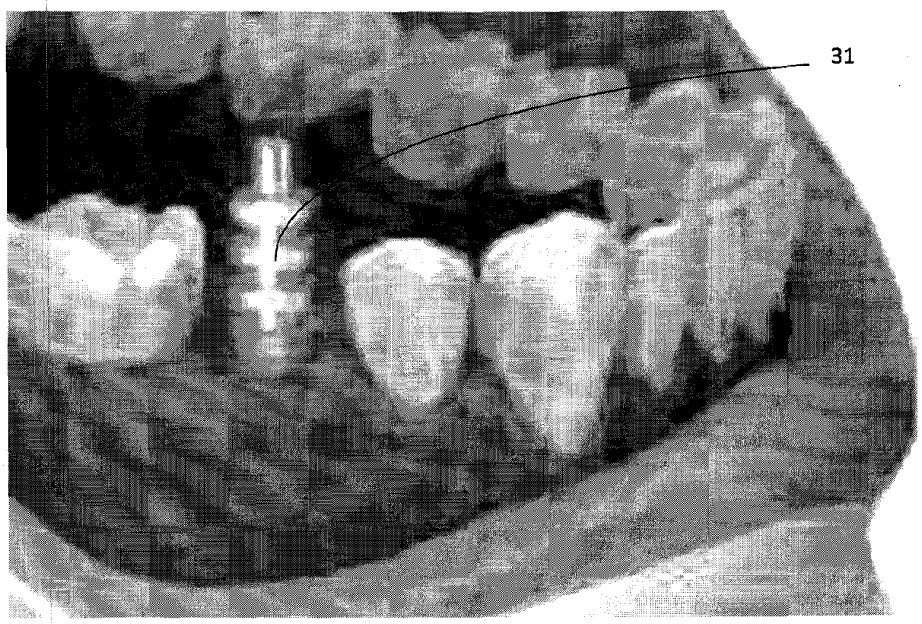


Fig 2 (Prior Art)

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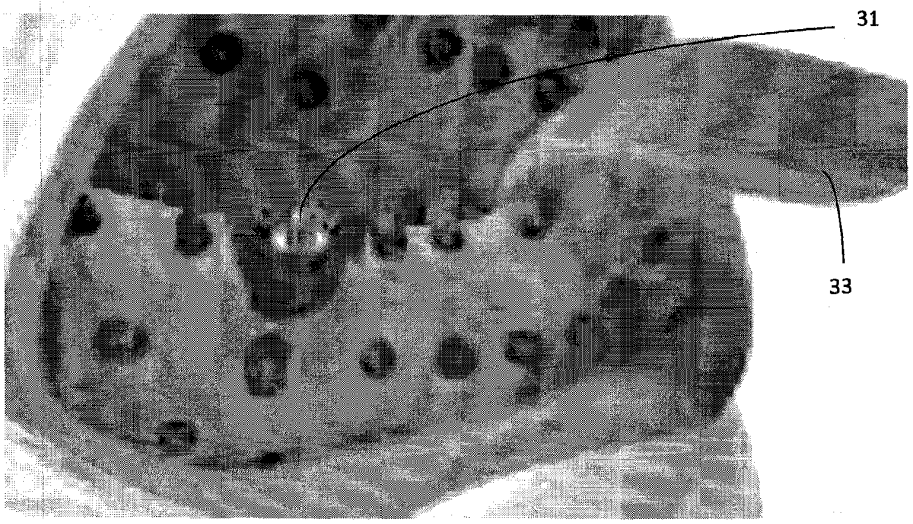


Fig. 3 (Prior Art)

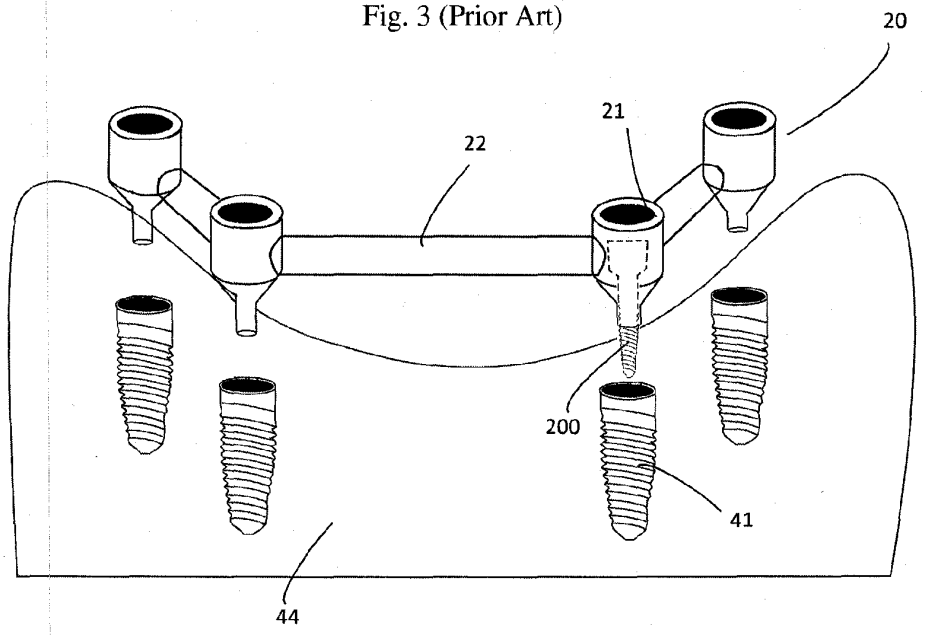


Fig. 4 (Prior Art)

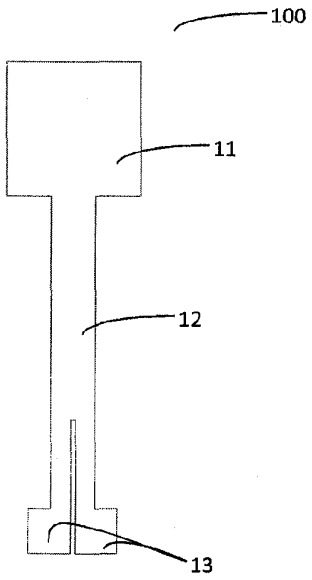


Fig. 5

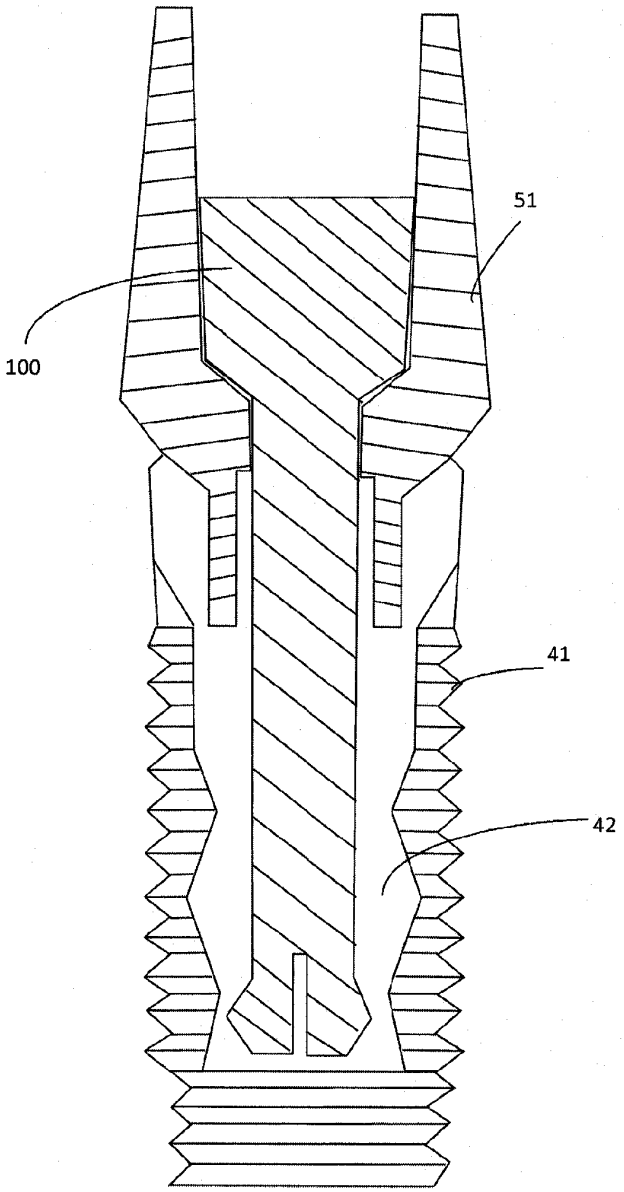


Fig. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/IL2012/050339

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	WO 2011/036268 A2 (DENTALPOINT AG [CH]; BOLLETER PHILIP [CH]; CHIUSOLO NICOLA [CH]) 31 March 2011 (2011-03-31) figure 16(b) page 16, line 5 - page 18, line 22 -----	1-8, 10-12
X	EP 0 685 209 A1 (TOBOSO RAMON JES S [ES]) 6 December 1995 (1995-12-06) figures 1,10 column 6, line 16 - column 9, line 19 -----	1-12

☐ Further documents are listed in the continuation of Box C.

☒ 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
13 December 2012	21/12/2012

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

Form PCT/ISA/210 (second sheet) (April 2005)

Straumann USA Exhibit 1023

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IL2012/050339

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2011036268 A2	31-03-2011	CH 701860 A1	31-03-2011
		EP 2480161 A2	01-08-2012
		WO 2011036268 A2	31-03-2011
EP 0685209 A1	06-12-1995	EP 0685209 A1	06-12-1995
		WO 9515128 A1	08-06-1995

Form PCT/ISA/210 (patent family annex) (April 2005)

Straumann USA Exhibit 1023

PE2E SEARCH - Search History (Prior Art)

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		AND (coping AND abutment AND screw)	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)				
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		OR bridge OR crown))					
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			JPO; DERWENT; IBM_TDB)				

PE2E SEARCH - Search History (Interference)

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N3	96	(dental OR orthodontic) AND coping AND (aperture OR opening OR hole OR gap) AND (implant$5) AND (abutment) AND (releas$5) AND ((thread OR threading OR screw) WITH (shaft OR pole OR rod OR column))	(US-PGPUB; USPAT)	OR	ON	ON	2025/06/25 04:54 PM

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	18827656
Filing Date	2024-09-06
First Named Inventor	Kofford, Brandon Dale
Art Unit	3772
Examiner Name	Huynh, Courtney Nguyen
Attorney Docket Number	SDC013

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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
	1	3115804	A	1963-12-31	Johnson	
	2	5135395	A	1992-08-04	Marlin	
	3	5213502	A	1993-05-25	Daftary	
	4	5238405	A	1993-08-24	Marlin	
	5	5350302	A	1994-09-27	Marlin	
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	7	5622500	A	1997-04-22	Niznick	
	8	5681167	A	1997-10-28	Lazarof	

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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
	1	20020039718	A1	2002-04-04	Kwan	
	2	20040121287	A1	2004-06-24	Morgan	
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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]
	1	2014153487	WO	A2	2014-09-25	Poovey		☐
	2	2016012581	WO	A1	2016-01-28	Bernhard et al.		☐

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	3	2018029650	WO	A1	2018-02-15	Samsfort et al.		☐
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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]
	1	MCGLUMPHY et al., "The combination Implant Crown: A Cement- and Screw-Retained Restoration", Compend Contin Educ Dent, Feb. 1992, pp. 34, 36,38, 40-42, Vol. XIII, No. 1.	☐
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EXAMINER SIGNATURE

Examiner Signature	/COURTNEY N HUYNH/	Date Considered	06/20/2025

*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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	Examiner Name	Huynh, Courtney Nguyen
	Attorney Docket Number	SDC013

CERTIFICATION STATEMENT

Please see 37 CFR 1.97(e) 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.

☒ A certification statement is not submitted herewith.

FEE

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

COPIES

☒ An identification of an earlier application pursuant to 37 CFR 1.98 (d) (1) is attached.

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)	2025-01-11
Name/Print	Daniel John Whittle	Registration Number	54,537

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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ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/827,656	**09/22/2025 09:58:24 PM Z ET**	**SDC013**

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 #	2702	FILED BY	Daniel Whittle
PATENT CENTER #	72406692	FILING DATE	09/06/2024
CUSTOMER #	112823	FIRST NAMED INVENTOR	Brandon Dale Kofford
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	-

Documents

TOTAL DOCUMENTS: 10

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
SDC013_RCE_IDS_Statement_SEP2025.pdf	2	Miscellaneous Incoming Letter	62 KB
sb0008c.pdf	4	Assertion regarding Information Disclosure Statement (IDS) Size Fee (SB/08C)	326 KB
Changing_trends_in_implant_designs_A_review.pdf	7	Non Patent Literature	1402 KB
Gracco.pdf	5	Non Patent Literature	18280 KB
Implant_Thread_DesignP.pdf	9	Non Patent Literature	8827 KB
KR20100013149A.pdf	14	Foreign Reference	424 KB
KR20100013149A_translatio	11	Foreign Reference	4648 KB

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sb0030e_fill.pdf	3	Request for Continued Examination (RCE)	681 KB
WO2020260263A1.pdf	54	Foreign Reference	3801 KB
ids-autoload.pdf	5	Information Disclosure Statement (IDS) Form (SB08)	1315 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
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IMPLANT BITE REGISTRATION JIG AND BITE FABRICATION METHOD USING THE JIG			
Patent Number	KR 10-2010-0013149 A (2010.02.09)	**Application Number**	10-2008-0074691 (2008.07.30)
Applicant	OSSTEM IMPLANT CO., LTD.	**Inventor**	RYU, Jae Ho | GONG, Tae Hyun | PARK, Moo Yong
Current IPC(Main)	A61C-008/00	**Current CPC(Main)**	A61C-0008/0001
Priority Number	-		
Abstract	PURPOSE: An implant jig for overbite relation of dental prosthesis is provided, which enables byte coping and impression coping at the same time and can reduce cost and time of prosthesis fabrication process. CONSTITUTION: An implant jig for overbite relation of dental prosthesis comprises: an articulation(11) supporting a byte material; a connection part(15) for uniting the implant jig in a fixture which is implanted in the gum; and a body part(13) formed between the articulation and connection part. A top surface(11a) of the articulation has the flat shape or the swollen shape. A peripheral surface(11b) of the articulation has a fixed diameter or a shape in which diameter changes to make diameter of a middle part be larger than diameter of the top surface.		
Claim(s)	Claim 1 As the implant jig for the byte acquisition among the implant operation. With the articulation supporting the byte material. With the connection part for uniting the implant jig with the fixture which becomes in gum in advance. The body part formed between articulation and connection part. The implant jig for the dental prosthesis overbite relation acquisition implying. Claim 2 As for claim 1. The implant jig for the dental prosthesis overbite relation acquisition, wherein the top surface of articulation it has the flat shape or the swollen shape ; and it has the smooth surface without the concavo-convex. Claim 3 As for claim 1. The implant jig for the dental prosthesis overbite relation acquisition, wherein the peripheral surface of articulation it separates and it makes facilitated whether it is the exact location ; it has the fixed diameter ; and the diameter of the middle part has the shape in which the diameter changes than the diameter of the top surface of the hardened byte material. Claim 4 As for claim 1. The implant jig for the dental prosthesis overbite relation acquisition which in order that the body part minimizes the interference with the interference with gum or the contiguity teeth is formed in order to have the small diameter which is the same like the diameter of articulation or. Claim 5 As for claim 1. The implant jig for the dental prosthesis overbite relation acquisition, wherein the articulation outside and body part external edge area is rounded. Claim 6 As for claim 1.		

The implant jig for the dental prosthesis overbite relation acquisition which is characterized in that the connection part includes the threaded screw part it is combined in the fixture which becomes within gum in advance.

Claim 7

As for claim 1.

The implant jig for the dental prosthesis overbite relation acquisition, wherein the connection part and fixture it is combined to the screw-clamping manner, and the snap fitting mode and one mode selected between the friction fit mode.

Claim 8

As for claim 1.

The implant jig for the dental prosthesis overbite relation acquisition which is characterized in that the implant jig includes the driver seating hole which can insert the screw driver when it is formed in the top surface of articulation and it unites the implant jig with the fixture or the top surface separates.

Claim 9

As for claim 8.

The implant jig for the dental prosthesis overbite relation acquisition which is used for the implant operation the screw driver is identical and the driver seating hole is formed in order to have the dimension of the size in which the screw driver can be - fitted with rubbing.

Claim 10

As for claim 8.

The implant jig for the dental prosthesis overbite relation acquisition in which the diameter magnification department in which the diameter is large than the driver seating hole is formed in the entrance circumference part of the driver seating hole.

Claim 11

As for claim 10.

The implant jig for the dental prosthesis overbite relation acquisition, wherein the diameter magnification department it has the inclined tapered shape or the stair-stepping in which it has the level difference.

Claim 12

As for claim 1.

The implant jig for the dental prosthesis overbite relation acquisition, wherein articulation and body part it is manufactured to the outer body member which is the part of one having the penetration hole inside ; and the connection part is manufactured to the connecting member which is the other part which is formed in order to be combined through the pipe hole in the fixture.

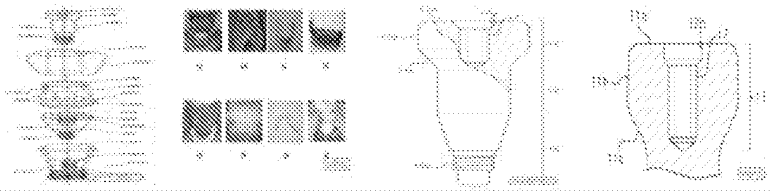
Claim 13

As for claim 12.

The penetration hole formed inside the outer body member comprises the body small diameter part in which the diameter is small, the diameter is the megasoma cask larger diameter portion, and body larger diameter portion it is formed to side articulation, and the body axis cervix which is formed so that the diameter be reduced between the body small diameter part.

The connecting member comprises the threaded screw part it is combined in the fixture which becomes already within with the connection small diameter part having the diameter of the size corresponding to the body small diameter part, with the connection larger diameter portion having the diameter of the size corresponding to the body larger diameter portion, with the connection narrow diameter part having the form corresponding to the body axis cervix, gum with implanted.

The implant jig for the dental prosthesis overbite relation acquisition, wherein the

	outer body part the screw part of the connecting member is combined in the state where the connection narrow diameter part of the connecting member contacts with each other with the body axis cervix of the outer body member in the fixture it can be fixed on the fixture. Claim 14 As the implant jig for the byte acquisition among the implant operation. Exante, the implant jig for the dental prosthesis overbite relation acquisition wherein the top surface which is attachably and detachably combined in the fixture which becomes in gum with implanted and supports the byte material is near with the opposite side tooth and it can be located. Claim 15 The prosthesis fabrication method wherein the implant jig in any one claim among the claims 1 through 12 in the impression, which is the method for making the implant for the implant ; and becomes in the state where the fixture is in gum the implanted with acquisition. And fixture the byte material are injected after doing the tightening and the byte which becomes with acquisition is utilized and the implant is made.
Drawings	
WIPS Family	KR10-0967527B1
Description	[DETAILED DESCRIPTION] [TECHNICAL FIELD] [0001] The invention relates to the implant recovering the deprived tooth of the patient but is used, and particularly, to the implant jig for being used during the dental prosthesis overbite relation (bite) acquisition among the implant operation and the prosthesis fabrication method using this implant jig. [BACKGROUND ART] [0002] The implant means the replacement making the deprived human tissue turn around. The replacement which fixes the dental implant after it dines out the fixture in the alveolar bone in which the natural tooth root is gone in order to replace the tooth root of the tooth which generally is deprived in the dental clinic and healing up and recovers the original function of tooth is meant. [0003] According to this kind of implant is the coupling method with the dental implant and tooth root, it is variously classified. And it has the screw-type implant which among them uses the coherence of the screw. This kind of conventional screw-type implant is illustrated in fig. 1. [0004] The head unit of the abutment is formed with the octagonal and because of being the octa abutment system the conventional screw-type implant system illustrated in Figure 1 calls. The conventional abutment system illustrated in Figure 1 is comprised of the fixture (Fixture) (110), abutment (120), cylinder (130), screw (140) and implant (150). [0005] The fixture (110) is made of the titanium excellent in terms of bio compatibility

for fusion with the human body bone tissue the role of fixing the implant system it is laid in the alveolar bone is played. The fixture (110) has the abutment joint groove (111), and the abutment seating groove (112) and the fixture body (113).
[0006] The abutment fastening groove 111 is formed inside the fixture 110 along the axis so that the abutment 120 can be fastened to the fixture 110. A screw thread is formed on the inner peripheral surface of the abutment fastening groove 111, so that the abutment 120 is screwed. The abutment seating groove 112 is formed to be inclined downward inside the fixture 110 along the axis and ends at a step 112a. The abutment seating groove 112 has a step 112a and is connected to the abutment fastening groove 111. The fixture body 113 has threads on its outer peripheral surface.

[0007] The abutment 120 is coupled to the fixture 110 and serves to fix and support the cylinder 130, and includes a head portion 121, a body portion 122, a thread portion 123, and a screw fastening groove (124).

[0008] The head portion 121 has a polygonal shape and is formed on the upper portion of the body portion 122. The body portion 122 is formed to be inclined downward at the lower portion of the head portion 121, and a step 122a is formed on the upper surface of the body portion 112 to distinguish it from the head portion 121. A threaded portion 123 is formed at the bottom of the body portion 122 and is screwed into the abutment fastening groove 111 of the fixture 110. And the screw fastening groove 124 is formed through the head part 121 and the body part 122, and a screw thread is formed on the inner peripheral surface so that the screw 140 is screwed together.

[0009] The cylinder 130 is seated on the head portion 121 and the step 122a of the abutment 120 and serves to support the prosthesis 150, including the outer peripheral surface 131, the screw seating groove 132, and a mounting groove (133) of the abutment.

[0010] The outer circumferential surface 131 has an upwardly sloping shape, and a cut surface 131a is formed at the upper part of the outer circumferential surface 131, and an edge 131b is formed at the lower end. A screw seating groove 132 is formed inside the cylinder 130. An abutment seating groove 133 in which the head portion 121 of the abutment 120 is seated is formed in the lower portion on the same axis as the screw seating groove 132. The abutment seating groove 133 has a shape corresponding to the head portion 121 (for example, a polygonal shape such as a hexagon or an octagon).

[0011] The screw 140 is screwed into the screw fastening groove 124 of the abutment 120 and serves to couple the cylinder 130 to the abutment 120. The screw 140 is composed of the head portion 141 and the body portion 142).

[0012] The head portion 141 has a cylindrical shape, and a drive coupling hole 141a is formed at the top. The body portion 142 is formed by extending from the bottom of the head portion 141, and a screw thread 141a having a certain length is formed at the bottom of the body portion 142.
[0013] The implant (150) is manufactured through the process including the impression coping, the working model manufacture, the wax pattern manufacture, flasking and small ring process etc. And the screw access hole (153) is formed on the manufacturing process. In case of it is formed through the center of the implant (150)

having the cylindrical shape and assembling the implant within the oral cavity the groove in which the screw (140) is inserted becomes this screw access hole (153).

[0014] As described above, the comprised implant is generally performed a surgical operation after the fixture dining out step, which is the implant substructure and impression coping and working model complete phase, and wax pattern manufacture and inner tube casting step, and the implant molding step, consisting of the outer tube formation step through the drawing recombination repair and the implant attaching stage binding the implant in the outer tube to the cement.

[0015] The byte (Bite) acquisition obtaining the information of top and bottom clam relation as to the prosthesis fabrication is the core course. It is made after the impression coping which is a process of imitating the byte acquisition process, ordinarily, the oral cavity situation of the patient. And the byte which becomes with acquisition is delivered to the pore minor for the prosthesis fabrication with the telamon.

[0016] In the general natural teeth surgical operation, because one tooth part (the abutment) remains deletion the tooth part remaining can be utilized as the supporting structure. The byte material is like that injected and the byte is received.

[0017] It is necessary to have the byte acquisition process as to the implant operation. The impression coping is implemented on the state where it becomes the fixture corresponding to the tooth root with implanted in case of the implant after the direction of one''s feet when one lies down. In at this time, after the fixture extracting tooth a tooth is the state that becomes with implanted to be paralleled generally in the gum surface. Therefore there is no supporting structure supporting the byte material.

[0018] Therefore, in the convention, as shown in FIG. 2, it sends in (a) hospital after the impression coping only (b) copied impression to the pore minor. (c) working model is manufactured. The separate rigidizer for the byte acquisition, in other words, the jig is made on (d) working model.

[0019] In this way, the manufactured separate jig is again sent to hospital in the pore minor and the patient comes to hospital (e) and the jig which is specially produced is screwed within the oral cavity of the patient. (f) byte material is injected and the byte is received. The byte which becomes with (g) acquisition is again sent to the pore minor. The byte which becomes with (h) acquisition is utilized as the guide and the implant is made.

[0020] The implant manufactured by the pore minor is again sent to hospital. Since the patient comes to hospital and the implant is screwed within the oral cavity of the patient the implant operation is completed.

[0021] There can be the inconvenience it does after a process of receiving the byte it is forwarded and the patient again comes to the hospital and therefore that the period required to the surgical operation has to be required for a long term and the patient has to spend the long time as the state where there is no tooth as the dental clinic the supporting jig is separately made among the implant operation for the byte acquisition in the pore minor as been described in the above.

[0022] Moreover, the byte supporting jig has the problem that cost and turn around time are increased since it has to make by there being no material of the exclusive and using the Mount, which is the expensive use extrinsic product the Temporary Abutment, the UCLA Abutment etc.

[0023] That is, there is a problem that the structure is designed to use the separate use extrinsic product for the byte acquisition bay. The patient again has to come to the dental clinic. And the dental prosthesis production process of the during the period is prolonged.

[DISCLOSURE OF THE INVENTION]

[TECH PROBLEM]

[0024] This conventional problems are resolved. And the invention relates to the thing to provide the implant jig for the dental prosthesis overbite relation acquisition in which at the same time, the byte acquisition is possible like the natural teeth surgical operation with the impression coping and reducing the cost at the prosthesis fabrication process and time as to the implant operation and the prosthesis fabrication method using the implant jig.

[TECH SOLUTION]

[0025] Provided is the implant jig for the dental prosthesis overbite relation acquisition including the articulation, the connection part for uniting the implant jig with the fixture, and the body part formed between articulation and connection part. The articulation is the implant jig for the byte acquisition among the implant operation for achieving the purpose and supports the byte material. The connection part for uniting the implant jig with the fixture becomes in gum in advance.

[0026] It is preferable that the top surface of articulation it has the flat shape or the swollen shape. And it has the smooth surface without the concavo-convex.

[0027] It is preferable that the diameter of the middle part of the byte material which the peripheral surface of articulation is hardened it has the fixed diameter it makes facilitated it is the exact location it separates it has the shape in which the diameter gradually changes than the diameter of the top surface as as possible.

[0028] It is preferable that the body part in order that the interference with the interference with gum or the contiguity teeth is minimized the small diameter is formed in order to have the diameter which is the same like the diameter of articulation or.

[0029] It is preferable that the articulation outside and body part external edge area is rounded.

[0030] It is preferable that the screw thread the connection part is combined in the fixture which becomes within gum in advance the formed screw part is included.

[0031] It is preferable that the connection part and fixture it is combined to the screw-clamping manner, and the snap fitting mode and one mode selected between the friction fit mode.

[0032] It is preferable that the implant jig the driver seating hole which can insert the screw driver when being formed in the top surface of articulation and uniting the implant jig with the fixture or separating is included.

[0033] It is preferable that the driver seating hole is the screw driver the screw driver is identical it is used for the implant operation the dimension is formed in order to have the dimension of the size which rubbing can be -fitted.

[0034] It is preferable that the diameter than the driver seating hole in the entrance circumference part of the driver seating hole the big diameter magnification department is formed.

[0035] It is preferable that the tapered shape or the level difference which the diameter magnification department is inclined it has the have stair-stepping.

[0036] It is preferable that articulation and body part it is manufactured to the outer body member which is the part of one having the penetration hole inside. The

connection part is manufactured to the connecting member which is the other part which is formed in order to be combined through the pipe hole in the fixture.

[0037] The penetration hole formed inside the outer body member comprises the body small diameter part in which the diameter is small, the diameter is the megasoma cask larger diameter portion, and body larger diameter portion is formed to side articulation, and the body axis cervix which is formed so that the diameter be reduced between the body small diameter part.

[0038] The connecting member includes the threaded screw part it is combined in the connection narrow diameter part having the connection larger diameter portion, and the form corresponding to the body axis cervix, and the fixture which becomes already within gum with implanted having the diameter of the connection small diameter part, and the size corresponding to the body larger diameter portion that has the diameter of the corresponding to size to the body small diameter part.

[0039] According to do it, in the state where the connection narrow diameter part of the connecting member contacts with each other with the body axis cervix of the outer body member, the outer body part can be fixed on the fixture since the screw part of the connecting member is combined in the fixture.

[0040] Moreover, according to another side of the invention, provided is the implant jig for the dental prosthesis overbite relation acquisition which can be the implant jig for the byte acquisition among the implant operation and in which the top surface which is attachably and detachably combined in the fixture which becomes in gum in advance and supports the byte material is near with the opposite side tooth and which be located.

[0041] Moreover, according to another side of the invention, provided is the prosthesis fabrication method which is the method for making the implant for the implant and injects the byte material the impression, which becomes with acquisition and the implant jig described vividly in the fixture in the state where the fixture is in gum the implanted after doing the tightening and utilizes the byte which becomes with acquisition and makes the implant.

[ADVANTAGEOUS EFFECTS]

[0042] Provided is the implant jig for the dental prosthesis overbite relation acquisition capable of the impression coping like the natural teeth surgical operation as to the implant operation, at once, the byte acquisition according to the invention as described above, and the prosthesis fabrication method using the implant jig. According to that, according to the invention, the cost at the prosthesis fabrication process and time is reduced.

[DESCRIPTION OF EMBODIMENTS]

[0043] Hereinafter, referring to the figure, specifically, the implant jig for the dental prosthesis overbite relation acquisition according to the preferred embodiment of the present invention and the prosthesis fabrication method using the implant jig are illustrated.

[0044] In fig. 3, the implant jig according to the first preferred embodiment of the present invention is illustrated. As shown in FIG. 3, the implant jig according to the first preferred embodiment of the present invention comprises the articulation (11) supporting the byte material, the connection part (15), combined in the fixture which becomes with implanted and articulation (11) and the body part (13) formed between the connection part (15).

[0045] The articulation (11) has the top surface (11a) supporting the byte material. It is preferable that the thing which the shape of this top surface (11a) is ordinary or it is minute is the swollen shape to the upside it is desirable. And it has the smooth surface without the concavo-convex.

[0046] Because of separating and making facilitated whether it is the exact location or not it is desirable of the byte material in which the thing having the shape in which the diameter of the diameter of the middle part becomes over the time smaller than the diameter of the top surface (11a) in the downside to the upside when the peripheral surface (11b) of the articulation (11) looking at in fig. 3 is hardened.

[0047] In the downside of the articulation (11), the body part (13) is positioned. And in order to be the same as that of the diameter of the articulation (11) or it has the diameter smaller than that in order to minimize the interference with the interference with gum or the contiguity teeth this body part (13) is formed. The slope part (11c) in which the diameter becomes downwards over the time smaller is formed at the upside between the peripheral surface (11b) of the articulation (11) in which the diameter is large and the body part (13) in which the diameter is small and the body part (13) and articulation (11) interval are smoothly connected.

[0048] It is preferable that the articulation (11) outside and body part (13) external all edge areas the damage including the gum within the oral cavity or tooth etc. is prevented is rounded.

[0049] In the meantime, the error is enlarged in the prosthesis fabrication as the byte material the thickness is thick. Therefore it is good that the top surface (11a) of the articulation (11) is near with the opposite side tooth and it is located. For this, according to the invention, since the length of the body part (13) and articulation (11), and especially, the length of the body part (13) are made with various dimensions and it fits to the oral state of the patient and the implant jig of the proper length is used the byte material maintains the optimal thickness of 0.5 ~ 1.5mm.

[0050] The connection part (15) comprises the threaded screw part (15a) it is combined in the fixture which becomes already within gum with implanted. According to the shape of the connection part (15) including the screw part (15a) is the form of the fixture, it can be made as the various specification it is of course. The connection part (15) and fixture the snap fitting, and the rubbing (friction) fit system can be used besides the above-described screw-clamping manner.

[0051] The top surface (11a) of the articulation (11) may be provided with the driver seating hole (17) described in the above when the implant jig being united with the fixture or separating the screw driver including the driver etc. is inserted. Size and shape can be set up so that this driver seating hole (17) go in gear with the driver and the rubbing which is the screw driver. In order that the screw driver like that uses to be used for the existing implant operation it fits to the dimension of this screw driver and the driver seating hole (17) is formed.

[0052] The entrance circumference part of the driver seating hole (17) may be provided with diameter magnification departments (17a, 17b) in which the diameter is large than this driver seating hole (17). If it can have the diameter which is bigger than the driver seating hole (17) this diameter magnification departments (17a, 17b) can have various types. For example, the diameter magnification department (17a) illustrated in Figure 3 includes the inclined tapered shape, and the stair-stepping in which the level difference has as to the diameter magnification department (17b) illustrated in Figure 4.

[0053] According to the invention, diameter magnification departments (17a, 17b) are formed in the opening of the driver seating hole (17). Therefore the byte material is applied for the impression coping at the upper part of the articulation (11) of

the implant jig. And yet for the byte material in which it has mobility, the amount finding way can be reduced within the driver seating hole (17).

[0054] In this way, the byte material finding way can be reduced within the driver seating hole (17). Therefore the error can be reduced as to the prosthesis fabrication process in the attaching/detaching toward the implant jig of the byte after the byte material solidifies. That is, according to the invention, the projection part finding way within the driver seating hole and solidifies is formed smaller than. Therefore the accurately the byte can be settled without the task hindered with the interference as to the prosthesis fabrication process etc. on the implant jig.

[0055] In fig. 5, the implant jig of many shape according to the first preferred embodiment of the present invention is illustrated. According to the invention, according to the kind of the oral state of the patient or the fixture etc, the various types of implant jig can be made and it can use.

[0056] Hereinafter, referring to Figure 7, the implant jig according to the second embodiment of the present invention is illustrated with the fig. 6.

[0057] In the figures 3 through 5, it is disclosed only the integrated implant jig (first embodiment) in which the articulation (11), and the body part (13) and connection part (15) are manufactured to one part. However as shown in FIG. 7, it consists of the part of 2 with the manufacture (second embodiment) and the implant jig of the present invention can be used according to the need with the fig. 6. That is, the articulation (11) at the first preferred embodiment, and the top of the connection part (15) and body part (13) are manufactured to the part of one having the penetration hole inside. The top can be manufactured to the part of another one of the bolt shape rathering long so that the screw part (15a) be combined through this penetration hole in the fixture.

[0058] The implant jig according to the second embodiment comprises the articulation (22) supporting the byte material like the implant jig according to the above-described the first preferred embodiment, the connection part (25), combined in the fixture which becomes with implanted and articulation (22), and the body part (23) formed between the connection part (25).

[0059] But the implant jig according to the second embodiment is formed into the outer body member (21) in which the articulation (22) and body part (23) are one member. It is different in that the connecting member (25) formed into the discrete is inserted within the penetration hole formed inside this outer body member (21).

[0060] The penetration hole formed as to this second embodiment inside the outer body member (21) includes the diameter is the megasoma cask larger diameter portion (21b), and these body larger diameter portion (21b) is formed to side the body small diameter part (21a), in which the diameter is small and articulation (22), and the body axis cervix (21c) which is formed between the body small diameter part (21a) so that the diameter be gradually reduced. At this time, it may be acceptable that if there is no need that the diameter is certainly gradually reduced and the outer body member (21) can be fixed with the connecting member (25) the body axis cervix (21c) has any form.

[0061] In the meantime, the connecting member (25) includes the threaded screw part (25d) it is combined in the connection narrow diameter part (25c) having the connection larger diameter portion (25b), and the form corresponding to the body axis cervix (21c), and the fixture which becomes already within gum with implanted having the diameter of the connection small diameter part (25a), and the size corresponding to the body larger diameter portion (21b) that has the diameter of the corresponding to size to the body small diameter part (21a).

[0062] In the state where the connection narrow diameter part (25c) of the

connecting member (25) contacts with each other with the body axis cervix (21c) of the outer body member (21), the outer body member (21) can be fixed on the fixture since the screw part (25d) of the connecting member (25) is combined in the fixture.
[0063] The opening of the driver seating hole (27) similarly the driver seating hole (27) is formed at the first preferred embodiment as to this second embodiment within the articulation (22) may be provided with the diameter magnification department (27b).
[0064] In fig. 7, the implant jig of many shape according to the second embodiment of the present invention is illustrated. According to the invention, according to the kind of the oral state of the patient or the fixture etc, the various types of implant jig can be made and it can use.
[0065] Hereinafter, referring to Figure 8, the byte acquisition process at the implant prosthesis fabrication method according to the present invention is explained.
[0066] According to the invention, in (a) hospital, before (b) copied impression is sent by the pore minor after the impression coping. The implant jig according to the present invention is screwed in the fixture which becomes already with (c). (d) byte material is injected and the byte is received. The byte which becomes with (e) acquisition is sent to the pore minor with the copied impression. (g) copied impression and byte are utilized as the guide and the implant is made. It is preferable that the implant jig after the byte acquisition it is separated from the fixture.
[0067] The implant manufactured by the pore minor is again sent to hospital. Since the patient comes to hospital and the implant is screwed within the oral cavity of the patient the implant operation is completed.
[0068] According to the invention, the byte acquisition is possible in the impression coping immediately after as been described in the above. Therefore the patient finishes necessary all preparations to one call in the prosthesis fabrication. Therefore, while a process of receiving the byte after separately making it is again forwarded to the dental clinic and the patient again comes to the hospital are passed through. The period and cost etc. are saved. Required for the surgical operation.
[0069] As described above, it has effect capable of the byte acquisition it decreases time and the cost in which the byte acquisition is possible with the impression coping and which is required among the implant operation as to the prosthesis fabrication process to the dental prosthesis production process and exact with the implant jig of the present invention.
[0070] As described above, referring to the figure, it illustrated. But the invention is not restricted by the working example and drawing which in the above, is explained. And the various correction and deformation of the invention can be made in the patent claim with the persons having the normal knowledge in the technical field belonging it is of course. It is the prosthesis fabrication method using the implant jig for the dental prosthesis overbite relation acquisition and implant jig according to the invention exemplified.

