

Published: — without international search report and to be republished upon receipt if that report (Rule 48.2(g))

(54) Title: AN INTERVERTEBRAL PROSTHESIS FOR UNREMOVABLY FIXING TWO ADJACENT VERTEBRAE

(57) Abstract: An intervertebral prosthesis for unremovable fixing of two adjacent vertebrae, comprising: a cage (2) insertable between two adjacent vertebrae, provided with a housing (3); a first opening (4) and a second opening (5), both the first opening (4) and the second opening (5) placing the housing (3) in communication with an outside of the cage (2); and in that it further comprises: a screw (6) insertable in the housing (3) through the first opening (4); a screw nut (7) dimensioned such as to engage with the screw (6) when the screw nut (7) and the screw (6) are inserted in the housing (3); at least a first arm (8) which can engage in the housing (3) such as to rotate between a first angular position (A), in which the first arm (8) is arranged internally of the housing (3), and a second angular position (B), in which a first portion (10) of the first arm (8) has exited from the second opening (5) such as to abut against a vertebral surface when the cage (2) is inserted between the two vertebrae, with a consequent blocking of the intervertebral prosthesis (1) to the two vertebrae, the rotation of the first arm (8) being commanded by the movement of the screw nut (7) along the screw (6).
AN INTERVERTEBRAL PROSTHESIS FOR UNREMOVABLY FIXING TWO ADJACENT VERTEBRAE

FIELD OF THE INVENTION

The present invention relates to the technical sector regarding invertebral prostheses destined to be inserted between vertebrae of a vertebral column of a living being; in particular, the invention relates to a prosthesis for unremovably fixing two adjacent vertebrae, which are made permanently solidly constrained to one another.

DESCRIPTION OF THE PRIOR ART

The surgical procedure that produces an unremovable fixing of two vertebrae (also referred to as vertebral fusion or spinal fusion), involves the following steps: removal of the degenerated intervertebral disc interposed between a first vertebra and a second vertebra; the scraping of the facing vertebral surfaces of the first vertebra and the second vertebra in order to roughen them; the spacing of the first vertebra and the second vertebra from one another by using an instrument for creating an intervertebral space; insertion of a cage between the first vertebra and the second vertebra in the place of the degenerated intervertebral disc; the disengagement of the spacer instrument, with a consequent compression of the cage by the spine via the first vertebra and the second vertebra.

Bone implants (including in the form of a gel) are applied to the cage before its insertion into the intervertebral space, with the purpose of facilitating, over time, usually over a few months, bone fusion and therefore the unremovable fixing of the first vertebra, the second vertebra and the cage to one another.

In the period between the surgical operation of inserting the cage and the bone fusion, the cage has to remain immobile in the vertebral interspace; this is facilitated by the compression exerted by the first and the second vertebrae
on the cage and the friction realised between the contact surfaces of the first vertebra and the second vertebra, which as has been mentioned are roughened, with the corresponding contact surfaces of the cage, which are usually rough and/or provided with indentations.

However practice has shown that these particulars are not sufficient to render the position of the cage as sufficiently stable: thus, after inserting the cage in the vertebral interspace the surgeon usually makes two holes in both the first and the second vertebrae and rigidly fastens the first vertebra to the second vertebra using four screws and two perforated connecting plates.

However, making holes (four in number) in the vertebrae is particularly invasive and weakens the bone structure of the vertebrae themselves; primarily, the screws and connecting plates are not removed with the aim of preventing a subsequent surgical operation.

To obviate the drawback of perforating the vertebrae, a second type of intervertebral prosthesis is used, which once inserted in the intervertebral interstice can be "expanded"; an example is constituted by intervertebral prostheses which exhibit an adjustable axial height.

SUMMARY OF THE INVENTION

The aim of the present invention consists in providing an intervertebral prosthesis which is an alternative to the intervertebral prostheses belonging to the second type mentioned herein above.

