Title: INTERVERTEBRAL IMPLANT AND SPINE STABILISATION DEVICE CONTAINING IT

Abstract: Intervertebral implant, comprising two plates (1, 2; 31, 32; 53-58) intended to come into contact with the patient’s vertebral plates, characterised in that at least one of said plates (1, 2; 31, 32) has a cutout delineating webs (6, 10; 35; 59-64) converging toward a zone where the plates (1, 2; 31, 32) are connected to one another, said webs (6, 10, 35; 59-64) not being in mutual contact when the prosthesis is ready for use. Spine stabilisation device comprising at least one such implant.
INTERVERTEBRAL IMPLANT AND SPINE STABILISATION DEVICE CONTAINING IT

This invention relates to devices intended to be implanted between vertebrae and, in some cases, more specifically to implants intended to replace damaged intervertebral disks.

Implants intended for the partial or complete replacement of intervertebral disks are used primarily in cervical, thoracic, lumbar and lower dorsal regions of the spine. Some of them comprise two plates each coming into contact with a vertebral plate, and which are pivotably connected to one another by a ball joint. This type of connection has the disadvantage of causing relatively intense rubbing during relative movements of the vertebrae. There is therefore a high probability of wear of the implant, which results in the release of debris in the patient’s body, which is obviously undesirable. To avoid this, it is necessary to use materials that have the disadvantage of being incompatible with examinations using scanners or MRI examinations. Moreover, this ball joint connection alone does enable the implant to return to a nominal position after a movement, a possibility that would be analogous to the elastic behaviour of a natural disk.

To overcome these disadvantages, implants intended to replace intervertebral disks have been conceived in which two plates coming into contact with the vertebral plates are connected to one another by elastic devices between them (see documents US 2003/0 236 571 and US 2003/0 065 395). However, these devices have a complex design in that they comprises a plurality of very small parts that are difficult to manufacture and assemble.

The aim of the invention is to propose new types of intervertebral implants having all the desired functionalities, in particular an elastic behaviour best reproducing that of a natural disk, while being as simple as possible to produce and to install, and capable of being used alone or integrated in a spine stabilisation device.

For this purpose, the invention relates to an intervertebral implant comprising two plates intended to come into contact with the patient's vertebral plates, characterised in that at least one of said plates has a cutout delimiting webs

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converging toward a zone where the plates are connected to one another, in which said webs are not in mutual contact when the prosthesis is ready for use.

Said plates may initially be separate parts, one of said plates having, in its web convergence zone, a hub having a seat, and the other of said plates having, in its web convergence zone, a hub comprising an excrescence which may penetrate and be held in said seat so as to fix said plates to one another.

Said plates may be two portions of the same part and are connected together by a pillar.

Said pillar may have a circular transverse cross section.

Said pillar may have a rectangular transverse cross section.

Said webs of at least one of the plates may have a substantially V-shaped longitudinal cross section.

Said webs of at least one of the plates may have a substantially U-shaped longitudinal cross section.

The opening of the U may be inclined toward the interior of the plates.

Said webs of at least one of the plates may have a substantially Ω-shaped longitudinal cross section.

Said webs of at least one of the plates may have a substantially S-shaped longitudinal cross section.

Said webs of at least one of the plates may be formed by a series of rectilinear portions.

Said webs of at least one of the plates may be located in the same plane as said plate.

Said webs of at least one of the plates may have a cavity.

Said webs of at least one of the plates may have an orientation having a helical curvature.

The webs of the upper plate may be interlaced with the webs of the lower plate.

Said zone where the plates may be connected to one another may be located substantially in the centre of the implant.

Said zone where the plates may be connected to one another may be located on the longitudinal axis of the implant and be offset in the rear zone of the prosthesis.
Said zone where the plates may be connected to one another may be located in the front zone of the implant.

At least one external surface of the implant may have a longitudinally concave and transversely convex shape.

At least one external surface of the implant may have a biconvex shape.

At least one external surface of the implant may have at least one excrescence ensuring the anchoring of the implant in the corresponding vertebral plate.

The external surface of at least one of said plates may have a cover.

Said webs may have indentations.

Said plates may have stops on their facing edges.