[BRIEF DESCRIPTION OF THE DRAWINGS]
[0071] Figure 1 is an exploded view showing the conventional implant in terms of each by part.
[0072] Figure 2 is drawing for illustrating the byte acquisition process at the conventional implant prosthesis fabrication method.
[0073] Figure 3 is drawing which partly cuts the implant jig and shown according to the first preferred embodiment of the present invention.
[0074] Figure 4 is drawing showing the changed example of the tapered portion

formed in the driver seating hole surrounding of the implant jig according to the first preferred embodiment of the present invention.
[0075] Figure 5 is drawing showing the various changed example of the implant jig according to the first preferred embodiment of the present invention.
[0076] The cross-sectional view of the implant jig according to the second embodiment of the fig. 6 silver the invention.
[0077] Figure 7 is a drawing illustrating drawing showing the various changed example of the implant jig according to the second embodiment of the present invention and fig. 8 is the byte acquisition process at the implant prosthesis fabrication method followed of the present invention.
[0078]
[0079] <The description of reference numerals showing the main elements in drawings>
[0080] 11, 22: articulation 11a: top surface.
[0081] 11b: slope part 13, 23: body part.
[0082] 15: connection part 15a, 25d: screw part.
[0083] 17, 27: driver seating hole 17a, 17b, 27b: tapered portion.
[0084] 21: the outer body member 21a: body small diameter part.
[0085] 21b: body larger diameter portion 21c: body axis cervix.
[0086] 25: connecting member 25a: connection small diameter part.
[0087] 25b: connection larger diameter portion 25c: connection narrow diameter part.

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Application Number	18827656
Filing Date	2024-09-06
First Named Inventor	Kofford, Brandon Dale
Art Unit	3772
Examiner Name	Huynh, Courtney Nguyen
Attorney Docket Number	SDC013

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	1	GRACCO et al., "Effects of thread shape on the pullout strength of miniscrews". American Journal of Orthodontics and Dentofacial Orthopedics, Volume 142, Issue 2, 186 - 190.	☐
	2	MISHRA et Al., "Changing trends in implant designs: A review". IP Int J Periodontol Implantol. 2023 ;8(3):117-123.	☐
	3	MANIKYAMBA et al., "Implant thread designs: An overview." Trends in Prosthodontics and Dental Implantology 2017; 8(1&2), 11-19.	☐

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(54) Title: DENTAL SCREW AND DENTAL FASTENING TOOL

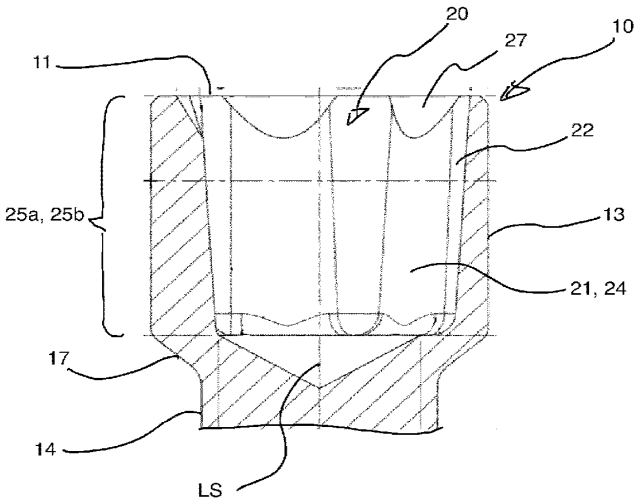


Fig. 1

(57) Abstract: The present disclosure provides a dental screw (10) for fixing dental components (1, 2) to each other, the dental screw having a proximal end (11), a distal end (12), and a longitudinal axis (LS), wherein the dental screw further comprises a screw head (13) including a tool engaging interface (20) for engaging a fastening tool (30) at the proximal end and distally to the screw head a screw shank (14), the screw shank comprising a torque limiting portion (15) and distally to the torque limiting portion a threaded portion (16) for engaging a dental component (1, 2, 3), wherein the dental screw is configured to transfer a minimum torque from the tool engaging interface to the threaded portion of 26 Ncm and the torque limiting portion is configured to limit the torque transferable to a maximum torque for preventing damage to the threaded portion. The disclosure also provides a dental fastening tool, a dental fastening set, and a dental support set.

[Continued on next page]

WO 2020/260263 A1

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DENTAL SCREW AND DENTAL FASTENING TOOL

TECHNICAL FIELD

The present invention relates to a dental screw, a dental fastening tool, a dental fastening set, and a dental restoration support set.

BACKGROUND OF THE INVENTION

A dental restoration that is anchored within the mouth of a patient using a dental implant has been proven to be a very successful solution for the replacement of one or more teeth. By now, there are numerous techniques for dental treatments available that allow for an aesthetical integration of a dental restoration into the dentition of a patient. Further, these dental restorations are also from a functional viewpoint basically identical to the one or more native teeth they replace so that patients do not experience major changes in comparison to a healthy native counterpart.

In order to be able to offer such a solution of a dental restoration to patients in a customized and economical manner, dental restorations generally have a modular design. Thus, these dental restorations are adapted to an individual patient by choosing a combination of dental components that provides the desired result for the replacement. A combination of dental components may simply be a dental implant that is directly connected to an artificial tooth. More commonly, it is a combination of an abutment, a dental implant, and an artificial tooth, wherein the abutment is arranged between the dental implant and the artificial tooth. Such abutments are available as one-piece abutments and multi-piece abutments. Further components that can be present in a dental restoration are bridging elements, caps, etc.

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One of the most common techniques to assemble a combination of dental components is the use of dental screws. Dental screws allow for both assembly and disassembly of a dental restoration. This is particularly advantageous for adapting a dental restoration in a dental lab as well as at the chair site in a dental clinic. Further, the use of screws renders a revision of at least parts of a dental restoration much easier than in case of for example using dental cement for connecting these components. Such dental screws have been proposed in WO 2018/091515 A1, WO 2017/070335 A1, and US 8,029,282 B2.

However, an increasing number of components requires a smaller size of dental screws in order to optimize adaptability of the dental restoration. Smaller dental screws also provide more flexibility in an area of a dentition where space is rather limited such as the front teeth.

These dental screws are used to assemble and fixate the dental components in relation to each other, wherein masticatory forces are primarily transferred through the dental components. Consequently, the primary function of the dental screws is to keep the assembly mounted. Further, the smaller the dental screws, the more material can be designated for the dental components to increase their strength for withstanding masticatory forces.

SUMMARY OF THE INVENTION

In view of the above, one of the objectives of the present disclosure was to provide dental screws with a design that allows for a further reduction of their size. However, the smaller the screws, the harder the handling of these screws becomes. As a result, another objective of the present disclosure was to enhance handling of such small dental screws. Further, a reduced size of these dental screws bears the risk to cause damage to the screws or dental components,

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in particular when transferring torque during tightening of the screws. Consequently, it was yet another objective of the present disclosure to improve the transfer of torque between fastening tools, screws, and/or dental components. The inventors also had a cost-efficient manufacturing of these dental screws, drivers, and dental components in mind.

In order to address these objectives, the present disclosure provides a dental screw for fixing dental components to each other. The dental screw has a proximal end, a distal end, and a longitudinal axis. The dental screw further comprises a screw head including a tool engaging interface for engaging a fastening tool at the proximal end and distally to the screw head a screw shank. The screw shank comprises a torque limiting portion and distally to the torque limiting portion a threaded portion for engaging a dental component. The dental screw is configured to transfer a minimum torque of 26 Ncm and the torque limiting portion is configured to limit the torque transferable to a predetermined maximum torque, in particular at a maximum tensile and or shear stress, for preventing damage to the threaded portion.

The torque limiting portion implemented as part of the screw shank causes the screw shank to fail if the maximum torque, in particular at a maximum tensile and/or shear stress, is exceeded. In other words, the material of the dental screw at the torque limiting portion is not able to withstand the shear forces caused by a torque that exceeds the maximum torque and that is applied via the tool engaging interface. However, the dental screw is configured to transfer a minimum torque of 26 Ncm in order to be able to securely fasten dental components to each other.

As a result, the torque limiting portion prevents damage to the threaded portion of the dental screw as well as to the threaded portion of the dental component the dental screw is engaged with. For example, the dental component may be a dental implant so that the dental screw prevents damage to the

implant. Consequently, it also provides as a benefit to a patient that this configuration of a dental screw prevents a revision of the implant due to such a damage.

Generally, the dental screw is in threaded engagement with a first dental component in order to fasten a second dental component to this first dental component. Resulting from the predefined failure of the dental screw at the torque limiting portion, the second dental component that the dental screw is intended to fasten may easily be removed. Further, the section of the shank remaining engaged with the first dental component after failure can also be easily removed using a tool such as pliers. As a result, the first dental component remains intact and does not have to be replaced. In fact, the only part that has to be replaced is the dental screw.

The torque limiting portion is preferably arranged (in a portion) adjacent to the screw head so that after failure of the torque limiting portion the major part of the shank engaged with the dental component remains in the dental component the dental screw was engaged with before failure. This facilitates the removal of the residual shank of the dental screw from this dental component. In other words, the torque limiting portion is preferably in a coronal (proximal) portion of the screw.

Due to the presence of a torque limiting portion, it is further possible to reduce the size of the dental screw without risking failure of the dental screw at a section of the dental screw that may cause damage to a dental component.

For weakening the dental screw at the torque limiting portion, the torque limiting portion may have the smallest section modulus along the shank.

Thus, the cross-section of the torque limiting portion is designed to have the least resistance to torque and, thus, breaks first if a torque is applied that exceeds the maximum

torque the torque limiting portion is designed to transfer. In other words, the section modulus of the torque limiting portion is smaller than the section modulus of the remaining shank including the threaded portion. The section modulus is preferably also smaller than any cross-section of the screw head that is designed for transferring a torque applied via the tool engaging interface.

Alternatively or additionally, the torque limiting portion may comprise at least one notch for initiating failure, may be made of a different material and/or may have different material properties.

Preferably, the maximum torque transferable at the torque limiting portion is 38 Ncm, 36 Ncm, 34 Ncm, or 32 Ncm. Applying a torque beyond the torque value chosen for the design of the dental screw will result in failure of the torque limiting portion and, thus, in failure of the dental screw.

Further, the torque limiting portion may be configured to withstand a maximum tensile force in a range of 300 N to 500 N and preferably in a range of 350 N to 450 N.

The application of torque results in a tensile force that is acting along the screw shank between the head of the screw and the threaded portion, i.e. also along the torque limiting portion. Exceeding the maximum tensile force a dental screw is designed for, in particular during application of torque, is configured to cause rupture of the screw shank at the torque limiting portion and, thus, failure of the dental screw.

The tool engaging interface may include a torque transfer zone that has a cross-section perpendicular to the longitudinal axis of the dental screw comprising a profile with four or five convex and/or planar sections alternating with four or five concave sections, respectively.

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These concave and convex sections form an undulating profile about the longitudinal axis of the dental screw. As a result, the transfer of torque via the tool engaging interface is enhanced. This is primarily caused by the torque being transferred across contact surfaces extending in a more radial direction between a corresponding dental fastening tool and the dental screw. Further, no force in the direction of the dental screw's longitudinal axis has to be applied for keeping the fastening tool and the dental screw engaged during the application of torque for fastening the dental screw to a dental component.

Further, having four or five convex and/or planar sections that alternate with four or five concave sections enables a design with a smaller screw head with sufficiently thick walls for transferring a predetermined torque and at the same time allowing for a compact design of the screw. It also allows for a screw driver with a smaller diameter. A higher number of sections requires the screw driver to be bigger, which results in an increase in size of the screw head and/or thinner walls that weaken the screw. The tool engaging interface is preferably formed as a recess.

It has been found that a higher number of concave sections and convex and/or planar sections primarily weakens the screw head, whereas a smaller number of concave and convex/planar sections shows an adverse effect in relation to torque transfer.

Preferably, the convex and/or planar sections and concave sections are connected or are merged at points of transition, and at each point of transition an angle between a tangent to the profile of the concave section and a tangent to the convex section is in a range of 90° to 180° or to 160°, preferably 95° to 150°.

Implementing an angle for a point of transition in the design of the dental screw that lies within above-listed

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ranges has been shown to provide for a smooth and efficient transfer of torque.

The point of transition between the alternating concave sections and convex and/or planar sections may be a point along the profile of the tool engaging interface, where two alternating sections continuously or smoothly transition from one to the other. In this case, the point of transition represents the point where the curvature changes signs with a continuous change in slope. As a result, a tangent to this point of transition has the same slope when being based on the adjacent concave section or the adjacent convex and/or planar section.

Alternatively, the point of transition may also be a point, where the alternating sections transition from one to the other in a discontinuous manner. In this case, the curvature changes signs or its direction with a sudden shift in slope. Consequently, a tangent at this point of transition derived based on the adjacent concave section results in a different slope compared to a tangent at this point of transition derived based on the adjacent convex and/or planar section.

The convex and/or planar sections and concave sections may form longitudinal engagement protrusions radially extending from a circle with a maximum inner diameter towards the longitudinal axis. The engagement protrusions preferably have chamfers at their proximal ends.

These longitudinal engagement protrusions are configured for engaging a fastening tool and receiving torque from this tool. In other words, they form at least a part of the torque transfer zone. If chamfers are present at the proximal ends of the engagement protrusions, it is easier for a dental professional to bring a fastening tool into engagement with the dental screw. More specifically, the chamfers that are preferably situated at the entrance of the tool engaging

interface guide a fastening tool into engagement.

The tool engaging interface may include a pick-up zone that tapers in a direction from the proximal end to the distal end of the dental screw. The pick-up zone is preferably located adjacent, proximally to, and/or at least partially along the torque transfer zone.

The taper of the pick-up zone allows for retaining the dental screw to a dental fastening tool via friction forces. In other words, the dental fastening tool may be inserted into the pick-up zone. Then, sufficient pressure is applied in order to press the dental fastening tool into the pick-up zone. This establishes a friction fit that can be easily reversed. For this reversible friction fit, the angle of the taper is preferably chosen in a range of 5° to 12°, in particular 6° to 9°, or substantially 7°. Alternatively, it may be in a range of 10° to 12° or substantially 11°.

Particularly if the pick-up zone extends at least partially along the torque transfer zone, i. e. the torque transfer zone and the pick-up zone are at least partially overlapping or identical, the tapered configuration results in the advantage of a continuously efficient torque transfer in the presence of wear. More specifically, if the dental fastening tool and/or the tool engaging interface of the dental screw are subject to wear, the dental fastening tool will simply be inserted further into the tapered torque transfer zone. Thus, torque transfer is essential not altered since the structure, where the torque transfer takes place, basically remains the same despite from wear occurring.

On the one hand, if the torque transfer zone and the pick-up zone at least partially overlap, this allows a more compact design of the screw head and the fastening tool along their longitudinal axes. On the other hand, if the pick-up zone and torque transfer zone do no overlap, wear may be reduced and a more precise fit of dental screw and fastening tool may be

Straumann USA Exhibit 1023

achieved due to the functional and spatial separation of the two zones.

The tool engaging interface may further include a verification zone for verifying the type of the dental screw. The verification zone is preferably located at the distal end of the tool engaging interface.

Based on the verification zone, a dental professional is in a position to verify if the dental screw is the appropriate screw to be used with a dental fastening tool or a dental component. For example, if a dental professional is not able to fully insert into and/or engage the fastening tool with the tool engaging interface, this indicates that either an incorrect screw or an incorrect dental component has been chosen for assembly. Consequently, such a verification zone prevents damage to a dental component or a dental screw if their configurations do not complement each other.

Alternatively or additionally to a verification zone, an appropriate combination of a dental component and a dental screw may also be ensured by configuring these two dental components so that they can only be assembled using a dental screw of correctly positioned and oriented in relation to each other. This is particularly described in detail in relation to figures 5 in the international application also filed by the present applicant with the number PCT/EP2018/071797, which is hereby incorporated by reference.

Further, the disclosure provides a dental fastening tool. The dental fastening tool has a proximal end, a distal end, and a longitudinal axis. The dental fastening tool comprises a screw engaging interface at the distal end for engaging a dental screw, in particular a dental screw as described above, and proximally to the screw engaging interface a torque limiting portion. The torque limiting portion is configured to limit the torque transferable to a maximum torque for preventing damage to the screw engaging interface.

The advantage of a dental fastening tool comprising a torque limiting portion is similar to the above described advantages achieved with a torque limiting portion incorporated into a dental screw. More specifically, if the torque transferred by the dental fastening tool exceeds the predefined maximum torque, the torque limiting portion is configured to fail. This failure prevents damage to the dental screw. After failure, the parts of the dental fastening tool separated at the torque limiting portion can easily be removed so that another dental fastening tool may be used to finish the assembly or to remove the dental screw, for example for checking the cause of the failure. In any case, the torque limiting portion of the dental fastening tool keeps damage from occurring at the level of a dental component, such as a dental implant or an abutment.

As already discussed above, the torque limiting portion also allows for a smaller design of the dental screw. Safety factors that are normally included for preventing damage to or failure of the dental screw or a dental component to be engaged with or fastened to the dental screw can be reduced. Instead of trying to prevent any damage, damage is controlled by a predetermined failure of the dental screw. In other words, the safety provided by means of safety margins is at least partly replaced by the safety mechanism of a controlled failure.

The torque limiting portion may be configured to bear a maximum torque of 35 Ncm or less, preferably in a range of 27.5 Ncm to 34 Ncm and more preferably in a range of 28 Ncm to 33 Ncm.

The higher values of these ranges such as 30 to 34 Ncm are preferably used for a dental fastening tool that also allows to transfer torque while the longitudinal axis of the dental fastening tool and the longitudinal axis of the dental screw are inclined in relation to each other. The lower values of these ranges, such as 27.5 to 29 Ncm are sufficient for dental

fastening tools that do not allow for such an inclination during a transfer of torque.

The screw engaging interface may include a torque transfer zone with a cross-section perpendicular to the longitudinal axis comprising four or five convex and/or planar sections alternating with four or five concave sections. The convex and/or planar sections and concave sections form an engagement structure about the longitudinal axis along the dental fastening tool.

The advantages of such a configuration of the torque transfer zone has already been discussed in relation to the corresponding zone of the dental screw. In terms of the dental fastening tool it should be noted that it is particularly advantageous to use five concave sections alternating with five convex and/or planar sections if the dental fastening tool is designed for a transfer of torque also in the aforementioned angled relationship to the dental screw.

A dental fastening tool that allows for an angled torque transfer between the longitudinal axis of the dental fastening tool and the longitudinal axis of a dental screw preferably has a curved profile in a cross-section along the longitudinal axis (longitudinal cross-section).

The curved profile preferably extends over an angle in this longitudinal cross-section so that it allows for a torque transfer taking place between the dental fastening tool and the dental screw while the relative angle between their longitudinal axes is in a range of 0 to 25°. Consequently, the curved profile may extend over a range of at least 25°.

The concave sections preferably have a curved profile in a cross-section perpendicular to the longitudinal axis of the dental fastening tool. Further, the convex sections may have a curved profile, in particular a circular shaped profile, or may include a profile that is both curved and straight

(linear). This corresponds to a convex and planar section along the circumference of the screw engaging interface. As previously described, it is also possible to use a planar section instead of a convex section. The skilled person will appreciate that a planar section is represented by a straight line in the fastening tool's cross-section perpendicular to the longitudinal axis.

Preferably, the convex and/or planar sections and concave sections are connected or are merged at points of transition, and at each point of transition an angle between a tangent to the profile of the concave section and a tangent to the convex section is in a range of 90° to 180° or to 160°, preferably 95° to 150°.

Similar to the dental screw, implementing an angle for a point of transition in the design of the dental fastening tool that lies within above-listed ranges has been shown to provide for a smooth and efficient transfer of torque.

The lower angles in a range of 90° to 110° and in particular 96° to 104° particularly enhance torque transfer between the tool engaging interface of a dental screw and a screw engaging interface of a dental fastening tool.

The greater angles in a range of 130° to 180° and in particular in a range of 142° to 148° may advantageously be combined with a higher number of aforenoted concave sections and convex and/or planar sections, in particular five of each. The angles in these ranges still provide for an efficient transfer of torque. They further allow for a configuration of the screw engaging interface that is able to transfer torque while the longitudinal tool axis and the longitudinal screw axis are not aligned, i. e. are inclined in relation to each other.

The angle at the point of transition of the dental screw's profile preferably substantially matches the angle at the

Straumann USA Exhibit 1023

point of transition of the dental fastening tool.

The point of transition between the alternating concave sections and convex and/or planar sections may be a point along the profile of the screw engaging interface, where two alternating sections continuously or smoothly transition from one to the other. In this case, the point of transition represents the point where the curvature changes signs with a continuous change in slope. As a result, a tangent to this point of transition has the same slope when being based on the adjacent concave section or the adjacent convex and/or planar section.

Alternatively, the point of transition may also be a point, where the alternating sections transition from one to the other in a discontinuous manner. In this case, the curvature changes signs or its direction with a sudden shift in slope. Consequently, a tangent at this point of transition derived based on the adjacent concave section results in a different slope compared to a tangent at this point of transition derived based on the adjacent convex and/or planar section.

The screw engaging interface may include a pick-up zone for holding a dental screw, the pick-up zone preferably being located adjacent, proximally to, and/or at least partially along the torque transfer zone.

The presence of a pick-up zone facilitates handling of a dental screw since the dental screw can be handled while being attached to the dental fastening tool. This is also advantageous since it prevents contamination of the dental screw during handling.

The pick-up zone may have a conical shape, in particular if the transfer of torque can only be effected while the longitudinal axis of a dental screw and the dental fastening tool are aligned with each other.

Alternatively, the pick-up zone may also have a curved profile in the longitudinal cross-section as described above in relation to the curved torque transfer zone of the dental fastening tool. Such a pick-up zone may also at least partly serve as a torque transfer zone.

In any case, the pick-up zone will, for example, be able to interact with a dental screw having a tapering tool engaging interface in order to establish the pick-up and retaining function via friction.

The screw engaging interface may further include a verification zone for verifying the type of a dental screw when engaging said dental screw. The verification zone is preferably located at the distal end of the tool engaging interface.

As described in relation to the dental screw from above, the verification zone has the purpose to verify an appropriate use of the dental fastening tool, e. g. that the dental fastening tool is used with a corresponding dental screw. Thus, it is possible to prevent an unintended use of the dental fastening tool.

The disclosure further provides a dental fastening set. The dental fastening set comprises a dental screw, in particular a dental screw according to one of the previously described configurations. The dental fastening set also comprises a dental fastening tool and in particular a dental fastening tool configured as described above. The dental screw and the dental fastening tool each comprise a torque limiting portion, wherein the torque limiting portion of the dental screw is configured to bear a maximum torque that is higher than the maximum torque that is transferable via the torque limiting portion of the dental fastening tool.

For a transfer of torque, the dental fastening tool and the dental screw correspond to each other. More specifically,

Straumann USA Exhibit 1023

the tool engaging interface of the screw and the screw engaging interface of the dental fastening tool correspond to each other.

Due to above-defined relationship between the torque limiting portion of the dental fastening tool and the torque limiting portion of the dental screw, failure during use of the dental screw and the dental fastening tool is configured to occur on the side of the fastening tool first. Consequently, damage to the dental screw or dental components is prevented. Designing the fastening set so that failure occurs further away from the dental component that is in engagement with the dental screw (such as a dental implant) makes the replacement of any of these dental components, dental screws or dental tools easier.

The dental screw of the dental fastening set may comprise a tool engaging interface, wherein the tool engaging interface includes a torque transfer zone with a cross-section comprising convex and/or planar sections alternating with concave sections, wherein the convex and concave sections preferably have curved profiles. For transferring torque in an engaged state of the dental screw and the dental fastening tool, at least an intermediate section of each of the convex and/or planar sections of the dental screw faces a profile of a concave section of the tool engaging interface at a distance.

Due to this distance, the convex and/or planar section of the dental fastening tool is not in engagement with the dental screw. This prevents a transfer of torque from the dental fastening tool to the dental screw at the part of the profile that would be otherwise rather inefficient. The transfer of torque may also cause an increase in wear due to the orientation of the contacting surface that negatively affects the transfer of torque as will be described in more detail further below. In other words, with such a configuration the torque transfer primarily takes place at the points of

Straumann USA Exhibit 1023

transition between the concave section and the convex and/or planar section of the screw engaging interface of the dental fastening tool and the tool engaging interface of the dental screw.

This results in this configuration also reducing wear at the convex and/or planar sections of the dental fastening tool. Wear may be reduced even further by using steel as a material for the dental fastening tool and, preferably, titanium or a titanium alloy as a material for the dental screw.

The torque transfer zone of the dental screw and the torque transfer zone of the dental fastening tool have a rotational play when being engaged with each other, in particular a play in a range of 1° to 3.5° and preferably 1.5° to 3°.

In other words, the cross-sectional profile of the torque transfer zone of the dental screw and the torque transfer zone of the dental fastening tool correspond to each other but do not necessarily match each other completely so that they are configured to provide such a rotational play. This rotational play serves as haptic feedback to a dental professional for determining the begin of a torque transfer. In particular, the dental professional is able to easily realize when contact is established between the profile of the dental fastening tool and the dental screw during rotation and, thus, the initiation of torque transfer. The rotational play also facilitates insertion of the dental fastening tool. This particularly applies if the dental fastening tool is configured to (only) allow torque transfer with the longitudinal axes of the dental fastening tool and the dental screw being aligned with each other.

The dental screw and the dental fastening tool may further each comprise a pick-up zone configured to engage each other by friction. As already described above, such a pick-up zone

facilitates handling of the dental screw and prevents contamination, in particular since a dental professional does not have to directly hold the dental screw.

The dental screw and the dental fastening tool may further each comprise a verification zone configured to allow engagement of the torque transfer zone of the dental fastening tool and the torque transfer zone of the dental screw when the dental fastening set is fully engaged.

In other words, a transfer of torque is only truly enabled, if the verification zones of the dental screw and the dental fastening tool are in full engagement. Without full engagement, the transfer of torque is at least hardly achievable and preferably impossible. As discussed above, this prevents damage to the dental fastening tool, the dental screw, and dental components from occuring of these are not intended to be used in combination.

Further, the disclosure provides a dental restoration support set comprising a dental screw, in particular a dental screw according to a configuration described above, and a dental component, wherein the dental component is in particular a dental implant, an abutment, and/or an artificial tooth.

In this combination, the smaller design of the dental screw allows for an increase in strength of the dental restoration support set and/or a smaller size of the dental restoration support set.

The dental screw may comprise a support surface. The support surface may be inclined in relation to a longitudinal axis of the dental component. Accordingly, the dental component comprises a screw seat. The screw seat may be inclined at an angle in relation to the longitudinal axis of the dental screw so that at least in a pre-fastened state a contact between the support surface of the dental screw and

the screw seat is generally established by a line contact. During contact of the screw seat and the support surface, the longitudinal axis of the screw seat is aligned with the longitudinal axis of the support surface.

The angular relationship between the support surface of the dental screw and the screw seat of the dental component that at least initially results in a line contact between the support surface and the screw seat has the advantage that this contact is more predictable than a surface contact leading to a better predictability of the fastening process. Consequently, it helps in predetermining the flow of forces within the screw and, thus, improves the predictability of failure. The line contact is preferably at a position at or close to the outer diameter of the screw head.

When being fastened, the angular gap between the support surface of the dental screw and the screw seat of the dental component may at least partially close. As a result, the increase in torque is dampened at the end of fastening. The dental professional can predict the end of fastening more easily. As a result, it is less likely that damage to the dental screw, the dental fastening tool, or the dental component occurs.

The screw seat as well as the support surface are preferably both formed as conical angular surfaces.

The dental screw comprises a threaded portion and the dental component comprises a threaded hole. In a fastened state, the thread flank of the threaded portion and the thread flank of the threaded hole, which are in contact with each other, are each in contact along at least 70% of their profile’s length in a radial direction.

In other words, when looking at the contact between the two flanks of the threads of the dental screw and the dental component in a profile of a longitudinal cross-section of the

Straumann USA Exhibit 1023

screw in a fastened state, the two thread profiles are in contact with each other along a length of at least 70% of each of their lengths. More specifically, the proximal flank of the dental screw's threaded portion is in contact with a distal flank of a dental component's threaded hole along at least 70% of each of their lengths along the thread flanks in a radial direction in relation to the dental screw's longitudinal axis.

This configuration has the advantage that the surface contact between the dental screw and the dental component is enhanced compared to normal threads, such as metric ISO-threads, so that the distribution of forces for fastening the dental screw within the threaded hole of the dental component is more uniform. It also allows for a build-up of the necessary tensile force for fastening with fewer revolutions and, thus, a quicker fastening and enables a shorter thread design. This enables a smaller design for the dental screw as well as for the threaded hole of the dental component. The strength of the dental restoration support set can be increased and/or its total size can be decreased.

SHORT DESCRIPTION OF THE DRAWINGS

The following figures illustrate preferred embodiments of the present invention. These embodiments are not to be construed as limiting but merely for enhancing the understanding of the invention in context with the following description. In these figures, same reference signs refer to features throughout the drawings that have the same or an equivalent function and/or structure. A repetitive description of these features is generally omitted for a concise description.

Figure 1 is a cross-sectional view along the longitudinal axis of a dental screw and in particular of a tool engaging interface of the dental screw;

Figure 2 is a plan view of the tool engaging interface of the dental screw illustrated in figure 1;

Figures 3a and 3b are cross-sectional views perpendicular to the longitudinal axis of the dental screw shown in figures 1 and 2 illustrating the tool engaging interface in engagement with a screw engaging interface of a dental fastening tool;

Figure 4 is a partial side view of the dental fastening tool shown in figures 3a and 3b;

Figure 5 is a cross-sectional view perpendicular to the longitudinal axis of the dental fastening tool shown in figures 3 and 4 at the level of a torque transmission section of the fastening tool;

Figures 6a and 6b are cross-sectional views along the longitudinal axes of the dental screws at the level of the tool engaging interface and in engagement with a dental fastening tool;

Figure 7 is a three-dimensional view of a dental screw according to another embodiment;

Figure 8 is a three-dimensional view of a dental fastening tool according to another embodiment for fastening the dental screw shown in figure 7;

Figure 9 is a detailed view of the screw engaging interface of the dental fastening tool of figure 8;

Figures 10a and 10b illustrate the functionality of the screw engaging interface's verification zone;

Figure 11 is a side view of another embodiment of a screw engaging interface of a dental fastening tool;

Figure 12 is a frontal view of the screw engaging

Straumann USA Exhibit 1023

interface of the dental fastening tool shown in figure 11;

Figure 13 is a schematic cross-sectional view of a threaded engagement between a dental screw and a dental implant; and

Figure 14 is a cross-sectional view along the longitudinal axes of a dental screw, an abutment, and an implant in engagement according to yet another embodiment.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Figure 1 shows a cross-sectional view along the longitudinal axis LS of a dental screw 10 according to an embodiment. In the following, a cross-section along a longitudinal axis is also referred to as a longitudinal cross-section. The longitudinal cross-section of the dental screw 10 in figure 1 shows the screw head 13 and a part of the screw shank 14. The screw head 13 comprises a tool engaging interface 20. As shown in figure 1, the tool engaging interface 20 is preferably formed as a recess.

For transferring torque, the tool engaging interface 20 comprises an engagement structure. This engagement structure includes convex sections 21 and concave sections 22. The convex sections 21 alternate with the concave sections 22. There is an equal number of convex sections 21 and concave sections 22. As illustrated, these sections are arranged on an inner circumferential wall of the tool engaging interface 20 and form a torque transfer zone 25b.

The tool engaging interface 20 of the exemplary embodiment of a dental screw in figure 2 comprises five convex sections 21 and five concave sections 22. As seen in a cross-section perpendicular to the longitudinal axis LS of the dental screw 10 (also referred to in the following as a perpendicular cross-section), the convex sections 21 and concave sections 22

form longitudinal engagement protrusions 24 extending from a circle 26. This circle is defined by the maximum inner diameter of the tool engaging interface 20. In case of a tapered tool engaging interface 20 as further described below, the diameter of the circle 26 decreases from the proximal end to the distal end of the dental screw 10.

In order to achieve a compact yet durable design for the dental screw 10, it has been found to be advantageous to provide the tool engaging interface 20 with four or five concave and convex sections each. Preferably, the screw engaging interface of a dental fastening tool comprises numbers of concave and convex sections that corresponds to the numbers of the concave and convex sections of a dental screw to be engaged.

As will be described in more detail below, five sections of each of the convex and concave sections is preferred for a fastening tool that allows an efficient and an angular application of torque (i. e. an application of torque via an angle).

A number of four sections of each of the concave and convex sections has been found to be particularly advantageous for a combination of a dental screw and a fastening tool whose longitudinal axes are aligned during the application of torque. In such an embodiment, the geometry of the engagement structures results in a very precise engagement and efficient torque transfer.

In the exemplary embodiments of dental screws and fastening tools shown in the figures, the concave sections 22 and the convex sections 21 have a curved profile. Nonetheless and as previously described, the convex sections 21 may also be planar. The concave sections 22 and convex sections 21 form an engagement structure. Along the profile of the engagement structure in a perpendicular cross-section, the concave sections 22 and the convex sections 21 are connected at points

Straumann USA Exhibit 1023

of transition 23. In the embodiment of figure 2, the transition between the concave sections 22 and the convex sections 21 is continuous.

However and as described above, the transition between these sections may instead be a discontinuous transition. An example of a discontinuous transition along a profile of the engagement structure is shown in figure 5 for a fastening tool 30. Here, a point of transition 43 of a screw engaging interface 40 of the fastening tool 30 is discontinuous in terms of a change in slope. Due to this discontinuity, the point of transition 43 represents a corner along the profile of the screw engaging interface 40 as seen in a perpendicular cross-section in relation to the longitudinal axis LT of the dental fastening tool 30. In the engagement structure 44, this point of transition 43 of the profile results in a longitudinal edge (cf. figure 4).

At the point of transition 23, the transfer of torque from a fastening tool 30 to the dental screw 10 is most effective. The tangent to the profile of the tool engaging interface 20 at this point of transition 23 extends in a direction closest to a radial direction. As a result, a torque applied by means of a fastening tool results at this point along the engagement profile in the maximum force component perpendicular to the surface of the tool engaging interface 20 and the minimum force component parallel to this surface. Consequently, torque transfer is very efficient at this point between a dental fastening tool and the dental screw 10, whereas the amount of wear is relatively low. Thus, it is advantageous to transfer torque between a fastening tool and the dental screw 10 at and near the point of transition 23.

A dental fastening tool 30 for transferring torque to a dental screw 10 comprises an engagement structure 44 that corresponds to the engagement structure 24. Figure 5 shows an exemplary embodiment of such a dental fastening tool 30 with an engagement structure 44 in a perpendicular cross-section in

relation to a longitudinal axis LT of this tool. The engagement structure 44 of the dental fastening tool 30 is part of a torque transfer zone 45b (cf. figure 4). Corresponding to the dental screw 10, the cross-sectional profile of the engagement structure 44 comprises convex sections 41 and concave sections 42. The convex sections 41 and the concave sections 42 merge or transition into each other at points of transition 43. Like the points of transition 23 of the torque transfer zone 25b of the dental screw 10, the point of transition 43 may be continuous or discontinuous points of transition 43. As already explained above, the point of transition 43 of the dental fasting tool 30 illustrated in figure 5 is a discontinuous point of transition.

Further, the concave section 42 is preferably curved. The convex section 41 may be curved and/or planer. In the exemplary embodiment illustrated in figure 5, the convex section 41 is curved and, more specifically, has a circular shape.

As described above, the angle at the point of transition 43 between a tangent to the convex section 41 and a tangent to the concave section 42 is preferably in a range of 90° to 180° or to 160°, preferably 95° to 150°. The closer this angle is to 90°, the more efficient is the torque transfer from the dental fastening tool 30 to the dental screw 10 at the point of transition 43. At 90°, the transfer of torque is basically performed in a circumferential direction. There is basically no force component acting in a direction parallel to the surface of the engagement structure 44 (which extends radially) and, as a result, wear of this surface caused by torque transfer can basically be prevented. For example, the dental fastening tools 130, 230 shown in figures 8 to 11 are designed for such an efficient torque transfer.

Figures 3 show a dental fastening tool 30 that has been inserted into a dental screw 10 (see figure 3a). The dental

fastening tool 30 is then rotated about its longitudinal axis LT so that the engagement structure 44 of the dental fastening tool 30 is brought into engagement with the engagement structure 24 of the dental screw 10 (see figure 3b). As described above, this rotational play provides haptic feedback to a dental professional and facilitates insertion of the screw engaging interface 40 of the fastening tool 30 into the tool engaging interface 20 of the dental screw 10. The rotation of the screw engaging interface 40 within the tool engaging interface 20 about the aligned longitudinal axes LT and LS from the intermediate position in figure 3a to the engagement position in figure 3b is about 0.5 times β. As described above, the rotational play β between rotational engagement orientations, i. e. an engagement orientation for fastening and an engagement orientation for loosening is preferably 1° to 3.5° and preferably 1.5° to 3°.

