Connecting intervertebral cage implant

A stand-alone cage for vertebral interbody fusion, consisting of a corpus (1) that has at least one threaded opening (4) in which a threaded shaft (2,10) with teeth (5) is screwed. At least a further opening (6) in the corpus (1) with a worm shaft (3) in it. The thread (7) of the worm shaft (3) mate with the teeth (5) of the threaded shaft (2,10).
Description

Technical Field

[0001] The invention concerns a device to fuse vertebral bodies in spine surgery.

The Existing State of the Art

[0002] Posterior Lumbar Interbody Fusion (PLIF) and Transforaminal Lumbar Interbody Fusion (TLIF) are surgical techniques to stabilize the lumbar spine involving surgical approach and the follow-up application of a bio-compatible material into the space of the intervertebral disc. The indication includes mostly degenerative affections of the lumbar spinal column, sometimes spondylolisthesis or even traumatic affections but very seldom. There are analogies with the aforementioned abbreviations, namely: ALIF (Anterior Lumbar Interbody Fusion) and ACIF (Anterior Cervical Interbody Fusion). There are no PCIF or TCIF techniques.

[0003] First, a posterior approach to the lumbar spine is made (either the standard approach in the centre line or the paramedial transmuscular one). Then, in case of using the PLIF technique, the flavum ligament between the discs of those vertebrae that are indicated for fusion is resected. The resection should be made in the minimum extent of the height of the intervertebral disc. Sometimes it shows necessary to resect part of the arch as well to make a better access. Then the dural sac is retracted medially, the posterior longitudinal ligament is exposed and the discectomy made. In case of using the TLIF technique introduced by Harms and Jeszensky, the approach into the intervertebral space is led more laterally via the intervertebral facet joint. Into the space created in this way, bone mash or a solid spongious bone graft worked into the desired shape or (at the present time prevailing) various implants are applied. The implants, mostly used at the present time, can be divided into basic types - straight cages with the necessity of application of two implants into one intervertebral space and banana-shaped cages which rotate through an angle of 90 degrees to reach a symmetrical position in the intervertebral space. The advantage of these cages is the unilateral approach only which results in smaller postoperative epidural scarring. The cages can be divided into circular-shaped cages, mostly provided with a thread (these cages are to be screwed in the intervertebral space provided always that the cavity of the cage is filled with bone grafts), into straight ones with rectangular section and into those with the base the contour of which is banana-shaped.

[0004] For better stability, the cages are, in most cases, combined with posterior stabilization either transpedicular or translaminar. If the cage is placed separately, i.e. without any supplementary stabilization, the technique is called "stand-alone".

As the stand-alone technique bears the considerable risk of no or insufficient healing and of formation of a non-union, it is used relatively rarely. For that reason, implants that should (using various mechanisms) ensure the desired stability without the supplementary posterior fixation (expandable PLIF cages) have been developed. Expandable PLIF cages are those cages which change their size using a threaded wedge that slides inside the cage. The better stability of these cages is, however, only illusory because in all the cages the stability is ensured by the weight (pressure) of the body above the cage and the expansibility of the cage (the change of height of the cage in the intervertebral space) does not change this parameter. Another direction of development of the PLIF (TLIF) stand-alone cages is a supplementary mechanism which, after being introduced, gets into contact with the cover plates and bodies of the adjacent vertebrae. They are, for example, the cages with a keel (or fin) which however can injure nerve roots or the implants where, after moving the mechanism at the end of the cage round a slight amount, two triangles in contact with the cover plate are formed. All the aforementioned implants are straight PLIF (TLIF) cages which have therefore to be introduced in pairs.

The Nature of the Invention

[0005] The aforementioned weaknesses are, to a large extent, eliminated and the goals of the invention accomplished by a stand-alone cage, especially a stand-alone cage for vertebral interbody fusion containing a corpus according to this invention, the principle of which lies in the fact that the corpus includes at least one threaded opening in which a threaded shaft with teeth is screwed provided always that there is at least another opening in the corpus in which a worm shaft is placed the thread of which mates with the teeth on the threaded shaft.