Said plates may each comprise at least three bearings connected to the pillar by said webs, said bearings being located in the extension of the external surfaces of covers having indentations enabling said bearings to be made even, said covers having grooves on their internal surfaces for the webs to lodge in.

There may be three of said bearings for each plate, one of said bearings is then located in the middle of the front edge of the corresponding plate, the web which bears it substantially following the longitudinal axis of the prosthesis.

The two other bearings are connected to the pillar by webs having a shape substantially a quarter circle or a quarter ellipse.

The invention also relates to a spine stabilisation device comprising at least one intervertebral plate, spine stabilisation elements and means for securing said stabilisation elements to the vertebrae of the zone to be stabilised, characterised in the at least one implant is of the aforementioned type.

Said spine stabilisation elements secured to the vertebrae can comprise one or more rods extending longitudinally along the spine.

Said means for securing said stabilisation elements to the vertebrae can comprise pedicle screws.

As will have been seen, the implant of the invention involves the shaping of the two plates intended to be placed in contact with the vertebral plates so as to provide them with a significant capacity for elastic deformation and flexibility, as well as a mobile centre of rotation. For this purpose, the plates have a cutout which delineates elastic webs converging toward a solid zone where the plates are
connected to one another. The deformations of the elastic webs make possible a great variety of relative movements between the vertebrae, namely:

- an axial compression,
- an anterior/posterior flexure,
- a lateral flexure,
- an axial rotation,
- combinations of all these movements, and
- mobility of the immediate centre of rotation.

Thus, the behaviour of natural disks is reproduced to the best extent.

In a first series of alternatives of the invention, the two plates are distinct in construction and nest one into the other at the level of their solid zones, for example by means of a tight fit and/or cemented and/or welded (by TIG or laser) connection.

In a second series of alternatives of the implant, the two plates form a unit and are united at the level of a pillar which may be located substantially in a central position or in an offset position toward the rear or front region on the longitudinal axis of the prosthesis.

The webs are not in mutual contact when the implant is ready for use. In particular, if the webs are not planar, the webs of the upper and lower plates have to be intercalated one between another to avoid such a contact which would prevent satisfactory functioning of the prosthesis.

This implant can be used in particular in two ways. It can be used as a total intervertebral disk prosthesis. For this purpose, the surgeon performs a total discectomy, then inserts the implant of the invention between the vertebrae concerned. It can also be used if necessary to only partially replace an intervertebral disk, in combination with a conventional spine stabilisation device, in particular a device comprising longitudinal rods, secured to the vertebrae, for example, by means of pedicle screws.

The invention will be better understood on reading the following description, given in reference to the following accompanying figures:

- Figure 1 shows, in a bottom view (Figure 1a), a front cross section view along B-B (Figure 1b), a left side view (Figure 1c) and a right side view (Figure 1d), a first example of an implant according to the invention, composed of two assembled plates,
of which the lower plate is shown in perspective seen from above in Figure 1e and seen from below in Figure 1f;

- Figure 2 shows in the same manner as Figure 1 a second example of an implant according to the invention which is an alternative to the preceding one;

- Figure 3 shows a bottom view (Figure 3a), a front cross section view along B-B, a left side cross section view along C-C, and a right side view of a third example of an implant according to the invention composed of two assembled plates, the lower plate being shown in perspective seen from above in Figure 3e and from below in Figure 3f;

- Figure 4 shows, in the same manner as Figure 1, a fourth example of an implant according to the invention;

- Figure 5 shows, in the same manner as Figure 1, a fifth example of an implant according to the invention;

- Figure 6 shows, in the same manner as Figure 1, a sixth example of an implant according to the invention;

- Figure 7 shows, in the same manner as Figure 3, a seventh example of an implant according to the invention;

- Figure 8 shows, in the same manner as Figure 3, an eighth example of an implant according to the invention;

- Figure 9 shows a bottom perspective view of an alternative of the lower plate capable of being used in an implant according to the invention;

- Figure 10 shows, in a bottom view (Figure 10a), a front cross section view along B-B (Figure 10b), a left cross section along C-C (Figure 10c), a right side view (Figure 10d), and a perspective view (Figure 10e), a ninth example of an implant according to the invention, the upper plate (Figure 10b) and lower plate (Figure 10g) being shown separately in perspective;