Once in engagement, torque is transferred across the concave section 42 of the dental fastening tool 30 to the convex section 21 of the dental screw 10. This is schematically indicated in figure 3b by means of thick black lines. More specifically, torque is transferred along the profiles of the engagement structures 24, 44 between the transition points 23, 43 to intermediate positions, preferably the middle position, along the concave sections 42 of the fastening tool 30 and the convex sections 21 of the dental screw 10. In other words, there is essentially no transfer of torque along the profile in the region of the convex sections 41 of the fasting tool 30 and the convex sections 21 of the dental screw 10. This is due to a gap being present between the convex sections 41 and the concave sections 22 facing each other while being engaged state. As a result, no wear is caused in this area. Further, torque is provided in an efficient way at the transition point and its vicinity. Transfer of torque also takes place in an area further away from the outer wall of the dental screw 10, i. e. in an area with a higher wall thickness. Due to this and the torque transfer along the curved concave section 42 and the

correspondingly curved convex section 21, stress concentrations are avoided. Consequently, these features also enable a more compact design of the dental screw.

Figure 4 illustrates a partial view of a dental fastening tool 30 in a longitudinal cross-section. The dental fastening tool 30 is also illustrated in the longitudinal cross-section in figures 6 referred to further below. As illustrated in figure 4, the torque transfer zone 45b of the screw engaging interface 40 is curved. More specifically, it is in particular at least partly a basically circular profile. Further, at the distal end 32, the dental fastening tool 30 preferably has a rounded tip 33. This geometric configuration allows to tilt the dental fastening tool 30 while transferring torque from the dental fastening tool 30 via the screw engaging interface 40 to the tool engaging interface 20 of the dental screw 10. This is, for example, illustrated in figures 6, where the longitudinal axis LS of the dental screw is inclined in relation to the longitudinal axis LT of the fastening tool 30. Further, above-described curved and rounded configuration of the screw engaging interface 40 prevents damage or scratches to the surface of the engagement structure 24, which may otherwise reduce the strength of the dental screw 10. Similar to the dental screw 10, the torque transfer zone 45b also acts as pick-up zone 45a as will be described in more detail further below.

The dental fastening tool of figure 4 also comprises proximally to the screw engaging interface 40 a torque limiting portion 35. Preferably, a shank 36 is arranged between the screw engaging interface 40 and the torque limiting portion 35 so that the dental fastening tool 30 does not break within the tool engaging interface 20 of the dental screw 10 during failure. This facilitates removal of the part of the dental fastening tool 30 comprising a portion that remains inside the tool engaging interface 20.

As already described above, the torque limiting portion 35

Straumann USA Exhibit 1023

is configured to fail if a torque applied exceeds a predefined maximum value. Preferably, the torque limiting portion is configured to bear a maximum torque of 35 Ncm or less, and preferably in a range of 27.5 Ncm to 34 Ncm and more preferably in a range of 28 Ncm to 33 Ncm.

As illustrated in figure 4, the torque limiting portion 35 may be designed with a reduced cross-section so that the strength at this cross-section is reduced. In other words, the torque limiting portion 35 has the lowest section modules along the dental fastening tool 30. Consequently, the torque limiting portion 35 has a section modulus that is lower than the section modulus of the waisted portion adjacent to the screw engaging interface 40 and the shank 36.

As illustrated in figure 1, the convex sections 21 of the tool engaging interface 20 that form the tip of the longitudinal engagement protrusions 24 are chamfered at their proximal ends, i.e. at the entrance for the dental fastening tool to the tool engaging interface 20. The resulting chamfers 27 facilitate insertion of a dental fasting tool. On the one hand, they allow an initial insertion of a dental fastening tool without the engagement structure 44 of the dental fastening tool 30 being correctly aligned with the engagement structure 24 of the dental screw 10 in a rotational direction. On the other hand, the longitudinal axis LS of the dental screw 10 may initially have too much inclination in relation to the longitudinal axis LT of the fastening tool 30. Here, the chamfers 27 have a guiding function.

Further, the dental screw 10 in figure 1 comprises a tapered tool engaging interface 20. More specifically, the tool engaging interface 20 becomes narrower in a direction from the proximal end 11 to the distal end of the dental screw 10. In other words, the tool engaging interface 20 may have a substantially conical shape. Due to the tapered shape, the tool engaging interface 20 forms a pick-up zone 25a for picking-up and retaining a dental screw. In this exemplary

embodiment of a dental screw and as illustrated in figures 1, 2, and 6, the pick-up zone 25a and the torque transfer zone 25b overlap each other.

The pick-up function will be explained in the following in more detail under reference to figures 6. As illustrated in figure 6a, a fastening tool 30 may engage the dental screw 10 by friction when the fastening tool 30 is inserted along the longitudinal axis LS into the recess of the tool engaging interface 20. Since the tool engaging interface 20 is tapered, the friction caused due to insertion of the fastening tool 30 enables the pickup function. More specifically, the dental screw 10 can be retained by the fastening tool 30.

As described above, the angle of the taper is preferably chosen in a range of 5° to 12°, in particular 6° to 9°, or may be substantially 7°. Alternatively, it may be in a range of 10° to 12°, or may be substantially 11°. These values allow to safely retain a dental screw and at the same time allow the connection between a fastening tool 30 and the dental screw 10 to be easily releasable. Thus, these angles also prevent unnecessary wear from occurring.

Besides the pick-up function, the taper of the tool engaging interface 20 also ensures optimum engagement between the engagement structures of the dental fastening tool 30 and the dental screw 10. This is schematically shown in figures 6a and 6b. In figure 6a, the dental fastening tool 30 has its initial size, i.e. it has not been subject to wear. As a result, engagement between the dental fastening tool 30 or more specifically the screw engaging interface 40 occurs on the proximal side of the tool engaging interface 20 of the dental screw 10.

Preferably, the dental fastening tool 30 is configured to be reusable and is preferably made of metal, in particular steel. As a result, wear occurs during continued use and reuse of this tool. Wear occurring at the engagement structure 44 of

the dental fastening tool 30 results in a decrease of the size of this structure. However, since the tool engaging interface 20 of the dental screw 10 is tapered, the dental fastening tool 30 will simply be pushed further into the tool engaging interface 20. This achieves the same quality of engagement, which ensures an efficient transfer of torque. This is shown in figure 6b, where the dental fastening tool 30 that has been subject to wear is now engaging the tool engaging interface 20 of the dental screw 10 more distally.

Figure 7 illustrates another embodiment of a dental screw 110. As illustrated in figure 7, the dental screw 110 comprises a torque limiting portion 115 that is directly adjacent to the screw head 113. The skilled person will appreciate that such a torque limiting portion 115 may also be present along the screw shank 14 in the embodiment of a dental screw 10 illustrated in figure 1, either at the same position or at a different position along the screw shank 14.

Similar to the torque limiting portion 35 described in relation to the dental fastening tool 30, the torque limiting portion 115 has the smallest section modulus along the part of the body of the dental screw 110 that transfers torque, i.e. the part of the body that is subject to increasing shear stresses and tensile stresses during fastening of the dental screw 110.

The torque limiting portion 115 is part of and arranged along the screw shank 114. At the end of the screw shank 114, i. e. at the distal end 112 of the dental screw 110, is a threaded portion 116. The threaded portion 116 is for engaging a dental component such as a dental implant 401 or an abutment 402 (cf. figure 14). For example, the dental screw 110 may be used to attach an abutment 402 to a dental implant 401.

As already defined above, the minimum torque that the torque limiting portion 115 of the dental screw 110 should withstand and transfer is preferably 26 Ncm. When exceeding

the maximum torque value, the torque limiting portion 115 should particularly prevent failure of any part of the dental screw 110 distally of the torque limiting portion 115, in particular a failure of the threaded portion 116. Controlling the failure of the dental screw in this manner ensures that the dental component, which is in engagement with the dental screw 110, remains intact. This is particularly advantageous in case of the dental component been a dental implant that is anchored within the bone tissue of a patient since a revision of the implant is prevented.

Figure 8 illustrates another embodiment of a dental fastening tool 130. The screw engaging interface 140 at the distal end 132 of the dental fastening tool 130 also comprises convex sections 141 and concave sections 142, which form a circumferential engagement structure 144. The dental fastening tool 130 is configured for a dental screw preferably comprising an engagement structure with a corresponding number of convex and concave sections. As described above, the convex sections may also be at least partially planar.

Nonetheless, the dental fastening tool 130 particularly differs from the dental fastening tool 30 of the previous figures in terms of the screw engaging interface 140. In particular, the screw engaging interface comprises four of each of the convex and concave sections instead of five.

Turning to figure 9, the screw engaging interface 140 of the dental fastening tool 130 also differs in relation to the previous embodiments in that the pick-up zone 145a is separate from the torque transfer zone 145b. More specifically, the torque transfer zone 145b is located adjacent and distally to the pick-up zone 145a. In other words, the pick-up zone 145a does not overlap with the torque transfer zone 145b. The pick-up zone 145a basically has a conical shape for engagement with a corresponding pick-up zone of a dental screw by friction to facilitate handling of a dental screw as has already been described above.

Straumann USA Exhibit 1023

Although the torque transfer zone 145b of the dental fastening tool 130 of figure 9 has a concave shape similar to the pick-up zone 145a, it may alternatively have a cylindrical form as shown in another embodiment of a dental fastening tool 230 illustrated in figures 11 and 12 and described further down below.

In addition to the pick-up zone 145a and the torque transfer zone 145b, the dental fastening tool 130 comprises adjacent to its distal end 132 a verification zone 145c. On the one hand, this verification zone 145c has the function to prevent engagement with the tool engaging interface 120b of a dental screw 110b that does not comprise a verification zone with a corresponding shape (cf. figure 10b). Further, a dental screw 110b without a corresponding verification zone may also prevent engagement of a pick-up zone 145a since it will not be possible to insert the dental fastening tool 130 far enough into the tool engagement interface of this dental screw 110b for bringing these zones into engagement.

On the other hand, if a dental screw 110a comprises a corresponding verification zone such as the dental screw 110a in figure 10a, the dental fastening tool 130 is able to engage the tool engaging interface 120a of this screw.

Figures 11 and 12 illustrate yet another embodiment of a dental fastening tool 230 with a screw engagement interface 240 similar to the screw engaging interface 140 of the previous embodiment. However, in difference to the previous embodiment, the dental fastening tool 230 does not comprise a verification zone. Instead, the screw engaging interface 240 may only comprise a pick-up zone 245a and a torque transfer zone 245b. Although in the embodiment of a dental fastening tool 230 shown in figure 11 and in the embodiment of a dental fastening tool 130 shown in figure 10 the torque transfer zones 145b, 245b are located adjacent and distally to the pickup zones 145a and 245a, the skilled person will appreciate that this sequence may well be reversed. Thus, the pick-up

zones 145a, 245a may be located distally to the torque transfer zones 145b, 245b. Further, the pick-up zones 145a, 245a and the torque transfer zones 145b, 245b do not have to be adjacent to each other but may be spaced apart from each other.

For a cost-efficient production, the concave sections 242 are machined in a proximal direction beyond the screw engaging interface 240. As a result, the pick-up zone 245a basically has a conical shape that is interrupted by concave sections. However, this is functionally not necessary although it may provide a more defined friction between the pick-up zone 245a and a corresponding dental screw. The same applies to the dental fastening tools of the previous embodiments.

Figure 12 illustrates a frontal view of the dental fastening tool 230 as seen from the distal end 232. As illustrated in this figure, the screw engaging interface 240 comprises four convex sections 241 alternating with four concave sections 242. As already noted in relation to the previous embodiments, the convex sections 241 may instead be planar sections. In this exemplary embodiment, the convex sections 241 are curved and have in particular a circular shape as seen in a perpendicular cross-section in relation to the longitudinal tool axis LT.

As shown by way of example in figure 12, the angle α between a tangent to the convex sections and a tangent to the concave sections is at least close to the optimal angle of approximately 90 °for transfer as explained above. In other words, the angle α is in above-noted lower range. Thus, the configuration of the torque transfer zone 245b of the screw engaging interface 240 provides for an efficient transfer of torque and is less prone to wear during continued use and reuse. For keeping wear of the dental fastening tools of this disclosure low, at least the screw engaging interfaces and preferably the fastening tool is made of metal, in particular steel.

In difference to the dental fastening tool 30 of the previous figures, the screw engaging interface 240 is only engageable with the tool engaging interface of a dental screw if the longitudinal tool axis LT and the longitudinal axis are basically in alignment. As described above, this alignment may be facilitated by providing chamfers at the entrance to the tool engaging interface of a dental screw.

Figure 13 is a schematic longitudinal cross-section of a threaded engagement between a dental component, in particular a dental implant 301, and a dental screw 310. Naturally, this configuration is applicable for any combination of a dental component and a dental screw.

In a tightened state, a distal flank 303 of the dental implant's thread is in tight contact with a proximal flank 318 of the dental screws threaded portion 316. Thus, the force provided by tightening the dental screw 310 to fasten another dental component to the dental implant 301 is transferred as contact force between the thread flanks 303 and 318.

In the configuration of this disclosure, the threaded hole of the implant 301 and the outer thread of the dental screw 310 are dimensioned so that the overlap of the dental flanks, indicated in figure 13 as black continuous lines, is at least 70% of the length of each of the thread flanks in a radial direction. The length of the thread flanks in a radial direction is defined as the length between the tip of a thread and its root that allows for transfer of forces in a longitudinal direction of the threaded screw shaft of the dental screw or threaded hole of the dental component. For comparison, normal threads such as threads according to the ISO-standard only have an overlap of at least 60%.

Further, the overlap of the threaded connection according to this embodiment is up to 90%, 93%, and preferably 96%. Nonetheless, it is particularly the difference in minimum overlap of 10% in comparison to ISO-threads that allows for a

significantly improved strength of the thread. This result enables a more compact design of the dental screw 310 since the transfer of compressive forces within this threaded connection is more effective.

Figure 14 shows a partial cross-sectional view in a longitudinal direction along the longitudinal screw axis LS. It illustrates an abutment 402 that is fastened to a dental implant 401 via a dental screw 410. As described above, the torque limiting portion of a dental screw according to the present disclosure is dimensioned to transfer at least a minimum amount of torque. Further, the dental screw is configured for a controlled failure at torque values that exceed a maximum torque value.

When fastening the dental screw 410 of figure 14 to the dental implant 401, a support surface 417 of the screw head 413 at the distal end of the screw head 113 is pressed against a screw seat 404 of the dental abutment 402. As a result of the contact established between the support surface 417 and the screw seat 404, a part of the torque transferred from a dental fastening tool (not shown) via the tool engaging interface 420 of the dental screw 410 is transferred to the abutment 402.

As also shown in figure 14, the screw seat 404 and the support surface 417 have a conical shape. The conical shape of the screw seat 404 and the conical shape of the support surface 417 have cone angles that differ from each other. Preferably, the cone angle of the support surface 417 is larger than the cone angle of the screw seat 404. However, a configuration, in which the cone angles are dimensioned vice versa is alternatively possible. The difference between the cone angles of the support surface 417 and the screw seat 404 is indicated as γ in figure 14.

Due to this angle γ, a contact between the support surface 417 and the screw seat 404 is essentially established by a

line contact. This is on the one hand advantageous since such a line contact causes less torque to be transferred from the dental screw 410 to the abutment 402. On the other hand, the torque transferred and not used to tighten the threaded connections can be more accurately determined. Both advantages allow for a more predictable behavior of a torque limiting portion of the dental screw 410. In other words, this configuration renders the failure of the dental screw 410 at the torque limiting portion more reliable and, thus, may contribute to a more compact design of the dental screw 410.

As previously described, the gap created due to the difference γ between the cone angles may at least partially be closed at the end of fastening process of the dental screw 410. This closure of the gap is caused by deformation of the screw seat 404 and the support surface 417 and further decreases the amount of torque that is transferred towards the threaded portion of the dental screw 410 in relation to the amount of torque that is transferred to the abutment 402. This change in transfer ratio has a dampening effect during the application of torque and enables a more precise adjustment of the maximum torque at the end of fastening the threaded connection between the dental screw 410 and the dental implant 401. Thus, these features of the screw seat 404 and the support surface 417 and their configuration in a dental assembly also enable a more compact design for the dental screw 410.

REFERENCE SIGNS

The following lists the last two digits of the reference signs used in the description and the drawings. Throughout the drawings these digits refer to features that have the same or an equivalent function and/or structure. The preceding digit represents the embodiment.

1 dental implant

2	abutment
3	flank of threaded hole
4	screw seat
10	dental screw
11	proximal end
12	distal end
13	screw head
14	screw shank
15	torque limiting portion
16	threaded portion
17	support surface
18	flank of threaded portion
20	tool engaging interface
21	convex section
22	concave section
23	point of transition
24	engagement structure of dental screw
25a	pick-up zone
25b	torque transfer zone
25c	verification zone
26	circle with maximum inner diameter
27	chamfer
30	fastening tool
31	proximal end
32	distal end
33	rounded tip
35	torque limiting portion
36	shank
40	screw engaging interface
41	convex section
42	concave section
44	engagement structure of fastening tool
45a	pick-up zone
45b	torque transfer zone
45c	verification zone
LS	longitudinal axis of screw
LT	longitudinal axis of fastening tool

α	angle at point of transition between tangent to convex section and tangent to concave section
β	rotational play between dental screw and fastening tool
γ	difference in cone angle between screw seat and support surface of screw head

Straumann USA Exhibit 1023

CLAIMS

1. A dental screw (10) for fixing dental components (1, 2) to each other, the dental screw having a proximal end (11), a distal end (12), and a longitudinal axis (LS), wherein the dental screw further comprises a screw head (13) including a tool engaging interface (20) for engaging a fastening tool (30) at the proximal end and distally to the screw head a screw shank (14), the screw shank comprising a torque limiting portion (15) and distally to the torque limiting portion a threaded portion (16) for engaging a dental component (1, 2), wherein the dental screw is configured to transfer a minimum torque of 26 Ncm and the torque limiting portion is configured to limit the torque transferable to a maximum torque for preventing damage to the threaded portion.

2. The dental screw (10) according to claim 1, wherein the torque limiting portion (15) has the smallest section modulus along the shank.

3. The dental screw (10) according to claim 1 or 2, wherein the maximum torque transferable at the torque limiting portion (15) is 38 Ncm, 36 Ncm, 34 Ncm, or 32 Ncm.

4. The dental screw (10) according to any one of the preceding claims, wherein the torque limiting portion (15) is configured to withstand a maximum tensile force in a range of 300 N to 500 N and preferably in a range of 350 N to 450 N.

5. The dental screw (10) according to any one of the preceding claims, wherein the tool engaging interface (20) includes a torque transfer zone (25b) having a cross-section perpendicular to the longitudinal axis (LS) comprising a profile with four or five convex and/or planar sections (21) alternating with four or five concave sections (22), respectively.

6. The dental screw (10) according to claim 5, wherein the

convex sections (21) and concave sections (22) form longitudinal engagement protrusions (24) radially extending from a circle with a maximum inner diameter (26) towards the longitudinal axis (LS), the engagement protrusions preferably having chamfers (27) at their proximal ends.

7. The dental screw (10) according to any one of the preceding claims, wherein the tool engaging interface (20) includes a pick-up zone (25a) that tapers in a direction from the proximal end (11) to the distal end (12) of the dental screw, the pick-up zone preferably being located adjacent, proximally to, and/or at least partially along the torque transfer zone (25b).

8. The dental screw (10) according to any one of the preceding claims, wherein the tool engaging interface (20) further includes a verification zone (25c) for verifying the type of the dental screw (10), the verification zone preferably being located at the distal end of the tool engaging interface.

9. A dental fastening tool (30), the dental fastening tool having a proximal end (31), a distal end (32), and a longitudinal axis (LT), wherein the dental fastening tool comprises a screw engaging interface (40) at the distal end for engaging a dental screw (10), in particular a dental screw according to any one of the preceding claims, and proximally to the screw engaging interface a torque limiting portion (35), the torque limiting portion being configured to limit the torque transferable to a maximum torque for preventing damage to the screw engaging interface.

10. The dental fastening tool according to claim 9, wherein the torque limiting portion (35) is configured to bear a maximum torque of 35 Ncm or less, preferably in a range of 27.5 Ncm to 34 Ncm and more preferably in a range of 28 Ncm to 33 Ncm.

11. The dental fastening tool (30) according to claim 9 or 10, wherein

the screw engaging interface (40) includes a torque transfer zone (45b) with a cross-section perpendicular to the longitudinal axis (LT) comprising four or five convex and/or planar sections (41) alternating with four or five concave sections (42), respectively, and

the convex and/or planar sections (21) and concave sections (22) form an engagement structure (44) about the longitudinal axis (LT) along the dental fastening tool, the engagement structure preferably having a curved profile in a cross-section along the longitudinal axis (LT).

12. The dental fastening tool (30) according to claim 11, wherein the convex and/or planar sections (41) and concave sections (42) are connected at points of transition (43), and at each point of transition an angle (α) between a tangent to the profile of the concave section and a tangent to the convex section or the planar section is in a range of 90° to 180° or to 160°, preferably 95° to 150°.

13. The dental fastening tool (30) according to any one of claims 9 to 12, wherein the screw engaging interface (40) includes a pick-up zone (45a) for holding a dental screw (10), the pick-up zone preferably being located adjacent, proximally to, and/or at least partially along the torque transfer zone (45b).

14. The dental fastening tool (30) according to any one of claims 9 to 13, wherein the screw engaging interface (40) further includes a verification zone (45c) for verifying the type of a dental screw (10) when engaging said dental screw, the verification zone preferably being located at the distal end of the tool engaging interface.

15. A dental fastening set comprising:

a dental screw (10), in particular a dental screw according to any one of claims 1 to 10, and

Straumann USA Exhibit 1023

a dental fastening tool (30), in particular a dental fastening tool according to any one of claims 11 to 15,

wherein the dental screw and the dental fastening tool each comprise a torque limiting portion (15, 35), wherein the torque limiting portion (15) of the dental screw is configured to bear a maximum torque that is higher than the maximum torque that is transferable by the torque limiting portion (35) of the dental fastening tool.

16. The dental fastening set according to claim 15,

the dental screw (10) comprising a tool engaging interface (20), wherein the tool engaging interface includes a torque transfer zone (25b) with a cross-section comprising convex and/or planar sections (21) alternating with concave sections (22); and

the dental fastening tool (30) comprising a screw engaging interface (40), wherein the screw engaging interface includes a torque transfer zone (45b) with a cross-section comprising convex and/or planar sections (41) alternating with concave sections (42),

wherein in an engaged state of the dental screw and the dental fastening tool for transferring torque, at least an intermediate section of each of the convex and/or planar sections of the dental screw faces a profile of a concave section (22) of the tool engaging interface (20) at a distance.

17. The dental fastening set according to claim 15 or 16, wherein the torque transfer zone (25b) of the dental screw (10) and the torque transfer zone (45b) of the dental fastening tool (30) have a rotational play when being engaged with each other, in particular a play in a range of 1° to 3.5° and preferably 1.5° to 3°.

18. The dental fastening set according to any one of claims 15 to 17, wherein the dental screw (10) and the dental fastening tool (30) each comprise a pick-up zone (25a, 45a) configured to engage each other by friction.

19. The dental fastening set according to any one of claims 15 to 18, wherein the dental screw (10) and the dental fastening tool (30) each comprise a verification zone (25c, 45c) configured to allow engagement of the torque transfer zone (45b) of the dental fastening tool (30) and the torque transfer zone (25b) of the dental screw (10) when the dental fastening set is fully engaged.

20. A dental restoration support set comprising a dental screw according to any one of claims 1 to 10, and a dental component (1; 2), wherein the dental component is in particular a dental implant (3), an abutment (2), and/or an artificial tooth.

Straumann USA Exhibit 1023

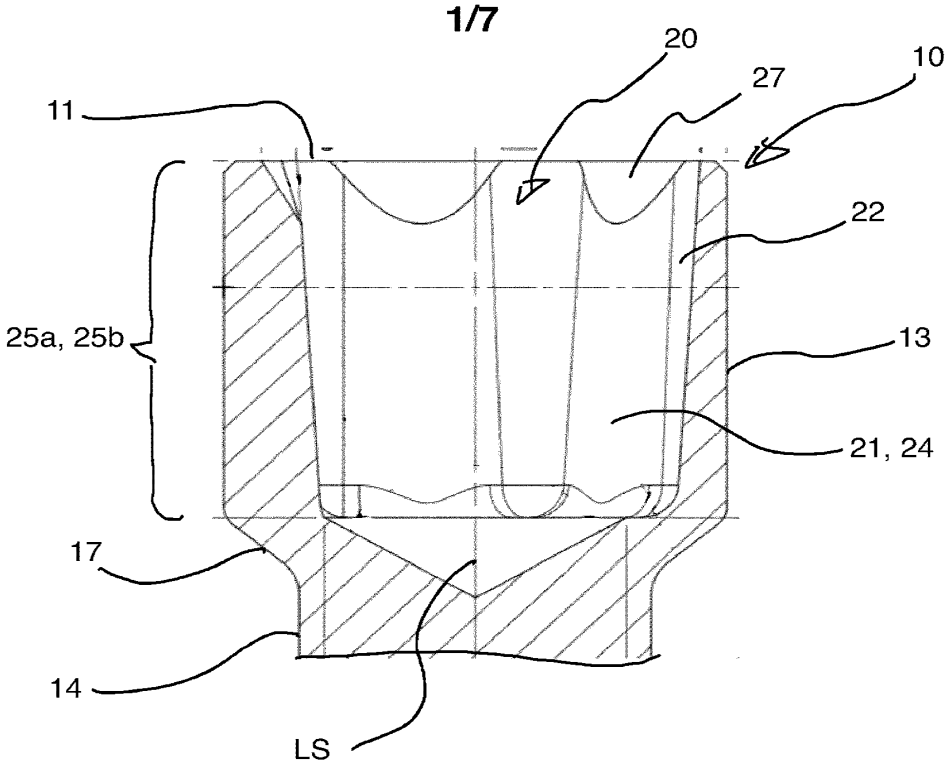


Fig. 1

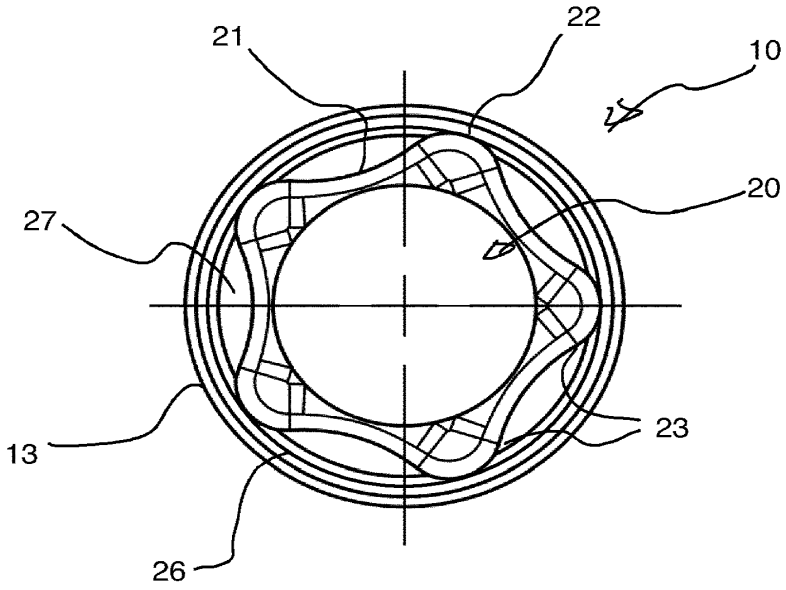


Fig. 2

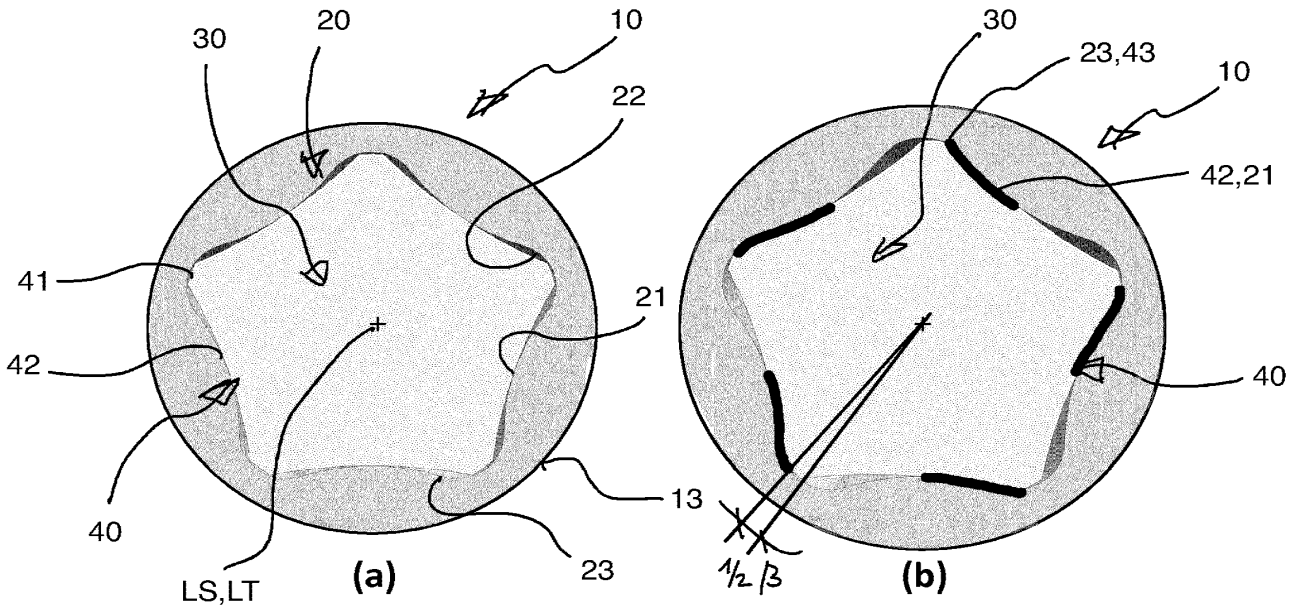

30
20
10
22
41
21
42
40
13
23
LS,LT
(a)
30
23,43
10
42,21
40
½ β
(b)

