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(54) **SURGICAL REDUCTION CLAMP**

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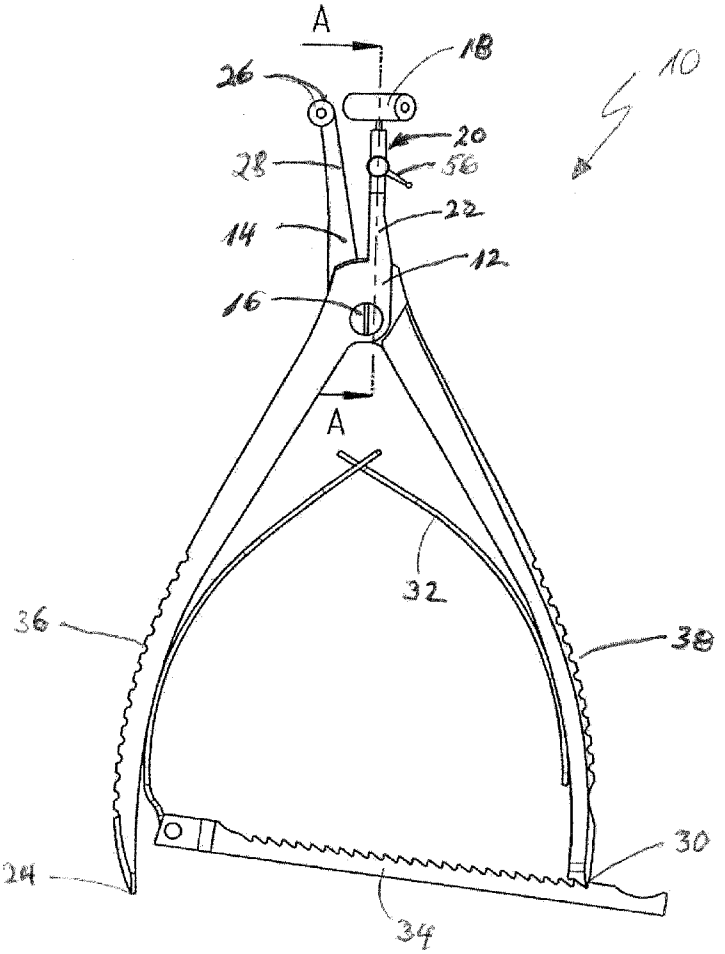
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(57) **ABSTRACT**

A surgical reduction clamp has a first clamping arm and a second clamping arm movable relative to the first clamping arm. The first clamping arm comprises a base portion, a tip portion, a joint movably coupling the tip portion to the base portion, and a locking member adapted to lock the joint so as to fasten a position of the tip portion relative to the base portion. The joint is a revolute joint having a spherical portion which can be locked into position by a clamping force.