- Figure 11 shows (offset by 1/4 turn with respect to the other similar figures) a bottom view (Figure 11a), a front view (Figure 11b), a left side view (Figure 11c), and a right side cross section view along D-D of a tenth example of an implant according to the invention;
- Figure 12 shows a bottom view (fig. 12a), a front view (fig. 12b), a left side view (fig. 12c) and a right side cross section view along D-D of an eleventh example of an implant according to the invention;

- Figure 13 shows a twelfth example of an implant according to the invention, in the same manner as Figure 12;

- Figure 14 shows, in the same manner as figure 12, a thirteenth example of an implant according to the invention;

- Figure 15 shows, in a bottom view (Figure 15a), a front view (fig. 15b) and in a partial cross section view along A-A, a left side cross section view along C-C (Figure 15c), and a right side view (Figure 15d), a fourteenth example of an implant according to the invention;

- Figure 16 shows in perspective the implant of Figure 15 and the covers which preferably complete it;

- Figure 17 shows a fourteenth example of an implant according to the invention, in the same manner as in Figure 15;

- Figure 18 shows a bottom view (Figure 18a), a front cross section view along B-B (Figure 18b), and a left side view (Figure 18c) of the implant of Figure 17 equipped with its covers;

- Figure 19 shows in perspective the separated elements of a fifteenth example of an implant according to the invention;

- Figure 20 shows in perspective the same example in the assembled state;

- Figure 21 shows a bottom view (fig. 21a), a left side cross section view along B-B (fig. 21b), a top cross section view along C-C (fig. 21c), a left side view (fig. 21d), a right side cross section view along E-E (fig. 21e), a front cross section view along F-F (fig. 21f) and a front cross section view along G-G (fig. 21g) of the same example of an implant without its covers;

- Figure 22 shows a top view (fig. 22a), a left side cross section view along B-B (fig. 22b), a bottom view (fig. 22c) and a rear view (fig. 22d) of the lower cover of the same example of an implant.

A first example of an intervertebral implant according to the invention is shown in Figure 1. This implant has an upper plate 1 and a lower plate 2. The contours of these two plates 1, 2 are substantially identical in shape and dimension.
and are preferably, as shown, designed to substantially closely follow, with their front 3, 3' and rear 4, 4' edges, the contours of the vertebral plates.

The upper plate 1 has a circular perforation 5, within which elastic webs 6 with a substantially V-shaped cross section extend from its periphery to the centre. These webs 6 radially connect the periphery of the perforation 5 to a central hub 7 of the upper plate 1. This hub 7 is generally cylindrical in shape and has a seat 8 turned toward the lower surface of the upper plate 1.

The lower plate 2 has a circular perforation 9, within which elastic webs 10 with a substantially inverted V-shaped cross section extend from its periphery to the centre. These webs 10 radially connect the periphery of the perforation 9 to a central hub 11 of the lower plate 2. This hub 11 is generally cylindrical in shape and is designed to be able to penetrate into the seat 8 of the hub 7 of the upper plate 1 with a tight fit ensuring fixing of the two plates 1, 2 to one another during the assembly of the implant before installation in a patient's intervertebral space. This tight fit may be completed or replaced by a laser weld or any other fixing mode. As may be seen in Figures 1a to 1d, the webs 6 of the upper plate 1 and the webs 10 of the lower plate 2 are angularly mutually offset so as not to come into mutual contact when the implant is assembled.

The implant shown in Figure 2 is identical in principle to that of Figure 1 except that the webs 6 of the upper plate have a U-shaped cross section and the webs 10 of the lower plate have a cross section with a substantially inverted U-shape. It is also noted that the thickness of each web 6, 10 can vary according to the region of the web, so as to optimise their strength and flexibility. This feature can be found in the webs 6, 10 of any alternative of the implant.

The implant shown in Figure 3 is identical to that of Figure 1 except that the webs 6, 10 of the two plates 1, 2 each have a cavity 12 whereby each web 6, 10 is attached to the corresponding hub 7, 11 in a single zone and is attached to the periphery of the corresponding perforation 5, 9 in two zones. The flexibility of the webs may thereby be increased without greatly reducing their strength.