The above-stated aim is obtained by an intervertebral prosthesis according to claim 1, comprising: a cage insertable between two adjacent vertebrae, provided with a housing; characterised in that: the cage is further provided with a first opening and a second opening, both the first opening and the second opening placing the housing in communication with an outside of the cage; and in that it further comprises: a screw insertable in the housing through the first opening; a screw nut dimensioned such as to engage with the screw when the
screw nut and the screw are inserted in the housing; at least a first arm which can engage in the housing such as to rotate between a first angular position, in which the first arm is arranged internally of the housing, and a second angular position, in which a first portion of the first arm has exited from the second opening such as to abut against a vertebral surface when the cage is inserted between the two vertebrae, with a consequent blocking of the intervertebral prosthesis to the two vertebrae, the rotation of the first arm being commanded by the movement of the screw nut along the screw.

The prosthesis can therefore be inserted in the intervertebral space, with the first arm occupying the first angular position; after which, by acting on the screw through the first opening a sliding of the screw nut can be caused, which in turn causes a rotation of the first arm, a first portion of which exits from the second opening up to abutting against a vertebral surface. In this way, by acting on the crew the intervertebral prosthesis can be stably blocked to the two vertebra; it is advantageously no longer necessary to perforate the vertebrae and apply screws and metal connecting plates between the vertebrae, as the blocking of the intervertebral prosthesis to the vertebrae is stable and prevents undesired displacements of the intervertebral prosthesis before the unremovable fixing by bone fusion of the intervertebral prosthesis to the vertebrae is consolidated.

In a first embodiment, the first arm can be provided with anchoring means for anchoring the vertebral surface; the anchoring means can comprise, for example, at least a tooth, a projection, a cusp or the like which originates from the first portion of the first arm; the bone surface can be previously fashioned such as to provide seatings for receiving the teeth of the first arm, which facilitates the stable blocking of the intervertebral prosthesis to the vertebrae.

BRIEF DESCRIPTION OF THE DRAWINGS

Specific embodiments of the invention, and advantageous technical-functional characteristics correlated to the embodiments, will be described in the
following of the present description, according to what is set out in the claims and with the aid of the accompanying tables of drawings, in which:

- figure 1 is a perspective view of the intervertebral prosthesis according to the present invention;

- figure 2 is a perspective view of the prosthesis of figure 1, without the relative cage;

- figures 3 and 4 are two different perspective views of the exploded view of the prosthesis, without the cage;

- figure 5 is a lateral view of the intervertebral prosthesis of figure 1, in a first operating configuration;

- figure 6 is a lateral view like the view of figure 5, in which the prosthesis is without the relative cage;

- figure 7 is a lateral view of the intervertebral prosthesis of figure 1, in a second operating configuration;

- figure 8 is a lateral view like the view of figure 7, in which the prosthesis is without the relative cage;

- figure 9 is a view of an axial section of the intervertebral prosthesis of figure 1, in a second operating configuration.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In general terms, the intervertebral prosthesis (1) for unremovably fixing two adjacent vertebrae, object of the present invention, comprises: an intervertebral prosthesis according to claim 1, comprising: a cage (2) insertable between two adjacent vertebrae, provided with a housing (3); characterised in that: the cage (2) is further provided with a first opening (4) and a second opening (5), both the first opening (4) and the second opening (5) placing the housing (3) in communication with an outside of
the cage (2); and in that it further comprises: a screw (6) insertable in
the housing (3) through the first opening (4); a screw nut (7)
dimensioned such as to engage with the screw (6) when the screw nut
(7) and the screw (6) are inserted in the housing (3); at least a first arm
(8) which can engage in the housing (3) such as to rotate between a
first angular position (A), in which the first arm (8) is arranged internally
of the housing (3), and a second angular position (B), in which a first
portion (10) of the first arm (8) has exited from the second opening (5)
such as to abut against a vertebral surface when the cage (2) is
inserted between the two vertebrae, with a consequent blocking of the
intervertebral prosthesis (1) to the two vertebrae, the rotation of the first
arm (8) being commanded by the movement of the screw nut (7) along
the screw (6).

The first arm (8) may be provided with anchoring means (12) for
anchoring the vertebral surface, which anchoring means (12) may
include one or more teeth (12) or cusps that originate from the first
portion (10) of the first arm (8).

To further improve the anchoring, before inserting the cage (2) in the
vertebral interspace (not shown), anchoring seats (not shown) can be
made in the vertebral surface that are suitable for receiving the teeth
(12) or cusps.

The first arm (8) can be rotatable, when it engages in the housing (3),
relative to an axis perpendicular to the axis of the screw (6) when the
screw (6) is inserted into the housing (3).

