**Abstract:** A transverse spinal linking device (1) links at least one spinal osteosynthesis bar (2) to a transverse bar (3). The device (1) may include a first part (11) that has a vertical axis and a first jaw (111), a second part (12) that has a second jaw (121), and a clamping resource (13). The first part (11) may include a sliding surface (114), which may be inclined in relation to the vertical axis, and which may mate with at least one sliding surface (124) of the second part (12). The sliding surfaces (114, 124) may be configured so that the descent of the second part (12) results in an approach of the jaws (121, 111), with the clamping action of the clamping resource (13) causing the fixing and/or the locking of the device (1) on the osteosynthesis bar (2) and the fixing and/or the locking of the transverse bar (3).
Transverse spinal linking device and system

This present invention concerns the area of spinal implants in general and in particular osteosynthesis devices, vertebral support devices, and transverse spinal linking devices. Transverse spinal linking devices provide a transverse spacing link between two spinal osteosynthesis bars stabilising the vertebral column and/or correcting deformations of the vertebral column. Various embodiments of the present invention provide a device that links at least one spinal osteosynthesis bar and a transverse bar. The spinal osteosynthesis bars are intended to adapt to the physiological or pathological curvatures of the vertebral column, and to stabilise the latter and/or correct its curvature defects. These spinal osteosynthesis bars are fixed along the vertebral column by means of bony anchoring resources such as pedicle screws or any other type of fixing means. Often, to facilitate correct retention of the osteosynthesis bars and to allow a good reduction and/or a good setting action, these spinal osteosynthesis bars are connected to each other at one or more points by means of transverse bars. This transverse spacing enhances the stability of the fitting and/or corrective effect (in distraction or in compression).

One problem in the area of transverse spinal linking devices concerns the fitting of these devices to fix the transverse bar to the spinal osteosynthesis bars. In fact, the osteosynthesis bars are fixed along the vertebral column, and the bulk on either side of these bars renders difficult the implantation of the transverse bars and of the transverse spinal linking devices. In fact, the implantation of the transverse spinal linking devices is often difficult because of their small size, and of their structure, which is often complicated to assemble and to mount on the osteosynthesis bars, and because of the frequent necessity to clear the surroundings of the osteosynthesis bar (possibly with an avivement or stripping of the articular processes or a resection of vertebral material).

From previous designs, in particular from patent application WO 03/068087A1 or from patent EP 0793947B1, one is familiar with transverse
spinal linking devices with reduced bulk that can be installed on the osteosynthesis bar from the top (by a posterior approach in relation to the vertebral column). These devices of previous design can be mounted on osteosynthesis bars posterior to the vertebral column, using a posterior approach, and allow fixing onto the bar possibly without touching the anterior face of the bar (the side facing the vertebral column). These devices are composed of two jaws that are hinged on an axis located either between the two jaws or off-centre on one of the jaws (which is then fixed). These two jaws are used to grip the bar and to fix the device, which includes a head with a conduit perpendicular to the axis of the spinal osteosynthesis bar. Clamping resources are liable to project into this conduit and to fix the transverse bar while also inducing the closure of the jaws. This closure of the jaws during the clamping of the bar by the clamping resources is achieved by means of the fact that the bar presses onto an edge of at least one of the jaws. These devices have the drawbacks, firstly, of being expensive and relatively complex, requiring an assembly that is complicated and sometimes not very stable, and secondly that the bar is locked between an edge of at least one of the jaws and the clamping resources, which may impose large stresses on the bar and embrittles the bar. These devices have another drawback due to the fact that the jaws tend to close spontaneously even when the clamping resources do not press the bar onto the edge of one of the jaws, which renders difficult the implantation of the devices on the osteosynthesis bar. These devices sometimes correct the latter drawback by means of the presence of stop elements that limit the closure of the two jaws, but this solution adds an extra element, and therefore increases the complexity of these devices.