The implant shown in Figure 4 is identical to that of Figure 1 except that the webs 6, 10 of the two plates 1, 2 do not connect the peripheries of the perforations 5, 9 to the hubs 7, 11 radially but along an orientation having a helical curvature. The
length of usable fibre for bending is thus increased. It should be understood that this latter characteristic could also be adapted to the examples of Figures 2 and 3.

The implant shown in Figure 5 is identical to that shown in Figure 4, except that the webs 6, 10 are thinner and have a more accentuated curvature, to the extent that when the prosthesis is assembled, the webs 6 of the upper plate 1 and 10 of the lower plate 2 are interlaced. The length of usable fibber for bending is thus increased and the compression movement of the webs 6, 10 is optimised.

The implant shown in Figure 6 is identical to that of Figure 1 except that the webs 6, 10 have an approximately Ω-shaped cross section. The length of usable fibber for bending is thus increased and the movement of the centre of rotation is thus optimised.

The implant shown in Figure 7 is distinguished from the preceding ones in that the outer shape of the plates 1, 2 is a simple square. In this case, there is no particular attempt to follow the contours of the vertebral plates between which the prosthesis is to be installed. This configuration could be adopted for the other prostheses according to the invention which have been or will be described. Moreover, the prosthesis of Figure 7 is also distinguished from that of Figure 1 in that the webs 6, 10 have an S-shaped cross section. The length of usable fibber for bending is thus very substantially increased.

The implant shown in Figure 8 resembles that of Figure 2 in that the webs 6, 10 are U-shaped. However, it will be noted that the opening of the U is slightly inclined toward the interior of the plates 1, 2, and more strongly so for the upper plate 1 than for the lower plate 2. Another difference from the preceding prostheses is the configuration of the plates 1, 2 themselves. The upper plate 1 has on its surface intended to come into contact with the vertebral plate a slightly concave shape longitudinally and a slightly convex shape transversely. It also has pointed excrescences 13, 14, 15 on its perimeter, intended to facilitate anchoring of the prosthesis to the vertebral plate of the upper vertebra. The lower plate 2 has, on its surface intended to come into contact with the vertebral plate, two excrescences 16, 17 in the form of transverse bosses. These bosses 16, 17 become embedded in the patient's vertebral plates. For this purpose, in the preparation of the vertebral plates, prior to the insertion of the implant, female recesses with a shape corresponding to
that of the bosses 16, 17 are formed in the plates. The two plates 1, 2 also have two longitudinal grooves 18, 19, 20, 21 on their internal surfaces. These grooves 18, 29, 20, 21 are used for the connection of the implant holder when the implant is positioned by impaction. Thus, the implant/implant holder assembly can be an integrated, non-deformable unit that is not subject to mechanical stresses during the insertion of the implant.

Figure 9 shows an alternative of the lower plate 2. Differing from other configurations of the webs 10 described up to now, its webs 10 are constituted by successive rectilinear portions 22, 23, 24 and not by curved portions. They are connected to one another practically at a right angle (in the example shown, but this is an optional feature) and form a U that opens toward the centre of the plate 2. This type of lower plate 2 may be associated with an upper plate 1 (not shown) whose webs 6 are configured in the same way or differently.

Figure 10 shows an implant which differs from the alternative of Figure 1 essentially in the external configuration of the external surfaces of the upper 1 and lower 2 plates. These plates 1, 2 have biconvex external surfaces, i.e. are convex in both their longitudinal and the transverse directions. On the other hand, each of the plates 1, 2 comprises on its external surface a circular cavity (in the example shown) 25, 26 within which a cover 27, 28 of corresponding shape is lodged and is attached by means not shown (screw, laser weld, adhesion, for example). These covers 27, 28 each bear an excrescence 29, 30 extending along the longitudinal axis of the plate 1, 2 and intended to form an anchoring element for the prosthesis in the corresponding vertebral plate.