[0006] To improve penetration into the vertebral bodies, it is advantageous if the threaded shaft is provided with at least one self-cutting element.

[0007] Moreover, it is advantageous if the worm shaft is, on at least one of its ends, provided with a hole for the assembly instrument, preferably if the hole is in the shape of the Phillips drive or if it can accommodate a hexagonal or torx inner wrench.

[0008] It is important to prevent the worm shaft and the corpus from mutual disconnection when introduced. For that reason, it is recommendable that the worm shaft is provided with grooves at its ends which facilitate its rotation inside the corpus and, at the same time, prevent the worm shaft and the corpus from disconnection.

[0009] It is advantageous if at least one pair of the threaded openings is arranged symmetrically in the corpus with threaded and toothed shafts screwed in each of them on the understanding that the corpus has another opening with a worm shaft the thread of which mates with the teeth on the threaded shafts.

[0010] It is the most advantageous if two pairs of the threaded openings are arranged symmetrically in the cor-
The stand-alone cage (Fig. 1) for the vertebral body fusion consists of a corpus 1 in which two pairs of threaded openings 4 are symmetrically arranged. Inside the openings are screwed the threaded shafts 2 provided with teeth 5. Moreover, in the corpus 1, between the threaded openings 4 are two other openings 6 in which two worm shafts 3 are placed. The thread of the worm shafts 7 mates with the teeth on the threaded shafts 2. In this way, four worm gearings are created between the two worm shafts 3 and the teeth 5 made on the threads of the four threaded shafts 2.

Outline of Individual Figures on the Drawing

[0012] The threaded openings in which the threaded shafts are placed do not have to be perpendicular to the base of the corpus but to ensure the best possible penetration of the threaded shaft into the vertebral body, it is advantageous if the threaded opening is perpendicular to the base of the corpus.

[0011] It is further advantageous if the threaded openings are provided with threads that are not in the same directions.

An Example of the Design of the Invention

[0022] The stand-alone cage for vertebral interbody fusion consists of a corpus 1 in which two pairs of threaded openings 4 are symmetrically arranged. Inside the openings are screwed the threaded shafts 2 provided with teeth 5. Moreover, in the corpus 1, between the threaded openings 4 are two other openings 6 in which two worm shafts 3 are placed. The thread of the worm shafts 7 mates with the teeth on the threaded shafts 2. In this way, four worm gearings are created between the two worm shafts 3 and the teeth 5 made on the threads of the four threaded shafts 2.

[0023] The threaded shafts 2 are provided with a self-cutting element 9 (self-cutting blade) at the end.

[0024] On one of their ends, the worm shafts 3 are provided with the Phillips drive 11 for the assembly instrument.

[0025] Moreover, the worm shafts 3 are provided with grooves at their ends (not shown) which facilitate rotation of the worm shafts 3 inside the corpus 1 and, at the same time, prevent the worm shaft 3 and the corpus 1 from mutual disconnection.

[0026] The threaded openings 4 are provided with threads in the same direction and are arranged perpendicularly to the base 8 of the corpus 1.

[0027] The threaded openings 4, inside which the threaded shafts 2 with the teeth 5 are screwed, are arranged perpendicularly to the openings 6 with the worm shafts 3 inside.

[0028] The contour of the base 8 of the corpus 1 is banana-shaped and includes openings 6 for the worm shafts 3 the axes of which intersect in front of the concave side of the corpus 1. The worm shafts 3 pass through the concave side of the corpus 1 and are ended in front of the convex side of the corpus 1.

[0029] The sections of the threaded shafts 2 are solid but they can, optionally, be hollow.

[0030] The shafts 10 of the threaded shafts 2 have the same diameter along the whole of their length but the diameter can, optionally, be variable. The teeth 5 are made along the whole length of the threads 9 on the threaded shafts 2. Optionally, the teeth 5 can be made just along a part of the threads 9 on the threaded shafts 2. The sections of the worm shafts 3 are solid but they can, optionally, be hollow.