In this context, it is useful to propose a transverse spinal linking device having a simpler design and a structure configured to ameliorate one or more of the problems presented above, which allows a fixing of the bar without making the latter fragile, and whose jaws do not tend to close completely before the insertion of the devices on the osteosynthesis bar.
Various embodiments of this present invention may overcome certain drawbacks of previous designs, for example by having a relatively simple design, by being relatively easy to assemble and/or to implant, whose different elements are not embrittled by the assembling process, by avoiding imposing large stresses on these elements, and/or by reducing the bulk of various elements.

Accordingly, various embodiments of this present invention provide a spinal stabilisation device and system that may include a transverse link of simple design, may be easy to assemble and/or implant, whose different elements are not embrittled by the assembling process, for example by avoiding imposing large stresses on various elements, and/or may have various elements with reduced bulk.

Various embodiments of this present invention provide a transverse spinal linking device, attaching at least one spinal osteosynthesis bar to a transverse bar, and that includes at least two jaws intended to grip the spinal osteosynthesis bar, and at least one bearing surface intended to support the transverse bar, with the device being characterised in that it includes:

- a first part that has a first jaw, and a fixing head that mates with clamping resources pressing onto the transverse bar,

- a second part that has a second jaw and a fixing body that includes a passage of dimensions that are larger, at least in the approach axis of the jaws, than the fixing head of the first part on which it is intended to be threaded, along a so-called vertical axis which is substantially orientated in the direction of the osteosynthesis bar,

- the clamping resources, the first part and the second part being arranged so that the clamping action of the clamping resources induces their descent in relation to the head of the first part, with this descent causing the transverse bar to press against the bearing surface of the second part, which causes the descent of the second part in relation to the first part, thereby causing the fixing and/or the locking of the transverse bar and the fixing and/or the locking of the device on the osteosynthesis bar thanks to at least one sliding surface of the first part, which is inclined in relation to the vertical
axis, and which mates with at least one sliding surface of the second part so that the descent of the second part results in an approach of the jaws.

According to another feature of some embodiments, the two jaws are of shapes and dimensions that are suitable to grip the osteosynthesis bar while leaving free a substantial part of its periphery even during the fixing and/or the locking of the device.

According to another feature of some embodiments, at least one of the first and second parts includes at least one stop element limiting the approach of the two jaws so that they form between them, in the maximum approach position, sufficient space so that a thrust exerted on the device in the position bearing onto the osteosynthesis bar causes the opening of the jaws and allows the threading of the device onto the osteosynthesis bar.

According to another feature of some embodiments, the two jaws are substantially symmetrical, and each includes a clamping surface acting in an opposing manner on the osteosynthesis bar and enabling them to be fitted to osteosynthesis bars of different diameters.

According to another feature of some embodiments, the first jaw is extended, at its link to the fixing head, by a surface that is substantially horizontal and flat, and able to mate with a flat area on the osteosynthesis bar, in order to stabilise the device on the latter.

According to another feature of some embodiments, the fixing head of the first part is of substantially cylindrical shape, and the passage in the fixing body of the second part is of substantially oblong or elongated shape, so as to create transverse play of the second part in relation to the first and to allow the approach of the jaws during the clamping action of the clamping resources.

According to another feature of some embodiments, the first part includes a passage that is substantially oblong or elongated along the vertical axis, in order to accept the transverse bar and to allow its descent during the clamping action of the clamping resources liable to project in this passage.
According to another feature of some embodiments, the second part includes a passage that is intended to accept the transverse bar and that includes the bearing surface of this bar on the second part.

According to another feature of some embodiments, the fixing head of the first part includes a vertical conduit opening onto the passage, and in which the clamping resources are inserted in order to fix the transverse bar.

According to another feature of some embodiments, the vertical conduit includes a tapping that mates with a thread located on the periphery of at least one portion of the clamping resources.

According to another feature of some embodiments, the two passages are orientated so as to allow fixing of the transverse bar substantially perpendicular to the osteosynthesis bar.

According to another feature of some embodiments, the shapes and dimensions of the two passages are arranged so as to allow movement of the transverse bar around at least one axis perpendicular to the osteosynthesis bar.

According to another feature of some embodiments, the fixing head of the first part includes a stud projecting from passage of the second part when the latter is threaded onto the fixing head and intended to receive the clamping resources, with this passage opening onto the bearing surface.