Fig. 3

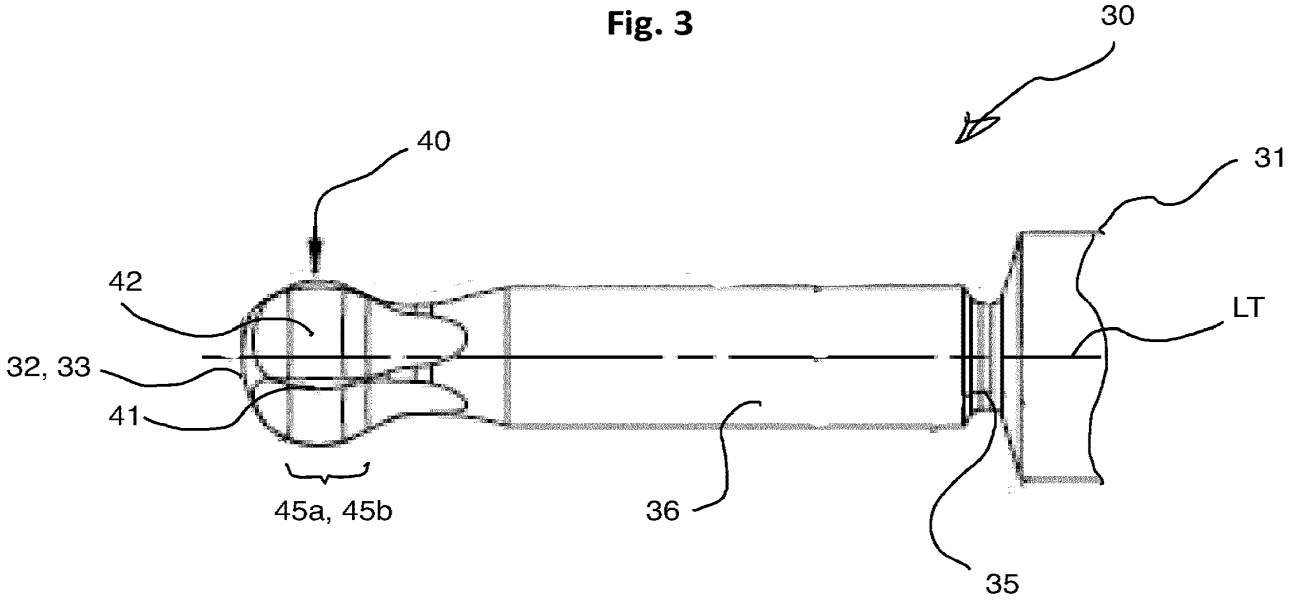

30
40
31
42
LT
32, 33
41
45a, 45b
36
35

Fig. 4

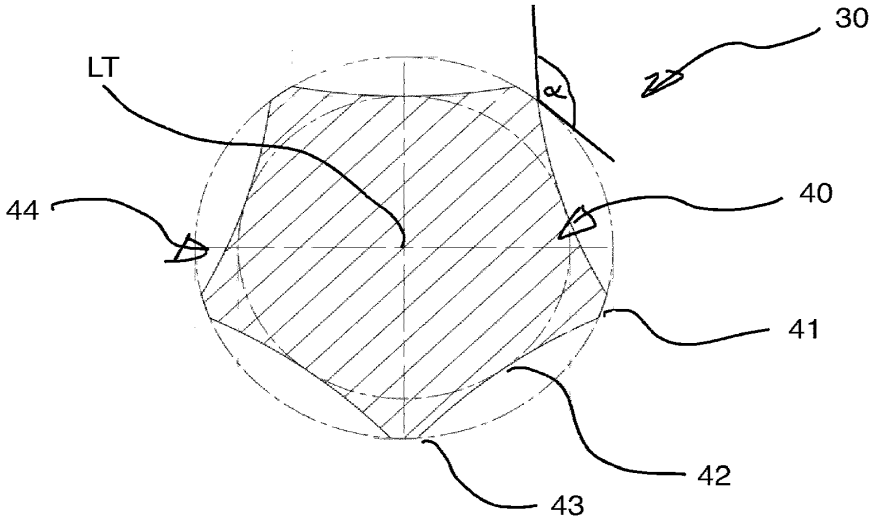


Fig. 5

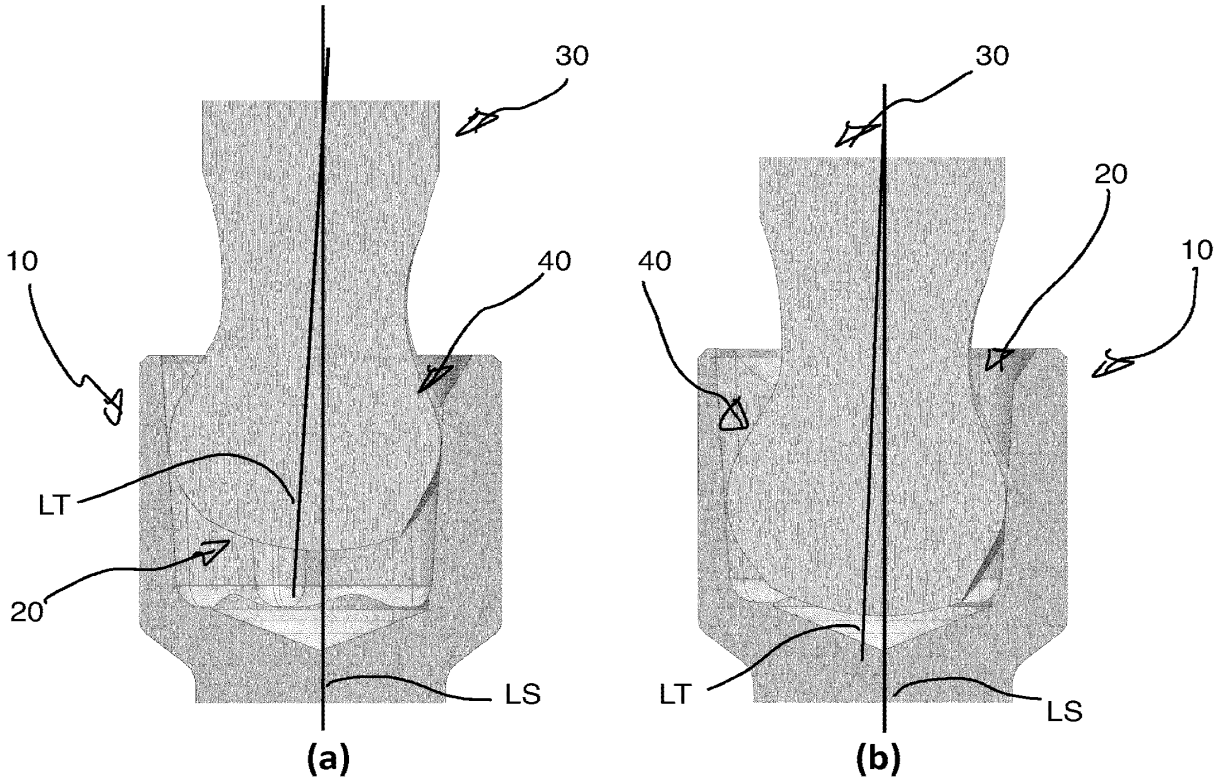


Fig. 6

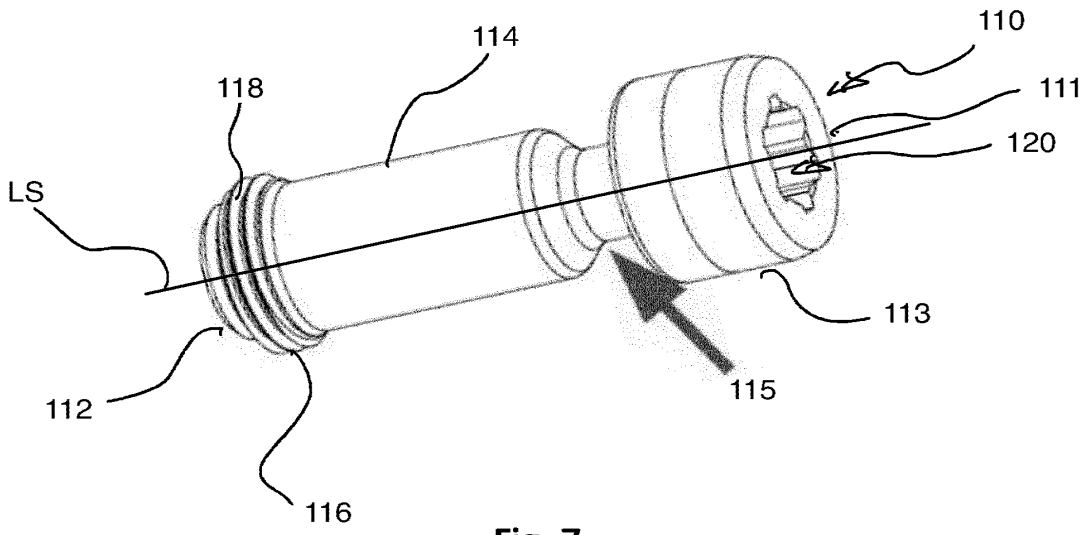

110
114
118
111
120
LS
113
115
112
116

Fig. 7

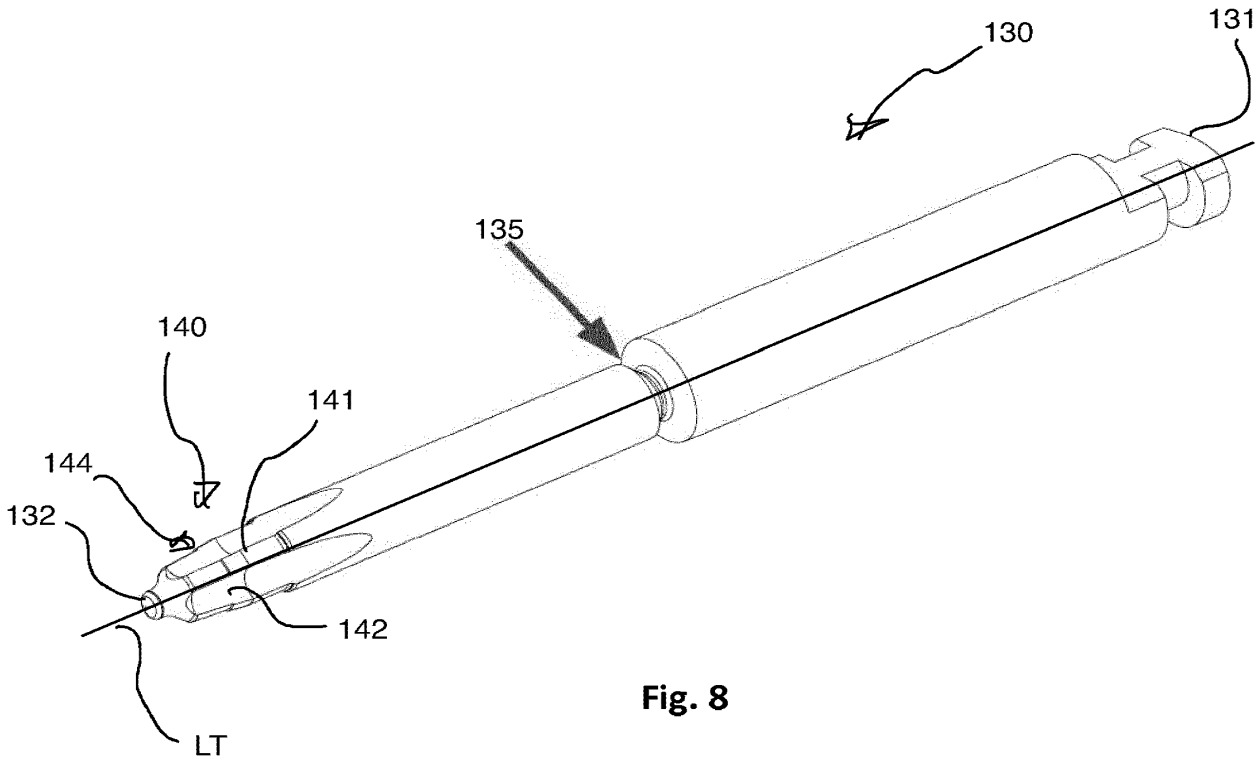

130
131
135
140
141
144
132
142
LT

Fig. 8

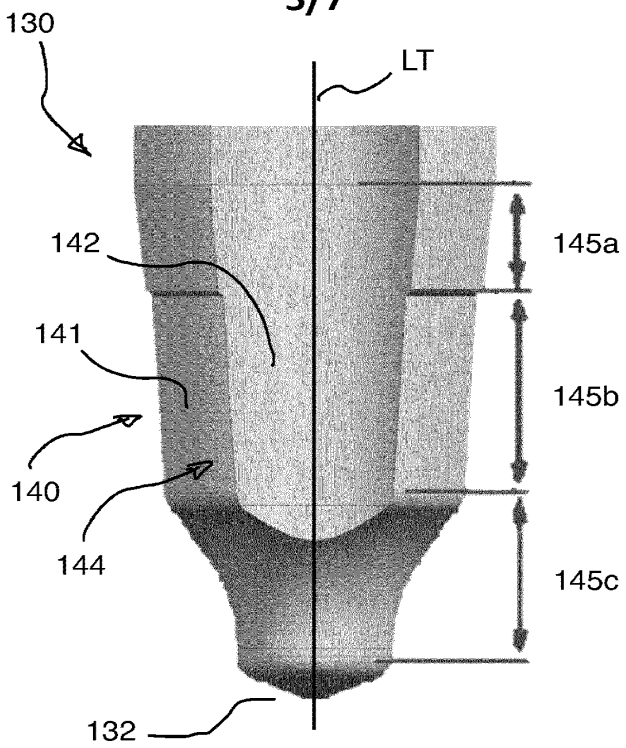

130
LT
142
145a
141
145b
140
144
145c
132

Fig. 9

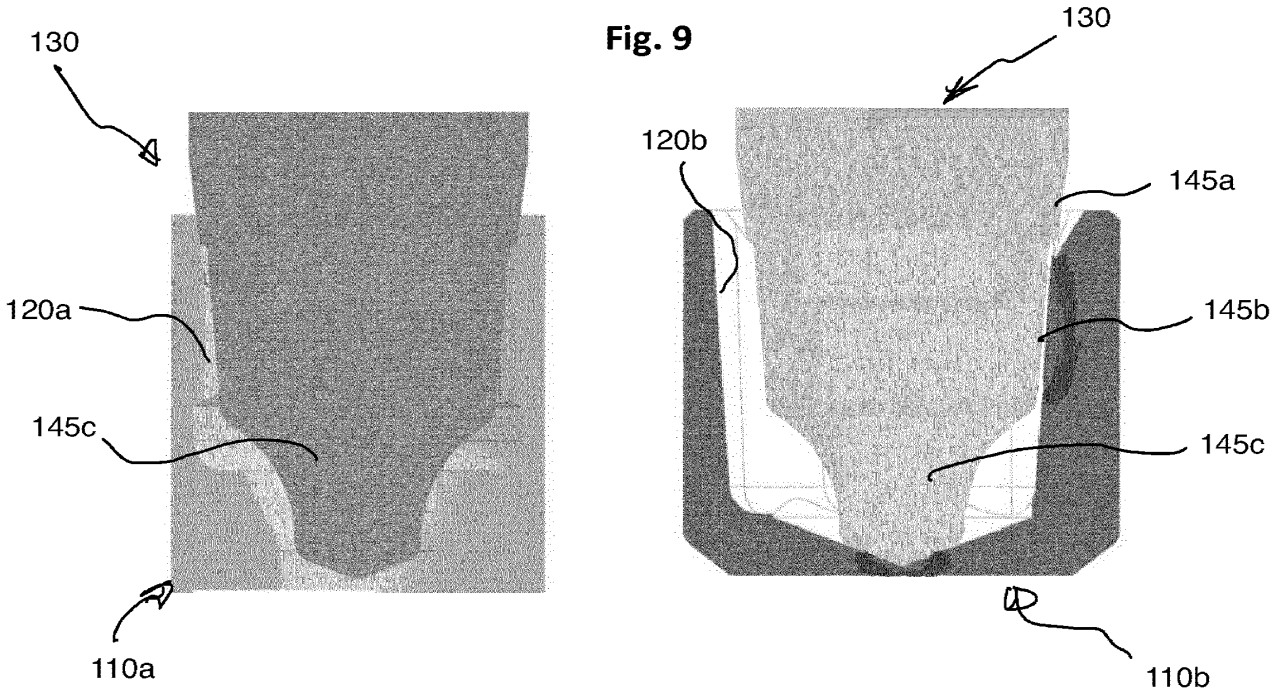

130
120a
145c
110a
(a)
130
120b
145a
145b
145c
110b
(b)

Fig. 10

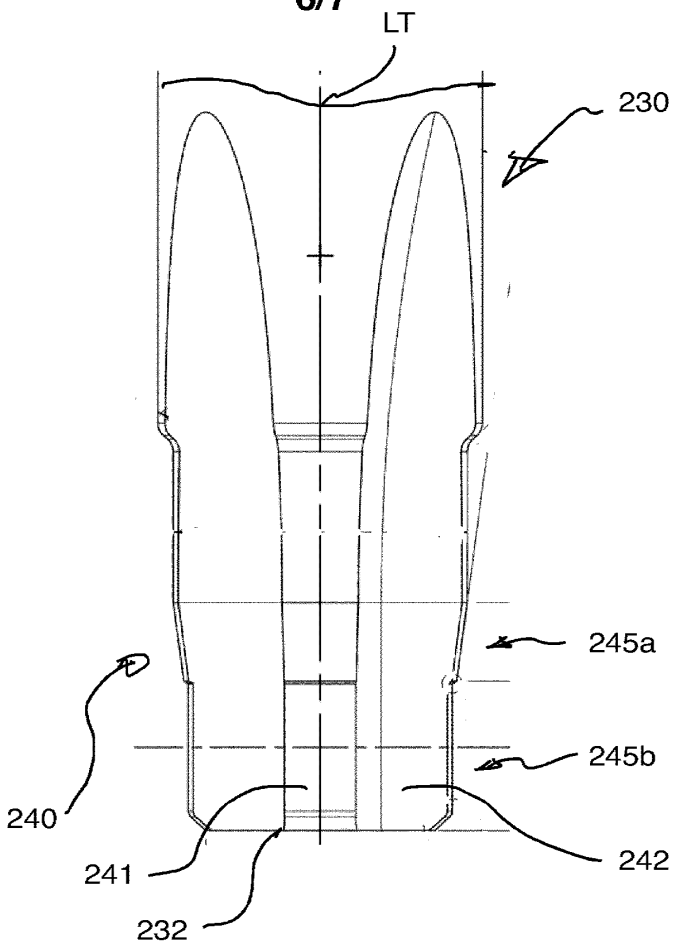


Fig. 11

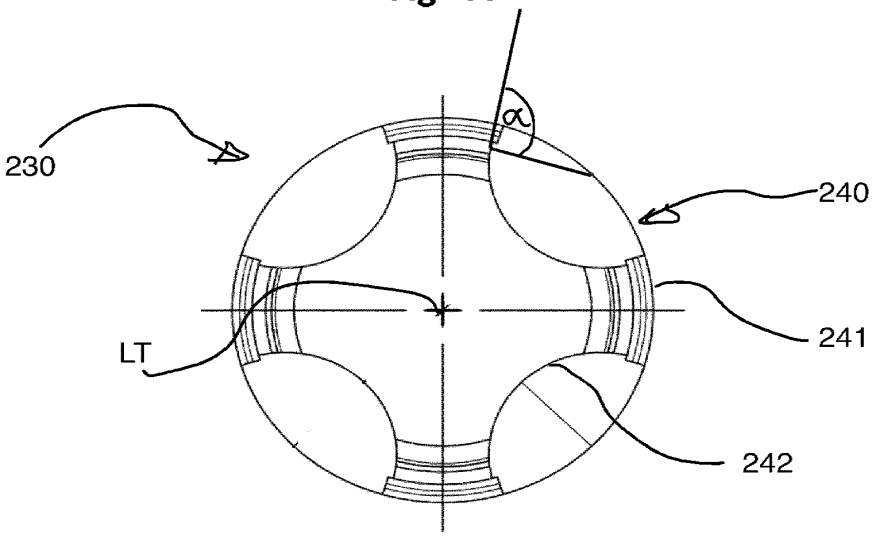


Fig. 12

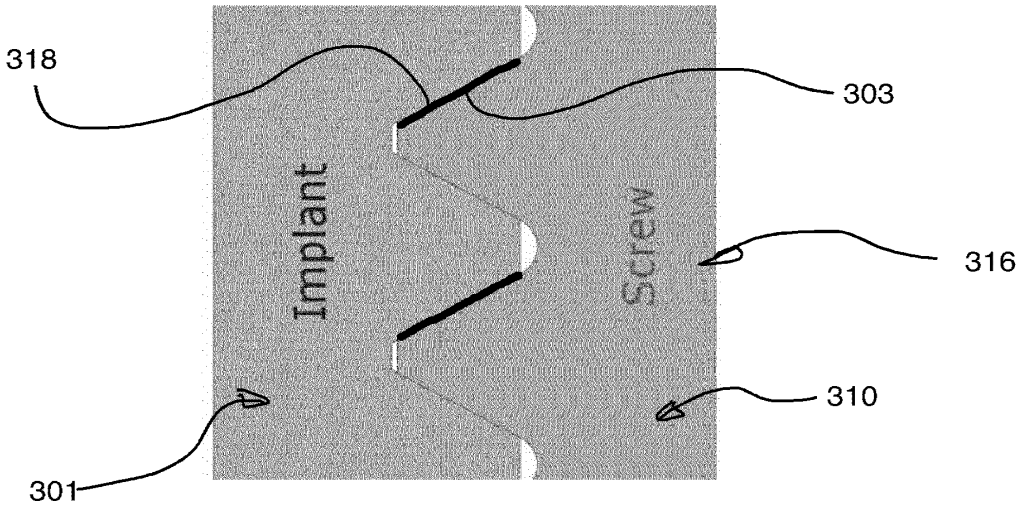

318
303
Implant
Screw
316
310
301

Fig. 13

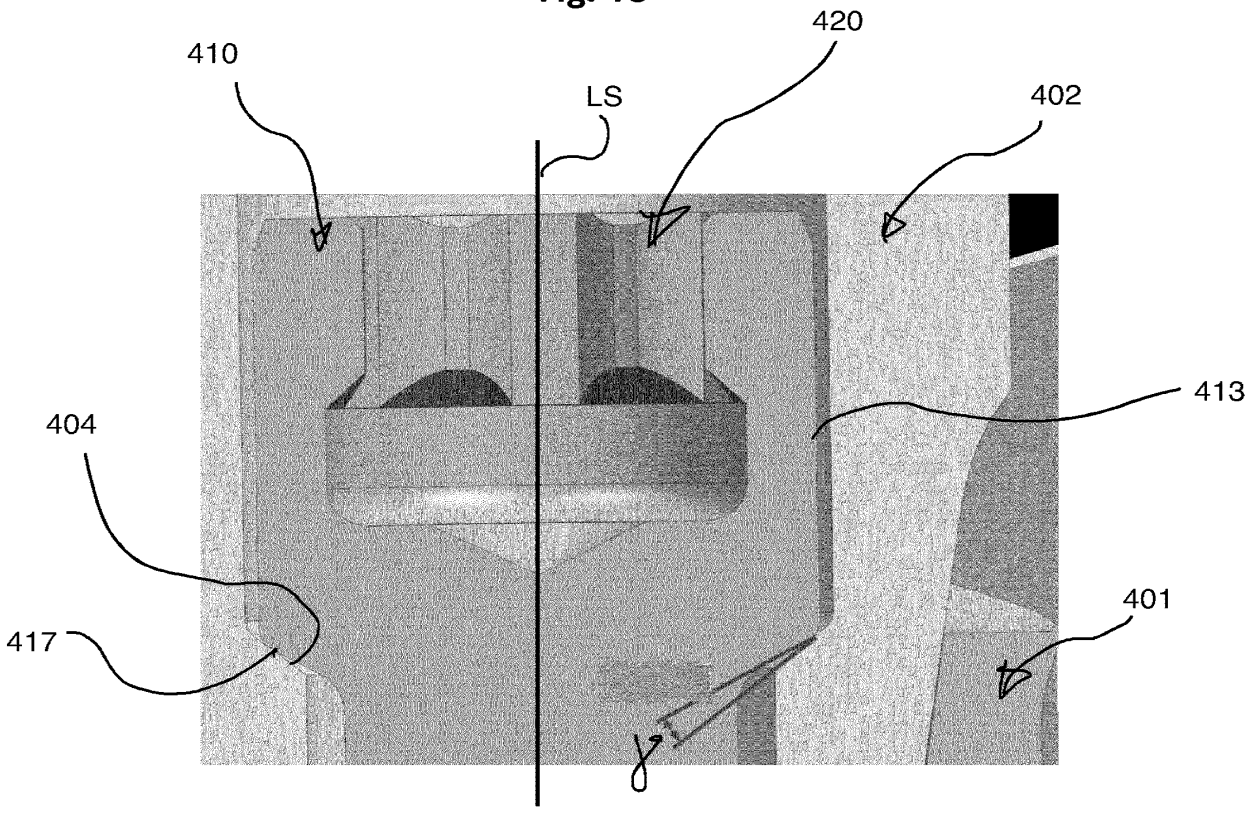

410
LS
420
402
404
413
417
401

Fig. 14

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2020/067467

A. CLASSIFICATION OF SUBJECT MATTER
INV. A61C8/00 A61B17/88 A61B90/00
ADD. A61C1/18

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 A61B

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

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X Y A	DE 198 50 097 A1 (WIELAND EDELMETALLE [DE]) 4 May 2000 (2000-05-04) paragraphs [0032], [0007] - [0013], [0025]; claims 11, 21-23; figures 3, 4 -----	9,10,12, 14 11,13 15-19
Y	WO 2018/091515 A1 (LABORATOIRE DENTAIRE HORNBECK JACQUES S A R L [LU]) 24 May 2018 (2018-05-24) cited in the application paragraphs [0008], [0016] - [0018], [0030] - [0033] ----- -/--	5-7,11, 13

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"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
3 September 2020	18/09/2020

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	Ardhuin, Hélène

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INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2020/067467

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	US 5 295 831 A (PATTERSON CHAD J [US] ET AL) 22 March 1994 (1994-03-22) column 3, line 45 - column 5, line 11	9,10
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A	US 2003/228556 A1 (GIORNO THIERRY M [FR]) 11 December 2003 (2003-12-11) paragraphs [0034] - [0036]	1-20

1

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2020/067467

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Implant thread designs: An overview

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Dental treatment aims partial or total replacement of the damaged or diseased tooth structure to restore the function and esthetics. Over the years, several methods have been employed for this purpose and among these implants have become popular in the recent past.[1] Formation of direct contact between the implant and the surrounding bone i.e., osseointegration is considered as the essential parameter that determine the clinical success of dental implants.[2] According to Alberktson et al, the six most important factors for establishing a reliable osseointegration are implant material, implant design, surface quality, bone status, surgical technique and loading conditions.[3]

Presently there are many implant body designs available and they may be categorized as cylinder, screw, press fit or a combination of features. Cylinder or press fit implant has a friction fit insertion and encounter less risk of pressure necrosis caused due to high insertion pressure. There is no need to bone tap (even in dense bone), and may have the cover screw already in place because no rotational force is required to insert the implant. As a result, cylinder or press fit designs were very popular in the 1980s and were reported to have high initial success rates. However, after 5 years of loading, cylindrical implants had loss of crestal bone and subsequent implant failure. This is related to fatigue over load and harmful shear loads on the bone necessitating large turnover rates and ultimately resulted in less bone implant contact and higher risk of overload failure.[4,5]

Implant body designs with threaded features have the ability to convert occlusal loads into more favorable compressive loads at the bone interface.[4] Bolind et al had evaluated 85 cylinder implants and 85 threaded (machined) implants retrieved from human beings and observed that the bone-implant contact (BIC) was greater in threaded implants, and greater marginal bone loss was observed in the cylinder implants.[6] Huang et al observed that threaded implants could reduce both bone stress and implant bone sliding distance. Thus potentially improving initial implant stability and long term survival.[7] Implant threads are designed to maximize initial contact, provide primary stability, enhance surface area, cause compression of bone, facilitate dissipation of loads at the bone – implant interface and minimize the micro movement to hazen osseointegration.[4]

Thread geometry:

Functional surface area per unit length of the implant may be modified by varying three geometric thread parameters: thread pitch, thread shape, and thread depth and width[4] (Fig: 1).

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Straumann USA Exhibit 1023

Thread pitch:

Thread pitch is the distance measured between adjacent threads, measured on the same side of the axis. It also refers to the number of threads per unit length. Therefore, when implants have the same length, smaller pitch indicates more threads, leading to greater surface area[4,5,8] (Fig: 2).

Another geometric parameter related to thread pitch is lead. Lead is the distance that a screw would advance in the axial direction per one complete revolution. Several manufacturers advertise implant bodies with double or triple thread leads (e.g., Zimmer, Nobel Biocare). These terms relate to the manufacturing process and do not increase functional surface area. Rather than machining one thread at a time with one cutting instrument, a double thread uses two cutting blades and a triple thread uses three blades. In a single-threaded screw, lead is equal to pitch, however in a double threaded screw, lead is double

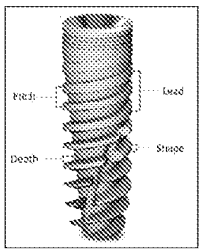


Fig. 1: *Geometric implant thread parameters*

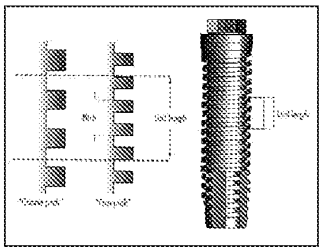


Fig. 2: *The implant on the right has smaller thread pitch and greater surface area, whereas the implant on the left has a larger thread pitch and less surface area.*

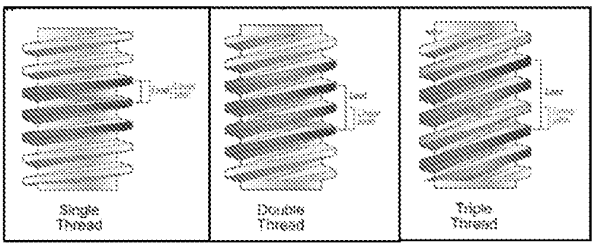


Fig. 3: *This figure illustrates the thread configuration in relation to thread number, pitch and lead. Single threaded implants have an equal thread pitch and lead. Double-threaded implants have a lead that is double the pitch. Triple-threaded implants have a lead that is triple the pitch.*

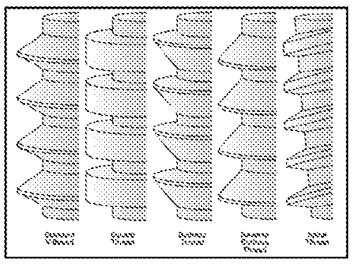


Fig. 4: *Currently available implant thread pattern types*

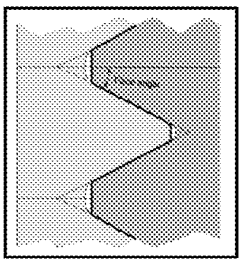


Fig. 5: *Face angle*

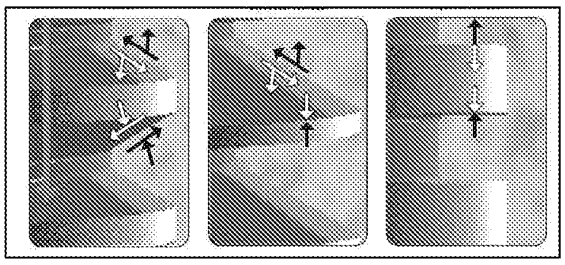


Fig. 6: *Direction of forces generated at the implant and bone interface resulting from axial loading.*

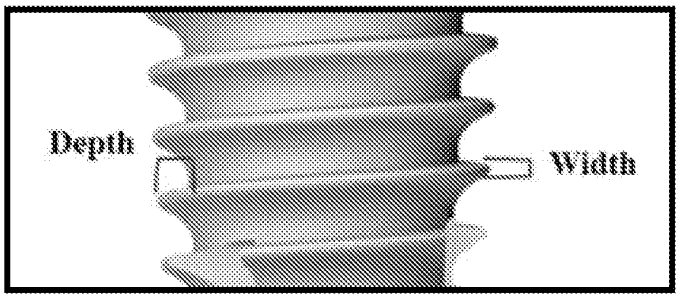


Fig 7: *Implant thread width and depth*

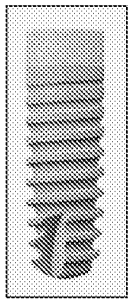


Fig. 8: Implant with progressive threads (greater depth in apical portion and lesser depth in coronal portion)

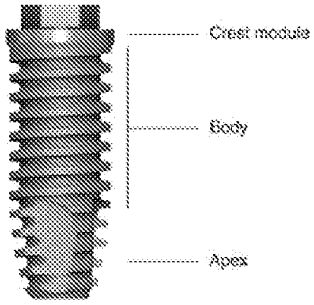


Fig. 9: *Crest module*

Straumann USA Exhibit 1023

Table 1: *Available literature on thread pitch*

Authors	Method	Implants	Bone	Load	Conclusion
Roberts et al. (1984)9	Femur of Rabbits	V-shape threads	Natural bone: cortical and cancellous	100 grams horizontal	Higher BIC was observed with implants with greater thread number. The lower the pitch the higher the BIC
Chun et al. (2002)10	FEA	Plateau type, plateau with small curvature, triangular with 0.7-mm pitch, square with 0.9-mm pitch, square with small radius	Jaw bone model	100N axial and 15°	Effective stress decreases as screw pitch decreases and as implant length increases.
Liang et al. (2002)[11]	FEA				Implant length had higher influence than thread pitch on stress distribution
Motoyoshi et al. (2005)[12]	FEA	Titanium mini-implants with thread pitches from 0.5 to 1.5mm	Cortical bone	Traction force of 2N 450 to the bone surface	No difference when no abutment was connected. When the abutment was connected the best stress distribution was related to the lower pitch distance
Kong et al. (2006)[13]	FEA	V-shaped thread pitches from 0.5 to 1.6mm	Jaw bone models	Axial load and bucco-lingual load	Stress decreased with lower pitch from 1.6 mm up to 0.8 mm. Thread pitch with less than 0.8mm showed more stress. Thread pitch affects stress more significantly incancellous bone.
Ma et al. (2007)[14]	FEA	Identical implants with different thread pitches (0.8, 1.6, 2.4mm)		Vertical and horizontal loading	0.8mm pitch showed a stronger resistance to vertical load
Chung et al. (2008)[15]	Beagle dogs	Branemark with 0.6 mm pitch, machined surface with 0.5 mm pitch, thermally oxidized surface with 0.5 mm pitch	Natural bone: cortical and cancellous	6–12 months of loading	0.6mm pitch had more crestal-bone loss than the 0.5mm pitch. Mean crestal bone resorption was greatest in the Branemark group. The percentage of BIC was highest in the thermally oxidized implants.
Lee et al (2010)16	FEA	Implants with thread pitches 0.5, 0.6 and 0.8mm	Jaw bone model	Axial load of 100N and oblique load of 100N at 150 incline to implant axis	Square thread with 0.6mm pitch has optimal contact area and stress distribution on marginal bone
Orsini et al. (2012)[17]	Sheep iliac crest	"Narrow-pitch" implant (0.5 mm), "wide-pitch" implant (1.7 mm)	Natural bone: cortical and cancellous	8 weeks of loading	Increasing the implant surface area by using implants with smaller pitch might be beneficial to improve primary stability in cancellous bone.
Lanet al. (2012)[18]	FEA	Triangular with pitches of 0.8, 1.2, 1.6 mm, trapezoidal with pitches of 1.2, 1.6 mm		143 N axial and oblique load	Optimal thread pitch values for triangular and trapezoidal implants were 1.2 mm and 1.6 mm respectively. Thread pitch with more than 0.8 mm exhibited better results for a screwed implant.
Ormianer (2016)[19]	Humans	implants with thread pitches 1.05mm and 0.6mm			Implants with larger pitch showed less long term bone loss

Straumann USA Exhibit 1023

Table 2: *Available literature on thread shape*

Study	Method	Thread shape	Load	Conclusion
Chun et al. (2002)[10]	FEA	Plateau type, plateau with small radius of curvature,triangular, square and square filleted with small radius	100N axial and 150	Plateau shape had maximum effective stress, square thread filleted with small radius had minimum stress
Geng et al. (2004)[21,22]	FEA	V-thread, thin thread, two square threads of 0.24 mm and 0.36 mm thread widths	141 N oblique load at 45°	V-thread and thick square thread had significantly less stress in cancellous bone.
Steigenga et al. (2004)[23]	Tibia, Rabbits	Square thread, V-shaped and reverse buttress	No intentional loading	Square-thread design achieved greater BIC
Erslanet al. (2010)[24]	FEA	V-thread, buttress, reverse buttress, square thread	100 N axial load	Maximum stress was located at cervical cortical bone regions next to the first thread. The maximum von Mises stress value of the square thread type was lowest.
Lee et al (2010)[16]	FEA	Symmetrical, square and buttressed thread designs	Axial load of 100N and oblique load of 100N at 150 incline to implant axis	The contact area of the square thread was the highest. The maximal stress of the square thread was the least
Chang et al. (2012)[25]	FEA	Acme (trapezoidal) thread, buttress thread, square thread, standard V-thread	300 N axial load	All micromotion was located near the interface of cortical and cancellous bone. An implant with an square thread profile might provide the best primary stability under immediate loading.
McAllister et al. (2012)[26]	Human, 55 patients	Variable-thread tapered implant (Nobel Active, Nobel Biocare)	Immediate loading, 24-month follow-up	The variable-thread tapered implant can be a safe and effective treatment option.
Arnhartet al. (2012)[27]	Human, 177 patients	Variable-thread tapered – NAI (Nobel Active internal connection), NAE (Nobel Active external connection) Standard tapered – NR(Nobel Replace)	Immediate loading, 36-month follow-up	Variable-thread design showed results comparable to those of standard tapered implants.
Oswalet al (2016)[28]	FEA	V-thread, buttress, and reverse buttress thread designs	100 N axial load	Minimum Von Mises stresses were seen with reverse buttress thread design at the cortical bone.
De Andrade et al (2017)[29]	FEA	square, trapezoidal, and triangular thread designs	200 N axial occlusal load	a triangular thread design results in lower stress when compared with square- or trapezoidal-shaped threads in a simulated bonded bone-to-implant contact surface.

Straumann USA Exhibit 1023

the pitch and in a triple-threaded lead is triple the pitch (Fig: 3). As a result, when a one thread lead implant rotates once, the implant inserts a distance of one thread. A double-thread implant at 1 rpm inserts two threads into the bone. An implant with double threads would insert twice as fast the single threaded and the triple threaded would only need a third of the required time for a single thread.[3,4] The available literature on thread pitch is summarized in Table 1.

Thread shape:

In general, bone is constantly remodeling itself to adapt to external stimuli in the surrounding environment, this is known as bone homeostasis. In 1892, Wolff observed a direct association between bone form and mechanical loading and proposed his theory that 'every change in the form and function of bone or its function alone is followed by certain definite changes in the external form and internal architecture of bone. His theory entails that with increasing stresses new bone formation occurs, while a decreased stress leads to bone loss. However, other authors have questioned this theory after demonstrating that bone resorption also occurs under extreme stresses.[3]

When an implant receives optimal functional load, the surrounding bone experiences remodeling and produces woven bone. However, under extreme adverse stresses, microfractures occur in the alveolar bone inducing "osteoclastogenesis". Since bone formation is not fast enough to fill in the damage, the defect becomes worse, resulting in severe bone loss and ultimately implant failure. However, optimal stress distribution is difficult to achieve, and too little or high stress can induce bone resorption.[8] Hence, implant threads should be designed to maximize the delivery of optimal favorable stresses while minimizing the amount of extreme adverse stresses to the bone implant interface. In addition, implant threads should allow for better stability and more implant surface contact area.[3]

The type of force applied at the implant – bone interface may influence the degree and strength of osseointegration. Three types of loads are generated at the interface; compressive, tensile and shear forces. In general, materials are strongest under compressive loads and weakest to shear loads. This is true for porcelain, dental cements, implant materials, fixation screws and bone. Compressive force increases the bone density and thus increases its strength. While, tensile and shear forces have been shown to result in weaker bone with shear being the least tolerated by bone. The type of force that is generated depends on the shape of the implant thread. Hence, an ideal implant thread design should provide a balance between compressive and tensile forces while minimizing shear force generation.[3]

Implant thread shape has also been found to influence the type of force transferred to the surrounding bone. Initial implants introduced had V- shape design. With the understanding of stress patterns, the variants of V- shape thread design came into existence. Presently available thread designs include; V-shape, square shape, buttress, reverse buttress and spiral shape (Fig: 4).

The face angle is the angle formed between a face of the thread and a perpendicular plane drawn to the long axis of the implant (Fig: 5). In the implant literature

Table 3: *Available literature on thread depth*

Study	Method	Thread depth and width	Load	Conclusion
Kong et al. (2008)[30]	FEA	Cylinder implants with height of 0.2-0.6 mm and width of 0.1-0.4 mm	100 N axial load and 50 N, 45° buccolingual load	The optimal values of thread depth and width were 0.34-0.5 mm and 0.18-0.3 mm respectively. Thread depth was also a more sensitive factor to reduce the peak stress concentration within the bone.
Aoet al. (2010)[31]	FEA	Cylinder implants with height of 0.2-0.6 mm and width of 0.1-0.4 mm	100 N axial load and 30 N, 45° buccolingual load	Thread depth affected the stress distribution more significantly than thread width. Threads with depth of more than 0.44 mm and width of 0.19-0.23 mm showed the most favorable results.

Straumann USA Exhibit 1023

the most studied face angle is that of the apical face where most of the loading forces are dissipated.[3,20] The face angle of the thread or plateau in an implant body can modify the direction of occlusal load imposed on the prosthesis and abutment connection to a different direction at the bone interface.

The amount of shear force generated by the different thread shapes increases as the thread face angle increases. Misch et al. (2008) suggested that V and reverse buttress thread have 300 and 150 angle respectively, whereas square thread may be perpendicular to long axis (00). Hence V-shape threads generate higher shear force than both reverse buttress and square thread, with square thread generating the least shear force. In squared and buttress threads, the axial load of these implants are mostly dissipated through compressive force, while V-shaped and reverse buttress-threaded implants transmit axial force through a combination of compressive, tensile and shear forces.[5] A shear force in a V – thread and reverse buttress thread is 10 times greater than the shear force on a square thread. The reduction in shear loading at the thread bone interface provides for more compressive load transfer, which is particularly important in compromised bone density, short implant lengths, or higher force magnitude[4,5] (Fig: 6). The available literature on thread shape is tabulated in Table 2.

Thread depth and width:

According to Misch, thread depth is the distance between the major and minor diameter of thread. The thread depth can also be defined as the distance from the outermost tip of the thread to the body of the implant.

Table 4: *Available literature on crest module*

Study	Method	Crestal module	Load	Conclusion
Abrahamsson & Berglundh (2006)[35]	Beagle dogs	Similar implant with microthreaded or smooth crestal module	In occlusion for 10 months	BIC in the coronal portion was higher in the microthreaded group (81.8%) than in the control group (72.8%)
Lee et al. (2007)[36]	Human, 17 patients	Similar implant type with and without microthreaded crestal module	In occlusion Follow-ups up to 3 years	Marginal bone loss was lower in the microthreaded group
Schrotenboer et al. (2008)[37]	FEA	Implants with microthreaded crestal module vs. smoothneck	100N at 900 vertical and 150 oblique angle	Increase bone stress in the microthreaded implants
Amid et al. (2013)[38]	FEA	Implants with and without microthreads	100 N vertical load	Addition of microthread design at the implant neck decreased stresses in the surrounding bone.
Negriet al. (2014)[39]	Beagle dogs	1.5 mm polished collar (control) vs. 0.7 mm polished and 2.5 mm microthreaded collar (test)	1, 2, 3 months of immediate loading	Test group showed less crestal bone resorption
Calvo-Guiradoet al. (2015)40	Human, 53 patients	Microthreads up to the prosthetic platform (MIS Implants Inc)	Immediate loading, 3-year follow-up	The implant system used in this study had 100% survival rate and minimal marginal bone loss. The locations of microthreads played an important role in the stabilization process.
Chowdharyet al. (2015)[41]	FEA Rabbit tibia and femur	Oxidized titanium implants with and without microthread	4 weeks of loading	Microthreads promote bone formation and contribute to the effective stress distribution in the cancellous bone.
De Andrade et al (2017)29	FEA	square, trapezoidal, and triangular thread designs	200 N axial occlusal load	When compared with smooth collar, microthreaded design positively influenced the biomechanical behavior of a single implant restoration anchored in posterior maxillary bone.

Straumann USA Exhibit 1023

Thread width is the distance in the same axial plane between the coronal most and the apical most part at the tip of a single thread[5] (Fig: 7).