Generally, it should be understood that, in this class of alternatives of the invention, the plates 1, 2 do not necessarily have webs of similar configurations. If it is desired to confer different deformation characteristics on the plates 1, 2, webs 6, 10 of different conformations may be used, on condition, of course, that their shapes are compatible: the webs of a given plate should be able to be intercalated between the webs of the other plate without mutual contact.

Similarly, the external surfaces of the plates 1, 2 may have different configurations.
The examples described and shown above are also non-limiting with regard to
the number of webs 6, 10 of each plate. This number can be higher or lower than
what is shown in the figures.

In the alternative shown in figure 11, a lower plate 2 provided with webs 10,
similar (in the example shown) to those of the alternative of figure 1, has been
associated with an upper plate 1 completely free of webs, and therefore entirely rigid.

In this example, it can also be noted that the lower plate 2 has a circular
periphery and that it is embedded in its cover 28, which therefore confers on the
implant its external shape. In the example of figure 10, however, it is the covers 27,
28 that are embedded in the plate 1, 2. Moreover, the single longitudinal
excess 29, 30 are each replaced by two longitudinal excesses 29, 29', 30,
30', which end in the region of the centre of the cover 27, 29 bearing them. These
characteristics can be applied to other types of implants.

The preceding examples of implants are characterised by the fact that the two
plates, upper 1 and lower 2, are originally separate parts, which are assembled at the
level of their hubs 7, 11. In the following examples, the two plates become integral
and are joined at the level of a pillar. But all the functionalities described for the
preceding examples are found, or may be found, in the examples which follow.

The example of an implant according to the invention shown in Figure 12 is
composed, upon manufacture, of a single part having an upper plate 31 and a lower
plate 32, connected at the level of a pillar 33 which, in the example shown, is located
substantially at the centre of the implant. Orifices 34 are cut out in said plates 31, 32
so that the remaining material forms webs 35 connecting the periphery of the plates
31, 32 to the pillar 33. In the example of Figure 11, there are six of these webs 35,
identical and regularly distributed around the pillar 33, which in this case has an
approximately cylindrical shape. In the example shown, the front edges 36, 36' of the
plates 31, 32 are rounded so as to closely follow the shape of the vertebral plates in
the zone where the implant is to be implanted.

The example of the implant shown in Figure 13 is analogous to that of Figure
12, except that in the example of Figure 3, cavities 37 have been created in the webs
35 so that each web is attached to the pillar 33 at a single point, and to the periphery
of the plate 31 or 32 at two points. The flexibility of the webs 35 is thus increased.
The implant shown in Figure 14 is identical to that of Figure 12 in principle, except that the pillar 33 is no longer at the centre of the prosthesis, but is offset on the longitudinal axis of the prosthesis toward the rear zone. The webs 35 are then found with different lengths and widths. Furthermore, in the example shown, there are only five webs 35 because none was provided for connecting the pillar 33 and the rear edges of the plates 31, 32, along the longitudinal axis of the implant. Such a web would inevitably be very short, and thus have very little flexibility, and would considerably limit the deformation capacity of the prosthesis.

Because of the rearward offset of the pillar 33 with respect to the centre of the prosthesis, it is possible to achieve a better reproduction of the natural division of forces undergone and exerted by the disk during the patient's movements. In particular, the prosthesis is endowed with the possibility of a deformation of greater amplitude when the spine works in flexion (when the patient leans forward) than when the spine works in extension (when the patient leans backward).

An offset of the pillar 33 in the front region can also be considered if it is desired, for example, to favour the possibility of extension movements at the level of the spine concerned. In general, the location of the pillar 33 must be chosen optimally according to the patient's morphology and weight, as well as the region of the spine where the implant is to be installed.

The implant shown in Figure 15 is comparable to that of Figure 14. It differs from it essentially in the following points.

Firstly, the pillar 33 has a rectangular, not circular, transverse cross section. In this way, deformations of the implant in lateral directions may be privileged, if as shown the large dimensions of the rectangle are perpendicular to the longitudinal axis of the implant.

On the other hand, the edges of the webs 35 are no longer rectilinear, but have indentations 37 which thin them locally and increase their flexibility.

It is also seen that, differing from the configuration of Figure 14, the webs 35 are located in the same plane as the plates 31, 32, simplifying the construction of the assembly.