According to another feature of some embodiments, the transverse bar includes, close to at least one of its ends, at least one passage intended to be threaded onto the stud so as to bring the transverse bar into contact with the bearing surface of the second part and to allow the descent of the transverse bar and of the second part during the clamping action of the clamping resources.

According to another feature of some embodiments, the stud includes a thread on the periphery of its top end, intended to mate with a tapping located on at least one portion of the clamping resources.

According to another feature of some embodiments, the shapes and dimensions of the stud and of the passage of the transverse bar are arranged
so as to allow movement of the transverse bar in relation to the rest of the device.

According to another feature of some embodiments, the bearing surface is substantially flat and intended to mate with a substantially flat bottom surface of the transverse bar.

Various embodiments of this present invention provide a spinal stabilisation system that includes at least one transverse bar and at least one osteosynthesis bar, characterised in that it includes at least one device for fixing these bars together and in accordance with one of the embodiments of the device according to the invention.

Other particular features and advantages of various embodiments of this present invention will appear more clearly on reading the description that follows, with reference to the appended drawings, in which:

- figures 1A and 1B represent front views of one method of implementation of a transverse spinal linking system embodiment, respectively before and after fixing onto an osteosynthesis bar,
- figures 2A and 2B respectively represent views in perspective of a system in exploded view and assembled, according to a transverse spinal linking system embodiment,
- figures 3A and 3C represent a view from above of a second part and a first part, respectively, of a transverse spinal linking device embodiment, and figures 3B and 3D respectively represent views in section, along axis 3B–3B of figure 3A and axis 3D–3D of figure 3C, of the second and first parts of such embodiment,
- figures 4A and 4B represent views from above of a transverse spinal linking system embodiment, respectively before and after locking of the device,
- figures 5A and 5C represent views in section, respectively along axis 5A–5A of figure 4A and axis 5C–5C of figure 4B, respectively before and after locking, and figures 5B and 5D represent detail of the area indicated respectively by reference 5B of figure 5A and reference 5D of figure 5C,
- figures 6A and 6B represent front views of one embodiment of a transverse spinal linking device, respectively before and after fixing onto an osteosynthesis bar, the clamping axis (AS) of the clamping resources in this embodiment being aligned with the osteosynthesis bar, and figures 6C and 6D represent front views of another embodiment of a transverse spinal linking device, after fixing onto an osteosynthesis bar, the clamping axis (AS) of the clamping resources in this embodiment being offset in relation to the axis (AB) of the osteosynthesis bar,

- figures 7A and 7B respectively represent views in perspective of a system in exploded view and of such system assembled, according to a transverse spinal linking system embodiment,

- figures 8A and 8C represent a view from above of a second part and a first part, respectively, of a transverse spinal linking device embodiment, and figures 8B and 8D respectively represent views in section along axis 8B–8B of figure 8A and axis 8D–8D of figure 8C,

- figures 9A and 9B respectively represent a view from above of a transverse spinal linking system embodiment, before and after locking the device,

- figures 10A and 10C respectively represent views in section along axis 10A–10A of figure 9A and axis 10C–10C of figure 9B, respectively before and after locking the device, and figures 10B and 10D respectively represent a detail of the device indicated by the area referenced 10B in figure 10A and by the area referenced 10D in figure 10C,

- figures 11A and 11B represent views in perspective of two transverse spinal linking system embodiments,

- figures 12A and 12B respectively represent a view in perspective and a cross-sectional view of a transverse spinal linking system embodiment,

- figures 13A and 13B respectively cross-sectional views of two transverse spinal linking system embodiments.