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Fig. 1

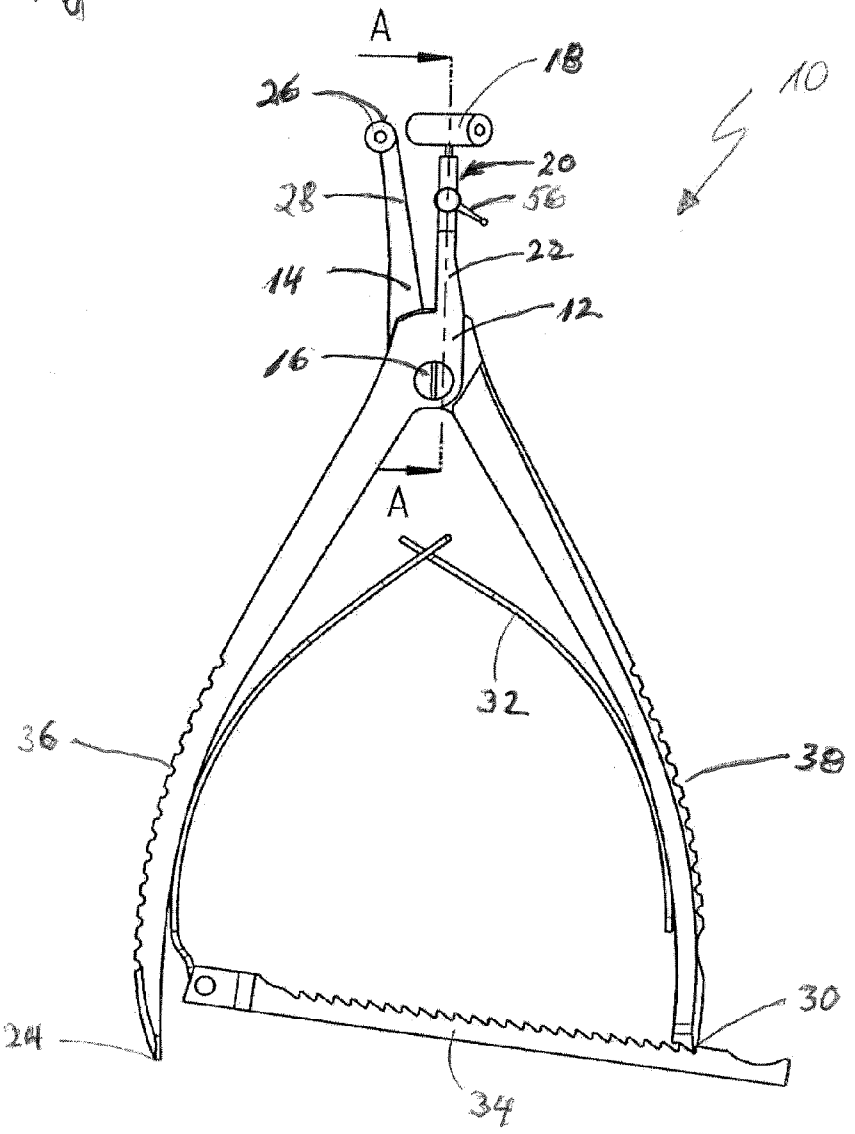


Fig 2

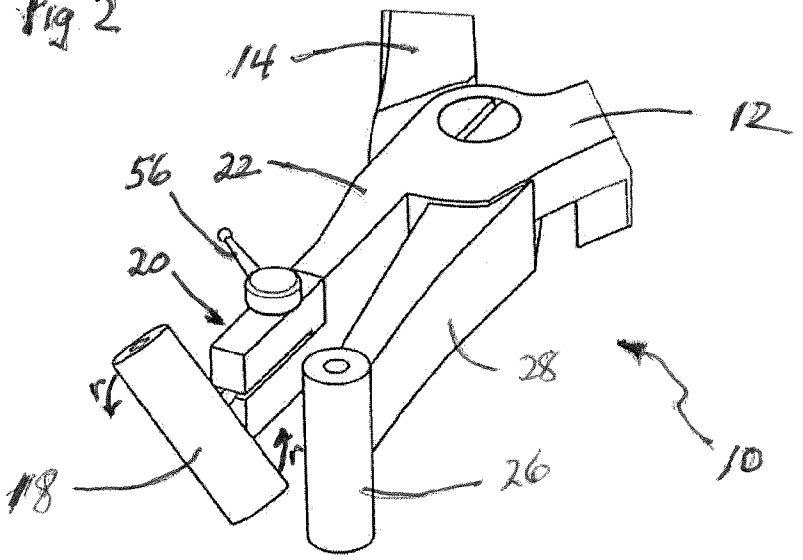


Fig 3

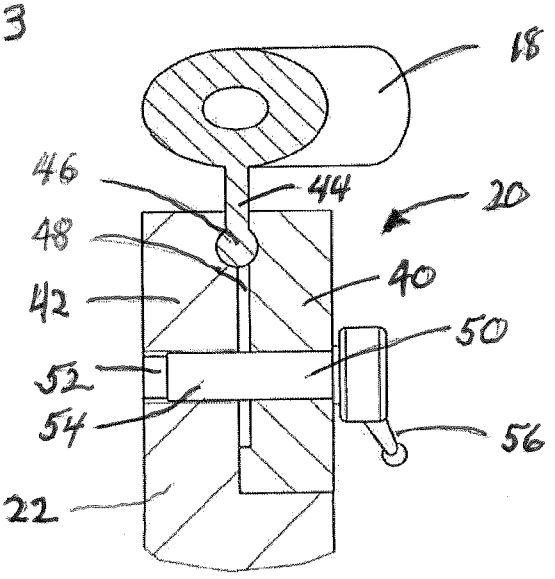


Fig 4a

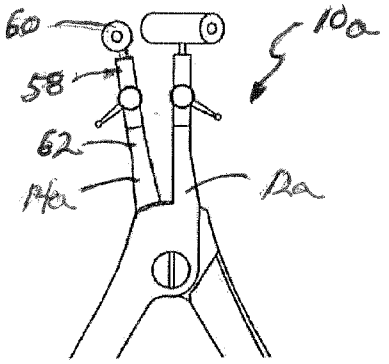


Fig 4b

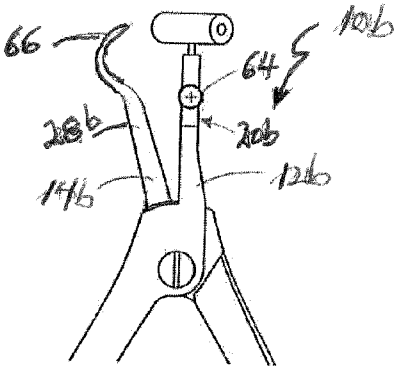


Fig 4c

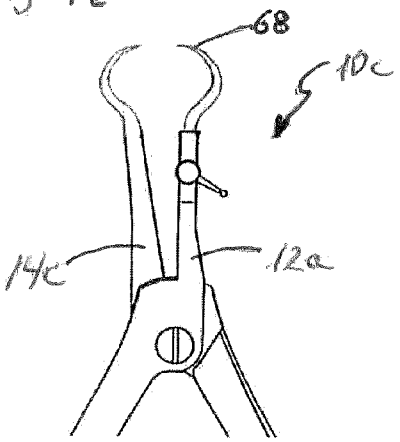
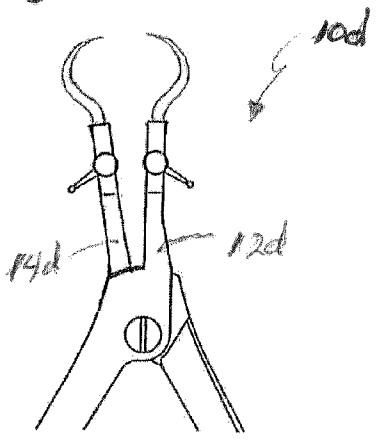


Fig. 4d



SURGICAL REDUCTION CLAMP

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority from European Patent Application No. 12 005 423.4 filed Jul. 25, 2012, the disclosure of which is hereby incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] The present disclosure generally relates to the field of surgical instruments. In particular, a surgical reduction clamp is described.

[0003] When treating a bone fracture, bone fragments are typically aligned in a first step. The act of aligning and restoring the correct position of bone fragments is called reduction. Perfect anatomical reduction reverses the mechanism of injury which originally created the fracture displacement.

[0004] In a surgical procedure, often a screw, plate, pin or wire is installed across a fracture in order to maintain the alignment of the bone fragments for the later adhesion process. During the installation procedure, it is in many cases important to clamp the bone fragments together so as to eliminate the existence of gaps which may potentially reduce the chances of proper adhesion.

[0005] Various types of reduction clamps are available for such osteosynthesis procedures. Many of them are limited in their practical applicability for certain surgical treatments due to insufficient usability characteristics from the perspective of the operating surgeon.