Conventional implants provide a uniform thread depth throughout the length of the implant. A straight minor diameter, which is used in almost every screw type implant, results in uniform cross-sectional area throughout a parallel walled implant length. A tapered implant often has a similar minor diameter, but the outer diameter decreases in relation to the taper, so the thread depth decreases toward the apical region. The tapered, threaded implant may have less ability to anchor the bone in the apical region at initial insertion and has less functional surface area. The implant body taper may result in higher stress, especially in shorter implant lengths.[4,5]

Greater the thread depth, greater the surface area of the implant. Greater thread depth may be an advantage in areas of softer bone as it causes condensation of bone and creates a relatively denser lining along the implant surface and in areas of higher occlusal force because of the higher functional surface area in contact with bone. The more shallow the thread depths, the easier it is to thread the implant in dense bone, and the less likely bone tapping is required prior to implant insertion.[3,8]

There is a commercially available implant system which is characterized by progressive threads (e.g., Ankylos, Dentsply Friadent, Mannheim, Germany), this means threads have higher depth in the apical portion and then decreases gradually coronally (Fig: 8). This design might increase the load transfer to the more flexible cancellous bone instead of crestal cortical bone. This may contribute to less cortical bone resorption.[3]

The implant increases surface area by 15 to 25% for every 1 mm increase in diameter. However, as an implant becomes wider, the depth of the thread may be deeper without decreasing the body wall thickness between the inner diameter and abutment screw space within the implant. Thus, the thread depth may be modified relative to the diameter of the implant and thereby, the overall surface area may be increased by 150% for every 1mm increase in diameter.[4,5] The available literature on thread depth is summarized in Table 3.

Table 5: *Some of the implant systems available in India and their thread designs*

V- thread	Branemark system (Nobel Biocare)
Square thread	External implant system (BioHorizon)
Buttress thread	Straumann standard
Reverse buttress thread	Nobel Replace (Nobel Biocare)
Square thread	Adin implant system
Buttress thread	Genesis implant system
Cylinder / Pressfit	Zimmer implant system

Crest module:

The part of the implant in contact with cortical bone near the crest is called as crest module. The crest module of an implant body is the transosteal region, which extends from the implant body and often incorporates the antirotation components of the implant abutment connection (Fig: 9).[5] This area is where the implant meets the soft tissue and changes from a virtually sterile environment to the hostile oral cavity. The crest module of an implant should be slightly larger than the outer thread diameter of the implant body to completely seal the osteotomy, providing a barrier and acts as detterent to the ingress of bacteria or fibrous tissue during initial healing.[4] Also, in this area, the bone density is higher (e.g., primary cortical bone) and therefore helpful to achieve or maintain primary stability. Furthermore, this is the area where stress concentration happens when the implant is put to function.[3]

Bozkaya et al. (2004) compared implant systems with different thread profiles and crestal modules. They found moderate occlusal loads did not change the compact bone. However, when extreme occlusal loads were applied, overloading occurred near the superior region of the compact bone. Hence, the authors concluded that the crestal module may play a role in minimizing stresses to bone.[32]

Originally crest module was always smooth and polished. Use of a smooth neck on implants was incorporated to decrease plaque retention because in majority of the implants coronal portion was not embedded in bone.[3] When the smooth portion of the implant was placed under the bone crest, it resulted in crestal bone loss due to shear forces and eventually pocket formation.[33,34] Recently, the concept of microthreads in the crestal portion has been introduced to maintain marginal bone and soft tissues around the implants. Some authors attributed this bone loss to 'disuse atrophy'. In the presence of a smooth neck, negligible forces are transmitted to the marginal bone leading to its resorption. However, the presence of retentive elements at the implant neck will dissipate some forces leading to the maintenance of the crestal bone height according to Wolff's law.[3] The available literature on crest module is summarized in Table 4.

Straumann USA Exhibit 1023

Conclusions

The following clinical conclusions about various implant thread design features can be drawn: For thread shape, the square thread profile may provide the best primary stability. When primary stability is a concern, implants with smaller pitch are beneficial by increasing bone implant contact. Thread depth is more critical for dissipating peak stresses within the bone than thread width and the optimal values of thread depth and width may vary depending on thread shape and other geometric factors. The microthread configuration at the implant neck may improve bone formation and stress distribution for the implants inserted in the cancellous bone under immediate loading. Some of the implant systems available in India and their thread designs are listed in Table 5.

For a specific implant, the benefits from a single design feature could be enhanced or reduced by the other variables of the implant. Such as biological conditions and mechanical features. Clinicians should consider the fact that a singular design factor alone will not guarantee implant success and survival.

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Review Article

Changing trends in implant designs: A review

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ABSTRACT

Implantology is an ever-evolving scientific field that undergoes continuous refinement and innovation. Dedicated research and development efforts are focused on consistently improving the success rates of implants through innovative redesign and advancements. The introduction of advanced technologies has revolutionized the evaluation of patients in three dimensions, enabling clinicians to utilize precise and predictable approaches for diagnosis, planning, and treatment. This multidisciplinary patient-centric framework has opened new avenues for providing tailored and effective healthcare solutions. Therefore, it is of utmost importance for clinicians to conduct a comprehensive analysis of each patient's condition, ensuring meticulous selection of the suitable implant design and material, and making informed decisions regarding the most appropriate technique to be employed.

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1. Introduction

Dental implants are widely recognized as one of the most promising and effective solutions for replacing missing teeth. With long-term success rates surpassing 90%, they have proven to be highly effective in restoring oral function and aesthetics in both partially and fully edentulous patients.[1] Thanks to the current availability of advanced diagnostic tools that assist in treatment planning, along with the ongoing research leading to improved implant designs, materials, and techniques, a wide range of challenging clinical situations can now be effectively managed with a high level of predictability and success.[2] Implant design features are vital factors that have a significant impact on the initial stability of implants and their ability to endure loading throughout the osseointegration process and beyond. These design elements play a fundamental role in ensuring the long-term stability and durability of dental implants. Furthermore, dental implants are engineered with specific textures and shapes that can promote cellular activity and facilitate direct bone apposition, facilitating successful integration with the surrounding tissues.[3]

Dental implant design has undergone significant advancements in recent years. In the past, primitive dental implants such as blade, staple, and periosteal types were used, but they had inherent biomechanical limitations, leading to high failure rates.[4] Recent advancements have brought about significant improvements in the morphology, structure, and design of dental implants, aimed at enhancing their biomechanical properties, stability, and long-term success. These developments reflect the ongoing commitment to innovation and the continuous pursuit of excellence in the field of dental implantology.

Implant design encompasses the comprehensive three-dimensional structure of the implant, including its various elements and characteristics. It encompasses factors such as form, shape, configuration, as well as the surface macrostructure and macro irregularities, all of which

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contribute to the overall attributes of the implant's three-dimensional structure.

2. Implant Shape

Implant shape directly influences the surface area available for stress transfer, playing a critical role in determining the implant's initial stability. The predominating macro structure for root-form endosseous implants is the screw shape, which consists of parallel-sided screw and the tapered screw.[2] Smooth-sided cylindrical implants offer a convenient advantage when it comes to surgical placement.[4] A tapered implant with smooth sides enables the transfer of a comprehensive load to the interface between the bone and the implant, the extent of which depends on the taper's degree. Implants with threaded design and circular cross sections facilitate easy surgical placement and enable enhanced optimization of the functional surface area to effectively transmit compressive loads to the bone-to-implant interface.[2]

3. Implant Geometry

The primary criterion for developing the treatment plan is still the size of the implant, including its diameter and length, primarily determined by the amount of available alveolar bone. For a given implant length, increasing the implant diameter will increase the implant surface area that is available for force transfer to the bone.[5] Provided there is sufficient bone volume, a larger diameter implant is better able to resist occlusal forces, particularly in the molar region. When designing the treatment plan, it is important to consider the drawbacks associated with bone augmentation, which used to be considered the "gold standard" in severe atrophy cases. These drawbacks include morbidity at the donor site, elevated risks of complications, extended time and increased costs, as well as potential resorption of the bone graft. Additionally, the advancing capabilities of smaller-sized implants should be considered when formulating the treatment approach.[6]

Several new concepts may provide other options for implantation, aiming to reduce treatment duration, minimize complication rates, and simplify the overall treatment procedure, such as:

4. One-piece Implant

In a one-piece implant the endosseous and abutment portions form a single unit. By eliminating the abutment interface, the one-piece implant enhances the strength and stability of the prosthesis. It is a suitable option for patients or surgical sites with insufficient bone to adequately support a prosthesis. In spite of these advantages, one-piece dental implants do have a limitation in terms of flexibility compared to two-piece implants. Their single-unit construction restricts the ability to make precise adjustments once placed.

The design of one-piece implants allows for uninterrupted healing of the soft tissues surrounding the implant and avoids any disruption to the soft tissue seal when placing the final prosthetic restoration.[7]

5. Mini-Implants

Compared to standard dental implants, mini-implants are characterized by their reduced diameter, typically less than 3 mm, and shorter length. Despite their smaller size, they are typically made from the same biocompatible materials as standard implants. These implants are particularly useful when achieving acceptable and satisfactory function with conventional prostheses is challenging. Clinical situations like flabby ridges, atrophic ridges, or inadequate residual bone where denture retention is less, are likely to do well with mini-implants.[8]

6. Short Implants

Placing conventional implants can be challenging in cases of atrophic alveolar ridges due to various anatomical restrictions. These include the presence of the maxillary sinus, nasal floor, nasopalatine canal, and inferior alveolar canal. These structures can limit the available bone volume and affect the feasibility of conventional implant placement. To address these and other vertical bone deficits, additional surgical procedures are often employed to facilitate the placement of standard implants. These may include guided bone regeneration, block bone grafting, maxillary sinus lift, distraction osteogenesis, and nerve repositioning. These techniques aim to augment the available bone volume, create a favorable environment for implant placement, and overcome the challenges presented by the anatomical restrictions.

Short implants are often regarded as a simpler and more effective solution for rehabilitating the atrophic alveolar ridge. By minimizing the likelihood of complications, patient discomfort, procedure costs, and overall treatment time, they offer several advantages. In this context, however, it is worth mentioning that the categorization of a dental implant as "short" is subjective, and there are no universally defined criteria for determining the specific length that qualifies as a short dental implant. Recently, less than 8 mm- long short implants have been offered by implant companies.[9]

7. Tilted and Zygomatic implants

The utilization of a tilted or angulated implant in the posterior maxilla has been suggested as a potential alternative to sinus augmentation procedures. In the All-on-4 concept (a theory that uses four implants to restore total edentulism) for completely edentulous maxilla patients trans-sinus tilted implants are employed.

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Zygomatic implants present an alternative to sinus augmentation procedures. They are lengthy implants travelling through the sinus or laterally into the sinus and are almost identical to trans-sinus tilting implants.[10]

8. Pterygoid implants

Pterygoid implants were introduced as another method of increasing the amount of bone that can be used for placement of implants in posterior maxillary region. The typical implant size for this method is between 15 and 20 mm. The implant enters the maxilla in the first or second molar region, following an oblique mesio-cranial direction. From there, the implant trajectory proceeds posteriorly toward the pyramidal process. Thereafter, it ascends between wings of the pterygoid processes and continues its course in the sphenoid bone to find anchorage in pterygoido scaphoid fossa.

The presence of dense cortical bone provides excellent engagement and stability for the pterygoid implants. That and an opportunity to obviate the requirement for maxillary sinus augmentation and other grafting procedures are two benefits of employing these implants.[11]

9. Tuberosity implants

Tuberosity implants are designed to be placed at the most distal aspect of the maxillary alveolar process, specifically targeting the tuberosity region. They are positioned to potentially engage the pyramidal process of the maxilla. Because of the dense bone present in this region, the difference in bony support for a pterygoid implant and a tuberosity implant can be significant.[11]

10. Utilizing three-dimensional printing for customized implants

The initial adoption of three-dimensional printing (3DP) for custom implants took place in the domains of rapid tooling and rapid prototyping. Digital scanning was combined with a CAD/CAM design and using 3DP, dental labs produced dental prostheses and patient models in significantly less time and with a precision that was unmatched by most traditional procedures. The combination of cone beam computed tomography (CBCT) and CAD/CAM was proposed to generate a surgical guide for precise implant placement.[12]

11. Transitional Implant

Their length varies from 7 to 14 mm, and diameter is between 1.8 and 2.8 mm. Transitional implants are manufactured using pure titanium and consist of a single-body design with a treated surface. They play an important role by absorbing the masticatory stress during the healing phase. This stress absorption helps promote a stress-free environment for the maturation of bone around the submerged implants, allowing them to heal smoothly and without complications.

Some commercially available Transitional Implant System include the Immediate Provisional Implant System–IPI by Nobel Biocare; Modular Transitional Implant System -MTI by Dentatus; and TRN/ TRI Implants by Hi Tec implants.[13]

12. Ligaplant

This technology involves the integration of periodontal ligament (PDL) cells with implant biomaterial. Research is currently being done to make this implant honourable. In Ligaplant, the PDL cells serve as a soft, vascular tissue that distributes forces, absorbs shocks, and provides proprioception for the tooth within its socket.[14]

13. Design Variables in Surface Area Optimization Thread Geometry

The market today offers a variety of implant systems with different implant thread configurations (Figure 1). The number of threads, width of the thread, depth of the thread, face angle of the thread and its pitch are among the various geometric combinations that affect final bone-implant contact (BIC) and distribution of load. A greater number of threads and increased thread depth provides greater available surface area for load distribution.[15]

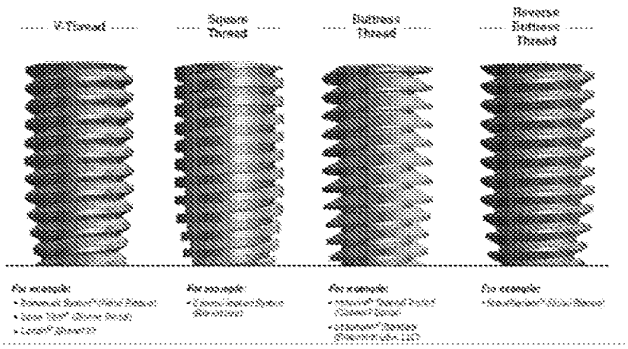


Fig. 1: Thread shapes of dental implants (V-thread, square, buttress, and reverse buttress).
Source: Grant Bullis .Functional Basis for Dental Implant Design. In: Misch,s Contemporary Implant Dentistry .4th ed. St Louis, USA: Mosby.;2021. p.48-68.

Implant threads are crucial for achieving primary stability, particularly in areas where bone quality is not good and for dissipating stresses at the bone-implant interface. This aids in minimizing the risk of complications and supports successful healing and integration of the implant with the bone.

The implant apical region should be tapered to assist insertion into the osteotomy and initial engagement of

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threads of the implant. It should be either rounded or flattened to reduce the probability of perforating membranes during placement. It will have flat regions or grooves circumferentially arranged on the implant body to stabilize the implant against rotation after healing and to aid in insertion.[16]

14. Implant Crest Module and Abutment (Figures 2 and 3)

Current knowledge of prosthetic connections suggests that an internal prosthetic connection offers the best functionality. Of the internal prosthetic connection types in use today, the conical prosthetic connection have the best feature set, also conical prosthetic connections provide a stable abutment connection, lower peak bone stresses when positioned level to the marginal bone, and have a high resistance to axial loads. The Morse taper implant abutment connection features a tapered projection on the abutment that fits into a tapered recess in the implant. This creates a friction fit and cold welding to prevent rotation, providing stability during function. Taper angles vary, such as 8° in ITI Straumann or Ankylos, or 11° in Astra. The Bicon implant system has rounded channels with a 1.5 degree taper. When the cross section of the implant permits, platform shifting should be used to redistribute the stress away from the bone-implant interface. Platform shifting or using abutments with a diameter less than the implant collar is thought to be advantageous to maintain marginal bone levels while providing a biomechanical advantage in osseointegrated implants as it redirects the concentration of stress, taking it away from the cervical region of bone-implant interface; with an inverse relationship between the amount of implant-abutment diameter mismatch and cortical bone stress concentration.

Angled abutments, UCLA Abutment, Ceramic abutments, CERADAPT Abutment, and Multi- Unit abutment are recent advancements in implant abutments.[17]

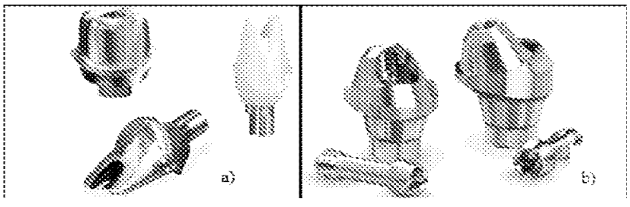


Fig. 2: a): CAD/ CAM custom abutments. Left to right, posterior milled titanium abutment, anterior milled titanium abutment, and hybrid milled zirconia bonded to titanium abutment base. **b):** Multiunit abutments with screws.

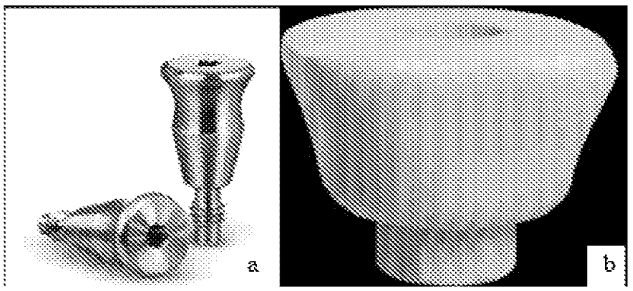


Fig. 3: a): Stock/standardized healing abutments **b):** Custom healing abutment with ideal contours.
Source: Park NI, and Kerr M. Terminology in Implant Dentistry. In: Misch,s Contemporary Implant Dentistry .4th ed. St Louis, USA: Mosby.;2021.p.20-4

15. Implant Materials

Dental implants have been tested using various materials, including metals, alloys, ceramics, polymers, glasses, and carbon. Biocompatibility, bio functionality, availability, and the ability to Osseo integrate are specific characteristics needed for their manufacturing.

Materials for dental implants and the prosthetic components they support must adhere to several strict requirements. For dental implants, titanium alloys continue to have the finest mechanical and biocompatibility qualities, and their usage is recommended. Currently, commercially pure titanium, titanium alloys, and zirconia (zirconium dioxide, ZrO2), ceramic implants are the representative biomaterials in wide use for dental implant applications. Additional other advanced material are Zirconia Toughened Alumina (ZTA) and Alumina Toughened Zirconia (AZT), Poly-Ether-Ether-Ketone (PEEK), Powder Injection Molding (PIM), Tantalum Implants, Porous Tantalum Trabecular Metal (PTTM), LASER- LOK Technology.[18]

16. Surface Modification of Implants

Research has shown that microrough surfaces had higher degrees of bone-to-implant contact or BIC. These modifications can be divided into subtractive and additive processes, depending on whether material is removed or deposited on the implant surface in the development of the surface.[19] Plasma arc is an additive process that involves depositing a bioactive hydroxyapatite (HA) material onto the implant surface. Polishing, machining, and acid etching are subtractive procedures used for implant surface treatment. These treatments can be classified into various methods, including mechanical, chemical, electrochemical, electropolishing, vacuum, thermal, and laser techniques (Figure 4). Various modifications have been implemented to enhance the biological surface of dental implants, aiming to achieve optimal bone-to-implant contact.[20]

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Surface treatments involving calcium deposition have shown increasing bioactivity over time, with the highest deposition observed in the sandblasted, acid-etched, and thermally oxidized group. This is in lieu of greater surface roughness that promotes cell adhesion, proliferation, and differentiation.[20]

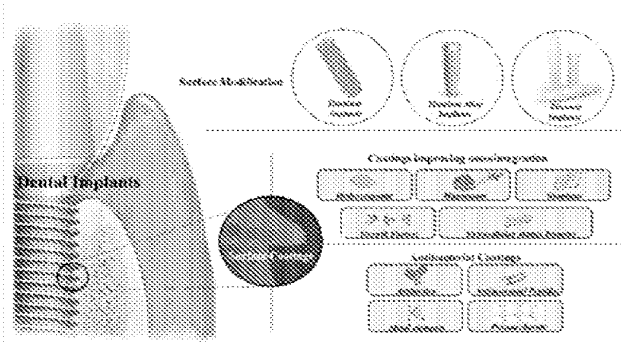


Fig. 4: Schematic illustration depicting surface modification and coatings of dental implants Source: Dong H, Liu H, Zhou N, Li Q, Yang G, Chen L, MouY. Surface Modified techniques & Emerging Functional Coating of Dental Implants. Coatings 2020, 10(11),1012:3-25

Recent studies have explored bioactive surface modifications of dental implants using inorganic materials (e.g., HA, calcium phosphate), growth factors, peptides, and extracellular matrix components. These approaches aim to enhance implant osseointegration and improve biological responses.[20] Research has shown the potential of utilizing stem cell-mediated bone regeneration for the treatment of peri-implant defects. However, stem cell implant technology is still in its early stages and is not currently a viable option for replacing missing teeth. Ongoing research hopes to enhance these techniques and develop more cost-effective procedures involving stem cells.[21]

17. Current Technologies for Implant Design and Placement Analysis

The success of dental implantation depends on accurate imaging. Cone Beam Computed Tomography (CBCT) utilising three-dimensional images is one of the newest technologies in dentistry imaging. This technology offers a continuous flow of data that allows dental surgeons to reconstruct images as needed, while minimizing radiation exposure for patients.[22,23]

18. Current developments in computed tomography technology include

1. (a) *Cone beam Computed Tomography:* This technology utilises a cone shaped beam of radiations. The image is reconstructed with special software. Comprehensive information like a Computed Tomography is obtained, albeit with 1/8th of radiation exposure and at minimal cost.
   (b) *Microtomograph:* This device helps in obtaining serial sections of the interface between implant and bone.
   (c) *Multislice helical CT:* This device has the advantage of providing high quality images when compared to Computed Tomography. It is referred as Dentascan Imaging.
   (d) *Interactive Computed Tomography:* This device develops image files that can be transferred from Radiologist to dentist's computer, who can work upon the case with precision and ease. Both the dentist and the radiologist work together and simulate placement of cylinders of arbitrary sizes in images, replicating root form implants, allowing for virtual surgical planning and an "Electronic Surgery".
   (e) *Magnetic resonance imaging (MRI):* This 3D non-invasive imaging method uses an electronic image acquisition process where image is produced digitally.

Better stability is made possible by the shape and configuration of implants, which is essential for the osseo-integration process. Refinement of drilling machines has led to better control over drilling speed and associated torque, which reduces risk of overheating the surrounding bone.[24] Improved control of water irrigation and the incorporation of internal implant irrigation systems also play a crucial role in minimizing the elevation of bone temperature during implant procedures. Additionally, the use of custom-made surgical splints, guided by CT data, assists in accurately defining the implant location and angulation, ensuring precise and optimal placement.[25]

Dental professionals and specifically prosthodontists have greater concern of the occlusal load on given prosthesis. Achieving precise dental implant alignment and connecting implants in a triangular configuration is crucial for the successful placement of fixed bridges in some cases. This configuration enhances stability and helps to resist lateral displacement forces.[26]

19. Peri implant surgery

It is common for tooth loss to be accompanied by the simultaneous resorption of the alveolar bone. As adequate implant width and length are crucial for long-term success of any implant, cases with insufficient remaining bone often pose a problem. The volume of the bone can be increased by varied techniques. For slight depressions, a simple onlay bone graft can be used while an inlay bone

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graft can be employed where a sandwich osteotomy is required. Maxillary sinus floor augmentation can be used to increase bone volume in the upper jaw. Distraction osteogenesis is also a state-of-the-art procedure used for augmenting areas of bone. Now a days, osteo-inductive and osteo-conductive substances can help accelerate the healing process. Vestibuloplasty and palatal graft transplant are getting popular in cases where ablative surgery or tissue atrophy decreases the amount of available soft tissue. Free gingival graft transplant is a simpler procedure that produces less overall patient morbidity. Thus, the issues linked to either the soft tissue or bone deficit around the implant can likely be treated by combining several peri- implant operations.[27,28]

20. Image Guided Implantology

Image-guided implant surgery has experienced remarkable advancements in recent years. It involves two main types that utilize dedicated software for precise implant planning to define implant angulation and position, while avoiding contact with the maxillary sinus or with the inferior alveolar nerve. While one procedure consists of real-time navigational implant surgery, the other inserts implants using a surgical splint created using stereo lithography.[29]

Computer-designed surgical splints significantly expedite the implant placement process. However, any errors in planning or splint fabrication cannot be easily corrected during surgery. In such cases, surgeons may need to forgo the use of the splint altogether, potentially leading to incorrect implant placement.[30]

21. Conclusion

The future of dental implantology holds immense potential through continuous innovation and progress. Areas such as biomaterials, implant design, surface modification, and functionalization are critical for improving patient care and enhancing treatment outcomes. Advancements at every stage, including diagnosis, treatment planning, surgery, grafting, and implant designs, are essential for achieving successful long-term results in restoring missing dentition. By focusing on these areas of improvement, we can strive towards better patient outcomes and advancements in dental implant technology.

22. Source of Funding

None.

23. Conflict of Interest

None.

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Straumann USA Exhibit 1023

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Straumann USA Exhibit 1023

Attorney Docket No. SDC013 PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re: Kofford et al. Confirmation No. 2702
Application No.: 18/827,656 Group Art Unit: 3772
Filing Date: September 6, 2024 Examiner: Courtney Nguyen Huynh
For: **SCREW-ATTACHED PICK-UP DENTAL COPING SYSTEM AND METHODS**

Date: September 22, 2025

Commissioner for Patents
Box 1450
Alexandria, VA 22313-1450

Request for Continued Examination under 37 CFR 1.114

Remarks begin on page 2 of this document.

Straumann USA Exhibit 1023

Remarks

As a result of litigation and legal proceedings of related US Patents 11,937,992 and 12,156,781, additional potential prior art has been provided to or discovered by Applicant. As a result, this RCE and IDS are being submitted in this application.

CONCLUSION

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/

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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/827,656	**09/22/2025 09:58:24 PM Z ET**	**SDC013**

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 #	2702	FILED BY	Daniel Whittle
PATENT CENTER #	72406692	AUTHORIZED BY	-
CUSTOMER #	112823	FILING DATE	09/06/2024
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Brandon Dale Kofford

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 5436	**E20259LL59447900**	**Daniel Whittle**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
2830	PROCESSING FEE, EXCEPT IN PROVISIONAL APPLICATIONS	60.00	1	60.00
2801	REQUEST FOR CONTINUED EXAMINATION (RCE) - 1ST REQUEST (SEE 37 CFR 1.114)	600.00	1	600.00
			TOTAL AMOUNT:	**¤660.00**

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.

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(54) 보철 교합관계 채득용 임플란트 지그 및 상기 임플란트지그를 이용한 보철물 제작방법

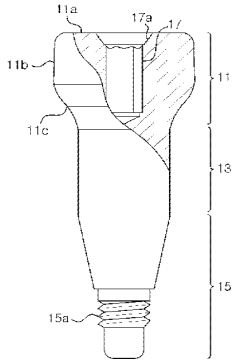
(57) 요 약

본 발명은 임플란트 시술중 보철 교합관계(bite) 채득시 사용되기 위한 임플란트 지그 및 이 임플란트 지그를 이용한 보철물 제작방법에 관한 것이다.

본 발명에 따르면, 임플란트 시술중 바이트 채득을 위한 임플란트 지그로서, 바이트 재료를 지지하는 교합부와; 상기 임플란트 지그를 사전에 잇몸에 식립되어 있는 픽스츄어에 결합하기 위한 연결부와; 상기 교합부와 상기 연결부 사이에 형성되는 몸통부; 를 포함하는 것을 특징으로 하는 보철 교합관계 채득용 임플란트 지그 및 이 임플란트 지그를 이용한 보철물 제작방법이 제공된다.

그에 따라 임플란트 시술에 있어서도 자연치 시술과 마찬가지로 인상 채득과 동시에 바이트 채득이 가능하도록 한 보철 교합관계 채득용 임플란트 지그 및 상기 임플란트 지그를 이용한 보철물 제작방법이 제공되어, 보철물 제작 과정에서의 비용 및 시간을 감소시킬 수 있게 된다.

대 표 도 - 도3



Straumann USA Exhibit 1023

특허청구의 범위

청구항 1

임플란트 시술중 바이트 채득을 위한 임플란트 지그로서,

바이트 재료를 지지하는 교합부와;

상기 임플란트 지그를 사전에 잇몸에 식립되어 있는 픽스츄어에 결합하기 위한 연결부와;

상기 교합부와 상기 연결부 사이에 형성되는 몸통부;

를 포함하는 것을 특징으로 하는 보철 교합관계 채득용 임플란트 지그.

청구항 2

청구항 1에 있어서,

상기 교합부의 상부 표면은 평평한 형상이나 볼록한 형상을 가지며, 요철 없이 매끄러운 표면을 가지는 것을 특징으로 하는 보철 교합관계 채득용 임플란트 지그.

청구항 3

청구항 1에 있어서,

상기 교합부의 외주 표면은, 경화된 바이트 재료의 분리 및 정확한 위치 인가를 용이하게 하기 위해서, 일정한 직경을 가지거나, 중간 부분의 직경이 상부 표면의 직경보다 크게 되도록 직경이 변화하는 형상을 갖는 것을 특징으로 하는 보철 교합관계 채득용 임플란트 지그.

청구항 4

청구항 1에 있어서,

상기 몸통부는, 잇몸과의 간섭이나 인접 치아와의 간섭을 최소화하기 위해서, 상기 교합부의 직경과 같거나 작은 직경을 가지도록 형성되는 것을 특징으로 하는 보철 교합관계 채득용 임플란트 지그.

청구항 5

청구항 1에 있어서,

상기 교합부 외부 및 상기 몸통부 외부의 에지부분은 라운드 처리되는 것을 특징으로 하는 보철 교합관계 채득용 임플란트 지그.

청구항 6

청구항 1에 있어서,

상기 연결부는 잇몸 내에 사전에 식립되어 있는 픽스츄어에 결합될 수 있도록 나사산이 형성되어 있는 나사부를 포함하는 것을 특징으로 하는 보철 교합관계 채득용 임플란트 지그.

청구항 7

청구항 1에 있어서,

상기 연결부와 픽스츄어는 나사 체결방식, 스냅식 끼워맞춤 방식, 및 마찰 끼워맞춤 방식 중에서 선택된 어느 하나의 방식으로 결합되는 것을 특징으로 하는 보철 교합관계 채득용 임플란트 지그.

청구항 8

청구항 1에 있어서,

상기 임플란트 지그는, 상기 교합부의 상부 표면에 형성되어 상기 임플란트 지그를 픽스츄어에 결합 또는 분리할 때 체결 공구를 삽입할 수 있는 드라이버 안착구멍을 포함하는 것을 특징으로 하는 보철 교합관계 채득용 임

플란트 지그.

청구항 9

청구항 8에 있어서,

상기 체결 공구는 임플란트 시술을 위해 사용되는 것과 동일하며, 상기 드라이버 안착구멍은 상기 체결 공구가 마찰 끼워맞춤 될 수 있는 크기의 치수를 가지도록 형성되는 것을 특징으로 하는 보철 교합관계 채득용 임플란트 지그.

청구항 10

청구항 8에 있어서,

상기 드라이버 안착구멍의 입구 둘레 부분에는 상기 드라이버 안착구멍보다 직경이 큰 직경 확대부가 형성되는 것을 특징으로 하는 보철 교합관계 채득용 임플란트 지그.

청구항 11

청구항 10에 있어서,

상기 직경 확대부는 경사진 테이퍼 형상 또는 단차가 있는 계단 형상을 가지는 것을 특징으로 하는 보철 교합관계 채득용 임플란트 지그.

청구항 12

청구항 1에 있어서,

상기 교합부 및 상기 몸통부는 내부에 관통구멍을 가지는 하나의 부품인 외부 몸통부재로 제작되고, 상기 연결부는 상기 관통구멍을 통해 픽스츄어에 결합될 수 있도록 형성된 다른 하나의 부품인 연결부재로 제작되는 것을 특징으로 하는 보철 교합관계 채득용 임플란트 지그.

청구항 13

청구항 12에 있어서,

상기 외부 몸통부재의 내부에 형성되는 관통구멍은, 직경이 작은 몸통 소직경부와, 상기 교합부 측에 형성되며 직경이 큰 몸통 대직경부와, 상기 몸통 대직경부 및 상기 몸통 소직경부 사이에 직경이 축소되도록 형성되는 몸통 축경부를 포함하며,

상기 연결부재는, 상기 몸통 소직경부에 상응하는 크기의 직경을 가지는 연결 소직경부와, 상기 몸통 대직경부에 상응하는 크기의 직경을 가지는 연결 대직경부와, 상기 몸통 축경부에 상응하는 형태를 가지는 연결 축경부와, 잇몸 내에 이미 식립되어 있는 픽스츄어에 결합될 수 있도록 나사산이 형성되어 있는 나사부를 포함하여,

상기 연결부재의 연결 축경부가 상기 외부 몸통부재의 몸통 축경부에 맞닿은 상태에서, 상기 연결부재의 나사부가 픽스츄어에 결합됨으로써 상기 외부 몸통부는 픽스츄어 상에 고정될 수 있는 것을 특징으로 하는 보철 교합관계 채득용 임플란트 지그.

청구항 14

임플란트 시술중 바이트 채득을 위한 임플란트 지그로서,

사전에 잇몸에 식립되어 있는 픽스츄어에 착탈 가능하게 결합되어 바이트 재료를 지지하는 상부 표면이 맞은 편 치아와 근접되어 위치될 수 있는 것을 특징으로 하는 보철 교합관계 채득용 임플란트 지그.

청구항 15

임플란트용 보철물을 제작하기 위한 방법으로서, 픽스츄어가 잇몸에 식립된 상태에서 채득된 인상과, 상기 픽스츄어에 상기 청구항 1 내지 청구항 12 중 어느 한 항에 기재된 임플란트 지그를 체결한 후 바이트 재료를 주입하여 채득된 바이트를 활용하여 보철물을 제작하는 것을 특징으로 하는 보철물 제작방법.

Straumann USA Exhibit 1023

명 세 서

발명의 상세한 설명

기 술 분 야

[0001] 본 발명은 환자의 상실된 치아를 회복하는데 사용되는 임플란트에 관한 것으로, 특히 임플란트 시술중 보철 교합관계(bite) 채득시 사용되기 위한 임플란트 지그 및 이 임플란트 지그를 이용한 보철물 제작방법에 관한 것이다.

배 경 기 술

[0002] 임플란트란 상실된 인체 조직을 회복시켜 주는 대치물을 의미하는데, 치과에서는 일반적으로 상실된 치아의 치근(뿌리)을 대신할 수 있도록 자연치근이 빠져나간 치조골에 픽스츄어를 매식하여 유착시킨 후 인공치아를 고정시켜 치아의 원래 기능을 회복하도록 하는 대치물을 의미한다.

[0003] 이와 같은 임플란트는 인공치아와 치근과의 결합방법에 따라서 다양하게 분류되며, 그 중에서 스크류의 결합력을 이용한 스크류 타입 임플란트가 있는데, 도 1에는 이와 같은 종래의 스크류 타입 임플란트가 도시되어 있다.

[0004] 도 1에 도시된 종래의 스크류 타입 임플란트 시스템은 어버트먼트(Abutment)의 헤드부가 8각형으로 형성되어 있어서 옥타 어버트먼트(Octa Abutment) 시스템이라 부른다. 도 1에 도시된 종래의 어버트먼트 시스템은 픽스츄어(Fixture)(110), 어버트먼트(120), 실린더(130), 스크류(140) 및 보철물(150)로 구성된다.

[0005] 픽스츄어(110)는 치조골에 매식되어 임플란트 시스템을 고정하는 역할을 하는데, 인체 골조직과의 융합을 위해서 생체적합성이 우수한 티타늄으로 제조된다. 픽스츄어(110)는 어버트먼트 체결홈(111), 어버트먼트 안착홈(112) 및 픽스츄어 몸통(113)을 가진다.

[0006] 어버트먼트 체결홈(111)은 어버트먼트(120)가 픽스츄어(110)에 체결될 수 있도록 축선을 따라서 픽스츄어(110)의 내부에 형성되어 있다. 어버트먼트 체결홈(111)의 내주면에는 나사산이 형성되어 있어 어버트먼트(120)가 나사체결된다. 어버트먼트 안착홈(112)은 축선을 따라 픽스츄어(110)의 내부에 하향 경사지게 형성되어 단턱(112a)에서 종단된다. 어버트먼트 안착홈(112)은 단턱(112a)을 가져 어버트먼트 체결홈(111)에 이어진다. 픽스츄어 몸통(113)은 그 외주면이 나사산을 가지고 있다.

[0007] 어버트먼트(120)는 픽스츄어(110)에 결합되어, 실린더(130)를 고정하여 지지하는 역할을 하는데, 헤드부(121), 몸통부(122), 나사부(123) 및 스크류 체결홈(124)을 가진다.

[0008] 헤드부(121)는 다각형 형상을 가지고 몸통부(122)의 상부에 형성되어 있다. 몸통부(122)는 헤드부(121)의 하부에 하향 경사지게 형성되어 있는데, 몸통부(112)의 상면에는 단턱(122a)이 형성되어 헤드부(121)와 구분된다. 몸통부(122)의 하단에는 나사부(123)가 형성되어, 픽스츄어(110)의 어버트먼트 체결홈(111)에 나사결합된다. 그리고 스크류 체결홈(124)은 헤드부(121) 및 몸통부(122)를 관통하여 형성되어 있으며, 내주면에는 나사산이 형성되어 스크류(140)가 나사결합된다.

[0009] 실린더(130)는 어버트먼트(120)의 헤드부(121)와 단턱(122a)에 안착되어 보철물(150)을 지지하는 역할을 하는데, 외주면(131), 스크류 안착홈(132) 및 어버트먼트 안착홈(133)을 가지고 있다.

[0010] 외주면(131)은 상향 경사진 형상을 가지는데, 외주면(131)의 상부에는 절개면(131a)이 형성되어 있고, 하단에는 엣지(131b)가 형성되어 있다. 실린더(130)의 내부에는 스크류 안착홈(132)이 형성되어 있다. 스크류 안착홈(132)과 동일 축상 하부에는 어버트먼트(120)의 헤드부(121)가 안착되는 어버트먼트 안착홈(133)이 형성되어 있다. 어번트먼트 안착홈(133)은 헤드부(121)에 상응하는 형상(예를 들어 6각형 또는 8각형 등의 다각형 형상)을 하고 있다.

[0011] 스크류(140)는 어버트먼트(120)의 스크류 체결홈(124)에 나사결합되어, 실린더(130)를 어버트먼트(120)에 결합하는 역할을 하는데 헤드부(141) 및 몸통부(142)로 구성된다.