The screw nut (7) preferably bears a first cursor (13), while a track (15)
is fashioned in the first arm (8) for receiving the first cursor (13). The
first cursor (13), therefore, is destined to engage in the track (15) such
that the movement of the screw nut (7) along the screw (6) causes the
first cursor (13) to slide in the track (15) with a consequent rotation of the first arm (8) between the above-cited angular positions (A, B).

The track (15) can be obtained by providing an opening in the first arm (8), which opening can be a through-opening, thus identifying a through-hole, or a blind-hole, effectively an undercut (not shown) in a side of the first arm (8).

When it is inserted into the slot (3), the screw (6) is supported by the housing (3); this allows the screw (6) to maintain a stable position internally of the housing (3) even during the blocking of the intervertebral prosthesis (1) following the rotation of the first arm (8) up to abutting against the vertebral surface. In this regard, the cage (2) is provided with a first support (16) arranged at an end of the housing (3), at the first opening (4), and a second support (17) arranged at the opposite end of the housing (3): the first support (16) comprises for example a through-hole, a cylindrical shape, for the passage of the screw shank (6) but not the screw head (6), which head is instead destined to abut against a corresponding surface (18) of the first support (16); the second support (17) comprises for example a blind hole (19), cylindrical in shape, to receive the end of the shank of the screw (6) freely in support. Therefore, the blind hole (19) of the second support (17) rotatably receives the shank of the screw (6).

The intervertebral prosthesis (1) in question preferably also includes a second arm (9) which can engage in the housing (3) such as to rotate between a first angular position (A), in which the second arm (9) is arranged to internally of the housing (3), and a second angular position (B), wherein a first portion (10) of the second arm (9) has exited from the second opening (5) in order to abut against the vertebral surface when the cage (2) is inserted between the two vertebrae, with a consequent blocking of the intervertebral prosthesis (1) to the two
vertebrae, the rotation of the second arm (9) being controlled by the movement of the screw nut (7) along the screw (6).

The second arm (9) is substantially identical to the first arm (8).

The second arm (9) can then be provided with anchoring means (12) to anchor the vertebral surface, which anchoring means (12) may include one or more teeth (12) or cusps that originate from the first portion (10) of the second arm (9).

The second arm (9) can be rotatable, when it engages in the housing (3), relative to an axis that is perpendicular to screw (6) axis when the screw (6) is inserted into the housing (3).

The first arm (8) and the second arm (9) are arranged on opposite sides of the screw (6) when the screw (6) is inserted into the housing (3) and the first and the second arm (9) engage in the housing (3). Moreover, the first arm (8) and the second arm (9) are arranged such as to abut against the vertebral surface when the cage (2) is inserted between the two vertebrae: the first arm (8) and the second arm (9) both protrude from the second opening (5) of the cage (2) when they are rotated such as to reach the second angular position (B).

The fact of having two arms (8, 9) arranged on opposite sides of the screw (6) and acting on the same vertebral surface advantageously ensures a particularly reliable and effective blocking of the intervertebral prosthesis (1) to the vertebrae between which it is interposed.

The prosthesis (1) further comprises an additional element (20), which: is so dimensioned as to engage in the housing (3), being integral therewith; a through hole (21) is made, through which the screw (6) is insertable, a first undercut (22) and a second undercut (23) (figures 3, 4) are made respective on two opposite sides, the first undercut (22) being conformed such as to rotatably couple with an end of the first arm.
the second undercut (23) being conformed such as to rotatably couple with an end of the second arm (9).

The additional element (20), in particular, can be symmetrical with respect to a plane passing through the axis of the through hole (21).

The nut (7) also preferably bears a second cursor (14) and a track (15) is fashioned in the second arm (9) for receiving the second cursor (14). The first cursor (13) and the second cursor (14) are arranged on two opposite sides of the screw nut (7); the first cursor (13) and the second cursor (14) have, for example a cylindrical shape. The screw nut (7), in particular, can be symmetrical with respect to a plane passing through the axis of the threaded through-hole (24) thereof, destined to engage with the screw (6).

The track (15) of the second arm (9) can also be obtained by realising an opening in the second arm (9), which opening can be a through-opening, thus identifying a through-hole, or can be "blind", identifying an undercut (not shown) at one side of the second arm (9).