[0006] WO 89/06939 A1 discloses a multi-purpose clamping forceps for use in orthopedic surgical procedures. The forceps has interchangeable tip elements and a reversible ratchet mechanism for controlling the tip elements. A variety of tip elements is provided and can be used for compression and distraction of plate and screw fixation systems as well as gripping and manipulating the bone.

[0007] WO 99/25262 A1 discloses a surgical tool for bone manipulation with a pair of pivotably connected handles. Joints provided at the ends of the handles are pivotably connected to respective attachment devices for engaging implants placed in a bone. A ratchet pivotably mounted to the first handle is engageable with the second handle.

[0008] However, such instruments are still not applicable in many surgical situations and usability aspects may still be improved.

BRIEF SUMMARY OF THE INVENTION

[0009] Accordingly, there is a need for a surgical reduction clamp which provides improved usability and which is easy to handle.

[0010] A surgical reduction clamp comprising a first clamping arm and a second clamping arm movable relative to the first clamping arm is provided. The first clamping arm comprises a base portion, a tip portion, a joint movably coupling the tip portion to the base portion, and a locking member adapted to lock the joint so as to fasten a position of the tip portion relative to the base portion.

[0011] The tip portion may form the proximal end of the first clamping arm and represent that portion of the first clamping arm that engages the human anatomy when applied in a surgical procedure. Alternatively, or in addition, the tip portion may engage surgical devices or implants applied during a treatment, such as a surgical wire. The tip portion may comprise a sharp bone tip to grip a bone, a sleeve to accommodate a surgical wire or another elongate member, or any other type of surgical instrument tip design.

