Title: SPINAL IMPLANT SET INCLUDING A QUICK CLOSURE

Abstract: Spinal implant comprising a quick closure (4) for securing a connecting element (2) in a bone screw (1) where the quick closure (4) is rotatively attachable in the clockwise or counterclockwise direction and lockable such as to be able to take up torques applied to the bone screw (1) while preserving the bone anchorage from manipulative stress.

Fig. 1
Spinal Implant Set Including a Quick Closure

The present invention relates to a spinal implant set including a quick closure device according to the preamble of claim 1.

Such closure devices are typically used in the surgical treatment of the spine. As the patients are increasingly aged, they have more often porotic bones, thereby limiting the anchoring ability of screws. It is therefore particularly important that connecting elements can be fastened in screw heads with minimum stress, ideally in such a manner that the screw anchorage in the bone remains unaffected.

Various quick closures are known in the art, all of which suffer from one or several drawbacks, however, as shown below.

For their comparative assessment, quick closures of the prior art are classified as follows: Internally or externally slidingly attachable quick closures, internally or externally rotatively attachable quick closures, as well as internal and external bayonet-like quick closures.

Among the internally slidingly attachable quick closures, the following ones are e.g. known in the art: EP0672388 (Metz-Stavenhagen et al., 1995), slidingly insertable with an end stop in the insertion direction; US6110172 (Jackson, 1998), insertable from two directions with an end stop in both directions after raising the cap; US6302888 (Mellinger, 1999), insertable without end stops. EP0836436 (Wisnewski et
al., 1995), not only slidingly but pivotably insertable without end stops.

Among the externally slidingly attachable quick closures, the following ones are e.g. known in the art: DE4107480 (Ulrich et al., 1991) and US6139549 (Keller, 1997), insertable at the bottom of the screw head near the bone thread without stops and with high space requirement.

Among the internally rotatively attachable quick closures, the following ones are e.g. known in the art: EP1119304 (Yuan, 1998), rotatively insertable in one direction with an end stop; US6258090 (Jackson, 2000), rotatively insertable in one direction without an end stop; US6652526 (Arafiles, 2001), rotatively insertable in two directions without an end stop; US6786903 (Lin, 2002), rotatively insertable in two directions with a positioning aid on the rod.

Among the externally rotatively attachable quick closures, the following ones are e.g. known in the art: US5346493 (Stahurski et al., 1993), rotatively insertable in both directions without an end stop; US6251112 (Jackson, 2000), rotatively insertable in one direction without an end stop; EP1190678 (Bono et al., 2001), rotatively insertable in one direction with an end stop.

Among the internal and external bayonet-like quick closures, the following ones are e.g. known in the art: DE9403231 (Aesculap, 1994), insertable at the bottom of the screw head from one side, with an end stop; US7235075 (Metz-Stavenhagen, 2003), insertable at the top of the screw head from one side, with an end stop.
In this respect, a main disadvantage of slidingly insertable quick closures is that relatively high moments have to be applied to the typically long instruments used in spinal surgery by the surgeon with the risk of creating uncontrolled situations at the location of the screw. For rotatively insertable quick closures, the required torque along the instrument always remains the same. A rotational insertability from two sides is therefore important as due to the increasingly frequent application of dynamic stabilizing systems, plastic rods are being used more and more frequently. They are, however, larger than metal rods for reasons of stability and therefore require more space.

In situations of limited space at the pedicle entrance, a quick closure that is rotatively insertable from only one side may lead to collisions with transverse processes or facet joints, which is less probable in the case of a rotational insertability from two sides. With quick closures without end stops, screws cannot be tightened without being retained by an additional instrument for which the access to the screw is difficult. Consequently, an end stop in the tightening direction preserves the bone bed while fastening the clamping screw whereas an end stop against the tightening direction preserves the bone bed while releasing the clamping screw. An end stop in both directions optimally preserves the bone bed in both directions.

Also as a result of the increasing dimensions of plastic rods for dynamic stabilizing systems, the space left between the screw head and the pedicle entrance is mostly insufficient for a quick closure coupling. In such cases, only systems are applicable where the quick closure is arranged at the top of the screw head.
Thus, an object of the present invention is to design a spinal implant set including a quick closure for fastening a connecting element in a bone screw in such a manner that it is easier to assemble and better protects the bone bed of the bone screw from manipulative stress.