When: the screw (6) is inserted into the housing (3); the screw nut (7) engages with the screw (6), the first arm (8), the second arm (9) and the additional element (20) engage in the housing (3), then the group formed by the screw (6), the nut (7), the first arm (8), the second arm (9) and the additional element (20) is symmetrical with respect to a plane passing through the axis of the screw (6) and the screw nut (7). This symmetry advantageously ensures improved stability of the intervertebral prosthesis (1) once it is blocked to the vertebrae by rotating the first arm (8) and the second arm (9) in the second angular position (B).

The additional element (20) is insertable into the housing (3) through the second opening (5); the additional element (20) is preferably designed to snugly couple (i.e. in a coupling between complementary
profiles) with a portion (25) of the edge of the second opening (5); in the example shown, the portion (25) is the portion that forms the end of the second opening (5) closest to the first opening (4).

The first undercut (22) and the second undercut (23) of the additional element (20) are shaped such to receive a second portion (11) (in particular, an end) respectively of the first arm (8) and the second arm (9) and allow rotation of the first arm (8) and the second arm (9) with respect to the additional element (20), between the first angular position (A) and the second angular position (B). The profiles of the first undercut (22) of the additional element (20) and the second portion (11) of the first arm (8) are complementary and in particular in the form of an arc of a circle (for example of a semi-circle); similarly, the profiles of the second undercut (23), the additional element (20) and the second portion (11) of the second arm (9) are complementary and in particular in the form of an arc of a circle (for example a semi-circle).

The additional element (20), at the first undercut (22), also exhibits a first projection (26) which is intended to engage in an opening in the first arm (8) and is intended, therefore, to retain the first arm (8) in position, preventing it from slipping out; in the example shown in the figures, in particular, the first projection (26) engages into the opening of the first arm (8) that conforms the track (15). Likewise, the additional element (20), at the second undercut (23), has a second protrusion (27) which is destined to engage in an opening in the second arm (9) and contributes, therefore, to retaining the second arm (9) in position, preventing it from slipping out; in the example shown in the figures, in particular, the second protrusion (27) engages in the opening of the second arm (9) that conforms track (15). In general, an additional opening (not shown) can be afforded in the first arm (8) for receiving the first projection (26); the same way, an additional opening can be
provided in the second arm (9) for receiving the second additional protrusion (27).

When the first arm (8) is inserted in the housing (3) and is coupled with the additional element (20), the first arm (8) is kept in position at a side thereof by the wall of the housing (3), and at the opposite side by the wall of the additional element (20) defined by the first undercut (22), while sliding thereof along the axis of the screw (6) is prevented precisely thanks to the presence of the first projection (26) of the additional element (20). Similarly, when the second arm (9) is inserted within the housing (3) and is coupled with the additional element (20), the second arm (9) is kept in position at one side by the wall of the housing (3), at the opposite side by the wall of the additional element (20) defined by the second undercut (23), while sliding thereof along the axis of the screw (6) is prevented precisely thanks to the presence of the second protrusion (27) of the additional element (20).

The first arm (8) and the second arm (9) can thus rotate respectively with respect to the first undercut (22) and the second undercut (23) of the additional element (20); this rotation, however, is subject to the coupling of the first cursor (13) and of the second cursor (14) of the screw nut (7) with the tracks of the first arm (8) and the second arm (9) respectively.

To rotate the first arm (8) and the second arm (9) it is therefore necessary to rotate the screw (6) (with a tool of known type, not shown), which determines the movement of the screw nut (7) along the shank of the screw (6) and, therefore, also of the first cursor (13) and of the second cursor (14) (for example obtained in a single body with the screw nut 7); the first cursor (13) and the second cursor (14), when sliding along the track (15) of the first arm (8) and the second arm (9), determine the rotation of the first arm (8) and the second arm (9).
The first arm (8) and the second arm (9) perform a simultaneous and synchronous rotation.

The housing (3) is preferably internal.

The cage (2) for example has an elongate shape, substantially prismatic or parallelepiped; first opening (4) is made at a first surface (28) of the cage (2) and is arranged for example in such a way that the axis of longitudinal development of the cage (2) passes through the first opening (4). The prosthesis (1) intervertebral is designed so that when inserted into a gap between two spinal vertebrae, the first opening (4) is accessible in order for it to be possible to act on the screw (6) contained in the housing (3).