Stops 38, 39 have also been provided on the mutually facing edges of the plates 31, 32, and limit the amplitude of relative movements of the plates 31, 32 in
the case of extension of the spine (stops 36) and when the patient leans to the side (stops 38).

Preferably, as shown in Figure 16, this implant has each of its plates 31, 32 equipped with a cover 40, 41. These covers 40, 41 ensure the contact between the implant and the vertebral plates. They preferably have a biconvex outer surface for better contact. They are fixed to the plates 31, 32 by screws 42 penetrating into threaded holes 43 formed in the plates 31, 32. A peripheral cementing and/or welding (laser or TIG) assembly at the level of the zones of contact between the plates 31, 32 and the covers 40, 41 can also be added or replace the screw assembly 42. Reliefs 44, 45 formed on the surfaces of the covers 40, 41 which contact the implant are inserted into hollows 46, 47 corresponding to the plates 31, 32 to ensure good positioning of the covers 40, 41. The covers 40, 41 also have a boss 49 in the vicinity of their front edge 48, whose function is similar to that of the bosses 16, 17 described above.

The implant shown in Figure 17 is comparable to that of Figures 15 and 16. It differs from it particularly in that the pillar 33 has a circular cross section, and in that there are no more than four webs instead of five. There is thus room to form in each plate 31, 32 a third threaded hole 43' located on the longitudinal axis of the prosthesis for a fixing screw 42 of a cover 40, 41. This provides a better distribution of the anchoring points which, preferably combined with welding and/or cementing, enhances the solidity of the assembly. Indentations 50, 51, 52 are likewise formed in the edges of the plates 31, 32 for the passage of stops provided on the covers 40, 41.

Figure 18 shows this same implant equipped with covers 40, 41 comparable to those of the prosthesis of Figures 15 and 16.

Figures 19 and 20 show the disassembled state (Figure 19) and the assembled state (Figure 20) of another example of the implant. Figures 21 and 22 show the components of the implant in greater detail.

In this example, the portions of the plates 31, 32 of the preceding examples which come into contact with the vertebral plates are each reduced to three bearings 53, 54, 55, 56, 57, 58 connected to the pillar 33 (which in this case has a circular cross section, but could have a rectangular cross section) by webs 59, 60, 61, 62, 63, 64. In fact, this amounts to having extended the cutouts 34 of the preceding examples so as to have them include the edges of the plates 31, 32.
Two bearings 53, 54, 58, 57 are placed at the two extremities of the rear edge of each plate 31, 32, and the portions of the webs 59, 60, 62, 63 which connect them to the pillar 33 have, in the example shown, a shape substantially of a quarter circle or quarter ellipse. The other bearing 55, 58 of each plate 31, 32 is placed at the middle of the front edge of the corresponding plate 31, 32 and is connected to the pillar 33 by a web 61, 64 which substantially follows the longitudinal axis of the plate 31, 32.

The implant is completed by two covers 65, 66 which are each placed on an upper or lower surface of one of the plates 31, 32. The internal surfaces 67, 68 of the covers 65, 66 bear grooves 69, 70, 71 into which the webs 59, 60, 61, 62, 63, 64 are inserted. The covers 65, 66 also have indentations 74, 75, 76, 77, 78, 78' on the periphery of their external surface 72, 73, enabling the bearings 53, 54, 55, 56, 57, 58 to themselves form portions of the external surfaces of the implant, once assembled, being located in the exact extension of the external surfaces 72, 73 of the covers 65, 66.

Preferably, the external surfaces 72, 73 of the covers 65, 66 bear excrescences 29, 30 ensuring the anchoring of the implant to the vertebral plates. These excrescences 29, 30 may take various forms, particularly those described and shown for other examples of implants.

The covers 65, 66 also preferably have orifices 79, 80, 81 for the insertion of gripping instruments facilitating the implantation of the implant. Such orifices 79, 80, 81 may be found in the other examples of prostheses which have been described.