[0012] The base portion may form the distal end of the first clamping arm and may be formed as an integral part thereof. The base portion may generally represent that part of the first clamping arm that may be used by the operating surgeon for gripping the reduction clamp so as to properly operate the clamp as required during the procedure.

[0013] Any type of structure allowing a movable relationship between the first and the second clamping arm so as to enable for a clamping capability between the first and the second arm may generally be used. The first and the second clamping arm may, for example, be coupled in a pivotable relationship relative to one another, hence, forming a forceps or pincers. In other implementations the first and the second clamping arm may be movable relative to each other in a translatory manner.

[0014] The tip portion of the first clamping arm may be movably coupled to the base portion of the first clamping arm. For certain applications, it may be desired to rotatably couple the tip portion to the base portion. In this way, the tip portion may be rotated relative to the base portion, and the joint member may be a revolute joint. The rotational direction may generally be orientated in any direction relative to the first clamping arm. The rotation may be limited about a longitudinal axis of the first clamping arm. A longitudinal axis of the tip portion may extend substantially perpendicularly to a longitudinal axis of the first clamping arm.

[0015] It will be understood that alternative or additional types of coupling the tip portion to the base portion are conceivable. The joint may, for example, pivotably couple the tip portion to the base portion, thus, allowing a pivoting movement of the tip portion relative to the base portion. A pivoting and a rotational coupling may also be combined so that a pivoting movement about a pivot axis and a rotational movement about a longitudinal axis of the first clamping arm are allowed at the same time. Such behavior may be realized by coupling the tip portion to the base portion by means of, for example, a ball joint.

[0016] The position of the tip portion relative to the base portion may be fixed by locking the joint using a locking mechanism realized by the locking member. The locking member may be adapted to lock the joint by applying a clamping force. For this purpose, bearing members of the joint may be clamped together by the locking member. The joint may for example comprise two opposed bearing members exhibiting a clearance in between serving to receive and clamp a part of the tip portion, such as its distal end. The locking member may also be adapted to release the joint for loosening the clamping force again. The locking mechanism for creating or loosening the clamping force may comprise a screw-nut mechanism.

[0017] The locking member may comprise a handle for actuation by the operating surgeon. Placing or turning the handle into a locking position or direction, respectively, may create the clamping force to lock the joint. Placing or turning the handle into a release position or direction, respectively, may loosen the clamping force and release the joint. As an alternative, the locking member may also comprise a screw head for actuating the locking member. The screw head may serve for the same purpose as the handle described above.

[0018] The joint may further be adapted to allow the tip portion to be releasable from the base portion, thus, making the tip portion interchangeable. A sleeve tip may for example be exchanged by a sharp bone tip, or vice versa.

[0019] A spring may be provided between the first clamping arm and the second clamping arm so as to bias the first clamping arm and the second clamping arm relative to one another. The bias may be selected so as to support the surgeon operating the reduction clamp. The bias may, for example, establish a force pushing the tip portions of the clamping arms away from each other.

[0020] Further, a ratchet toothed member or any other mechanism may extend from one of the first and the second clamping arm towards the other clamping arm so as to permit locking of the position of the first and the second clamping arm relative to one another (e.g., by engagement of the other clamping arm with the teeth of the ratchet toothed member). The ratchet toothed member may particularly act jointly with the spring in that the spring bias forces the one clamping arm into the teeth of the ratchet toothed member, thus, preventing the one clamping arm from slipping out of the teeth it engages with.

[0021] Further realizations of the surgical reduction clamp may be defined by the configuration of the second clamping arm. The second clamping arm may generally exhibit the same configuration as the first clamping arm. The second clamping arm may also comprise a base portion, a tip portion, a joint movably coupling the tip portion to the base portion of the second clamping arm, and a locking member adapted to lock the joint so as to fasten a position of the tip portion relative to the base portion of the second clamping arm. Further, the second clamping arm may comprise a tip portion that is integrally joined to the base portion of the second clamping arm. In any of these cases, the tip portion of the second clamping arm may comprise a sleeve, a sharp bone tip, or any other type of surgical instrument tip design.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022] Further details, advantages and aspects of the present disclosure will become apparent from the following description of exemplary embodiments taken in conjunction with the drawings, wherein:

[0023] FIG. **1** shows a side view of the surgical reduction clamp according to an embodiment of the present disclosure;

[0024] FIG. **2** shows a perspective view of a tip portion of the surgical reduction clamp of FIG. **1**;

[0025] FIG. **3** shows a cross-sectional view along line A-A of the surgical reduction clamp of FIG. **1**; and

[0026] FIGS. **4***a-d* show variants of the surgical reduction clamp of FIG. **1** exhibiting different tip portion designs according to further embodiments of the present disclosure.