This present invention concerns a transverse spinal linking device (1), for attaching at least one spinal osteosynthesis bar (2) with a transverse bar
(3). This type of device is generally used to connect two osteosynthesis bars to each other by means of at least one transverse bar. A spinal stabilisation system may comprise a device (1), a transverse bar (3), and an osteosynthesis bar (2). Such a system may be called, by way of illustration, a “transverse spinal linking system,” for example referring to embodiments configured to provide a transverse link between osteosynthesis devices or vertebral support devices, such as those described, respectively, in application FR 2 859 095 (and WO 2005/020829) and in application FR 06 11198 (and US 11/672,745), filed by the applicant, for example. These applications thus respectively describe examples of osteosynthesis devices and vertebral support devices on which various embodiments of this present invention may be used, although various embodiments may be used with other types of osteosynthesis devices or vertebral support devices. Application FR 2 859 095 discloses an osseous anchoring implant comprising a body equipped with osseous anchoring means and a head bearing fixation means capable of receiving and fixing at least one bar, in particular of osteosynthesis, the head of the implant being traversed by at least one duct receiving the bar through a lateral aperture and by a threaded channel having an axis not parallel to the axis of the duct and receiving a fixation screw of the bar, the implant being characterised in that it comprises fixation means of the head on a part of the body of the implant extending along the osseous anchoring means, these fixation means of the head consisting in a portion of the head which forms a ring into which is inserted a fixation olive threaded onto the part of the body of the implant extending along the osseous anchoring means and allowing, prior to blocking and fixing, at least a determined clearance of the head around at least one axis not parallel to the axis of symmetry of the osseous anchoring means, and in that the fixation screw of the bar comprises a ball and socket at its base allowing at least a determined clearance of the bar around at least one axis parallel to the axis of the duct, the fixation means of the head and the ball and socket of the fixation screw of the bar allowing a determined clearance of the head around the axis of symmetry of the osseous anchoring means, even
when the bar is inserted into the duct. Application FR 06 11198 discloses a vertebral support device comprising at least two osseous anchoring implants, each designed to be anchored in a vertebra along an axis, called dorso-ventral axis, and at least one linking element having a longitudinal axis and connecting together the osseous anchoring implants, characterised in that the linking element includes at least two rigid elements each connected to an implant by the clamps and articulated together by at least one elastic dampening element, providing freedom of movement to the patient on which the device is intended to be implanted, absorbing the stresses experienced by the linking element during these movements, and tending to return the device to its initial configuration, the dampening element comprising, on the one hand, at least one elastic portion, called central, located between the two rigid elements and cooperating with them to absorb the compression stresses occurring on the linking element and, one the other hand, at least one elastic portion, called longitudinal, comprising two extremities, each maintained fixed with respect to the implants and/or to the rigid elements by latches of the longitudinal portion, so as to absorb the extension or flexion stresses occurring on the linking element. The term “osteosynthesis bar” used hereafter may refer to these types of bars, with or without dampening and/or elastic portions. The invention can be used with such (or other) types of systems and therefore also concerns a transverse spinal linking system that includes a device according to one of the embodiments presented here or to a similar variant. Since the different elements of such a system are intended to be implanted in patients, they will generally be implemented in a material that has been approved for implantation.

Various transverse spinal linking device (1) embodiments may include a jaw mechanism for its fixation onto the osteosynthesis bar. This jaw mechanism may comprise jaws (111, 121) intended to grip a spinal osteosynthesis bar (2). Various transverse spinal linking device (1) embodiments may include a bearing surface (120) intended to support a transverse bar (3). For example, the device (1) may include a first part (11) that has a first jaw (111) and a fixing head (112) that mates with clamping
resources (13) pressing onto the transverse bar (3). A device (1) may also include a second part (12) that has a second jaw (121) and a fixing body that has a passage (123) engaging the fixing head (112) of the first part (11), along an axis that is substantially orientated in the direction of the osteosynthesis bar (2). Here, this axis is called the vertical axis and is represented as being substantially vertical in figures of the device (1). However, what is meant here by the term “vertical axis” is the axis along which the second part (12) and/or the clamping resources (13) engage the first part (11), but it will be apparent to the professional, on reading this present description, that this so-called vertical axis may be orientated differently, and is not necessarily vertical in any particular sense. It should also be noted here that in operation, when the device is fixed onto the osteosynthesis bars (2), this axis generally may be substantially perpendicular to the longitudinal axis of the vertebral column, and therefore generally may be substantially horizontal if the patient carrying the device is upright. The terminology used, therefore, is to be interpreted only as a guide when referring to the device such as represented in the illustrative drawings, like figure 1A for example. However, during the implantation process, the patient is lying on his stomach, and the device will be positioned onto the osteosynthesis bar (2) from the top downwards, which is then vertical in fact.