Such an implant set is suggested according to claim 1. The further claims define preferred embodiments thereof.

Accordingly, the quick closure is attachable in two directions (clockwise and counterclockwise direction) and subsequently lockable so as to be able to take up torques acting upon the screw in both directions.

Preferably, the invention proposes the quick closure defined in claim 1, which is rotatively attachable over protrusions on the screw head from the left or from the right. Furthermore, the rotative attachment of the quick closure in the screw head may be assisted by centering properties of the preassembled clamping element.

In a preferred use, the quick closure is retracted manually or by means of a clamping screw so that hooks of the quick closure engage in protrusions of the screw head and a filler of the quick closure in a recess of the protrusion of the screw head and lock therewith. In this manner, torques transmitted from the clamping element to the bone screw can be taken up by the quick closure without applying additional stresses to the bone bed of the bone screw. Furthermore, due to its guidance in the screw head, the clamping element is able to directly transmit longitudinal forces from the connecting element to the bone screw.
The present invention is explained in more detail hereinafter by means of a preferred exemplary embodiment with reference to the appended drawings which merely illustrate the exemplary embodiment.

The drawings schematically show:

Fig. 1  3D-view of an implant set assembly.

Fig. 2a an exploded view of the bone screw, the quick closure, and the clamping element.

Fig. 2b an assembly drawing of the bone screw, the quick closure, and the clamping element.

Fig. 3a a sectional view of the locked and non-clamped quick closure.

Fig. 3b a sectional view of the locked and clamped quick closure.

Fig. 1 illustrates the bone screw 1, the connecting element 2, the clamping element 3, and the quick closure 4 in the assembled state.

Fig. 2a illustrates the bone screw 1 with the screw head protrusions Ia, the recess Ib between the protrusions Ia, and the clamping element guide Ic on one half of the bone screw head, as well as the seat Id of a connecting element; the clamping element 3 with its surface 3a that fits the clamping element guide Ic and its threaded portion 3b; the
quick closure 4 with its hooks 4a that fit the screw head protrusions 1a and its filler 4b that fits the recess 1b.

Fig. 2b illustrates the bone screw 1 with the hooks 4a abutting the screw head protrusions 1a from below 1a, the filler 4b of the quick closure 4 inserted in the recess 1b, and the clamping element surface 3a of the clamping element 3 inserted in the clamping element guide 1c.

Fig. 3a illustrates a longitudinal section of the bone screw 1 with the connecting element 2, the clamping element 3, and the cross-section of the quick closure 4 in the locked but non-clamped state.

Fig. 3b illustrates the longitudinal section of the bone screw 1, of the connecting element 2, the clamping element 3, and the cross-section of the quick closure 4 in the locked and clamped state.

This assembly provides a quick and secure attachment of a connecting element 2 in a pedicle screw 1.

Notably, the clamping element guides 1c cover a sufficient wrap angle that the clamping element 3 is safely held even in the longitudinal direction of the connecting element 2.

For use of the closure, the connecting element 2 is placed in the head 1a of the bone screw 1. The quick closure 4 with the clamping element 3 in a retracted position is set on the screw head in sliding the connecting element down the clamping element guides 1c. Quick closure 4 is set on the head in a position that the locking extensions bearing the hooks 4a and the filler 4b pass between the screw head
protrusions Ia or stops arrangements. The quick closure 4 is turned so that the fillers 4b slide into recesses Ib when the quick closure 4 is retracted. This backward movement is limited by the hooks 4a hitting the protrusions Ia. Then, the clamping element 3 is screwed down using a tool attached to the accessible end of the threaded portion 3b. Once it hits the connecting element 2 (cf. Fig. 3b), it will exert a force on the connecting element 2 as well as on the quick closure 4 keeping both in their locked position. The quick closure 4 is now locked by positive interlockings: In axial direction, the hooks 4a engage with the screw head protrusions Ia, and a rotation in both directions is inhibited by the filler 4b resting in the recess Ib between the head protrusions Ia providing stop faces on both sides of the filler 4b.