DETAILED DESCRIPTION

[0027] In the following, various embodiments of a surgical reduction clamp will be described. The same reference numerals will be used to denote the same or similar structural features.

[0028] FIG. **1** shows a side view of an embodiment of a surgical reduction clamp **10**. The reduction clamp **10** comprises a first clamping arm **12** and a second clamping arm **14** which are pivotably coupled to one another by a screw or bolt member **16**. The first clamping arm **12** includes a tip portion **18** forming its proximal end. In FIG. **1**, the tip portion **18** is formed as a sleeve for accommodating a surgical wire, such as a k-wire. The tip portion **18** is coupled to a joint **20** and the joint **20**, in turn, adjoins a base portion **22** of the first clamping arm **12** which extends to the distal end **24** thereof.

[0029] As opposed to the first clamping arm **12**, the second clamping arm **14** does not include a joint. The second clamping arm **14** only includes a tip portion **26** forming its proximal end and a base portion **28** integrally adjoining the tip portion **26** and extending to the distal end **30** of the second clamping arm **14**. Similar to the tip portion **18** of the first clamping arm **12**, the tip portion **26** of the second clamping arm **14** is formed as a sleeve.

[0030] By pivotably coupling the first clamping arm **12** to the second clamping arm **14** in the manner as depicted in FIG. **1**, the reduction clamp **10** takes the shape of a forceps. When pushing the distal ends **24** and **30** of the first and the second clamping arm **12** and **14** together, the tip portions **18** and **26** of the first and the second clamping arm **12** and **14** undergo a pivoting movement about member **16** and are also pushed towards each other at their proximal ends. In this way, a clamping capability between the tip portions **18** and **26** is provided which allows the operating surgeon to align bone fragments in a surgical procedure with the help of, for example, k-wires.

[0031] It will be understood that the tip portions **18** and **26** may comprise any other kind of surgical instrument tip design instead of the illustrated sleeves **18** and **26**. It will further be understood that the first and the second clamping arms **12** and **14** do not necessarily have to be coupled in the forceps-like manner as illustrated in FIG. **1**. Any other type of movable relationship (e.g., in a translatory manner) between a first and a second clamping arm providing a clamping capability between their tip portions could likewise be implemented.

[0032] A leg spring **32** is disposed between the first clamping arm **12** and the second clamping arm **14** providing a bias that pushes the distal ends **24** and **30** of the first and the second clamping arm **12** and **14** away from each other. Due to the pivotable coupling of the first and the second clamping arm **12** and **14** by means of the member **16**, this bias forces the tip portions **18** and away from each other. The bias particularly improves the handling of the reduction clamp **10** and assists the operating surgeon in operating the reduction clamp during a surgical procedure. Any other type of spring may be employed to establish a bias force between the first and the second clamping arm **12** and **14**.

[0033] Further, a ratchet toothed member **34** is shown in FIG. **1** that extends from near the distal end **24** of the first clamping arm **12** towards the distal end **30** of the second clamping arm **14**. In this exemplary embodiment, the ratchet toothed member **34** is attached to the distal end of that leg of the spring leg **32** that is fixed to the first clamping arm **12**. It will be understood that the ratchet toothed member **34** may also be attached to the first clamping arm **12** directly.

[0034] The ratchet toothed member **34** has teeth facing in the direction towards the proximal end of the reduction clamp **10** and thereby provides a structure to engage the distal end **30** of the second clamping arm **14**. Specifically, the teeth of the ratchet toothed member **34** permit to lock the position of the first and the second clamping arm **12** and **14** relative to one another so as to maintain a clamping force established between the tip portions **18** and **26**. The bias of the leg spring **32** acts jointly with the ratchet toothed member **34** in that it forces the distal end **30** of the second clamping arm **14** into the teeth of the ratchet toothed member **34** and, thus, prevents the

distal end **30** of the second clamping arm **14** from slipping out of the teeth of the ratchet toothed member **34** it engages with.

[0035] When the distal end **30** of the second clamping arm **14** is disengaged from the teeth of the ratchet toothed member **34** (e.g., by the operating surgeon), the bias provided by the leg spring **32** forces the distal ends **24** and **30** and, accordingly, the tip portions **18** and **26** away from each other unless the distal end **30** is engaged with (possibly other) teeth again. Thus, the bias force assists the operating surgeon in loosening the clamping arms **12** and **14** relative to one another when the distal end **30** is not engaged with the teeth of the ratchet toothed member **34**. It will be understood, of course, that any other type of locking mechanism may be employed in order to lock the position of the first and the second clamping arm **12** and **14** of the reduction clamp **10** relative to one another so as to maintain a clamping force established between the tip portions **18** and **26**.