This so-called vertical axis will preferably be orientated substantially in the direction of the osteosynthesis bar (2) to be fixed by the device (1) and various embodiments of the invention allow the device to be fixed along the osteosynthesis bar with a certain angulation in relation to the latter. Likewise, when other structures are said to be vertical in this present description, such orientation generally is with reference to a direction from the osteosynthesis bar to the spinal column.

In various embodiments, the passage (123) in the second part (12) by which the latter engages the fixing head (112) of the first part (11) may have larger dimensions than the fixing head (112), at least along an approach axis of the jaws (for example, perpendicular to the orientation of the osteosynthesis bar). Thus, for example, this passage (123) may be of
elongated or oblong or ovoid shape, or other shape providing play or some freedom of movement of the second part (12) in relation to the first part (11), at least along an approach axis of the jaws (111, 121). However, this passage (123) may also be larger in other directions, in addition to that of the approach of the jaws (111, 121), and may therefore have any shape as long as it is designed to engage the fixing head (112). In one method of implementation, shown in figures 2A, 2B and 3A to 3D, the fixing head (112) of the first part (11) is of substantially cylindrical shape, and the passage (123) in the fixing body of the second part (12) is of substantially oblong or elongated shape to create transverse play of the second part (12) in relation to the first (11), along an axis of the approach of the jaws (111, 121). As explained below, this transverse play allows the approach of the jaws (111, 121) during the closure of the clamping resources (13). The particularly advantageous cylindrical shape of the fixing head (112) is only illustrative, and it will be clear to the professional that the latter may be polyhedral or have any shape. The passage (123) also may have different shapes, preferably complementary to that of the fixing head (112). This shape of the passage preferably allows the fixing body of the second part (12) to engage the fixing head (112) of the first part (11), and it is not necessary for the passage (123) to have exactly the same shape as the head (112). Likewise, the fixing body of the second part (12) is represented in figures 2A, 2B, 3A, and 3B as being substantially cubic, with rounded edges, but other shapes may be used.

In various embodiments, the clamping resource (13) may be arranged in such a manner that its clamping action induces its descent in relation to the head (112) of the first part (11). In operation, the clamping resources thus may bring the transverse bar (3) closer to at least one surface of the first part (11) and/or the second part (12). In an advantageous manner, the clamping resource (13) may press onto the bar (3), which presses onto the second part (12) and thus causes it to approach the first part (11). This descent of the clamping resources (13) causes the transverse bar (3) to bear against the bearing surface (120) of the second part (12) and the second part (12) to
descend in relation to the first part (11). In addition, the first part (11) may include a sliding surface (114) inclined in relation to the vertical axis of the device (1). This sliding surface (114) and the vertical axis of the device (1) therefore form an angle. This sliding surface (114) of the first part (11) may mate with at least one sliding surface (124) of the second part (12) thus guiding the second part (12) in relation to the first part (11). Therefore, by the contact between these two sliding surfaces (114, 124), the descent of the second part (12), in relation to the first part (11), results in an approach of the jaws (121, 111). Thus, during the clamping action of the clamping resources (13), the second part (12) slides along the inclined sliding surface (114) of the first part (11) and by means of the play allowed by its passage (123) is moved sideways and causes the approach of the second jaw (121) in relation to the first jaw (111). The clamping action of the clamping resource (13) causes the descent of the transverse bar (3) pressing onto the second part (12), via the bearing surface (120), and the descent of the second part (12) causes the closure of the jaws (121, 111), via the sliding surfaces (114, 124). A further closure of the clamping resources (13) then causes the fixing and/or the locking of the device (1) on the osteosynthesis bar (2), trapped between the jaws, and the fixing and/or the locking of the transverse bar (3), trapped between the clamping resources (13) and the bearing surface (120). At least one of the sliding surfaces (114, 124) is inclined in relation to the vertical axis of the device. In some embodiments, for example such as the one shown in figures 12A and 12B, both the sliding surfaces (114 and 124) of both the first (11) and the second (12) parts are inclined in relation to the vertical axis of the device. Such arrangement of course facilitates the descent of second part (12) in relation to the first part (11) and the approach of the jaws (121, 111). In a particularly advantageous manner, the transverse bar (3) and the bearing surface cooperate by at least a portion of complementary shape. For example, figure 7A shows a substantially flat bearing surface (120). Thus, the forces exerted on the bar and on the bearing surface during the clamping action of the clamping resources (13) may be better absorbed by the contact
surfaces, which may benefit the materials and may help preserve the integrity of the assembly.