Based on the foregoing description the one skilled in the art is able to derive modifications without leaving the scope of protection which is defined by the claims.
Claims

1. Spinal implant set comprising:
   - a connecting element (2),
   - at least one bone screw (1), the bone screw having a head with a seat (Id) for the connecting element and extending axially,
   - a quick closure element (4), and
   - a clamping element (3),
 characterized in that
   - the quick closure element is provided with at least a hook portion (4a) and a filler portion (4b),
   - the head of the bone screw is provided with at least one axial stop face and at least two twist stop faces on its outward lateral surface,
   - the clamping element is insertable in the head of the bone screw and provided with an adjustable connection with the quick closure element, so that the hook portion is axially engageable with the axial stop face and the filler portion bidirectionally circumferentially with the two twist stop faces when the quick closure element is attached to the bone screw, and the clamping element is adjustable to create an axial force between the head of the screw and the quick closure element once the connecting element (2) is placed in the head of the screw, in order to lock the quick closure element against axial removal from and rotation with respect to the bone screw.

2. Spinal implant set according to claim 1, characterized in that the axial stop face and the twist stop faces are constituted by at least two protrusions (Ia) producing a circumferential recess (Ib) in between so that respective
faces of the protrusions delimiting the recess essentially constitute the twist stop faces.

3. Spinal implant set according to claim 2, characterized in that the width of the circumferential recess \((1b)\) matches the filler portion \((4b)\) in order to lock the quick closure element \((4)\) against rotation in a substantially play-free manner.

4. Spinal implant according to claim 1, characterized in that the quick closure element \((4)\) is provided with at least two hook portions \((4a)\), the hook portions being circumferentially displaced and the filler portion \((4b)\) being arranged about circumferentially centered between the hook portions, preferably in an axial configuration that the hook portions and the filler portion constitute essentially a T-shape.

5. Spinal implant set according to claim 1, characterized in that the hook portion \((4a)\) and the filler portion \((4b)\) are substantially protrusions on at least one extension of the quick closure element \((4)\), the extension being shaped to extend over an outward surface of the head of the bone screw \((D)\).

6. Spinal implant set according to claim 1, characterized in that the head of the bone screw \((1)\) is provided with two screw stop arrangements \((1a)\) of axial and twist stop in a substantially diametrically opposed configuration, and the quick closure element \((4)\) is provided with two closure locking arrangements \((4a, 4b)\) of hook \((4a)\) and filler portion \((4b)\).

7. Spinal implant set according to claim 1, characterized in that the adjustable connection comprises a threaded portion (3b) of the clamping element (3) and a corresponding threaded hole in the quick closure element (4).

8. Spinal implant set according to claim 1, characterized in that the head of the bone screw (1) comprises an axial slide guide (Ic) for the clamping element (3) for inhibiting a radial movement of the clamping element.

9. Spinal implant set according to claim 8, characterized in that the axial slide guide (Ic) comprises at least two axially extending wall portions of the screw head with an inner surface corresponding to a cross-section of the clamping element and covering each an effective angle, preferably being shaped as partial cylinder walls allowing a rotation of the clamping element (4).

10. Spinal implant set according to claim 1, characterized in that the connecting element (2) is a rod, preferably a round rod.

11. Spinal implant set according to claim 1, characterized in that the connecting element (2) is made of metal or plastics.

12. Spinal implant set according to claim 8, characterized in that the clamping element (3) centers the quick closure (4) due to the guidance (Ic) in the head of the bone screw (1) in the longitudinal axis of the screw.

13. Spinal implant set according to claim 8, characterized in that due to its guidance (Ic) in the head of the bone
screw (1) in the longitudinal axis of the screw, the clamping element (3) is able to transmit forces along the longitudinal axis of the connecting element from the connecting element (2) to the bone screw (1).

14. Spinal implant set according to claim 1, characterized in that the clamping element (3) consists of a cylindrical stem (3a) and of a threaded portion (3b).

15. Spinal implant set according to claim 1, characterized in that the quick closure (4) engages the end of the head of the bone screw (1) opposite the thread of the bone screw.
Fig. 1
A. CLASSIFICATION OF SUBJECT MATTER
INV. A61B17/70
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) A61B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched.

Electronic database consulted during the international search (name of database and, where practical, search terms used) EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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<td>A</td>
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D. Further documents are listed in the continuation of Box C X See patent family annex

Special categories of cited documents

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Date of the actual completion of the international search 1 September 2010

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