[0036] The first and the second clamping arm **12** and **14** both exhibit a sequence of grooves **36** and **38** at outer surfaces of their distal ends **24** and **30**. These grooves **36** and **38** define a hand grip portion that allows the operating surgeon to securely hold the reduction clamp **10**.

[0037] Referring now to FIG. **2**, a perspective view of a proximal part of the surgical reduction clamp **10** is shown. This view particularly illustrates the specific movability of the tip portion **18** relative to the base portion **22** of the first clamping arm **12**.

[0038] At the second clamping arm **14**, the tip portion **26** is integrally joined to the base portion **28** and is thus in a rigid connection therewith. The sleeve representing the tip portion **26** is depicted in an upright position and is not movable relative to the base portion **28**. The tip portion **18** of the first clamping arm **12**, on the other hand, is coupled to the base portion **22** in a movable relationship by means of the joint **20**. The sleeve representing the tip portion **18** is depicted in a slightly rotated position as compared to the upright position of the tip portion **26**. The longitudinal axis of the sleeve extends substantially perpendicularly to the longitudinal axis of the base portion **22** indicated by line A-A in FIG. **1**.

[0039] As indicated by arrows r, the tip portion **18** may be rotated about a longitudinal axis of the first clamping arm **12** (i.e., about the longitudinal axis indicated by line A-A in FIG. **1**). A rotational movement of the tip portion **18** relative to the base portion **22** is thus allowed. The rotational direction indicated by arrows r in only one exemplary direction shall not be a limitation, and it will be understood that a rotational movement of the tip portion **18** in the opposite direction of the arrows r is allowed as well.

[0040] FIG. **3** shows a cross-sectional view of the surgical reduction clamp **10** along line A-A in FIG. **1** and illustrates in more detail how the coupling between the tip portion **18** and the base portion **22** is realized by means of the joint **20**.

[0041] As shown in FIG. **3**, the joint **20** comprises a bearing member **40**, a proximal portion of the base portion **22** denoted as bearing base portion part **42**, a cylindrical portion **44** of the tip portion **18** and a ball-shaped portion **46** of the tip portion **18**. The ball-shaped portion **46** is adjacent to the cylindrical portion **44** and forms the distal end of the tip portion **18**.

[0042] A clearance **48** is present between the bearing member **40** and the bearing base portion part **42** and the clearance **48** is dimensioned so as to receive the cylindrical portion **44** and the ball-shaped portion **46**. For this purpose, a part of the clearance exhibits a cylindrical space formed by two opposing semi-cylindrical bearing recesses, one of which is formed in the bearing member **40** and one of which is formed in the bearing base portion part **42**, for receiving the cylindrical portion **44**. Distally adjacent to the cylindrical space, another part of the clearance **48** exhibits a spherical space formed by two opposing semi-spherical recesses, one of which is again formed in the bearing member **40** and one of which is again formed in the bearing base portion part **42**, for receiving the ball-shaped portion **46**.

[0043] The cylindrical space and the spherical space serve as a revolute bearing for the cylindrical portion **44** and the ball-shaped portion **46** and, thus, allow a rotational movement of the tip portion **18** relative to the base portion **22** only. The diameter of the ball-shaped portion **46** is generally greater than the diameter of the cylindrical space and, thus, the ball-shaped portion **46** is retained in the spherical space and may thus not inadvertently disengage from the joint **20**.

[0044] A locking member **50** is disposed between the bearing member **40** and the bearing base portion part **42** and permits to pull the (moveable) bearing member **40** and the (stationary) bearing base portion part **42** together, thus reducing the clearance **48** and applying a clamping force on one or both of the cylindrical portion **44** and the ball-shaped portion **46**. This clamping force fastens the position of the tip portion **18** relative to the base portion **22**. The locking member **50** is realized by means of a screw-nut relationship as indicated by a screw **54** and a nut **52**.

[0045] As long as the locking member **50** is not fully locked, the cylindrical portion **44** and the ball-shaped portion **46** are not clamped and are thus allowed to freely rotate about a longitudinal axis of the first clamping arm **12** as described above. As soon as the locking member **50** is fully locked, however, the cylindrical portion **44** and the ball-shaped portion **46** are clamped together and the rotational position of the tip portion **18** relative to the base portion **22** is fixed.