In various embodiments, the two jaws may have shapes and dimensions configured to grip the osteosynthesis bar (2) while leaving free a substantial part of its periphery even during the fixing and/or the locking of the device (1), as shown particularly in figures 1B, 5C, 6B and 10C. These particularly advantageous embodiments allow the device (1) to be placed on the osteosynthesis bars (2) without covering their anterior face (that located alongside the vertebral column). This particular feature may facilitate the implantation of the device by limiting its size. Thus, for such embodiments the device (1) may be implanted on the bar (2) by a posterior approach, and may not require the clearance of space around the osteosynthesis bar (2) or in the vertebrae (such as the articular processes).

In various embodiments, at least one of the first (11) and second (12) parts may include a stop element limiting the approach of the two jaws (111, 121). As shown particularly in the figures, this stop element may in fact comprise simply the relative size of the passage (123) of the second part (12) in relation to the fixing head (112) of the first part (11). The lateral (or transverse) play provided by this size difference is easily limited, and such a stop function may be implemented simply by the contact of an inside edge of the passage (123) with an outside edge of the fixing head and/or contact of the sliding surface (114) of the first part (11) with the sliding surface (124) of the second part (12).

In various embodiments, the stop function may be implemented in such a manner that the two jaws (111, 121) form between them, in the closest approach position, sufficient space so that a thrust exerted on the device (1) in the position bearing onto the osteosynthesis bar (2) causes the opening of the jaws (111, 121) and allows placement of the device (1) onto the osteosynthesis bar (2).

In various embodiments, the two jaws (111, 121) may be substantially symmetrical, and each may include a clamping surface acting in an opposing manner on the osteosynthesis bar (2), thus enabling them to be fitted to
osteosynthesis bars (2) of different diameters. For example, the clamping surfaces may be concave, having a profile suitable for reliable securing to the osteosynthesis bar. The clamping surfaces may have a radius of curvature that is constant or not, and may thus have a single concavity or a double concavity or a triple concavity, and so on. Thus, by means of this multiple concavity option, the clamping surfaces may be particularly suitable for clamping osteosynthesis bars (2) of differing diameters.

In various embodiments, an example of which is particularly visible in figure 3D, the first jaw (111) is extended, at its link to the fixing head (112), by a surface (115) that is complementary to a surface of the osteosynthesis bar (2), in order to stabilise the device (1) on the latter. For example, in figure 3D, this surface (115) of the first part (11) is substantially horizontal and flat, so as to mate with a flat area (20, figure 2A) of the bar. The cooperation between this flat area and this bottom flat area of the first part allows the device (1) to be positioned on the bar (2) and moveably retained before the clamping action, which allows the device (1) to be moved along the bar, for example in order to adjust its position along the vertebral column.