[0031] First, the stand-alone cage is inserted into the intervertebral space. Then, when turning the worm shafts
3. the threaded shafts 2 rotate and screw themselves off the corpus 1 into the vertebral bodies by which they stabilize the given segment of the spinal column.

[0032] In other advantageous designs or variants (not shown), the corpus can be in the shape of a rectangular parallelepiped and can be provided with one or more openings for threaded shafts and with one or more openings for worm shafts. The axes of the openings for the threaded shafts can be positioned symmetrically and do not have to be perpendicular to the base of the corpus. The axes of the worm shafts can be parallel. The threads of the threaded shafts do not have to be in the same direction.

Industrial Utility

[0033] The stand-alone PLIF and TLIF cage for vertebral interbody fusion with the stability ensured by using threaded shafts is intended to be used in the field of spine surgery.

Claims

1. The stand-alone cage, especially the stand-alone cage for vertebral interbody fusion, consisting of a corpus (1), distinguishing itself by the fact that at least one threaded opening (4) is arranged in the corpus (1) inside of which a threaded shaft (2) provided with teeth (5) is screwed on the understanding that there is at least another opening (6) in the corpus (1) with a worm shaft (3) the thread (7) of which mates with the teeth on the threaded shaft (2).

2. The stand-alone cage according to Claim 1 distinguishing itself by the fact that the threaded shaft (2) is provided with at least one self-cutting element (9) at its end.

3. The stand-alone cage according to some of the previous Claims distinguishing itself by the fact that the worm shaft (3) is provided with a drive for the respective assembly instrument minimally at one of its ends.

4. The stand-alone cage according to some of the previous Claims distinguishing itself by the fact that the worm shaft (3) is provided with grooves at its ends which facilitate its rotation inside the corpus (1) and, at the same time, prevent the worm shaft (3) and the corpus (1) from mutual disconnection.

5. The stand-alone cage according to some of the previous Claims distinguishing itself by the fact that at least one pair of threaded openings (4) is arranged inside the corpus (1) inside of which threaded shafts (2) with teeth (5) are screwed, provided always that there is another opening (6) in the corpus (1) with a worm shaft (3) in it the thread (7) of which mates with the teeth (2) on the threaded shafts.

6. The stand-alone cage according to some of the previous Claims distinguishing itself by the fact that two pairs of threaded openings (4) are arranged in the corpus (1) inside of which threaded shafts (2) with teeth (5) are screwed it being understood that between the threaded openings (4) in the corpus (1) are another two openings (6) with a worm shaft (3) in them the thread (7) of which mates with the teeth on the threaded shafts (2).

7. The stand-alone cage according to some of Claims 5 or 6 above distinguishing itself by the fact that the threaded openings (4) are provided with threads in the same direction.

8. The stand-alone cage according to some of the previous Claims distinguishing itself by the fact that the threaded opening (4) is perpendicular to the base (8) of the corpus (1).

9. The stand-alone cage according to some of the previous Claims distinguishing itself by the fact that the threaded opening (4) inside of which the threaded shaft (2) with teeth (5) is screwed is perpendicular to the opening (6) inside of which the worm shaft (3) is placed.

10. The stand-alone cage according to some of Claims 6, 7, 8 or 9 above distinguishing itself by the fact that the corpus (1) with the banana-shape contoured base (8) includes openings (6) the axes of which intersect in front of the concave side of the corpus (1).

11. The stand-alone cage according to some of the previous Claims distinguishing itself by the fact that the teeth (5) are made only on part of the thread (9) on the threaded shaft (2).

12. The stand-alone cage according to some of the previous Claims distinguishing itself by the fact that the shaft (10) of the threaded shaft (2) has variable diameter.

13. The stand-alone cage according to some of the previous Claims distinguishing itself by the fact that the threaded shaft (2) is hollow.