[0046] It will be understood that any other type of mechanism for pulling together the bearing member **40** and the bearing base portion part **42** may be employed. Also, the clamping structure does not necessarily have to be realized by clamping together the bearing member **40** and the bearing base portion part **42**. Any other clamping structure which receives and fixes in a stationary manner a part of the tip portion may be implemented.

[0047] In order to eventually create the clamping force between the bearing member **40** and the bearing base portion part **42**, the locking member **50** needs to be actuated. In this exemplary embodiment, the locking member **50** comprises a handle **56** for this purpose. The handle **56** may be turned and, thus, depending on the turning direction, will tighten or loosen the locking member **50**. As mentioned above, the locking member **50** exhibits a screw-nut relationship and turning the handle **56** is therefore directly translated into a screwing action of the screw **54** in the nut **52**.

[0048] The handle **56** provides a convenient means for the operating surgeon to lock or release the joint **20**. Placing or turning the handle **56** into a locking position or direction may create the clamping force to lock the joint **20** and fasten the position of the tip portion **18**. Placing or turning the handle **56** into a release position or direction may loosen the clamping force and release the joint **20** and, thus, allow for a rotational movement of the tip portion **18** relative to the base portion **22** again.

[0049] Instead of the handle **56**, the locking member **50** may also comprise a screw head for actuating the locking

member **50**. In such an implementation, a separate tool (e.g., screw driver) may be provided for turning the locking member **50**.

[0050] The coupling mechanism described above in conjunction with FIGS. **2** and **3** shall not limit the present disclosure. Various other embodiments of coupling a tip portion to a base portion are conceivable. Instead of allowing merely a rotational movement, the coupling mechanism may also be configured to allow a pivotable movement of the tip portion relative to the base portion. This may allow the tip portion to be pivoted about a pivot axis relative to the base portion. A pivoting and a rotational movement may also be combined. Such a behavior may be accomplished by coupling the tip portion to the base portion by means of a ball joint, for example.

[0051] Further, the coupling mechanism may generally allow for a configuration of the joint that permits the tip portion to be releasable from the base portion, thus, making the tip portion interchangeable. A sleeve tip may for example be exchanged by a another type of surgical instrument tip design. In the example illustrated in FIG. **3**, the screw **54** may be fully disengaged from the nut **52** and the bearing member **40** may thus be fully detached from the bearing base portion part **42**. In such a configuration the tip portion **18** may be replaced by another tip portion, before re-attaching the screw **54** together with the bearing member **40** in the nut **52** of the bearing base portion part **42**.

[0052] Turning now to FIGS. **4***a* to **4***d*, variants of the surgical reduction clamp **10** with different configurations of the first and the second clamping arm **12** and **14** according to further embodiments of the present disclosure are shown.

[0053] Generally, the second clamping arm may, similar to the first clamping arm **12**, also comprise a base portion, a tip portion, a joint movably coupling the tip portion to the base portion of the second clamping arm, and a locking member adapted to lock the joint so as to fasten a position of the tip portion relative to the base portion of the second clamping arm. The second clamping arm may even have the same configuration as the first clamping arm **12**.

[0054] In the description of the exemplary variants shown in FIGS. **4***a* to **4***d*, the same reference numerals as previously used will be applied, but supplemented by a lower-case letter. Unless specifically noted in the following, reference is made to the above remarks for the purpose of describing the structural features denoted by the same reference numerals.

[0055] FIG. **4***a* depicts a surgical reduction clamp **10***a* with a first clamping arm **12***a* having the same configuration as the first clamping arm **12** described above. The second clamping arm **14***a* of the reduction clamp **10***a* exhibits the same configuration as the first clamping arm **12***a* and therefore comprises a joint **58** that allows a tip portion **60**, here illustrated as a sleeve, to be adjusted in its rotational position relative to a base portion **62** of the second clamping arm **14***a*.

[0056] FIGS. **4***b* similarly shows a surgical reduction clamp **10***b* with a first clamping arm **12***b* having a configuration as the first clamping arm **12** described above, except that, instead of the handle **56**, a screw head **64** is used to lock or release the joint **20***b*. The second clamping arm **14***b*, in the present embodiment, is realized as a tip portion **66** having a sharp bone tip which is integrally joined to the base portion **28***b* of the second clamping arm **14***b*. By employing sharp bone tips, the operating surgeon may be allowed to align fragments by gripping the bone, soft tissue structure or any other parts of the human anatomy.