In various embodiments, examples of which are particularly visible in figures 1 to 5, the first part (11) includes a passage (130) that is substantially oblong or elongated along the vertical axis, in order to accept the transverse bar (3) and to allow its descent during the clamping action of the clamping resource (13). In various embodiments, the second part (12) also includes a passage (120bis) configured to receive the transverse bar (3). This passage includes the bearing surface (120), by means of which the transverse bar (3) presses onto the second part (12) for the approach of the first part (11). In the example shown, this bearing surface (120) of the transverse bar (3) is formed by the bottom surface of the passage (120bis), as shown particularly in figures 2A and 3B. In various embodiments, this passage (120bis) may open onto the top surface of the fixing body of the second part, in such a manner that the transverse bar (3) may be inserted into it from the top. Preferably, this passage (120bis) comprises a hole drilled through the fixing body of the second part and the transverse bar (3) is inserted into it by the
side. In most of the variants, this passage will have a diameter that is slightly larger than that of the transverse bar. These passages (130) of the first part (11) and (120bis) of the second part (12) are preferably orientated substantially perpendicular to the axis of the osteosynthesis bar (2), meaning substantially parallel to the approach axis of the jaws (111, 121). These two passages (120bis, 130) are therefore preferably orientated so as to allow fixing of the transverse bar (3) substantially perpendicular to the osteosynthesis bar (2). In certain variants, these passages may form an angle in relation to this approach axis of the jaws (111, 121). In various embodiments, the passages (130) of the first part (11) and (120bis) of the second part (12) may have a flared profile, and/or may be substantially wider than the diameter of the transverse bar (3), in a manner to allow movement of the transverse bar (3), which may then be fixed with an orientation that is perpendicular or not to the axis of the osteosynthesis bar (2). Thus, the shapes and dimensions of the two passages (120bis, 130) are arranged so as to allow movement of the transverse bar (3) around at least one axis perpendicular to the osteosynthesis bar (2). In particular, these shapes may comprise parallelepipeds, cylinders, etc. In these embodiments, amongst other things, the fixing head (112) of the first part (11) includes a vertical conduit (113a) opening onto the passage (130) and into which the clamping resource (13) may be inserted in order to fix the transverse bar (3). This vertical conduit (113a) may then include a tapping that mates with a thread located on the periphery of at least one portion of the clamping resource (13). The clamping resource may then comprise a screw whose head includes a hexagonal hole (blind or not) or a star-shaped hole or any shape intended to mate with a tool of a known type.

In other embodiments, examples of which are particularly visible in figures 6 to 10, the fixing head (112) of the first part (11) may include a stud (113b) projecting through a passage (123) of the second part (12) when the latter is disposed about the fixing head (112). The stud (113b) may be configured to receive a clamping resource (13). The passage (123), for example, may open onto a bearing surface (120), and the transverse bar (3)
may include, close to at least one of its ends, a passage (30) intended to be disposed about the stud (113b). This passage (30) may comprise an eyelet at the end of the bar, that comprises a widening of the bar and an aperture, for example as shown in figure 7A, or slot, or comprises simply an aperture or slot in the bar. This passage (30) allows the transverse bar (3) to be disposed about the stud (113b) and pressed onto the bearing surface (120) of the second part (12). Thus, the clamping resource (13) mounted on the stud (113b) may cause the descent of the transverse bar (3) and the second part (12). In these embodiments, amongst other things, the stud (113b) may include a thread on the periphery of its top end that is intended to mate with a tapping located on at least a portion of the clamping resource (13). Thus, the clamping resource (13) may comprise a nut or any type of tapped female structure that may be screwed onto the threaded stud. In these embodiments, the shapes and dimensions of the stud (113b) and of the passage (30) of the transverse bar (3) are arranged so as to allow movement of the transverse bar (3) in relation to the rest of the device (1). The bearing surface (120) is substantially flat, and intended to mate with a substantially flat bottom surface of the transverse bar (3). In other variants, the bearing surface may be concave and the bar cylindrical, or any other possible combination of these variants.