[0012] 헤드부(141)는 원통 형상을 가지며, 상부에는 드라이브 결합공(141a)이 형성되어 있다. 몸통부(142)는 헤드부(141)의 하단에서 연장되어 형성되고, 몸통부(142)의 하단에는 일정 길이를 가진 나사산(141a)이 형성되어 있다.

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[0013] 보철물(150)은 인상채득, 작업모형 제작, 납형제작, 매몰 및 소환 공정 등의 공정을 통해 제작되며, 제작 공정상에서 스크류 엑세스홀(153)이 형성되는데, 이 스크류 억세스홀(153)은 원통 형상을 가지고 보철물(150)의 중앙을 관통하여 형성되어 보철물을 구강 내에 조립할 경우 스크류(140)가 삽입되는 홈이 된다.

[0014] 이상 상술한 바와 같이 구성된 임플란트는 일반적으로, 임플란트 하부 구조물인 픽스츄어 매식단계와, 인상 채득 및 작업모형 완성단계와, 납형제작 및 내관주조단계와, 도재수복을 통한 외관형성단계로 이루어진 보철물 성형단계와, 보철물을 외관에 시멘트(cement)로 결합시키는 보철물 접착단계를 거쳐 시술된다.

[0015] 보철물 제작에 있어서 상하 대합 관계의 정보를 획득하는 바이트(Bite) 채득은 필수 과정이다. 바이트 채득 과정은 통상 환자의 구강 상황을 본뜨는 과정인 인상 채득 후 이루어지며, 채득된 바이트는 보철물 제작을 위하여 인상체와 함께 기공소로 전달된다.

[0016] 일반 자연치 시술에서는 삭제를 한 치아 부분(지대치)이 남아 있기 때문에 남아있는 치아 부분을 지지 구조로서 활용할 수 있어, 그대로 바이트 재료를 주입하여 바이트를 채득한다.

[0017] 임플란트 시술에 있어서도 바이트 채득 과정이 필요한데, 임플란트의 경우는 발치 후 치근에 해당하는 픽스츄어가 식립된 상태에서 인상 채득을 시행한다. 이때에는 치아를 발치한 이후이며 픽스츄어는 잇몸 표면에 대략 평행하게 식립된 상태이므로, 바이트 재료를 지지할 수 있는 지지구조가 없다.

[0018] 따라서 종래에는 도 2에 도시된 바와 같이, (a) 병원에서 인상 채득 후, (b) 채득된 인상체만을 기공소로 보내어, (c) 작업 모형을 제작하고, (d) 작업 모형 상에서 바이트 채득을 위한 별도의 지지 구조물, 즉 지그(jig)를 제작한다.

[0019] 이와 같이 기공소에서 제작된 별도의 지그를 다시 병원으로 보내고 환자가 병원에 내원하여 (e) 환자의 구강 내에 별도 제작된 지그를 체결하고, (f) 바이트 재료를 주입하여 바이트를 채득하고, (g) 채득된 바이트를 다시 기공소로 보내어, (h) 채득된 바이트를 가이드로 활용하여 보철물을 제작한다.

[0020] 기공소에서 제작된 보철물은 다시 병원으로 보내지고, 환자가 병원에 내원하여 환자의 구강 내에 보철물을 체결함으로써 임플란트 시술이 완료된다.

[0021] 상기된 바와 같이 임플란트 시술중 바이트 채득을 위해서는 기공소에서 지지용 지그를 별도로 제작한 다음 다시 치과로 발송되고 환자는 다시 내원하여 바이트를 채득하는 과정을 거쳐야 하므로, 시술에 소요되는 기간이 장기간 소요되고 환자는 치아가 없는 상태로 오랜 시간을 지내야 하는 불편함이 있었다.

[0022] 또한, 바이트 지지용 지그는 전용의 재료가 없어 고가의 용도 외 제품인 Mount, Temporary Abutment, UCLA Abutment 등을 사용하여 제작해야 하므로 비용과 제작기간이 증가되는 문제가 있었다.

[0023] 즉, 바이트 채득만을 위하여, 별도의 용도 외 제품을 사용하여 지지 구조를 만들고, 환자는 다시 한번 치과에 내원하여야 하며, 그 기간 동안의 보철 제작 과정이 길어지는 문제점이 있었다.

발명의 내용

해결 하고자하는 과제

[0024] 이러한 종래의 문제점들을 해결하기 위한 본 발명은, 임플란트 시술에 있어서도 자연치 시술과 마찬가지로 인상채득과 동시에 바이트 채득이 가능하도록 하여 보철물 제작 과정에서의 비용 및 시간을 감소시킬 수 있는 보철 교합관계 채득용 임플란트 지그 및 상기 임플란트 지그를 이용한 보철물 제작방법을 제공하고자 하는 것이다.

과제 해결수단

[0025] 상기 목적을 달성하기 위한 본 발명의 일 측면에 따르면, 임플란트 시술중 바이트 채득을 위한 임플란트 지그로서, 바이트 재료를 지지하는 교합부와; 상기 임플란트 지그를 사전에 잇몸에 식립되어 있는 픽스츄어에 결합하기 위한 연결부와; 상기 교합부와 상기 연결부 사이에 형성되는 몸통부; 를 포함하는 것을 특징으로 하는 보철 교합관계 채득용 임플란트 지그가 제공된다.

[0026] 상기 교합부의 상부 표면은 평평한 형상이나 볼록한 형상을 가지며, 요철 없이 매끄러운 표면을 가지는 것이 바람직하다.

[0027] 상기 교합부의 외주 표면은, 경화된 바이트 재료의 분리 및 정확한 위치 인가를 용이하게 하기 위해서, 일정한

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직경을 가지거나, 중간 부분의 직경이 상부 표면의 직경보다 크게 되도록 점차로 직경이 변화하는 형상을 갖는 것이 바람직하다.

[0028] 상기 몸통부는, 잇몸과의 간섭이나 인접 치아와의 간섭을 최소화하기 위해서, 상기 교합부의 직경과 같거나 작은 직경을 가지도록 형성되는 것이 바람직하다.

[0029] 상기 교합부 외부 및 상기 몸통부 외부의 에지부분은 라운드 처리되는 것이 바람직하다.

[0030] 상기 연결부는 잇몸 내에 사전에 식립되어 있는 픽스츄어에 결합될 수 있도록 나사산이 형성되어 있는 나사부를 포함하는 것이 바람직하다.

[0031] 상기 연결부와 픽스츄어는 나사 체결방식, 스냅식 끼워맞춤 방식, 및 마찰 끼워맞춤 방식 중에서 선택된 어느 하나의 방식으로 결합되는 것이 바람직하다.

[0032] 상기 임플란트 지그는, 상기 교합부의 상부 표면에 형성되어 상기 임플란트 지그를 픽스츄어에 결합 또는 분리할 때 체결 공구를 삽입할 수 있는 드라이버 안착구멍을 포함하는 것이 바람직하다.

[0033] 상기 체결 공구는 임플란트 시술을 위해 사용되는 것과 동일하며, 상기 드라이버 안착구멍은 상기 체결 공구가 마찰 끼워맞춤 될 수 있는 크기의 치수를 가지도록 형성되는 것이 바람직하다.

[0034] 상기 드라이버 안착구멍의 입구 둘레 부분에는 상기 드라이버 안착구멍보다 직경이 큰 직경 확대부가 형성되는 것이 바람직하다.

[0035] 상기 직경 확대부는 경사진 테이퍼 형상 또는 단차가 있는 계단 형상을 가지는 것이 바람직하다.

[0036] 상기 교합부 및 상기 몸통부는 내부에 관통구멍을 가지는 하나의 부품인 외부 몸통부재로 제작되고, 상기 연결부는 상기 관통구멍을 통해 픽스츄어에 결합될 수 있도록 형성된 다른 하나의 부품인 연결부재로 제작되는 것이 바람직하다.

[0037] 상기 외부 몸통부재의 내부에 형성되는 관통구멍은, 직경이 작은 몸통 소직경부와, 상기 교합부 측에 형성되며 직경이 큰 몸통 대직경부와, 상기 몸통 대직경부 및 상기 몸통 소직경부 사이에 직경이 축소되도록 형성되는 몸통 축경부를 포함한다.

[0038] 상기 연결부재는, 상기 몸통 소직경부에 상응하는 크기의 직경을 가지는 연결 소직경부와, 상기 몸통 대직경부에 상응하는 크기의 직경을 가지는 연결 대직경부와, 상기 몸통 축경부에 상응하는 형태를 가지는 연결 축경부와, 잇몸 내에 이미 식립되어 있는 픽스츄어에 결합될 수 있도록 나사산이 형성되어 있는 나사부를 포함한다.

[0039] 그에 따라, 상기 연결부재의 연결 축경부가 상기 외부 몸통부재의 몸통 축경부에 맞닿은 상태에서, 상기 연결부재의 나사부가 픽스츄어에 결합됨으로써 상기 외부 몸통부는 픽스츄어 상에 고정될 수 있다.

[0040] 또한, 본 발명의 또 다른 측면에 따르면, 임플란트 시술중 바이트 채득을 위한 임플란트 지그로서, 사전에 잇몸에 식립되어 있는 픽스츄어에 착탈 가능하게 결합되어 바이트 재료를 지지하는 상부 표면이 맞은 편 치아와 근접되어 위치될 수 있는 것을 특징으로 하는 보철 교합관계 채득용 임플란트 지그가 제공된다.

[0041] 또한, 본 발명의 또 다른 측면에 따르면, 임플란트용 보철물을 제작하기 위한 방법으로서, 픽스츄어가 잇몸에 식립된 상태에서 채득된 인상과, 상기 픽스츄어에 상기된 임플란트 지그를 체결한 후 바이트 재료를 주입하여 채득된 바이트를 활용하여 보철물을 제작하는 것을 특징으로 하는 보철물 제작방법이 제공된다.

효 과

[0042] 상술한 바와 같은 본 발명에 의하면, 임플란트 시술에 있어서도 자연치 시술과 마찬가지로 인상 채득과 동시에 바이트 채득이 가능하도록 한 보철 교합관계 채득용 임플란트 지그 및 상기 임플란트 지그를 이용한 보철물 제작방법이 제공될 수 있다. 그에 따라 본 발명에 따르면 보철물 제작 과정에서의 비용 및 시간을 감소시킬 수 있게 된다.

발명의 실시를 위한 구체적인 내용

[0043] 이하, 본 발명의 바람직한 실시예에 따른 보철 교합관계 채득용 임플란트 지그 및 상기 임플란트 지그를 이용한 보철물 제작방법을 도면을 참조하여 상세하게 설명한다.

[0044] 도 3에는 본 발명의 제1 실시형태에 따른 임플란트 지그가 도시되어 있다. 도 3에 도시된 바와 같이, 본 발명

의 제1 실시형태에 따른 임플란트 지그는, 바이트 재료를 지지하는 교합부(11)와, 식립된 픽스츄어에 결합되는 연결부(15)와, 교합부(11)와 연결부(15) 사이에 형성되는 몸통부(13)를 포함한다.

[0045] 상기 교합부(11)는 바이트 재료를 지지할 수 있는 상부 표면(11a)을 갖는다. 이 상부 표면(11a)의 형상은 평평하거나 미세하게 위쪽으로 볼록한 형상인 것이 바람직하며, 요철 없이 매끄러운 표면을 가지는 것이 바람직하다.

[0046] 교합부(11)의 외주 표면(11b)은 도 3에서 볼 때 중간 부분의 직경이 상부 표면(11a)의 직경보다 크게 되도록 아래쪽에서 위쪽으로 갈수록 직경이 작아지는 형상을 갖는 것이 경화된 바이트 재료의 분리 및 정확한 위치 인가를 용이하게 하기 때문에 바람직하다.

[0047] 교합부(11)의 아래쪽에는 몸통부(13)가 위치하며, 이 몸통부(13)는 잇몸과의 간섭이나 인접 치아와의 간섭을 최소화하기 위해 교합부(11)의 직경과 같거나 그보다 작은 직경을 가지도록 형성된다. 직경이 작은 몸통부(13)와 직경이 큰 교합부(11)의 외주 표면(11b) 사이에는 위쪽에서 아래쪽으로 갈수록 직경이 작아지는 경사부(11c)가 형성되어 몸통부(13)와 교합부(11) 사이를 매끄럽게 연결하고 있다.

[0048] 구강 내의 잇몸이나 치아 등의 손상을 방지하기 위해서 교합부(11) 외부와 몸통부(13) 외부의 모든 에지부분은 라운드 처리되는 것이 바람직하다.

[0049] 한편, 바이트 재료는 두께가 두꺼울수록 보철물 제작시 오차가 커지므로, 교합부(11)의 상부 표면(11a)은 맞은편 치아와 근접되어 위치되는 것이 좋다. 이를 위해 본 발명에 의하면 교합부(11) 및 몸통부(13)의 길이, 특히 몸통부(13)의 길이를 여러 가지 치수로 제작하여 두고 환자의 구강 상태에 맞춰 적절한 길이의 임플란트 지그를 사용함으로써 바이트 재료가 0.5 ~ 1.5㎜의 최적의 두께를 유지할 수 있도록 할 수 있다.

[0050] 상기 연결부(15)는 잇몸 내에 이미 식립되어 있는 픽스츄어에 결합될 수 있도록 나사산이 형성되어 있는 나사부(15a)를 포함한다. 나사부(15a)를 포함한 연결부(15)의 형상은 픽스츄어의 형태에 따라 다양한 사양으로 만들어질 수 있음은 물론이다. 연결부(15)와 픽스츄어는 상술한 나사 체결방식 이외에도 스냅식 끼워맞춤(snap fit), 마찰(friction) 끼워맞춤 방식이 활용될 수 있다.

[0051] 상기 교합부(11)의 상부 표면(11a)에는 임플란트 지그를 픽스츄어에 결합 또는 분리할 때 드라이버 등의 체결 공구를 삽입할 수 있도록 하나 이상의 드라이버 안착구멍(17)이 형성되어 있다. 이 드라이버 안착구멍(17)은 체결 공구인 드라이버와 마찰에 의해 맞물리도록 크기 및 형상이 설정될 수 있다. 체결 공구는 기존의 임플란트 시술에 사용되는 것을 그대로 사용할 수 있도록, 이 체결 공구의 치수에 맞춰 드라이버 안착구멍(17)이 형성된다.

[0052] 드라이버 안착구멍(17)의 입구 둘레 부분에는 이 드라이버 안착구멍(17)보다 직경이 큰 직경 확대부(17a, 17b)가 형성되어 있다. 이 직경 확대부(17a, 17b)는 드라이버 안착구멍(17)보다 큰 직경을 가질 수만 있다면 다양한 형태를 가질 수 있다. 예를 들어, 도 3에 도시된 직경 확대부(17a)는 경사진 테이퍼 형상을 가지며, 도 4에 도시된 직경 확대부(17b)는 단차가 있는 계단 형상을 가진다.

[0053] 본 발명에 따르면, 드라이버 안착구멍(17)의 입구 부분에 직경 확대부(17a, 17b)가 형성되어 있기 때문에, 인상채득을 위해서 임플란트 지그의 교합부(11) 상부에 바이트 재료가 인가되더라도, 유동성이 있는 바이트 재료가 드라이버 안착구멍(17) 내로 흘러들어가는 양이 감소될 수 있다.

[0054] 이와 같이 드라이버 안착구멍(17) 내로 흘러들어가는 바이트 재료가 감소될 수 있으므로, 바이트 재료가 응고된 후 보철물 제작 과정에 있어서 바이트의 임플란트 지그에 대한 탈부착시 오차를 감소시킬 수 있다. 즉, 본 발명에 따르면, 드라이버 안착구멍 내로 흘러들어가 응고된 돌출부분이 작게 형성되므로, 간섭에 의해 방해받는 일 없이 보철물 제작과정 등에 있어서 바이트가 임플란트 지그 상에 정확하게 안착될 수 있다.

[0055] 도 5에는 본 발명의 제1 실시형태에 따른 여러 가지 형태의 임플란트 지그가 도시되어 있다. 본 발명에 따르면, 환자의 구강 상태나 픽스츄어의 종류 등에 따라 다양한 형태의 임플란트 지그를 제작 및 사용할 수 있다.

[0056] 이하, 도 6 및 도 7을 참조하여 본 발명의 제2 실시형태에 따른 임플란트 지그를 설명한다.

[0057] 도 3 내지 도 5에는 교합부(11), 몸통부(13) 및 연결부(15)가 하나의 부품으로 제작된 일체형 임플란트 지그(제1 실시형태)만이 개시되어 있지만, 필요에 따라서는 본 발명의 임플란트 지그는 도 6 및 도 7에 도시된 바와 같이 2개의 부품으로 제작(제2 실시형태)되어 사용될 수 있다. 즉, 제1 실시형태에서의 교합부(11), 몸통부(13)

Straumann USA Exhibit 1023

및 연결부(15)의 상부가 내부에 관통구멍을 가지는 하나의 부품으로 제작되고, 나사부(15a)가 이 관통구멍을 통해 픽스츄어에 결합될 수 있도록 기다란 볼트 형태의 또 다른 하나의 부품으로 제작될 수도 있다.

[0058] 제2 실시형태에 따른 임플란트 지그는, 상술한 제1 실시형태에 따른 임플란트 지그와 마찬가지로, 바이트 재료를 지지하는 교합부(22)와, 식립된 픽스츄어에 결합되는 연결부(25)와, 교합부(22)와 연결부(25) 사이에 형성되는 몸통부(23)를 포함한다.

[0059] 다만, 제2 실시형태에 따른 임플란트 지그는, 교합부(22)와 몸통부(23)가 하나의 부재인 외부 몸통부재(21)로 형성되고, 별개로 형성된 연결부재(25)가 이 외부 몸통부재(21) 내부에 형성된 관통구멍 내에 삽입된다는 점에서 상이하다.

[0060] 본 제2 실시형태에 있어서, 외부 몸통부재(21)의 내부에 형성되는 관통구멍은, 직경이 작은 몸통 소직경부(21a)와, 교합부(22) 측에 형성되며 직경이 큰 몸통 대직경부(21b)와, 이들 몸통 대직경부(21b) 및 몸통 소직경부(21a) 사이에 점진적으로 직경이 축소되도록 형성되는 몸통 축경부(21c)로 이루어진다. 이때, 몸통 축경부(21c)는 반드시 직경이 점진적으로 축소될 필요는 없으며 연결부재(25)에 의해 외부 몸통부재(21)가 고정될 수만 있다면 어떠한 형태를 가져도 좋다.

[0061] 한편, 연결부재(25)는, 몸통 소직경부(21a)에 상응하는 크기의 직경을 가지는 연결 소직경부(25a)와, 몸통 대직경부(21b)에 상응하는 크기의 직경을 가지는 연결 대직경부(25b)와, 몸통 축경부(21c)에 상응하는 형태를 가지는 연결 축경부(25c)와, 잇몸 내에 이미 식립되어 있는 픽스츄어에 결합될 수 있도록 나사산이 형성되어 있는 나사부(25d)를 포함한다.

[0062] 연결부재(25)의 연결 축경부(25c)가 외부 몸통부재(21)의 몸통 축경부(21c)에 맞닿은 상태에서, 연결부재(25)의 나사부(25d)가 픽스츄어에 결합됨으로써 외부 몸통부재(21)는 픽스츄어 상에 고정될 수 있다.

[0063] 본 제2 실시형태에 있어서도 제1 실시형태에서와 마찬가지로, 교합부(22) 내에는 드라이버 안착구멍(27)이 형성되며, 드라이버 안착구멍(27)의 입구 부분에는 직경 확대부(27b)가 형성된다.

[0064] 도 7에는 본 발명의 제2 실시형태에 따른 여러 가지 형태의 임플란트 지그가 도시되어 있다. 본 발명에 따르면, 환자의 구강 상태나 픽스츄어의 종류 등에 따라 다양한 형태의 임플란트 지그를 제작 및 사용할 수 있다.

[0065] 이하, 도 8를 참조하여 본 발명에 따른 임플란트 보철물 제작방법에서의 바이트 채득과정을 설명한다.

[0066] 본 발명에 따르면, (a) 병원에서 인상 채득 후, (b) 채득된 인상체를 기공소로 보내기 전에, (c) 이미 식립되어 있는 픽스츄어에 본 발명에 따른 임플란트 지그를 체결하고, (d) 바이트 재료를 주입하여 바이트를 채득하고, (e) 채득된 바이트를 채득된 인상체와 함께 기공소로 보내어, (g) 채득된 인상체 및 바이트를 가이드로 활용하여 보철물을 제작한다. 바이트 채득 후 임플란트 지그는 픽스츄어로부터 분리되는 것이 바람직하다.

[0067] 기공소에서 제작된 보철물은 다시 병원으로 보내지고, 환자가 병원에 내원하여 환자의 구강 내에 보철물을 체결함으로써 임플란트 시술이 완료된다.

[0068] 상기된 바와 같이 본 발명에 따르면, 인상 채득 직후에 바이트 채득이 가능하기 때문에, 환자는 한 번의 내원으로 보철물 제작에 필요한 모든 사전 준비를 마칠 수 있게 된다. 따라서, 종래 바이트 채득을 위해서 기공소에서 지지용 지그를 별도로 제작한 다음 다시 치과로 발송되고 환자는 다시 내원하여 바이트를 채득하는 과정을 거치던 것에 비해, 시술에 소요되는 기간과 비용 등이 절감될 수 있게 된다.

[0069] 상술한 바와 같이, 본 발명의 임플란트 지그에 의해 임플란트 시술 중 보철물 제작과정에 있어서 인상 채득과 동시에 바이트 채득이 가능하여 보철 제작과정에 소요되는 시간과 비용을 줄여주며, 정확한 바이트 채득이 가능한 효과를 가진다.

[0070] 이상과 같이 본 발명에 따른 보철 교합관계 채득용 임플란트 지그 및 상기 임플란트 지그를 이용한 보철물 제작방법을, 예시된 도면을 참조하여 설명하였으나, 본 발명은 이상에서 설명된 실시예와 도면에 의해 한정되지 않으며, 특허청구범위 내에서 본 발명이 속하는 기술분야에서 통상의 지식을 가진 자들에 의해 다양한 수정 및 변형이 이루어질 수 있음은 물론이다.

도면의 간단한 설명

[0071] 도 1은 종래의 임플란트를 각 부품별로 나타내는 분해도,

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[0072] 도 2는 종래의 임플란트 보철물 제작방법에서의 바이트 채득과정을 설명하는 도면,

[0073] 도 3은 본 발명의 제1 실시형태에 따른 임플란트 지그를 일부 절단하여 도시한 도면,

[0074] 도 4는 본 발명의 제1 실시형태에 따른 임플란트 지그의 드라이버 안착구멍 주위에 형성된 테이퍼부의 변형예를 나타내는 도면,

[0075] 도 5는 본 발명의 제1 실시형태에 따른 임플란트 지그의 다양한 변형예를 나타내는 도면,

[0076] 도 6은 본 발명의 제2 실시형태에 따른 임플란트 지그의 단면도,

[0077] 도 7은 본 발명의 제2 실시형태에 따른 임플란트 지그의 다양한 변형예를 나타내는 도면, 그리고

[0078] 도 8은 본 발명의 따른 임플란트 보철물 제작방법에서의 바이트 채득과정을 설명하는 도면이다.

[0079] < 도면의 주요 부분에 대한 부호의 설명>

[0080] 11, 22 : 교합부 11a : 상부 표면

[0081] 11b : 경사부 13, 23 : 몸통부

[0082] 15 : 연결부 15a, 25d : 나사부

[0083] 17, 27 : 드라이버 안착구멍 17a, 17b, 27b : 테이퍼부

[0084] 21 : 외부 몸통부재 21a : 몸통 소직경부

[0085] 21b : 몸통 대직경부 21c : 몸통 축경부

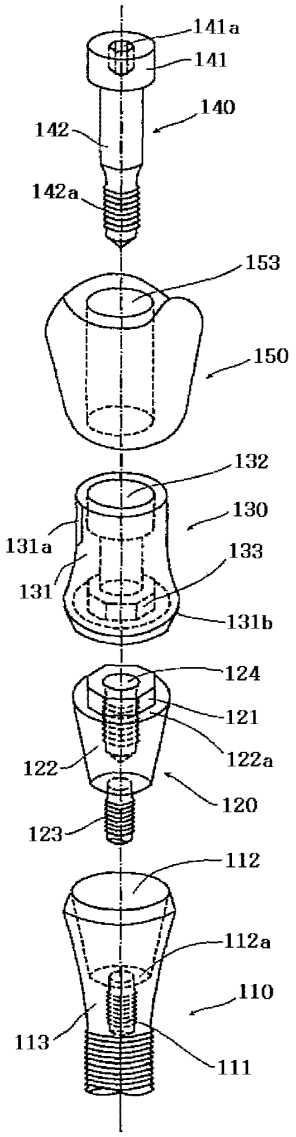
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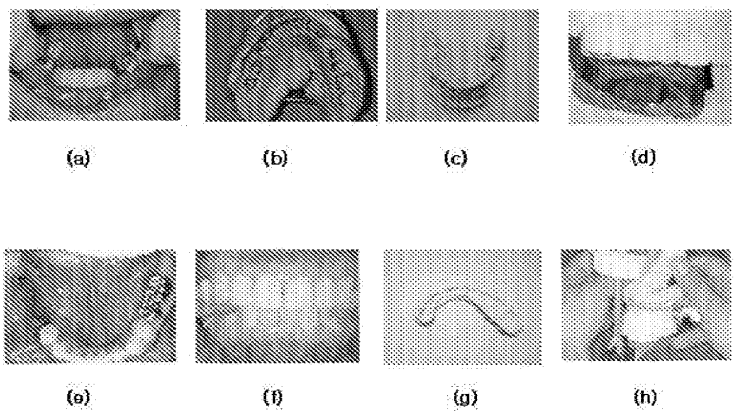
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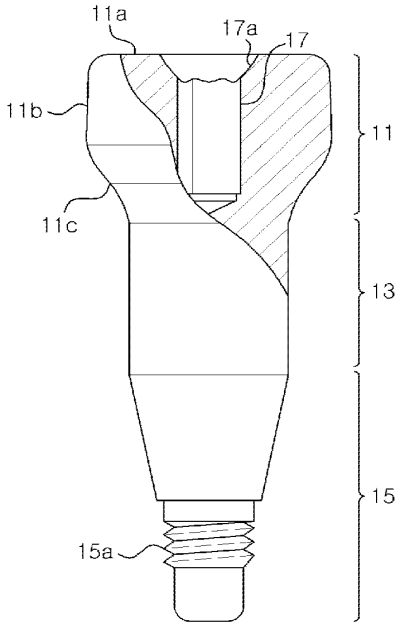
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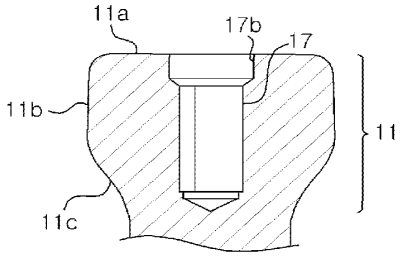
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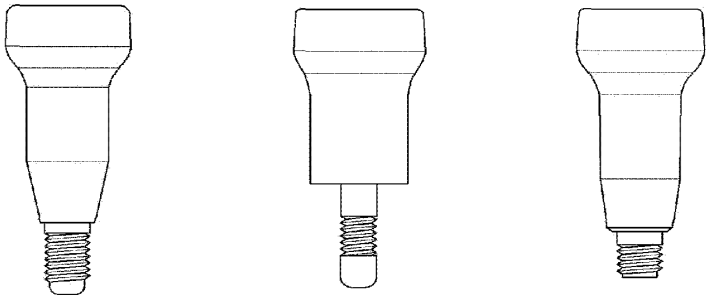
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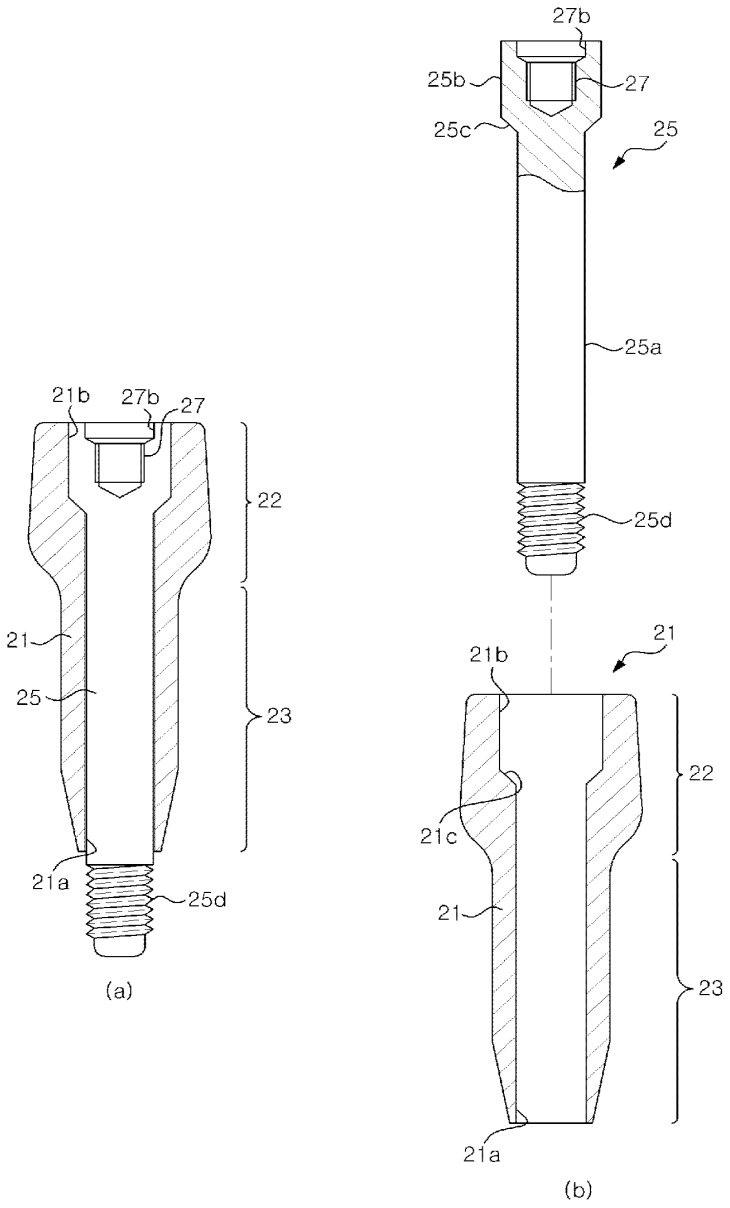
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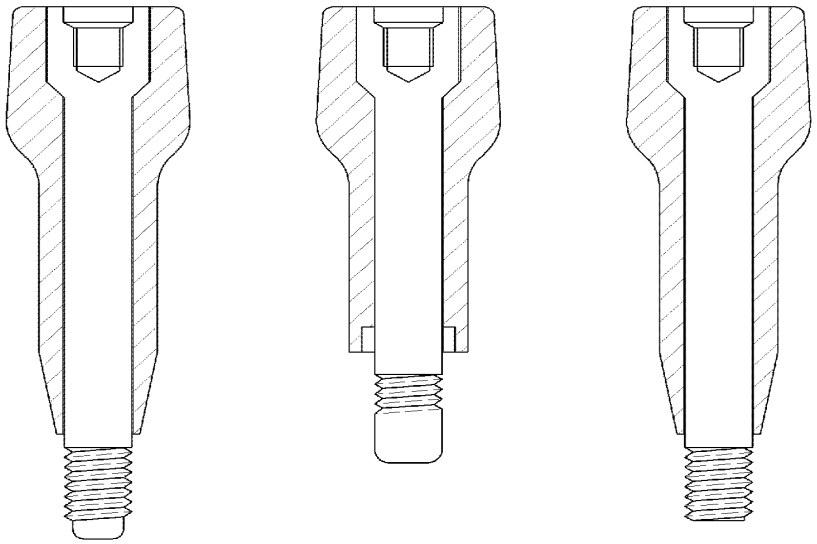
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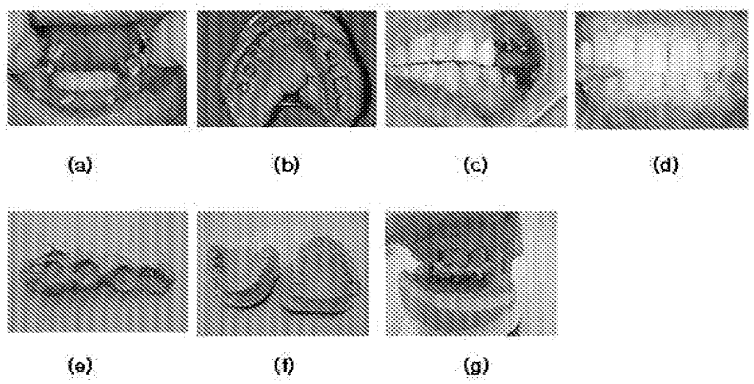
도면6


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도면7



도면8



Doc Code: IDS.SIZEFEE
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Application or Patent No.:	First Named Inventor:	Art Unit:
18827656	Kofford, Brandon Dale	3772
Filing Date:	**Attorney Docket Number:**	**Examiner:**
2024-09-06	SDC013	Huynh, Courtney Nguyen

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Signature	Date
/Daniel John Whittle, #54,537/	2025-09-22
Name (Print/Typed)	**Practitioner Registration Number (if applicable)**
Daniel John Whittle	54537

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AJO-DO

Effects of thread shape on the pullout strength of miniscrews

Antonio Gracco,[a] Costantino Giagnorio,[b] Serena Incerti Parenti,[c] Giulio Alessandri Bonetti,[d] and Giuseppe Siciliani[e]
Ferrara and Bologna, Italy

Introduction: The aim of this study was to determine the effects of variations in thread shape on the axial pullout strength of orthodontic miniscrews. **Methods:** A total of 35 miniscrews, 7 of each design being considered, were tested by performing pullout tests on a synthetic bone support. We used self-tapping and self drilling miniscrews having a diameter of 2 mm and a thread shaft length of 12 mm (the longest and the largest supplied by the manufacturer). A buttress reverse thread shape served as the control design and was tested against 4 experimental designs, each manufactured with a modification in thread shape while maintaining all other characteristics. The experimental groups had the following thread designs: buttress, 75° joint profile, rounded, and trapezoidal. **Results:** The control group with a buttress reverse thread shape had consistently higher pullout strength values than did the other designs. A statistically significant reduction in pullout force was found between the buttress reverse and the buttress thread miniscrews. **Conclusions:** Thread design influenced the resistance to pullout of the orthodontic miniscrews. The buttress reverse thread shape provided the greatest pullout strength. (Am J Orthod Dentofacial Orthop 2012;142:186-90)

The group of temporary anchorage devices, also known as skeletal anchorage systems, includes screw-type implants (miniscrews, mini-implants, microscrews, and micro-implants), onplants, miniplates, zygoma implants, and palatal implants.[1-3] With respect to other systems, miniscrews and miniplates are being progressively adopted in clinical orthodontics.[4] Miniscrews are generally more widely used because of their lower cost structure, ease of insertion and removal, and versatility of placement.[5-11] In clinical practice, miniscrews are loaded immediately after insertion, and achieving maximum primary stability—ie, the screw's initial holding power in the bone—is therefore of prime importance.[6,12] Only with such stability are miniscrew micromovements reduced, thereby favoring good tissue healing, a necessary condition to maintain the device in situ.[9,12]

Primary stability can be affected by various miniscrew design features, including length, diameter, thread design (shape, pitch, and depth), and self-drilling vs self-tapping threads.[13-17] Concerning thread design, little scientific evidence is available regarding the influence of thread shape on the mechanical yield of miniscrews.

Without an established gold standard for measuring primary stability, research has been focused on the in-vitro assessment of the biomechanical properties of miniscrews as indicators for their primary stability.[17] Measuring performance in pullout tests with axial forces is a well-established method to compare different screw designs, and the resulting pullout strength has been described in the orthopedic, maxillofacial surgery, and orthodontic fields as a fundamental biomechanical parameter contributing to the primary stability of screws.[17-19] The aim of this in-vitro study was to evaluate the role that variations in thread shape might have on the axial pullout strength of orthodontic miniscrews.

MATERIAL AND METHODS

Miniscrews with 5 different experimental designs were manufactured, each with a single feature altered while maintaining all other characteristics constant

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The authors report no commercial, proprietary, or financial interest in the products or companies described in this article.
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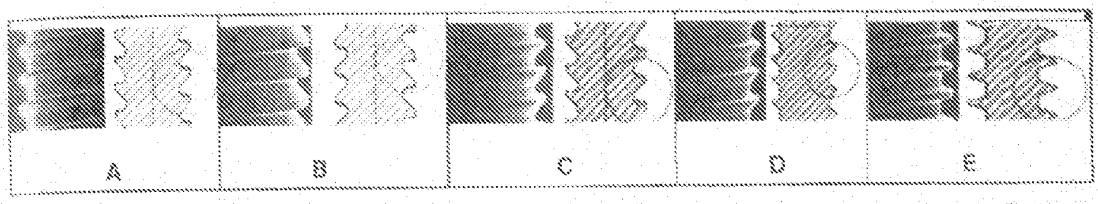


Fig 1. Schematic illustrations of miniscrew thread designs. A, buttress reverse thread shape (control); B, buttress thread; C, 75° joint profile thread; D, rounded thread; E, trapezoidal thread.

compared with a commercially available control design. By hypothesizing a mean difference of 15 N (SD, 9) in the pullout strengths between the different screw designs (derived from a pilot study), with power of 80% and $\alpha = 0.05$, a minimum of 6 miniscrews was required for each group.