Shoulders 82, 83, 84, 85 are preferably provided on the webs 59, 60, 61, 62, 63, 64 in the vicinity of the bearings 53, 54, 55, 56, 57, 58, so as to limit the penetration of the webs 59, 60, 61, 62, 63, 64 in the grooves 69, 70, 71 of the covers 65, 66. This further prevents contact between the webs 59, 60, 61, 62, 63, 64 and the walls of the grooves 69, 70, 71.

The covers 65, 66 preferably have, as shown, a biconvex external surface 72, 73, and the bearings 53, 54, 55, 56, 57, 58 consequently have shapes which prolong those of the covers 65, 66.
The implant which has been described and shown in Figures 19, 20, 21, 22 could of course be modified, for example by providing more than three bearings 53, 54, 55, 56, 57, 58 per plate.

The implant may particularly be assembled by laser welding.

This configuration shown in figures 19 to 22 provides an excellent compromise between the properties of deformation and strength of the prosthesis and its manufacturing cost.

The different elements of the prostheses according to the invention may particularly be manufactured be electro-erosion or by laser cutting. They may particularly be made of titanium or carbon fibre.

The various implants which have been described and shown are non-limiting examples. A characteristic may be taken from one of the examples and transposed into another of the examples, in place of another functionally equivalent characteristic, or in addition to described characteristics, if this appears possible to those skilled in the art, without departing from the scope of the invention.

Because of the absence of mechanical connecting parts with displacement, the implants according to the invention do not generate debris which is capable of spreading in the patient’s body.

The implants can be used in particular in two ways.

In a first mode of use, they can form a total intervertebral disk prosthesis. The surgeon performs a total discectomy of the damaged disk, then adequately prepares the vertebral plates using conventional methods and instruments. Then, the implant is implanted via the anterior approach, again using conventional methods.

In a second mode of use, they can be used as elements of a spine stabilisation device. To this end, they can replace just a portion of a disk. They are, as seen in other intervertebral implants, combined with other elements contributing to the stabilisation of the spine, secured to the vertebrae of the zone to be stabilised. The main elements known for this purpose consist of one or more rods extending longitudinally along the spine, secured to the vertebrae, for example, by means of pedicle screws. In this case, one or more implants such as those described can be used depending upon whether the zone of the spine to be stabilised as one or more intervertebral disks.
In this stabilisation device, intervertebral implants that are not all identical to one another can be used, as long as at least one of them is of the type described above.
CLAIMS

1. Intervertebral implant, comprising two plates (1, 2; 31, 32; 53-58) intended to come into contact with the patient's vertebral plates, characterised in that said plates (1, 2; 31, 32) have a cutout delineating webs (6, 10; 35; 59-64) converging toward a zone where the plates (1, 2; 31, 32) are connected to one another, said webs (6, 10; 35; 59-64) not being not in mutual contact when the prosthesis is ready for use.

2. Implant according to claim 1, characterised in that said plates (1, 2) are initially separate parts, one (1) of said plates (1, 2) having, in its convergence zone of the webs (6), a hub (7) comprising a seat (8), and the other (2) of the plates (1, 2) having, in its convergence zone of the webs (10), a hub (11) comprising an excrescence able to penetrate and be kept in said seat (6) for fixing said plates (1, 2) to one another.

3. Implant according to claim 1, characterised in that said plates (31, 32) are two portions of the same part and are connected to one another by a pillar (33).

4. Implant according to claim 3, characterised in that said pillar (33) has a circular transverse cross section.

5. Implant according to claim 3, characterised in that said pillar (33) has a rectangular transverse cross section.

6. Implant according to one of claims 1 to 5, characterised in that said webs (6, 10) of at least one of the plates (1, 2; 31, 32) have a substantially V-shaped longitudinal cross section.

7. Implant according to one of claims 1 to 6, characterised in that said webs (6, 10) of at least one of the plates (1, 2; 31, 32) have a substantially U-shaped longitudinal cross section.
8. Implant according to claim 7, characterised in that the opening of the U is inclined toward the interior of the plates (1, 2).

9. Implant according to one of claims 1 to 8, characterised in that said webs (8, 10) of at least one of the plates (1, 2; 31, 32) have a substantially Ω-shaped longitudinal cross section.

10. Implant according to one of claims 1 to 9, characterised in that said webs (6, 10) of at least one of the plates (1, 2; 31, 32) has a substantially S-shaped longitudinal cross section.