The cage is preferably made of PEEK®.

The second opening (5), instead, is made at a second surface (29) of the cage (2) for such as to face towards one of the vertebrae between which the cage (2) is to be interposed. Therefore, the first surface (28) of the cage (2) and the second surface (29) of the cage (2) are adjacent to each other.

The second surface (29) of the cage (2) and a third surface (30) of the cage (2), opposite to the second surface (29), are irregular in order to facilitate bone fusion and to increase the friction between the cage (2) and the vertebrae between which the cage (2) itself is interposed.

The above is understood to have been described by way of non-limiting example, and any possible constructional variants are deemed to fall within the ambit of protection of the present technical solution, as claimed in the following.
CLAIMS

1. An intervertebral prosthesis (1) for unremovably fixing two adjacent vertebrae, comprising:

a cage (2) insertable between two vertebrae, provided with a housing (3);

characterised in that:

the cage (2) is further provided with a first opening (4) and a second opening (5), both the first opening (4) and the second opening (5) placing the housing (3) in communication with an outside of the cage (2);

and in that it further comprises:

a screw (6) insertable in the housing (3) through the first opening (4);

a screw nut (7) dimensioned such as to engage with the screw (6) when the screw nut (7) and the screw (6) are inserted in the housing (3);

at least a first arm (8) which can engage in the housing (3) such as to rotate between a first angular position (A), in which the first arm (8) is arranged internally of the housing (3), and a second angular position (B), in which a first portion (10) of the first arm (8) has exited from the second opening (5) such as to abut against a vertebral surface when the cage (2) is inserted between the two vertebrae, with a consequent blocking of the intervertebral prosthesis (1) to the two vertebrae, the rotation of the first arm (8) being commanded by the movement of the screw nut (7) along the screw (6).

2. The prosthesis (1) of the preceding claim, wherein the first arm (8) is provided with anchoring means (12) for anchoring the vertebral surface.

3. The prosthesis (1) of the preceding claim, wherein the anchoring means (12) comprise at least a tooth which originates from the first portion (10) of the first arm (8).
4. The prosthesis (1) of any one of the preceding claims, wherein the screw nut (7) bears a first cursor (13), and wherein the first arm (8) affords a track (15) for receiving the first cursor (13).

5. The prosthesis (1) of the preceding claim, wherein the track (15) is conformed as an opening fashioned in the first arm (8).

6. The prosthesis (1) of any one of claims from 1 to 3, comprising a second arm (9), the first arm (8) and the second arm (9): being arranged on opposite sides of the screw (6) when the screw (6) is inserted in the housing (3) and the first arm (8) and the second arm (9) engaging in the housing (3); and being able to abut against the vertebral surface when the cage (2) is inserted between the two vertebrae.

7. The prosthesis (1) of the preceding claim, further comprising an additional element (20), dimensioned such as to engage in the housing (3), becoming solidly constrained thereto, which affords a through-hole through which the screw (6) is insertable; which additional element (20) affords a first undercut (22) and a second undercut (23) respectively on two opposite sides, the first undercut (22) being conformed such as to rotatably couple with an end of the first arm (8), the second undercut (23) being conformed such as to rotatably couple with an end of the second arm (9).

8. The prosthesis (1) of claim 6 or 7, wherein the screw nut (7) bears a first cursor (13) and a second cursor (14) arranged respectively on two opposite sides, wherein the first arm (8) affords a track (15) for receiving the first cursor (13) and wherein the second arm (9) affords a track (15) for receiving the second cursor (14).

9. The prosthesis of claim 8, wherein when: the screw (6) is inserted in the housing (3); the screw nut (7) engages with the screw (6); the first arm (8), the second arm (9) and the additional element (20) engage in
the housing (3); then the group formed by the screw (6), the screw nut (7), the first arm (8), the second arm (9) and the additional element (20) is configured such as to be symmetrical with respect to a plane passing through the axis of the screw (6) and the screw nut (7).

10. The prosthesis (1) of claim 8, wherein the track (15) of the first arm (8) is conformed by an opening fashioned in the first arm (8).

11. The prosthesis (1) of claim 8 or 10, wherein the track (15) of the second arm (9) is conformed by an opening fashioned in the second arm (9).