Seven miniscrews made of titanium grade V (Ti$_6$Al$_4$V), 12.0 mm in length and 2.0 mm in external diameter, were selected as the control (NeoTAS; Omeo, Glendora, Calif). The longest miniscrews with the largest possible diameter offered by the manufacturer were chosen because these characteristics have been shown to provide greater resistance to pullout.[4,5] The aim was also to develop an experimental condition under which the greatest number of threads was available to better understand how the variations in thread design of miniscrews affect the pullout load values. The screws were self-drilling and self-tapping, with a cutting flute at their apex. They had a 15° conical shaft and an asymmetrical buttress reverse thread shape (Fig 1, *A*).

Four experimental design groups of 7 miniscrews each were made by modifying the thread shape: [1] buttress thread, opposite to the buttress reverse, with thread peaks inclined toward the miniscrew tip (Fig 1, *B*); [2] 75° joint profile thread, with the threads joining the shaft at an angle of 75° (Fig 1, *C*); [3] rounded thread, with the thread peaks rounded (Fig 1, *D*); and [4] trapezoidal thread, with the thread profile trapezoidal (Fig 1, *E*). All the other geometries of the screws were identical to the control design.

Thus, in total, 35 miniscrews were tested, 7 of each design. A synthetic bone support (15.2-12 Cellular Rigid Polyurethane Foam; Sawbones Europe, Malmö, Sweden) was used to ensure uniformity in the pullout strength evaluations.[21] On the upper surfaces of each sample, the geometric center was marked, and the miniscrews were inserted at these points to a depth corresponding to the entire thread length. Insertion was carried out through a hole (2 mm in diameter), made at the center of an appositely created steel bar (1.5 mm in thickness) bent into a U shape. The bar served as a guide for the miniscrews to be placed in a perpendicular orientation to the foam bone surface and minimized any wobbling during insertion. All procedures were performed manually by the same operator (A.C.) using a dynamometric torque driver calibrated to 15 Ncm to ensure optimal control of insertional torque.

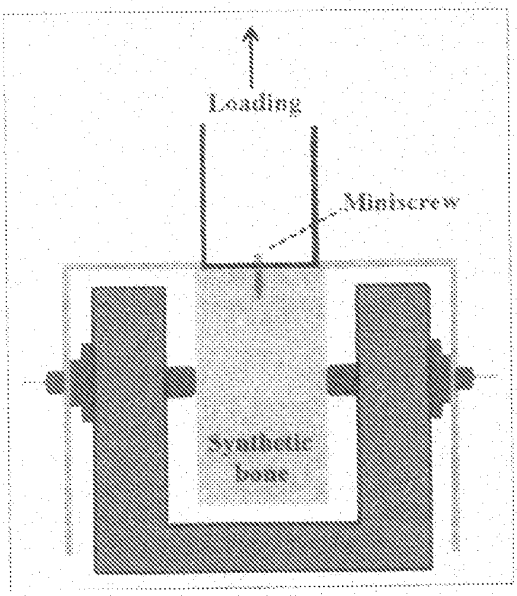


Fig 2. Configuration of testing setup.

For pullout testing, each synthetic bone support was housed securely in a frame that was fastened to a testing machine (Instron model 4467; TestResources, Shakopee, Minn) by a series of threaded bolts. This configuration of the testing setup (Fig 2) permitted a perfect axial coincidence between the miniscrew, the synthetic bone support, and the dynamometric cell. The distal ends of the steel bar were secured to the testing machine so that vertical forces, oriented parallel to the long axis of the miniscrews, were applied to the heads of the miniscrews. A crosshead speed of 10 mm per minute was chosen in accordance with previous reports.[21]

Straumann USA Exhibit 1008
Page 534 of 606
Straumann USA Exhibit 1023

Table I. Descriptive statistics for the pullout strength of the 6 miniscrew designs

Group	n	Mean (N)	SD	SE	95% CI		Minimum (N)	Maximum (N)
					Lower limit	Upper limit		
Buttress reverse (control)	7	192.8	13.3	5.0	180.5	205.2	184.3	217.7
Buttress	7	170.0	10.1	3.9	160.5	179.5	159.3	186.9
75° joint profile	7	181.4	11.6	4.4	170.5	191.9	161.5	193.6
Rounded	7	188.4	8.7	3.3	180.4	196.5	174.4	198.6
Trapezoidal	7	186.7	8.8	3.3	178.6	194.8	173.6	197.3

Table II. Tukey post hoc test

Groups	Mean difference	SE	Significance	95% CI	
				Lower limit	Upper limit
Buttress reverse vs buttress	22.8	5.9	0.001	6.2	39.4
Buttress reverse vs 75° joint profile	11.4	5.9	NS	−5.0	28.1
Buttress reverse vs rounded	4.4	5.9	NS	−12.2	21.0
Buttress reverse vs trapezoidal	6.1	5.9	NS	−10.6	22.7

NS, Not significant.

Statistical analysis

The pullout strength was measured as the peak force when the screw loosened from the synthetic bone support. The Levene and Lilliefors tests were used to verify the equality of variance and the normality of distribution of the examined variables. One-way analysis of variance (ANOVA) and Tukey post-hoc tests were used to compare the results obtained for each group. Statistical analyses were performed by using the statistical software (SPSS for Windows, version 16.0; SPSS, Chicago, Ill). The level of significance was set at 0.05.

RESULTS

Since the Levene and Lilliefors tests confirmed the equality of variance and the normality of distribution of the examined variables, 1-way ANOVA was used for the between-group comparisons. A statistically significant difference was detected between the groups ($F = 4.58$; $P < 0.05$). Table I shows the means, standard deviations, and standard errors of the maximum pullout forces for each design of miniscrew. The means in the pullout tests ranged from 170.0 ± 10.1 N (buttress) to 192.8 ± 13.3 N (buttress reverse). The Tukey post-hoc test subsequently showed a statistically significant difference between the buttress reverse screw (192.8 N) and that of the buttress thread profile (170.0 N) (Table II). All other paired comparisons showed no statistically significant differences.

DISCUSSION

The thread design of a miniscrew can vary in pitch, depth, and shape. All of these features can influence the resistance to pullout in a porous material, since the diameter, length, and screw or bone support material are constant.[14] The relationship between the mechanical properties of miniscrews and modifications in thread pitch and depth have been well documented. The ratio between thread depth and pitch has been expressed as a percentage (the so called "thread-shape factor"), with smaller pitch and greater depth showing greater pullout strength in porous synthetic materials and thus higher primary stability.[15] However, there are no reports in the orthodontic literature focusing on the influence of different thread shapes on the mechanical stability of miniscrews while controlling all other geometries.[15]

Likewise for a dental implant, thread shape is an important parameter when designing devices that will be subjected to early loading.[16] Different shapes (square, V-shaped, buttress, and buttress reverse) would allow for modifications in surface area and shear force development at the dental implant-tissue interface, therefore influencing the initial stability of the device.[17] The thread shapes that we examined in this study included buttress, 75° joint profile, rounded, and trapezoidal (Fig 1), which were not the same designs as commercially available orthodontic miniscrews.

In this study, the pullout tests were performed by applying vertical forces, oriented parallel to the long axis of the miniscrews.[11,14,18] It is well known that, by applying pullout tests in the axial direction, the clinical situation is not realistic because it is almost impossible to load miniscrews in the axial direction in a patient.[19] However, these tests are widely accepted as a method for comparing different types of screws in the orthopedic, maxillofacial surgery, and orthodontic fields.[11,17] The resulting pullout strengths provide valuable information

Straumann USA Exhibit 1006
Page 535 of 606
Straumann USA Exhibit 1023

regarding biomechanical parameters contributing to the primary stability of screws. In this study, a synthetic homogeneous material was used as a support to prevent any interference by uncontrollable variables.[14] The choice of foam here allowed us to recreate under in-vitro conditions the worst possible clinical situation, in which the bone could not hold the screws firmly.

The results showed a statistically significant difference in mechanical yield between the variations in thread designs, thereby confirming that thread shape affects the miniscrew's mechanical stability.[20] A significant reduction in pullout force was found between the buttress reverse and the buttress thread miniscrews. This result could be explained by the geometry of the thread that was inclined toward the tip, thus reducing the resistance to removal in an axial direction. This finding was consistent with previous reports, indicating a better pullout test performance of miniscrews characterized by an asymmetrical thread design, with 45° leading and 90° trailing angles.[7,14,20] Since the 75° joint profile thread showed the second highest value in terms of mean differences from the control design, it can be speculated that the magnitude of the angles of the thread might have some influence on the mechanical stability of miniscrews. Even if no statistically significant differences were detected, the buttress reverse thread design (control design) had consistently higher pullout strength values than did the 75° joint profile, the rounded, and the trapezoidal-thread designs. Therefore, these thread profiles did adversely affect the pullout values.

Since the experimental model used in this study could not really represent the clinical environment in which the cortical bone is the main factor in miniscrew stability, more research is needed to evaluate how the different thread types perform with a cortical bone analog. Further studies by using finite element models are also required to investigate the effects of each variation in thread design on stress distribution in bone.

CONCLUSIONS

Under the experimental conditions of this in-vitro study, by using a homogeneous synthetic bone support, the thread shape did influence the resistance to pullout and, therefore, the primary stability of miniscrews. The buttress reverse thread shape (as produced by the manufacturer) had consistently higher pullout strength values than did the other designs. A statistically significant difference was found between the buttress reverse and the buttress thread profile, with the buttress thread providing less pullout resistance than the buttress reverse; the 75° joint profile, rounded, and trapezoidal thread designs adversely affected the pullout values.

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REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	18827656	Filing Date	2024-09-06	Docket Number (if applicable)	SDC013	Art Unit	3772
First Named Inventor	Kofford, Brandon Dale			Examiner Name	Huynh, Courtney Nguyen		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

- ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____
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- ☐ Amendment/Reply
- ☒ Information Disclosure Statement (IDS)
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- ☐ Other _____

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____
(Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

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The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No _____

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature

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Signature of Registered U.S. Patent Practitioner			
Signature	/Daniel John Whittle, #54,537/	Date (YYYY-MM-DD)	2025-09-22
Name	Daniel John Whittle	Registration Number	54537

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112823 7590 10/10/2025

Daniel J Whittle
1229 Modoc Dr
Bellingham, WA 98229

EXAMINER	
HUYNH, COURTNEY NGUYEN	
ART UNIT	PAPER NUMBER
3772	

DATE MAILED: 10/10/2025

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/827,656	09/06/2024	Brandon Dale Kofford	SDC013	2702

TITLE OF INVENTION: Screw-attached Pick-up Dental Coping System and Methods

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$516	$0.00	$0.00	$516	01/12/2026

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

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PTOL-85 (Rev. 11/23)

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112823 7590 10/10/2025

Daniel J Whittle
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/827,656	09/06/2024	Brandon Dale Kofford	SDC013	2702

TITLE OF INVENTION: Screw-attached Pick-up Dental Coping System and Methods

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$516	$0.00	$0.00	$516	01/12/2026

EXAMINER	ART UNIT	CLASS-SUBCLASS
HUYNH, COURTNEY NGUYEN	3772	433-173000

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4a. Fees submitted: ❑Issue Fee ❑Publication Fee (if required)

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via the USPTO patent electronic filing system ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.

❑ Applicant asserting small entity status. See 37 CFR 1.27

NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.

❑ Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/827,656	09/06/2024	Brandon Dale Kofford	SDC013	2702

112823 7590 10/10/2025

Daniel J Whittle
1229 Modoc Dr
Bellingham, WA 98229

EXAMINER	
HUYNH, COURTNEY NGUYEN	
ART UNIT	PAPER NUMBER
3772	

DATE MAILED: 10/10/2025

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. 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 30 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, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. 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.

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. The United States Patent and Trademark Office (USPTO) collects the information in this record under authority of 35 U.S.C. 2. The USPTO's system of records is used to manage all applicant and owner information including name, citizenship, residence, post office address, and other information with respect to inventors and their legal representatives pertaining to the applicant's/owner's activities in connection with the invention for which a patent is sought or has been granted. The applicable Privacy Act System of Records Notice for the information collected in this form is COMMERCE/PAT-TM-7 Patent Application Files, available in the Federal Register at 78 FR 19243 (March 29, 2013).
https://www.govinfo.gov/content/pkg/FR-2013-03-29/pdf/2013-07341.pdf

Routine uses of the information in this record may include disclosure to:

1) law enforcement, in the event that the system of records indicates a violation or potential violation of law;
2) a federal, state, local, or international agency, in response to its request;
3) a contractor of the USPTO having need for the information in order to perform a contract;
4) the Department of Justice for determination of whether the Freedom of Information Act (FOIA) requires disclosure of the record;
5) a Member of Congress submitting a request involving an individual to whom the record pertains, when the individual has requested the Member's assistance with respect to the subject matter of the record;
6) a court, magistrate, or administrative tribunal, in the course of presenting evidence, including disclosures to opposing counsel in the course of settlement negotiations;
7) the Administrator, General Services Administration (GSA), or their designee, during an inspection of records conducted by GSA under authority of 44 U.S.C. 2904 and 2906, in accordance with the GSA regulations and any other relevant (i.e., GSA or Commerce) directive, where such disclosure shall not be used to make determinations about individuals;
8) 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));
9) the Office of Personnel Management (OPM) for personnel research purposes; and
10) the Office of Management and Budget (OMB) for legislative coordination and clearance.

If you do not furnish the information requested on this form, the USPTO may not be able to process and/or examine your submission, which may result in termination of proceedings, abandonment of the application, and/or expiration of the patent.

Notice of Allowability	Application No. 18/827,656	Applicant(s) Kofford et al.	
	Examiner COURTNEY N HUYNH	Art Unit 3772	AIA (First Inventor to File) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to the response filed 22 September 2025.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ 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.

3. ☑ The allowed claim(s) is/are 1-25 and 27-30 . As a result of the allowed claim(s), 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.**

4. ☐ 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)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☑ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 22 Sept 2025.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/COURTNEY N HUYNH/ Examiner, Art Unit 3772	/ERIC J ROSEN/ Supervisory Patent Examiner, Art Unit 3772

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.

Continued Examination Under 37 CFR 1.114

2. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after allowance or after an Office action under *Ex Parte Quayle*, 25 USPQ 74, 453 O.G. 213 (Comm'r Pat. 1935). Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, prosecution in this application has been reopened pursuant to 37 CFR 1.114. Applicant's submission filed on 22 September 2025 has been entered.

Reasons for Allowance

3. Claims 1-25 and 27-30 are allowed.

4. The following is an examiner’s statement of reasons for allowance:

1. In regard to independent claim 1, the prior art of record fails to teach or fairly suggest a dental system comprising: a coping having a proximal end; an implant abutment having threads extending distally; a definitive screw having a distal post portion having threads configured for securing the coping to the implant abutment threads through rotary engagement to a predetermined definitive fixation torque; and a temporary fastener comprising a shaft comprising a distal shaft portion sized and configured for rotary engagement with the implant abutment threads, wherein the distal shaft portion is configured to engage the implant abutment threads through an engagement depth of the implant abutment threads and is configured so that a portion of the temporary fastener holds the coping in alignment with the implant abutment, wherein the temporary fastener distal shaft portion is configured to rotate to couple to the

implant abutment through the engagement depth and to a predetermined temporary holding torque whereby the temporary fastener holds the coping into alignment against the implant abutment, wherein the temporary fastener is configured to release at least a portion of the temporary fastener and the coping from the implant abutment as a unit when an axial release force is applied in a proximal direction to the temporary fastener, wherein the temporary fastener distal shaft portion is sized and configured to make contact with the implant abutment threads over a first thread contact area to hold the coping against the implant abutment, and the definitive screw distal post portion is sized and configured to make contact with the implant abutment threads over a second thread contact area to hold the coping against the implant abutment, and wherein the first thread contact area is less than the second thread contact area, and in combination with other limitations set forth in the claim.

5. In regard to independent claim 10, the prior art of record fails to teach or fairly suggest a dental system comprising: an implant abutment having threads; a coping having a proximal end with a central aperture merging into a wider central open channel; a definitive screw having a distal post portion having threads configured for securing the coping to the implant abutment threads, wherein the distal post portion having threads is sized to extend through the coping aperture into the central open channel; a temporary fastener comprising: a head with a proximal end having a drive tool interface configured for rotating the temporary fastener to a predetermined temporary holding torque, and a shaft coupled to or integral with the head and configured to extend through the central aperture of the coping, wherein the shaft has a distal portion having an outer surface comprising threads, wherein a maximal width of the distal portion with the threads is smaller than a maximal width of the distal post portion of the definitive screw with the threads, wherein the temporary fastener is configured so that, in position and engaged with the threads of the implant abutment at the predetermined temporary holding torque, the temporary fastener cooperates with the coping to align the coping into position with the implant abutment, and wherein the temporary fastener is configured so that in response to

application of an axial release force above a predefined value in a proximal direction, the coping and at least a portion of the temporary fastener are released as a unit from the implant abutment without rotation, and in combination with other limitations set forth in the claim.

6. In regard to independent claim 15, the prior art of record fails to teach or fairly suggest a dental system comprising: a coping having a proximal end with an aperture and a distal end with a coping seating surface; and an implant abutment comprising: female threading, wherein the female threading resides proximate a proximal end of the implant abutment and extends distally thereof, and an outer wall surrounding the female threading, the outer wall comprising an implant abutment seating surface; a temporary fastener comprising: a proximal portion with a width larger than the coping aperture; and a shaft comprising a distal shaft portion configured for rotary engagement with the implant abutment female threading, wherein the shaft of the temporary fastener is sized to extend through the coping aperture, and wherein the temporary fastener distal shaft portion is configured to rotatably engage the implant abutment female threading at a predetermined temporary holding torque to an engagement depth sufficient to hold the coping seating surface aligned with and against the implant abutment seating surface, and wherein the temporary fastener is configured to release at least a portion of the temporary fastener and the coping from the implant abutment as a unit as a result of an axial release force in a proximal direction, and wherein the temporary fastener distal shaft portion discontinuously engages the female threading of the implant abutment between a most distal engagement position and a proximate end of the implant abutment female threading and in combination with other limitations set forth in the claim.

7. The closest prior art is the following:

8. Aldecoa (US 20080227057 A1) discloses a dental system comprising: a coping having a proximal end; an implant abutment having threads extending distally; a definitive screw a distal post portion having threads capable of securing the coping to the threads of the implant abutment through rotary engagement; and a temporary fastener comprising a shaft comprising

a distal shaft portion sized and capable of rotary engagement with the implant abutment threads, wherein the shaft of the temporary fastener is capable of extending through the aperture of the coping and the distal shaft portion is capable of engaging the implant abutment threads through an engagement depth measured axially between a most distal contact position with the implant abutment threads and the most proximal thread position of the implant abutment threads and is configured so that a portion of the temporary fastener holds the coping in alignment with the implant abutment prior to attachment of the definitive screw, wherein the temporary fastener is capable of releasing at least a portion of the temporary fastener and the coping from the implant abutment as a unit when an axial release force is applied in a proximal direction to the temporary fastener, wherein the distal shaft portion of the temporary fastener is sized and capable of making contact with the implant abutment threads over a first thread contact area to hold the coping against the implant abutment, wherein, after removal of the temporary fastener, the distal post portion of the definitive screw is sized and capable of making contact with the implant abutment threads over a second thread contact area to hold the coping against the implant abutment. Aldecoa is silent to a predetermined definitive fixation torque, wherein the first thread contact area is less than the second thread contact area, wherein the distal shaft portion of the temporary fastener is configured to rotate to couple to the implant abutment through the engagement depth and to a predetermined temporary holding torque whereby the temporary fastener holds the coping into alignment against the implant abutment, wherein the distal shaft portion of the temporary fastener is configured to have discontinuous contact with the implant abutment threads throughout the engagement depth.

9. Berrevoets (US 6517543 B1) discloses an implant having threads and a screw having a distal shaft portion wherein the distal shaft portion is sized and configured to make contact with the threads over a first thread contact area, wherein the distal shaft portion is capable of having discontinuous contact with the threads throughout an engagement depth. Berrevoets is silent to a dental system comprising a coping and a temporary fastener, wherein the distal shaft portion

of the temporary fastener is configured to rotate to couple to the implant abutment through the engagement depth and to a predetermined temporary holding torque.

10. Klardie (US 20030211445 A1) discloses a dental system wherein a component of the dental pick-up process system is polymeric. Klardie is silent to wherein the distal shaft portion of the temporary fastener is configured to rotate to couple to the implant abutment through the engagement depth and to a predetermined temporary holding torque whereby the temporary fastener holds the coping into alignment against the implant abutment, wherein the distal shaft portion of the temporary fastener is configured to have discontinuous contact with the implant abutment threads throughout the engagement depth.

11. Derey (WO 2013030839 A1) discloses a distal shaft portion sized and configured to make contact with threads over a first thread contact area where the apparatus is capable of releasing at least a portion of the fastener when an axial release force is applied in a proximal direction to the fastener. Derey is silent to wherein the distal shaft portion of the temporary fastener is configured to rotate to couple to the implant abutment through the engagement depth and to a predetermined temporary holding torque whereby the temporary fastener holds the coping into alignment against the implant abutment, wherein the distal shaft portion of the temporary fastener is configured to have discontinuous contact with the implant abutment threads throughout the engagement depth.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled “Comments on Statement of Reasons for Allowance.”

Conclusion

12. 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, Eric Rosen can be reached at (571) 270-7855. 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.

/COURTNEY N HUYNH/
Examiner, Art Unit 3772

/ERIC J ROSEN/
Supervisory Patent Examiner, Art Unit 3772

Notice of References Cited	Application/Control No. 18/827,656	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 YYYY-MM-DD	Name	CPC Classification	US Classification
*	A	US-6517543-B1	2003-02-11	Berrevoets; Greg A.	A61B17/68	411/419
*	B	US-20030211445-A1	2003-11-13	Klardie, Michael R.	A61C8/0001	433/172
*	C	US-20080227057-A1	2008-09-18	Anitua Aldecoa; Eduardo	A61C8/0001	433/174
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date YYYY-MM-DD	Country	Name	CPC Classification
	N	WO-2013030839-A1	2013-03-07	WO	DEREY OFER	A61C8/0057
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title, Date, Publisher, Edition or Volume, Pertinent Pages
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in YYYY-MM-DD format are publication dates. Classifications may be US or foreign.

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/827,656	Kofford et al.
	Examiner	**Art Unit**
	COURTNEY N HUYNH	3772

CPC						
Symbol					**Type**	**Version**
A61C	/	8	/	0068	F	2013-01-01
A61C	/	8	/	0066	I	2013-01-01
A61C	/	8	/	0001	I	2013-01-01
A61C	/	8	/	0078	I	2013-01-01
A61C	/	8	/	0074	I	2013-01-01
A61C	/	2201	/	00	A	2013-01-01
A61C	/	2008	/	0084	A	2013-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

/COURTNEY N HUYNH/ Examiner, Art Unit 3772	03 October 2025	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	29	
/ERIC J ROSEN/ Supervisory Patent Examiner, Art Unit 3772	07 October 2025	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	75

U.S. Patent and Trademark Office — Part of Paper No.: 20251003

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/827,656	Kofford et al.
	Examiner	**Art Unit**
	COURTNEY N HUYNH	3772

INTERNATIONAL CLASSIFICATION					
CLAIMED					
A61C8/00	/	8	/	00	

NON-CLAIMED					
	/		/		

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

/COURTNEY N HUYNH/ Examiner, Art Unit 3772	03 October 2025	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	29	
/ERIC J ROSEN/ Supervisory Patent Examiner, Art Unit 3772	07 October 2025	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	75

U.S. Patent and Trademark Office — Part of Paper No.: 20251003

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/827,656	Kofford et al.
	Examiner	**Art Unit**
	COURTNEY N HUYNH	3772

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	1	10	23	19	14	28	21								
2	2	11	24	20	29	29	22								
3	3	12	25	21	30										
4	4	13	27	22	15										
5	5	14	28	23	16										
6	6	15	10	24	17										
7	7	16	11	25	18										
8	8	17	12	26	19										
9	9	18	13	27	20										

/COURTNEY N HUYNH/ Examiner, Art Unit 3772	03 October 2025	**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	29	
/ERIC J ROSEN/ Supervisory Patent Examiner, Art Unit 3772	07 October 2025	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	75

U.S. Patent and Trademark Office Part of Paper No.: 20251003

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/827,656	Kofford et al.
	Examiner	Art Unit
	COURTNEY N HUYNH	3772

CPC - Searched*		
Symbol	**Date**	**Examiner**
A61C8/0001	10/24/2024	CNH
A61C8/0001	06/20/2025	CNH
A61C8/0001	10/03/2025	CNH

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**
411	419, 414	10/24/2024	CNH
411	419, 414	06/20/2025	CNH
411	419, 414	10/03/2025	CNH

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	**Date**	**Examiner**

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/827,656	Kofford et al.
	Examiner	Art Unit
	COURTNEY N HUYNH	3772

Search patent family in Global Dossier, Espacenet, Patentscope	10/22/2024	CNH
Inventor name search in PE2E and PDP/DAV	10/22/2024	CNH
PE2E- CPC and text search	10/22/2024	CNH
PE2E- CPC and text search -A61C2201/00, A61C2008/0084, A61C13/225,2255,265,2656,275, A61C11/088, F16B37/14, F16B35/06,041, F16B33/02, A61C8/0066,0068,00,005,008,0007,0082,0087,0066,0074,0078, USPC 411/396,397,411, 433/173 - see attached search history	10/24/2024	CNH
Search in IP.com	10/24/2024	CNH
Updated patent family search in Global Dossier, Espacenet, Patentscope	06/20/2025	CNH
Updated Inventor name search in PE2E and PDP/DAV	06/20/2025	CNH
PE2E- CPC and text search -A61C2201/00, A61C2008/0084, A61C13/225,2255,265,2656,275, A61C11/088, F16B37/14, F16B35/06,041, F16B33/02, A61C8/0066,0068,00,005,008,0007,0082,0087,0066,0074,0078, USPC 411/396,397,411, 433/173 - see attached search history	06/20/2025	CNH
PGR2025-00054 Reviewed Petition for Post Grant Review of U.S. Patent No. 12,156,781, Papers 1-5, Exhibits 1001-1021	06/20/2025	CNH
IPR2025-00956 Reviewed Petition for Inter Partes Review of U.S. Patent No. 11,937,992, Papers 1-6, Exhibits 1001-1027	06/20/2025	CNH
Consulted with Primary Examiner Ed Moran regarding allowability	06/25/2025	CNH
Updated patent family search in Global Dossier, Espacenet, Patentscope	10/03/2025	CNH
Updated Inventor name search in PE2E and PDP/DAV	10/03/2025	CNH
PE2E- CPC and text search -A61C2201/00, A61C2008/0084, A61C13/225,2255,265,2656,275, A61C11/088, F16B37/14, F16B35/06,041, F16B33/02, A61C8/0066,0068,00,005,008,0007,0082,0087,0066,0074,0078, USPC 411/396,397,411, 433/173 - see attached search history; Similarity Search	10/03/2025	CNH
PGR2025-00054 Updated Review of Petition for Post Grant Review of U.S. Patent No. 12,156,781, Papers 1-5, Exhibits 1022-1031, 2001-2018	10/03/2025	CNH
IPR2025-00956Updated Review of Petition for Inter Partes Review of U.S. Patent No. 11,937,992, Papers 1-6, Exhibits 1028-1034, 2001-2018 and 3101	10/03/2025	CNH

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	18/827,656	Kofford et al.
	Examiner	Art Unit
	COURTNEY N HUYNH	3772

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
	See attached search notes	06/25/2025	CNH
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[Continued on next page]

(54) Title: A METHOD FOR ATTACHING AND DETACHING DENTAL CONSTRUCTIONS AND A DEVICE THEREOF

(57) Abstract: The present invention relates to a flexible holding device for connecting a construction to an implant in a ridge of a mouth comprising: (a) a head for holding the construction from the inside of said construction; (b) more than one leg for holding the internal thread of said implant from the inside; and (c) a body, attached to said head and attached to said legs, for attaching said construction to said implant.

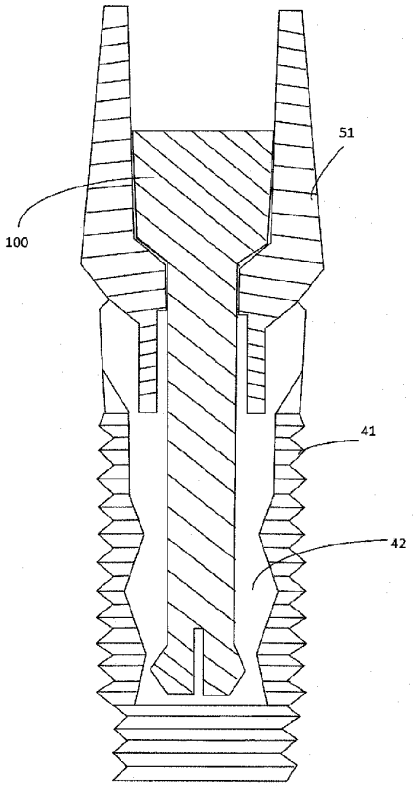


Fig. 6

WO 2013/030839 A1

Straumann USA Exhibit 1023

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A METHOD FOR ATTACHING AND DETACHING DENTAL CONSTRUCTIONS AND A DEVICE THEREOF

Field of the Invention

The present invention relates to the field of dentistry. More particularly, the invention relates to dental restoration systems.

Background of the Invention

The loss of permanent teeth creates the need for a denture, i.e. a dental restoration system, to replace the natural teeth. Conventional dentures rest on implants which are implanted in the gingival tissue of the ridge of the mouth. These dentures, where possible, may also be anchored to existing natural teeth. In cases where all of the teeth have been extracted from either the upper or lower jaw, or both, a full denture can be utilized.

One type of denture, used today, utilizes a prosthetic tooth, which connects to an abutment on a dental implant. After a dental implant is implanted, in the gingival tissue of the ridge, a construction, e.g. an abutment, is attached on top of the implant. The abutment is a metal cylinder that the prosthetic tooth is built onto. There are many types of abutments and they vary in length, width, angle, shape and color. On the abutment a prosthetic tooth is fastened and it should look, and function, just like any other tooth in the mouth.

A patient with a multiple implant restoration goes through the same process and the final prosthetic teeth can vary between multiple single teeth or several teeth connected by a bridge or even a partial fixed denture, based on the planning of the dentist and the needs of the patient.

Straumann USA Exhibit 1023

Another type of denture used today, utilizes a construction such as an overdenture bar. This dental reconstruction system comprises a conventional acrylic overdenture retained by suitable attachments, such as clips, to an implant supported cast bar otherwise known as an overdenture bar, e.g. a Dolder bar. The overdenture bar is attached to the implants, in the patient's ridge, using designated screws.

In any case, after fitting the construction(s) on the implant(s), the dentist is required to take an impression of the ridge, with the attached construction(s). The impression is taken by filling a standard form with a solidifying substance such as polyvinylsiloxane and pressing it inside the mouth of the patient. Once this is completed the dentist will send the impression out to the laboratory for building a model of the mouth. In the laboratory, after receiving the impression, a solidifying material, such as plaster of Paris, is then poured into the impression for creating the model. The model is then separated from the impression. Thus, the model sculpts the patient's alveolar, ridge, implants and the construction. However, since the model is used to create a prosthetic for a patient, the model has to be accurate enough in order to provide that the created prosthetic has a precise fit to the ridge of the patient. An inaccurate prosthetic can cause subsequent inconvenience, or even injuries, to the patient. Finally, the created prosthetic is seated in the mouth of the patient. However, this kind of procedure is time consuming, problematic, and may create inconveniences to the patient.

US 6,488,501 discloses a transfer jig for implant, in a dental surgery, which uses a tubular post and a tubular coping which is attachable and detachable from the post by a snap-fit attachment. The described post has a hexagonal portion for location in a hexagonal socket in an implant and a frusto-conical portion which is a seat for the coping. The coping has a diametrically opposed pair of slots in its end that seats on the post to receive a diametrically opposed pair of pins with a snap-fit, the pins being mounted on the post so that the coping is precisely located relative to the hexagonal portions. The coping also has apertures formed through its tubular wall through which dental

Straumann USA Exhibit 1023

impression material is forced to form structural links when a dental impression is taken. Nevertheless, the described mechanism is complicated and requires a number of specially-designed tight-fitting parts for applying the described method.

It would therefore be desired to propose a system void of the problems discussed above.

Summary of the Invention

It is an object of the present invention to provide a method for creating an accurate impression of the mouth ridge.

It is another object of the present invention to provide a method for creating comfortable and accurate dental restorations.

It is still another object of the present invention to provide a method for attaching and detaching dental constructions for measurements.

It is still another object of the present invention to provide a flexible device, for firmly holding a dental restoration construction in its place, over the implants in the ridge, and for allowing an easy detachment of the construction from the implants in the ridge when detaching the impression.

It is still another object of the present invention to provide a flexible device for firmly holding the dental restoration construction in its place over the implants in the ridge, even if the implants are not parallel to one another.

Other objects and advantages of the invention will become apparent as the description proceeds.

The present invention relates to a method for attaching and detaching a construction to an implant in a ridge of a mouth comprising the steps of: (a) inserting at least one flexible holding device into said construction, where said flexible holding device head is held inside said construction; (b) attaching said construction to said implant by fastening the legs of said holding device into said implant; and (c) detaching said construction by applying a pulling force, in an opposite direction to the implant, on said construction.

Preferably, the detaching is done by applying a pulling force on the form with an impression which engulfs the construction.

In one embodiment, the method is used for connecting and detaching an abutment.

In one embodiment, the method is used for connecting and detaching an overdenture bar. In one embodiment, the method is used for connecting the overdenture bar to a number of implants which are not parallel to one another in the ridge of the mouth.

The present invention also relates to a flexible holding device for connecting a construction to an implant in a ridge of a mouth comprising: (a) a head for holding the construction from the inside of said construction; (b) more than one leg for holding the internal thread of said implant from the inside; and (c) a body, attached to said head and attached to said legs, for attaching said construction to said implant.

Preferably, the device is made of Polyacetal.

Preferably, the device has two legs.

In one embodiment, the device is used instead of a transfer.

Brief Description of the Drawings

Some embodiments of the invention are 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 embodiments of the invention. In this regard, the description and the drawings make apparent to those skilled in the art how embodiments of the invention may be practiced.

In the drawings:

- Fig. 1 is a schematic diagram of the different dental parts of a prior art prosthetic tooth.
- Fig. 2 is a diagram of a mouth of a patient with an abutment secured, in a prior art fashion, in the mouth.
- Fig. 3 is a diagram of an impression taken, in a prior art fashion, in a mouth of a patient.
- Fig. 4 is a schematic diagram of an overdenture bar above the ridge of a mouth, before attaching the overdenture bar to the dental implant analogues, according to a prior art process.
- Fig. 5 is a schematic diagram of a flexible holding device, according to an embodiment of the invention.
- Fig. 6 is a schematic diagram of the flexible holding device attaching a construction to a typical dental implant analogue, according to an embodiment of the invention.

Detailed Description of Preferred Embodiments

The term "ridge" refers to the alveolar ridge which comprises gingival tissue and contains the sockets, i.e. alveoli, of the teeth.

Straumann USA Exhibit 1023

The terms "implant analogue(s)" and "implant(s)" are used throughout the description intermittingly and are meant to include any device which is inserted into the ridge for supporting a denture.

The terms "bar" "cast bar", "denture bar", "overdenture bar", "Perci bar", and "Dolder bar" are used throughout the description intermittingly and are meant to include any bar which supports the prosthetic overdenture.

The term "construction(s)" is meant to include any dental device which can be attached to the implant, such as, an abutment, a bridge, or an overdenture bar.

The term "denture(s)" is meant to include any prosthetic device for replacing the natural teeth, such as a prosthetic tooth or a prosthetic overdenture.

Fig. 1 is a schematic diagram of the different dental parts of a prior art prosthetic tooth. At first a dental implant 41 is implanted in the gingival tissue of the ridge 44. Then, an abutment 31 is fastened to the implant 41 using a prior art screw 200. After the abutment 31 has been attached and fastened to the implant 41, the dentist is required to take an impression of the ridge and the attached abutment 31, for casting a model of the ridge with its attached abutment 31. Since the model is used afterwards to create the prosthetic tooth 30, the model needs to be as accurate as possible. Any inaccuracy in the model may result in an inaccuracy of the prosthetic tooth which in turn may cause inconvenience to the patient. In some of the cases, due to the inaccuracies, the dentist may be required to amend and smooth the tooth in the mouth of the patient, after attaching the prosthetic tooth, a feat which is not easy to the dentist and inconvenient to the patient.

Fig. 2 is a diagram of a mouth of a patient with an abutment secured, in a prior art fashion, in the mouth. The abutment 31, as describe in relations to fig. 1, is secured, using a screw, prior to taking an impression. The abutment 31, of the prior art, is designed to be

taller than the other teeth of the mouth in order to allow the dentist to unfasten the screw of the abutment 31 and pull the abutment 31.

Fig. 3 is a diagram of an impression taken, in a prior art fashion, in a mouth of a patient. In the prior art process, a hole is cut in the standard form 33 in order to equip the abutment 31. The abutment 31, as described in relations to Fig. 1 and 2, sticks out from the ridge and therefore the standard form 33 is first cut in order to take the impression with the abutment 31. The cut is made in the corresponding place of abutment 31 and then the form 33 is filled with the solidifying material such as such as a combination of Zhermack's Hydrorise silicon and Hydroise putty. This cut form 33, with its solidifying material, is then pressed onto the ridge of the patient and held in place until it solidifies. After which the dentist first unscrews the abutment 31 and then lifts the form and sends it the lab for casting a model of the ridge.

Fig. 4 is a schematic diagram of an overdenture bar above the ridge of a mouth, before attaching the overdenture bar to the dental implant analogues, according to a prior art process. The overdenture bar 20 comprises poles, such as pole 21, connected between them by interconnecting bars, such as bar 22. The overdenture bar 20 may have any number of poles, and interconnecting bars, according to the needs of the patient and his ridge. In this embodiment the ridge 44 has four implants, such as implant 41, for supporting the overdenture bar 20, which has four poles. The poles of the overdenture bar 20 are attached to the implants by screws such as screw 200. The top part of the screw 200 which is inside the pole 21 is depicted in silhouette. In the prior art process, after attaching the overdenture bar with screws to the implants of the ridge an impression is taken.