[0057] FIG. **4***c* shows a surgical reduction clamp **10***c* with a second clamping arm **14***c* having the same configuration as the second clamping arm **14***b* of FIG. **4***b*. The first clamping arm **12***c* differs from the first clamping **12***b* in that the tip portion **68** is given by a rotationally adjustable sharp bone tip.

[0058] FIG. **4***d* shows a surgical reduction clamp **10***d* wherein both the first clamping arm **12***d* and the second clamping arm **14***d* exhibit the same adjustable configuration as the first clamping arm **12***c* of FIG. **4***c*.

[0059] It will be understood that FIGS. **4***a* to **4***d* only show examples of possible configuration options of the clamping arms. These and other manifold configuration options of the clamping arms, particularly their combined configuration variants, show that a highly versatile surgical instrument is provided which may be employed in a wide range of possible surgical applications.

[0060] While the present disclosure has been described with reference to exemplary embodiments, it will be appreciated that the present invention is not limited to what has been described above. Accordingly, it is intended that the present invention may be limited only by the scope of the claims appended hereto.

1. A surgical reduction clamp comprising a first clamping arm and a second clamping arm movable relative to the first clamping arm, the first clamping arm comprising:
a base portion;
a tip portion;
a joint movably coupling the tip portion to the base portion; and
a locking member adapted to lock the joint so as to fasten a position of the tip portion relative to the base portion.

2. The clamp according to claim **1**,
wherein the joint rotatably couples the tip portion to the base portion.

3. The clamp according to claim **2**,
wherein the tip portion is rotatable about a longitudinal axis of the first clamping arm.

4. The clamp according to claim **1**,
wherein the joint couples the tip portion to the base portion by means of a revolute joint.

5. The clamp according to claim **1**,
wherein a longitudinal axis of the tip portion extends substantially perpendicularly to a longitudinal axis of the first clamping arm.

6. The clamp according to claim **1**,
wherein the joint pivotably couples the tip portion to the base portion.

7. The clamp according to claim **1**,
wherein the locking member is adapted to lock the joint by applying a clamping force.

8. The clamp according to claim **1**,
wherein the locking member comprises a handle to lock or release the joint.

9. The clamp according to claim **1**,
wherein the locking member comprises a screw head to lock or release the joint.

10. The clamp according to claim **1**,
wherein the tip portion comprises a sleeve.

11. The clamp according to claim **1**,
wherein the tip portion comprises a sharp bone tip.

12. The clamp according to claim **1**,
wherein the tip portion is releasable from the base portion and interchangeable.

13. The clamp according to claim **1**,
wherein the first and the second clamping arm are pivotably coupled relative to one another.

14. The clamp according to claim **1**, wherein a spring is formed between the first and the second clamping arm so as to bias the first and the second clamping arm relative to each other.

15. The clamp according to claim **1**, wherein a ratchet toothed member is formed at one of the first and second clamping arm and extends towards the other clamping arm so as to permit locking of the position of the first and the second clamping arm relative to one another by engagement of the other clamping arm with the teeth of the ratchet toothed member.

16. The clamp according to claim **1**, wherein the second clamping arm comprises:
a base portion;
a tip portion;
a joint movably coupling the tip portion to the base portion of the second clamping arm; and
a locking member adapted to lock the joint so as to fasten a position of the tip portion relative to the base portion of the second clamping arm.

17. The clamp according to claim **1**, wherein the second clamping arm comprises a tip portion that is integrally joined to the second clamping arm.

18. The clamp according to claim **1**, wherein the tip portion of the second clamping arm comprises a sleeve.

19. The clamp according to claim **1**,
wherein the tip portion of the second clamping arm comprises a sharp bone tip.

20. A surgical reduction clamp comprising a first clamping arm and a second clamping arm movable relative to the first clamping arm, the first clamping arm comprising:
a base portion;
a tip portion;
a joint movably coupling the tip portion to the base portion; and
a locking member adapted to lock the joint so as to fasten a portion of the tip portion relative to the base portion, wherein the joint rotatably couples the tip portion to the base portion of a revolute joint, wherein a longitudinal axis of the tip portion extends substantially perpendicularly to a longitudinal axis of the first clamping arm, wherein the locking member is adapted to lock the revolute joint by applying a clamping force to a portion of the joint.

21. The clamp according to claim **20**,
wherein the tip portion has a cylindrical portion having a spherical end which spherical end portion form part of the revolute joint.

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