14. The stand-alone cage according to some of the previous Claims distinguishing itself by the fact that the worm shaft (3) is hollow.
<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document with indication, where appropriate, of relevant passages</th>
<th>Relevant to claim</th>
<th>CLASSIFICATION OF THE APPLICATION (IPC)</th>
</tr>
</thead>
</table>
            * column 1, line 57 - column 6, line 26; claims; figures *  | 1-12            | INV. A61F2/44                        |
            * paragraphs [0008] - [0058]; claims; figures 1a-7c *  | 1-14            |                                       |
            * paragraphs [0029] - [0041]; claims; figures *  | 1-12            |                                       |
            * paragraphs [0079] - [0084], [0150] - [0152]; claims; figures 13a-13f *  | 1-12            | TECHNICAL FIELDS SEARCHED (IPC) A61F |
            * claims; figures *  | 1-14            |                                       |
            * claims; figures *  | 1-14            |                                       |
            * page 2, line 18 - page 4; claims; figures *  | 1-14            |                                       |
            * paragraphs [0003] - [0031]; claims; figures *  | 1-14            |                                       |

The present search report has been drawn up for all claims.

<table>
<thead>
<tr>
<th>Place of search</th>
<th>Date of completion of the search</th>
<th>Examiner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Berlin</td>
<td>1 August 2011</td>
<td>Kühne, H</td>
</tr>
</tbody>
</table>

CATEGORY OF CITED DOCUMENTS:
X: particularly relevant if taken alone
Y: particularly relevant if combined with another document of the same category
A:  technological background
O:  non-written disclosure
P:  intermediate document
T:  theory or principle underlying the invention
E:  earlier patent document, but published on, or after the filing date
D:  document cited in the application
L:  document cited for other reasons
&:  member of the same patent family, corresponding document
# Annex to the European Search Report


This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on 01-08-2011. The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

<table>
<thead>
<tr>
<th>Patent document cited in search report</th>
<th>Publication date</th>
<th>Patent family member(s)</th>
<th>Publication date</th>
</tr>
</thead>
<tbody>
<tr>
<td>US 4636217 A</td>
<td>13-01-1987</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td>US 2007049943 A1</td>
<td>01-03-2007</td>
<td>US 2010324606 A1</td>
<td>23-12-2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WO 2008042305 A2</td>
<td>10-04-2008</td>
</tr>
<tr>
<td>US 2011054616 A1</td>
<td>03-03-2011</td>
<td>NONE</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>WO 2006110443 A2</td>
<td>19-10-2006</td>
</tr>
<tr>
<td>WO 2004080356 A2</td>
<td>23-09-2004</td>
<td>US 2005049590 A1</td>
<td>03-03-2005</td>
</tr>
<tr>
<td>FR 2795627 A1</td>
<td>05-01-2001</td>
<td>AT 291399 T</td>
<td>15-04-2005</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AU 6165200 A</td>
<td>22-01-2001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>BR 0011965 A</td>
<td>14-05-2002</td>
</tr>
<tr>
<td></td>
<td></td>
<td>CA 2373788 A1</td>
<td>11-01-2001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DE 60018988 D1</td>
<td>28-04-2005</td>
</tr>
<tr>
<td></td>
<td></td>
<td>DE 60018988 T2</td>
<td>13-04-2006</td>
</tr>
<tr>
<td></td>
<td></td>
<td>WO 0101894 A1</td>
<td>11-01-2001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IL 147400 A</td>
<td>29-04-2010</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 4189151 B2</td>
<td>03-12-2008</td>
</tr>
<tr>
<td></td>
<td></td>
<td>JP 2003503155 A</td>
<td>28-01-2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MX PA02000178 A</td>
<td>21-07-2003</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZA 200200791 A</td>
<td>26-03-2003</td>
</tr>
<tr>
<td>EP 2116212 A1</td>
<td>11-11-2009</td>
<td>NONE</td>
<td></td>
</tr>
</tbody>
</table>