11. Implant according to one of claims 1 to 10, characterised in that said webs (6, 10) of at least one of the plates (1, 2; 31, 32) are formed by a succession of rectilinear portions.

12. Implant according to one of claims 1 to 11, characterised in that said webs (35) of at least one of the plates (31, 32) are located in the same plane as said plate (31, 32).

13. Implant according to one of claims 1 to 12, characterised in that said webs (6, 10; 35) of at least one of the plates (1, 2; 31, 32) have a cavity (12; 37).

14. Implant according to one of claims 1 to 13, characterised in that said webs (6, 10; 35) of at least one of the plates (1, 2; 31, 32) have an orientation having a helical curvature.

15. Implant according to claim 14, characterised in that the webs (6) of the upper plate (1) are interlaced with the webs (10) of the lower plate (2).

16. Implant according to one of claims 1 to 15, characterised in that said zone where the plates (1, 2; 31, 32; 53-58) are connected to one another is located substantially at the centre of the prosthesis.
17. Implant according to one of claims 1 to 15, characterised in that said zone where the plates (1, 2; 31, 32; 53-58) are connected to one another is located on the longitudinal axis of the prosthesis and is offset into the rear zone of the prosthesis.

18. Implant according to one of claims 1 to 15, characterised in that said zone where the plates (1, 2; 31, 32; 53-58) are connected to one another is located on the longitudinal axis of the prosthesis and is offset into the rear zone of the prosthesis and is offset into the front zone of the prosthesis.

19. Implant according to one of claims 1 to 18, characterised in that at least one external surface of the prosthesis has a concave shape longitudinally and a convex shape transversely.

20. Implant according to one of claims 1 to 18, characterised in that at least one external surface of the prosthesis has a biconvex form.

21. Implant according to one of claims 1 to 20, characterised in that at least one external surface of the prosthesis has at least one excrescence (13, 14, 15, 16, 29, 30, 49) ensuring anchorage of the prosthesis to the corresponding vertebral plate.

22. Implant according to one of claims 1 to 21, characterised in that the external surface of at least one of said plates (1, 2; 31, 32; 53-58) has a cover (27, 28; 65, 66).

23. Implant according to one of claims 1 to 22, characterised in that said webs (6, 10; 35; 59-64) have indentations (37).

24. Implant according to one of claims 1 to 23, characterised in that said plates (1, 2; 31, 32; 53-58) have stops (38, 39) on their facing edges.

25. Implant according to claim 3, characterised in that said plates (31, 32) each comprise at least three bearings (53, 54, 55; 56, 57, 58) connected to the pillar (33) by said webs (59, 60, 61; 62, 63, 64), said bearings (53, 54, 55; 56, 57, 58) being
located in the extension of the external surfaces (72, 73) of the covers (65, 66) having indentations (74, 75, 76; 77, 78) enabling said bearings (53, 54, 55; 56, 57, 58) to be brought level, said covers (65, 66) having on their internal surface, grooves (68, 70, 71) in which the webs (58, 59, 60; 62, 63, 64) are lodged,

26. Implant according to claim 24, characterised in that there are three of said bearings (53, 54, 55; 56, 57, 58) for each plate (31, 32); in that one of the bearings (55, 58) is located in the middle of the front edge of the corresponding plate (31, 32), the web (61, 64) which bears it substantially following the longitudinal axis of the prosthesis.

27. Implant according to claim 26, characterised in that the two other bearings (53, 54; 56, 57) are connected to the pillar (33) by webs (59, 60; 62, 63) having a shape substantially of a quarter circle or a quarter ellipse.

27. Spine stabilisation device comprising at least one intervertebral implant, spine stabilisation elements and means for securing said stabilisation elements to the vertebrae of the zone to be stabilised, characterised in that at least one implant is of the type according to one of claims 1 to 27.

29. Device according to claim 28, characterised in that said spine stabilisation elements connected to the vertebrae comprise one or more rods extending longitudinally along the spine.

30. Device according to claim 28 or 29, characterised in that said means for securing said stabilisation elements to the vertebrae comprise pedicle screws.