However, since the construction is fastened by screws to the implants, any impression of the ridge and the construction is distorted by the construction. For example when the impression material, which may be any solidifying material such as a combination of Zhermack's Hydrorise silicon and Hydroise putty, is first poured on the ridge and the

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construction, the material flows around the construction, and in the spaces between the construction and the ridge, and solidifies. This however makes the task, of removing the impression intact and undamaged, time consuming and fairly difficult, since the construction is fastened with screws to the abutments of the implants in the ridge. In many cases it is almost impossible to detach the impression from the mouth of the patient without it being ripped or torn, due to the fact that the construction is secured to the ridge of the mouth and due to the fact that there is a space between the construction and the ridge and due to the fact that the impression material has solidified. In many cases the ripped and distorted impression hinders the ability to create an accurate model of the mouth of the patient which in turn may prevent the lab from creating a fitting prosthetic, whether the prosthetic is a prosthetic tooth or a prosthetic overdenture, or any other kind of construction.

Therefore, a device is proposed which can hold the construction in place when pouring the impression material, over the construction and ridge, and can easily detach from the ridge, when the impression solidifies, thus allowing the impression to keep engulfing the construction when lifted. Thus the impression, which includes the construction, may be used for casting the model of the ridge of the patient, after which the construction may be extracted from the impression and fastened to the model, effectively creating a more accurate model of the ridge and the construction of the patient. These flexible devices are designed to be used instead of the screws used for attaching the construction to the implants.

The described device may also spare the use of a transfer since it may be used as a transfer, even in cases where the implants are not implemented in the ridge in parallel.

Fig. 5 is a schematic diagram of a flexible holding device, according to an embodiment of the invention. The device 100 is designed as a flexible holding device having a head 11, a body 12, and two extended legs 13. The body 12 is designed to be slimmer than the head 11, in other words, the body 12 is designed to have a shorter circumference than the head

11. A typical dental construction is designed with a tunnel running through its axis, where the end of the tunnel is slightly slimmer in order to hold the head of the screw. The device 100 is designed to fit in a construction, instead of the designated screw. Thus the device 100 may be inserted into the construction, legs 13 first – head 11 last, and pushed to the limit, i.e. until the head 11 gets stuck close to the end of the construction, above the lower opening, and the legs 13 dangle out. The legs 13, which are designed for insertion and gripping, can then be inserted into the inside of an implant, where the legs 13 can grip the internal thread of the implant from within, due to the legs 13 elastic repelling force which repels the legs form one another. Typically, the construction can be attached to the implant by applying force on the top of the head 11 of device 100, which is in the tunnel of the construction, to force the legs 13 into the implant and gripping it from within, while the lower opening of the tunnel of the construction is on, or substantially close, to the implant.

Likewise the construction may be detached by pulling the construction from the ridge, thus forcing the legs 13 of device 100 to surrender their grip on the inner thread of the implant. The holding device 100 may be composed of Polyacetal or any other flexible and rigid material such as Toarplast POM.

In one embodiment, the wider part of legs 13, as described in relations to Fig 5, is designed as having an angle which sticks out of the device. In another embodiment the legs 13 may have their wider part rounded. Other embodiments are possible as well as long as the legs are designed to grip the internal thread of the implant from within.

In one of the embodiments, the device 100, as described in relations to Fig. 5, has more than two legs. There may be any number of legs to device 100 as long as they are designed to grip the internal thread of the implant from within.

In one embodiment the device 100, as described in relations to Fig. 5, is 10mm long, where the head 11 may be 2mm long, the body 12 may be 7mm long, and the legs 13

wider part may be 1mm long. In this embodiment the head 11 may have a diameter of 2mm, the body 12 may have a diameter of 1mm, and the legs 13 wider part may have a diameter of 2mm, when they are not pressed together. In one embodiment the legs 13 may be 2mm long. Other embodiments and other measurements are possible as well.

Fig. 6 is a schematic diagram of the flexible holding device attaching a construction to a typical dental implant analogue, according to an embodiment of the invention. The device 100, as described in relations to Fig. 5, is inserted in the construction 51 and into the implant 41. The head of device 100 secures the construction 51, and the legs, of device 100, grip the internal thread 42 of the implant 41 from within. Thus the construction 51 is held by device 100 to the implants 41. However, if an upper pulling force is applied to the construction 51, the legs of device 100 will surrender their grip and the construction 51 can be easily detached from the implant 41.

Due to the features of the described flexible holding device, it may be used for holding the constructions over implants where the implants are not parallel. Meaning, that even in cases where a number of implants are implanted in the ridge of the patient at different angles, the construction(s) may be held by a number of the described flexible devices, e.g. one for each implant, to the implants, and pulled away when necessary.

The device of the present invention is beneficial to the dental surgeon who performs the implant surgery, the dental laboratory which creates the dentures, and the patient who receives the denture. The dental surgeon can make an impression much easier since the construction is removed from the ridge along with the impression. With a securely attached construction, difficulty always is encountered with the impression material becoming lodged between the construction and the sutured gingival tissue. Since the construction is removed with the impression, no such difficulties are encountered taking the impression. Next, the dental laboratory can fashion a denture which is much tighter fitting since the construction is present in the laboratory during the denture manufacturing operation. This results in a better fit of the denture for the patient. Installation of the

construction, for usage, is accomplished easily by attaching the construction extracted from the impression into the implants in the ridge, prior to the patient being finally fitted with the custom-manufactured denture prosthetic.

While some embodiments of the invention have been described by way of illustration, it will be apparent that the invention can be carried into practice with many modifications, variations and adaptations, and with the use of numerous equivalents or alternative solutions that are within the scope of persons skilled in the art, without departing from the invention or exceeding the scope of claims.

Straumann USA Exhibit 1023

Claims

1. A flexible holding device for connecting a construction to an implant in a ridge of a mouth comprising:
    a. a head for holding the construction from the inside of said construction;
    b. more than one leg for holding the internal thread of said implant from the inside; and
    c. a body, attached to said head and attached to said legs, for attaching said construction to said implant.
2. A device according to claim 1, where the device is made of Polyacetal.
3. A device according to claim 1, where the device has two legs.
4. A device according to claim 1, where the device is used for connecting an abutment.
5. A device according to claim 1, where the device is used for connecting an overdenture bar.
6. A device according to claim 5, where the device is used for connecting the overdenture bar to a number of implants which are not parallel to one another in the ridge of the mouth.
7. A device according to claim 1, where the device is used instead of a transfer.
8. A method for attaching and detaching a construction to an implant in a ridge of a mouth comprising the steps of:
    a. inserting at least one flexible holding device into said construction, where said flexible holding device head is held inside said construction;
    b. attaching said construction to said implant by fastening the legs of said holding device into said implant; and
    c. detaching said construction by applying a pulling force, in an opposite direction to the implant, on said construction.
9. A method according to claim 8, where the detaching is done by applying a pulling force on the form with an impression which engulfs the construction.

Straumann USA Exhibit 1023

10. A method according to claim 8, where the method is used for connecting and detaching an abutment.
11. A method according to claim 8, where the method is used for connecting and detaching an overdenture bar.
12. A method according to claim 11, where the method is used for connecting the overdenture bar to a number of implants which are not parallel to one another in the ridge of the mouth.

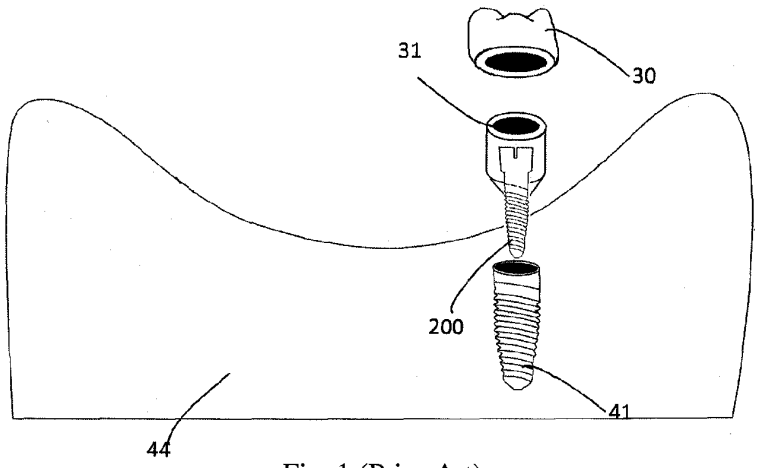


Fig. 1 (Prior Art)

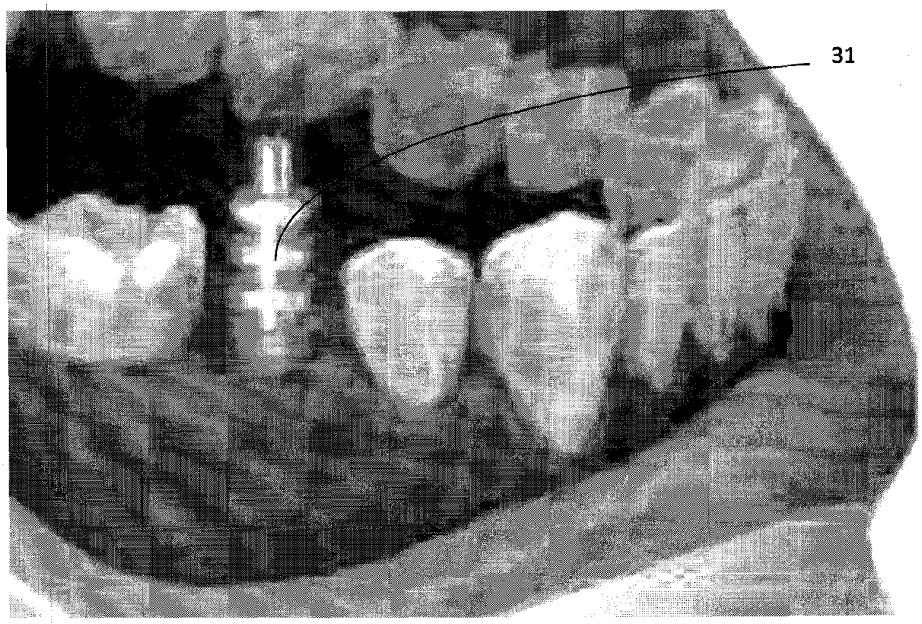


Fig 2 (Prior Art)

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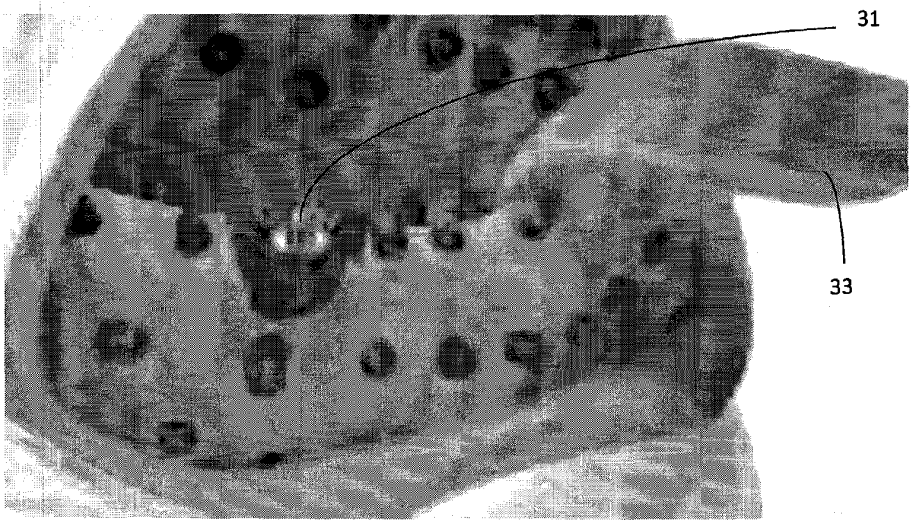


Fig. 3 (Prior Art)

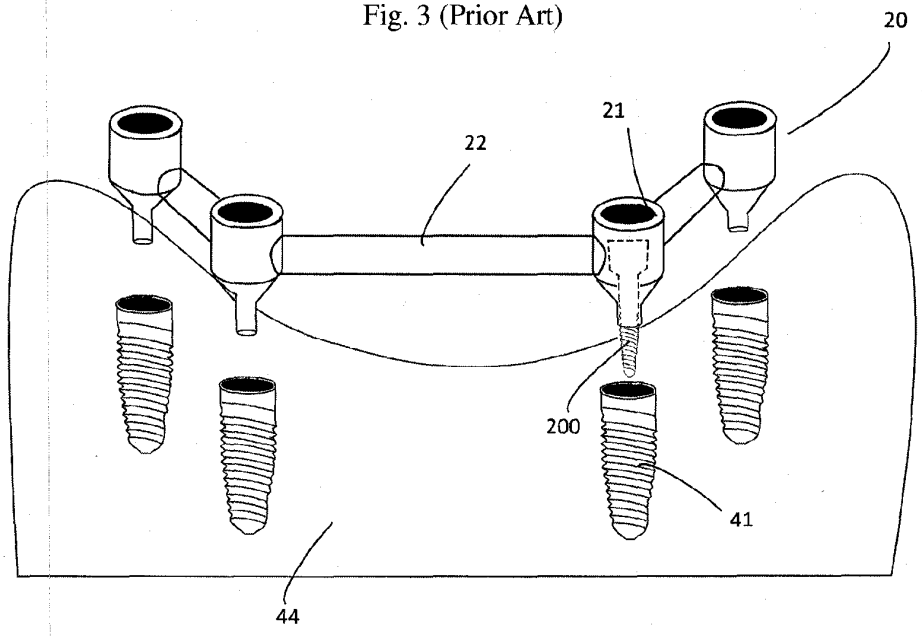


Fig. 4 (Prior Art)

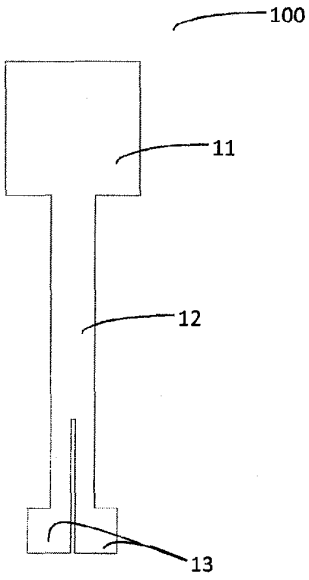


Fig. 5

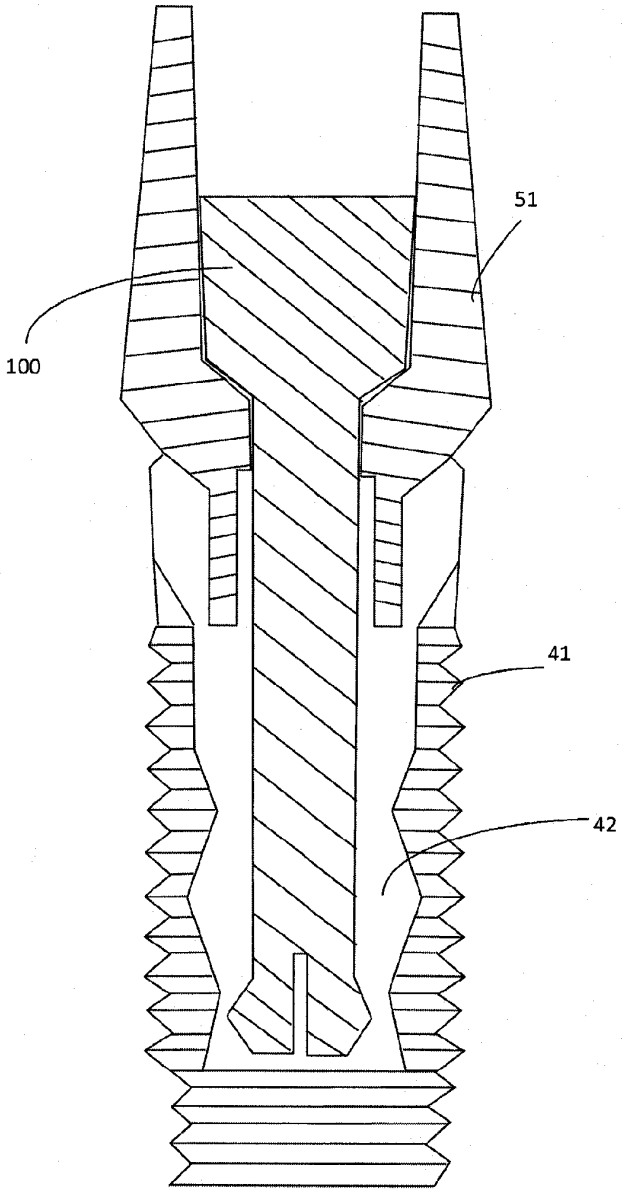


Fig. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/IL2012/050339

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	WO 2011/036268 A2 (DENTALPOINT AG [CH]; BOLLETER PHILIP [CH]; CHIUSOLO NICOLA [CH]) 31 March 2011 (2011-03-31) figure 16(b) page 16, line 5 - page 18, line 22	1-8, 10-12
X	EP 0 685 209 A1 (TOBOSO RAMON JES S [ES]) 6 December 1995 (1995-12-06) figures 1,10 column 6, line 16 - column 9, line 19	1-12

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"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

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"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

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Date of the actual completion of the international search	Date of mailing of the international search report
13 December 2012	21/12/2012

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

Form PCT/ISA/210 (second sheet) (April 2005)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IL2012/050339

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2011036268 A2	31-03-2011	CH 701860 A1	31-03-2011
		EP 2480161 A2	01-08-2012
		WO 2011036268 A2	31-03-2011
EP 0685209 A1	06-12-1995	EP 0685209 A1	06-12-1995
		WO 9515128 A1	08-06-1995

Form PCT/ISA/210 (patent family annex) (April 2005)

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Doc code: IDS
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Art Unit	3772
Examiner Name	Huynh, Courtney Nguyen
Attorney Docket Number	SDC013

U.S. PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Inventor of cited Document	Pages, Columns, Lines where Relevant Passages or Relevant Figures Appear
	1	6283752	B1	2001-09-04	Kumar	

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	1	20040053195	A1	2004-03-18	Blacklock	

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FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	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]
	1	20100013149	KR	A	2010-02-09	Ryu		☒
	2	2020260263	WO	A1	2020-12-30	NAGEL		☐

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PC.1.19.25

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.N.H./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT		
	Application Number	18827656
	Filing Date	2024-09-06
	First Named Inventor	Kofford, Brandon Dale
	Art Unit	3772
	Examiner Name	Huynh, Courtney Nguyen
	Attorney Docket Number	SDC013

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]
	1	GRACCO et al., "Effects of thread shape on the pullout strength of miniscrews". American Journal of Orthodontics and Dentofacial Orthopedics, Volume 142, Issue 2, 186 - 190.	☐
	2	MISHRA et Al., "Changing trends in implant designs: A review". IP Int J Periodontol Implantol. 2023 ;8(3):117-123.	☐
	3	MANIKYAMBA et al., "Implant thread designs: An overview." Trends in Prosthodontics and Dental Implantology 2017; 8(1&2), 11-19.	☐

If you wish to add additional non-patent literature document citation information, please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/COURTNEY N HUYNH/	Date Considered	10/03/2025

*EXAMINER: Initial if reference considered and 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.

PC.1.19.25

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.N.H./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT		
	Application Number	18827656
	Filing Date	2024-09-06
	First Named Inventor	Kofford, Brandon Dale
	Art Unit	3772
	Examiner Name	Huynh, Courtney Nguyen
	Attorney Docket Number	SDC013

TIMING STATEMENT

Please see 37 CFR 1.97(e) 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 timing statement under 37 CFR 1.97(e).

☒ A timing statement under 37 CFR 1.97(e) is not submitted herewith.

TIMING FEE

☐ The fee set forth in 37 CFR 1.17(p) has been submitted herewith.

COPIES

☐ An identification of an earlier application pursuant to 37 CFR 1.98(d)(1) is attached.

SIZE FEE ASSERTION

Please see 37 CFR 1.17(v) and the IDS Auto-Load Instructions for completing this form to make the appropriate selection of an assertion under 37 CFR 1.98. For the information disclosure statement (IDS) submitted herewith, the applicant or patent owner certifies the following with respect to the cumulative number of applicant-provided or patent-owner provided items of information submitted to date including those in the accompanying IDS (select only one):

☒ No IDS size fee is required under 37 CFR 1.17(v) at this time.

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(1).

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(2).

☐ The IDS is accompanied by the IDS size fee under 37 CFR 1.17(v)(3).

SIGNATURE

A signature of the applicant or representative is required in accordance with 37 CFR 1.33 and 11.18. Please see 37 CFR 1.4(d) for the form of the signature.

Signature	/Daniel John Whittle, #54,537/	Date (YYYY-MM-DD)	2025-09-22
Name/Print	Daniel John Whittle	Registration Number	54537

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ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /C.N.H./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT		
	Application Number	18827656
	Filing Date	2024-09-06
	First Named Inventor	Kofford, Brandon Dale
	Art Unit	3772
	Examiner Name	Huynh, Courtney Nguyen
	Attorney Docket Number	SDC013

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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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 the Freedom of Information Act requires disclosure of these record s.

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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Bibliographic Data

Application No: 18/827,656

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.
09/06/2024	433	3772	SDC013
RULE			

APPLICANTS

INVENTORS

Brandon Dale Kofford, Apex, NC, UNITED STATES

Charles Albert Rudisill, Apex, NC, UNITED STATES

CONTINUING DATA

This application is a CON of 18424696 01/26/2024 PAT 12156781

This application is a CON of 18328730 06/03/2023 PAT 11937992

This application is a CON of 17691108 03/09/2022 PAT 12318265

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

IF REQUIRED, FOREIGN LICENSE GRANTED**

09/17/2024

**** SMALL ENTITY ****

STATE OR COUNTRY

UNITED STATES

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Daniel J Whittle

1229 Modoc Dr

Bellingham, WA 98229

UNITED STATES

FILING FEE RECEIVED

$2,832

PE2E SEARCH - Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
L37	1	"6283752".pn.	(US-PGPUB; USPAT)	OR	ON	ON	2025/10/03 04:22 PM
L38	1	"20040053195".pn.	(US-PGPUB; USPAT)	OR	ON	ON	2025/10/03 04:25 PM
L39	1	"20100013149".pn.	(US-PGPUB; USPAT)	OR	ON	ON	2025/10/03 04:25 PM
L40	4	"20100013149".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, 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	2025/10/03 04:25 PM
L41	3	"2020260263".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, 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	2025/10/03 04:26 PM
L42	75	((("KOFFORD") near3 ("Brandon")) OR (("RUDISILL") near3 ("Charles"))).INV.	(US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT)	OR	ON	ON	2025/10/03 04:56 PM
L43	7172	(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,	OR	ON	ON	2025/10/03 04:57 PM

			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)				
L44	50	(Artificial Intelligence) Similar to: 18/827,656 with 0 CPC Selections and 0 Text Selections Text: (US-12156781-B1 OR US-12318265-B2 OR US-20220192793-A1 OR US-11937992-B1 OR US-20230200950-A1 OR US-11311354-B2 OR US-11957538-B2 OR US-20190167387-A1 OR KR-101693911-B1 OR AU-2010254532-A1 OR US-20150037761-A1 OR WO-2010138175-A1 OR AU-2010254532-B2 OR KR-20120027025-A OR US-11202693-B2 OR US-20170258558-A1 OR EP-3721830-B1 OR WO-2017156281-A1 OR US-10136967-B2 OR EP-3721830-A1 OR KR-101495904-B1 OR KR-20090042071-A OR CA-2763187-A1 OR AU-2010254532-B8 OR US-20100303316-A1 OR US-20240078674-A1 OR JP-2012527951-A OR US-20100086900-A1 OR US-12367580-B2 OR EP-2434981-B2 OR EP-2434981-B1 OR US-20100112520-A1 OR KR-20130084800-A OR WO-2011078560-A2 OR US-8794965-B2 OR WO-2009137545-A1 OR US-11816835-B2 OR EP-3187144-A1 OR KR-20060025263-A OR KR-100597393-B1	(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))	OR	ON	ON	2025/10/03 04:57 PM

		OR US-8002547-B2 OR US-20040209227-A1 OR US-5873721-A OR US-20030082499-A1 OR JP-5586691-B2 OR US-6283753-B1 OR KR-101134062-B1 OR US-20180344434-A1 OR AU-2006227608-B2 OR US-20110207082-A1).did.					
L45	335	(411/419,414).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	2025/10/03 04:58 PM
L46	12082	(A61C8/0068).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	2025/10/03 05:02 PM
L47	8330	(A61C8/006).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;	OR	ON	ON	2025/10/03 05:02 PM

			JPO; DERWENT; IBM_TDB)				
L48	6934	(A61C8/0066).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	2025/10/03 05:02 PM
L49	1943	(A61C2201/00).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	2025/10/03 05:02 PM
L50	1876	(((A61C8/0001).cpc.) OR ((A61C8/0066).cpc.) OR ((A61C2201/00).cpc.) OR ((A61C8/0068).cpc.)) AND (coping AND abutment AND screw)	(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	2025/10/03 05:02 PM
L51	1950	(((A61C8/0001).cpc.) OR ((A61C8/0066).cpc.) OR ((A61C2201/00).cpc.) OR	(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,	OR	ON	ON	2025/10/03 05:02 PM

		((A61C8/0068).cpc.)) AND (coping AND abutment AND (screw OR thread$5))	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)				
L52	90976	((A61C2201/00).cpc. OR (A61C2008/0084).cpc. OR (A61C13/225,2255,265,2656,275).cpc. OR (A61C11/088).cpc. OR (F16B37/14).cpc. OR (F16B35/06,041).cpc. OR (F16B33/02).cpc. OR (A61C8/0066,0068,00,005,008,0007,0001,0082,0087,0066,0074,0078).cpc. OR (411/396,397,411,419,414).ccls. OR (433/173).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	2025/10/03 05:02 PM
L53	2501	((A61C2201/00).cpc. OR (A61C2008/0084).cpc. OR (A61C13/225,2255,265,2656,275).cpc. OR (A61C11/088).cpc. OR (F16B37/14).cpc. OR (F16B35/06,041).cpc. OR (F16B33/02).cpc. OR (A61C8/0066,0068,00,005,008,0007,0001,0082,0087,0066,0074,0078).cpc. OR (411/396,397,411,419,414).ccls. OR (433/173).ccls.) AND (coping AND abutment AND (screw OR thread$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	2025/10/03 05:02 PM
L54	1985	((A61C2201/00).cpc. OR (A61C2008/0084).cpc. OR (A61C13/225,2255,265,2656,275).cpc. OR (A61C11/088).cpc. OR (F16B37/14).cpc. OR	(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,	OR	ON	ON	2025/10/03 05:02 PM

		(F16B35/06,041).cpc. OR (F16B33/02).cpc. OR (A61C8/0066,0068,00,005,008,0007,0001,0082,0087,0066,0074,0078).cpc. OR (411/396,397,411,419,414).ccls. OR (433/173).ccls.) AND (coping AND abutment AND ((pick near3 up) OR (impression)) AND (screw OR thread$5) AND (prosthesis OR denture OR bridge OR crown))	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)				
L55	1985	((A61C2201/00).cpc. OR (A61C2008/0084).cpc. OR (A61C13/225,2255,265,2656,275).cpc. OR (A61C11/088).cpc. OR (F16B37/14).cpc. OR (F16B35/06,041).cpc. OR (F16B33/02).cpc. OR (A61C8/0066,0068,00,005,008,0007,0001,0082,0087,0066,0074,0078).cpc. OR (411/396,397,411,419,414).ccls. OR (433/173).ccls.) AND (coping AND abutment AND ((pick near3 up) OR (impression) OR (closed near3 tray)) AND (screw OR thread$5) AND (prosthesis OR denture OR bridge OR crown))	(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	2025/10/03 05:02 PM

PE2E SEARCH - Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	British Equivalents	Time Stamp
N4	72	((A61C8/0068,0001,0066,0074,0078).cpc. OR (A61C2008/0084.cpc.) OR (A61C2201/00.cpc.)) AND coping AND (aperture OR opening OR hole OR gap) AND (implant$5) AND	(US-PGPUB; USPAT)	OR	ON	ON	2025/10/03 05:02 PM

		(abutment) AND (releas$5) AND ((thread OR threading OR screw) WITH (shaft OR pole OR rod OR column))					
N5	96	(dental OR orthodontic) AND coping AND (aperture OR opening OR hole OR gap) AND (implant$5) AND (abutment) AND (releas$5) AND ((thread OR threading OR screw) WITH (shaft OR pole OR rod OR column))	(US-PGPUB; USPAT)	OR	ON	ON	2025/10/03 05:02 PM

UNITED STATES
PATENT AND TRADEMARK OFFICE

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

FEE ADDRESS CHANGE

APPLICATION #	FILING OR 371(C) DATE	REQUEST ID
18/827,656	09/06/2024	24622769

The following fields have been changed to Customer Number 112823 on 01/10/2026 via Patent Center in view of the certification copied below that authorized the change.

- Maintenance Fee Address

The address for Customer Number 112823 is:

112823 - Daniel J Whittle
1229 Modoc Dr
Bellingham, WA 98229

I certify, in accordance with 37 CFR 1.4(d)(4), that I am :

An attorney or Agent of Record registered to practice before the Patent and Trademark Office who has been given power of attorney in this application

Signature	Name	Registration #

UNITED STATES
PATENT AND TRADEMARK OFFICE

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

ELECTRONIC ACKNOWLEDGEMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/827,656	**01/10/2026 06:53:10 PM Z ET**	**SDC013**

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 #	2702	FILED BY	Daniel Whittle
PATENT CENTER #	73925767	FILING DATE	09/06/2024
CUSTOMER #	112823	FIRST NAMED INVENTOR	Brandon Dale Kofford
CORRESPONDENCE ADDRESS	-	AUTHORIZED BY	-

Documents

TOTAL DOCUMENTS: 2

DOCUMENT	PAGES	DESCRIPTION	SIZE (KB)
web85b.pdf	3	Issue Fee Payment (PTO-85B)	58 KB
web85bfeeaddress.pdf	1	Maintenance Fee Address Change	26 KB

Digest

DOCUMENT	MESSAGE DIGEST(SHA-512)
web85b.pdf	CAAF739D945653DD035CD40EEFA2E00FCD5B21B6CBC1D7F317E110549D1C13EDBCE22EA88C37C9783CAD56EF172C070884D85A20308F64E74181A560B94380CC
web85bfeeaddress.pdf	FC2F6357D2E49D839890768AA2529E0EC83EC40A5C30456B70C7D9FDA5244C706760EC0084B023950B8F9EB8F08A186536

47BB082F1FADD5FC8A27450F92F5ED

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.

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ELECTRONIC PAYMENT RECEIPT

APPLICATION #	RECEIPT DATE / TIME	ATTORNEY DOCKET #
18/827,656	**01/10/2026 06:53:10 PM Z ET**	**SDC013**

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 #	2702	FILED BY	Daniel Whittle
PATENT CENTER #	73925767	AUTHORIZED BY	-
CUSTOMER #	112823	FILING DATE	09/06/2024
CORRESPONDENCE ADDRESS	-	FIRST NAMED INVENTOR	Brandon Dale Kofford

Payment Information

PAYMENT METHOD	PAYMENT TRANSACTION ID	PAYMENT AUTHORIZED BY
CARD / 5436	**E202610I53449700**	**Daniel Whittle**

FEE CODE	DESCRIPTION	ITEM PRICE($)	QUANTITY	ITEM TOTAL($)
2501	UTILITY ISSUE FEE	516.00	1	516.00
			TOTAL AMOUNT:	**$516.00**

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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.

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ISSUE FEE TRANSMITTAL FORM

APPLICATION #	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET #
18827656	**09/06/2024**	**Brandon Kofford**	**SDC013**

Title of Invention

Screw-attached Pick-up Dental Coping System and Methods

Application Information

APPLICATION TYPE	Nonprovisional Application under 35 USC 111(a)	DATE DUE	01/12/2026
CONFIRMATION #	2702	ISSUE FEE DUE	$ 516
EXAMINER	COURTNEY HUYNH	PUBLICATION DUE	$ 0
GROUP ART UNIT	3772	TOTAL FEES DUE	$516
CLASS - SUBCLASS	433/173000	PREV. PAID FEE	$ 0
ENTITY STATUS	Small		

1. CHANGE OF CORRESPONDENCE ADDRESS AND/OR INDICATION OF FEE ADDRESS (37 CFR 1.33 & 1.363)

Correspondence Address

CURRENT ADDRESS

Maintenance Fee Address

CURRENT ADDRESS

☐ Change of correspondence address requested,system generated AIA/122-PC form attached

☑ Fee address indication requested, system generatedSB/47-PC form attached

2. ENTITY STATUS

Change in Entity Status

NEW STATUS

3. THE FOLLOWING FEES ARE SUBMITTED

☑ Issue Fee

☑ Publication Fee

4. FEE AUTHORIZATION

☐ I authorize USPTO to apply my previously paid issue fee to the current fees due

☐ The Director is herby authorized to apply my previously paid issue fee to the current fee due and to charge deficient fees to Deposit Account Number:

☐ If in addition to the payment of the issue fee amount submitted with this form, there are any discrepencies in any amount(s) due, the Director is authorized to charge any deficiency, or credit any overpayment, to Deposit Account Number:

5. FIRM AND/OR ATTORNEY NAMES TO BE PRINTED

NOTE: If no name is listed, no name will be printed
For printing on the patent front page, list to be displayed as entered

Patent Leverage LLC
Daniel J Whittle

6. ASSIGNEE NAME(S) AND RESIDENCE DATA TO BE PRINTED

NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document has been filed for recordation as set forth in 37 CFR 3.11. Completion of this form is NOT a susbstitute for filing an assignment.

Smart Denture Conversions, LLC	Apex, NC UNITED STATES	Corporation

Signature

I certify, in accordance with 37 CFR 1.4(d)(4) that I am an attorney or agent registered to practice before the Patent and Trademark Office who has filed and has been granted power of attorney in this application. I also certify that this Fee(s) Transmittal form is being transmitted to the USPTO via Patent Center on the date indicated below.

Signature	Name	Registration #	Date
/Daniel John Whittle/	Daniel Whittle	54537	01/10/2026

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FEE ADDRESS INDICATION FORM

APPLICATION #	ATTORNEY DOCKET #	FILING DATE
18827656	**SDC013**	**09/06/2024**

Title of Invention

Screw-attached Pick-up Dental Coping System and Methods

Application Information

ART UNIT	3772	FIRST NAMED INVENTOR	Brandon Kofford
EXAMINER	COURTNEY HUYNH		

INSTRUCTIONS: In order for the fee address identified on this form to be effective, the issue fee must have been paid for the application listed on this form. Only an address represented by a customer number can be established as the fee address for maintenance fee purposes (hereafter, fee address). A fee address should be established when correspondence related to maintenance fees should be mailed to a different address than the correspondence address for the application. For more information on customer numbers, see the Manual of Patent Examining Procedure (MPEP) § 403

Maintenance Fee Address

Please recognize as the Fee Address under the provisions of 37 CFR 1.363 the address associated with:

112823 - Daniel J Whittle

1229 Modoc Dr
–
Bellingham, WA 98229
UNITED STATES

Signature

I certify, in accordance with 37 CFR 1.4(d)(4) that I am an attorney or agent registered to practice before the Patent and Trademark Office who has filed and has been granted power of attorney in this application.

Signature	Name	Registration #	Date
/Daniel John Whittle/	Daniel Whittle	54537	01/10/2026

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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/827,656	02/17/2026	12551319	SDC013	2702

112823 7590 02/04/2026

Daniel J Whittle
1229 Modoc Dr
Bellingham, WA 98229

ISSUE NOTIFICATION

The projected patent number and issue date are specified above. The patent will issue electronically. The electronically issued patent is the official patent grant pursuant to 35 U.S.C. § 153. The patent may be accessed on or after the issue date through Patent Center at https://patentcenter.uspto.gov/. The patent will be available in both the public and the private sides of Patent Center. Further assistance in electronically accessing the patent, or about Patent Center, is available by calling the Patent Electronic Business Center at 1-888-217-9197.

The USPTO is implementing electronic patent issuance with a transition period, during which period the USPTO will mail a ceremonial paper copy of the electronic patent grant to the correspondence address of record. Additional copies of the patent (i.e., certified and presentation copies) may be ordered for a fee from the USPTO's Certified Copy Center at https://certifiedcopycenter.uspto.gov/index.html. The Certified Copy Center may be reached at (800)972-6382.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Center (https://patentcenter.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Patents Stakeholder Experience (OPSE), Stakeholder Support Division (SSD) at (571)-272-4200.

IR103 (Rev. 10/09)

Straumann USA Exhibit 1023

INVENTOR(s) (Please see PATENT CENTER site https://patentcenter.uspto.gov for additional inventors):

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

APPLICANT(s) (Please see PATENT CENTER site https://patentcenter.uspto.gov for additional applicants):

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
18/827,656	09/06/2024	Brandon Dale Kofford	SDC013	2702

112823 7590 02/17/2026

Daniel J Whittle
1229 Modoc Dr
Bellingham, WA 98229

EXAMINER	
HUYNH, COURTNEY NGUYEN	
ART UNIT	PAPER NUMBER
3772	
MAIL DATE	DELIVERY MODE
02/17/2026	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.

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APPLICATION NO.	ISSUE DATE	PATENT NO.
18/827,656	17-Feb-2026	12551319

Daniel J Whittle
Bellingham, WA 98229

EGRANT NOTIFICATION

Your electronic patent grant (eGrant) is now available, which can be accessed via Patent Center at https://patentcenter.uspto.gov

The electronic patent grant is the official patent grant under 35 U.S.C. 153. For more information, please visit https://www.uspto.gov/electronicgrants