In the embodiments presented above, when the fixing head (112) of the first part (11) includes a vertical conduit (113a) opening onto the passage (130), and into which the clamping resources (13) are inserted, the fixing head may include a thread on its periphery, intended to mate with a tapped hole in the clamping resources (13), at the centre of which a stud is intended to penetrate into the conduit (113a). This example illustrates that the embodiments presented here for the clamping resources are purely illustrative, and after appreciating this disclosure the professional will understand that other clamping resources also are within the scope of the invention. In addition, the clamping action may be achieved using structures that are different from the mating action between thread and tapping presented here.
In some embodiments, the fixing head (112) of the first part (11) may be configured to be aligned with the center of the osteosynthesis bar when installed. As particularly shown on figures 6A and 6B, the shape and dimensions of the first part (11) may be, in that case, such that the clamping axis (shown as dotted line AS in figures 6A and 6B) of the clamping resources are aligned to the center of the osteosynthesis bar. In other embodiments, however, the first part (11) may be positioned offset to the osteosynthesis bar (2). As particularly shown on figures 6C and 6D, the shape and dimensions of the first part (11) may be, in that case, such that the clamping axis (AS) is offset from the vertical axis (AB) passing through the center of the osteosynthesis bar (2), for example while still being parallel to this vertical axis (AB). Thus, in such embodiments, the device (1) may be mounted onto the osteosynthesis bar (2) in two different ways. One may choose to offset the clamping resources to the right as shown on figure 6C or to offset them to the left as shown on figure 6D. Such embodiments may be advantageous to enable, for example, assembling the device (1) with transversal bars (3) of insufficient dimensions with respect to the spacing between two osteosynthesis bars (2), or to enable a fixation of a transversal bar (3) by two devices (1) at two points further apart than devices with a centered vertical axis would enable. Furthermore, such offset embodiments may allow the assembling of the device with different sizes of transverse bars (3). These embodiments thus have an advantage in term of cost for the system composed of the osteosynthesis bars (2), the linking devices (1) and the transversal bars (3), because such devices can be used in systems requiring fewer transversal bars (3) of different sizes, since they may be adapted more easily just by changing the orientation as shown in figures 6C and 6D.

The present invention also concerns any possible combination of the embodiments described herein. In some embodiments, examples of which are particularly visible in figures 13A and figures 13B, the fixing head (112) of the first part (11) may include a stud (113b) projecting through a passage (123) of the second part (12), when the second part (12) is disposed about
the fixing head (112), as in the examples of figures 6 to 10, but also comprises a passage (130) that is oriented substantially horizontally and that is substantially oblong or elongated along the vertical axis, in order to accept the transverse bar (3) and to allow its descent during the clamping action of the clamping resource (13), such as in the examples of figures 1 to 5. This stud (113b) may be configured to receive a clamping resource (13). For example, a swivel can be screwed on a threaded part of the stud (113b). In the embodiment of figure 13B, the second part (12) is configured with a passage (120bis) comprising a bearing surface (120) and arranged for receiving the transverse bar (3) when it is engaged in the passage (130) of the stud (113b). The clamping resource (13) is arranged to enter the passage (123) for the stud (113b) in the second part (12) and to press onto the transverse bar (3) which presses on the bearing surface (120) of the passage (120bis) for the transverse bar (3). In the embodiment of figure 13A, the second part (12) is configured with an upper bearing surface (120) on top of the second part (12), as in the example of figure 8B. The transverse bar (3) can be engaged in the passage (130) in the stud (113b) and be pressed against this bearing surface (120) when the clamping resource (13) is actuated. These intermediate embodiments but may also comprise an inclined surface (114, 124) on one or both the first and second parts (11, 12) for facilitating the approach of the jaws when the clamping resources (13) are tightened and induce the descent of the transverse bar (3) and thus the second part (12), in relation to the first part (11). The shape and dimensions of the passage (130) in the stud (113b) and/or of the passage (123) in the second part (12) are arranged to enable the movement of the various elements as described herein, between a loose configuration in which the elements, when assembled, have a clearance and a tightened configuration in which the device (1) clamps the osteosynthesis bar (2) and the transverse bar (3).

After appreciating this disclosure, it will be apparent to those of skill in the art that this present invention allows embodiments and methods of implementation in many other forms without moving outside the spirit of the
invention as claimed. As a consequence, the disclosed embodiments and methods are illustrative only, and may be modified within the scope of attached claims, and the invention is not limited to the details given above.
CLAIMS

1. A transverse spinal linking device (1), attaching at least one spinal osteosynthesis bar (2) to a transverse bar (3), and that includes at least two jaws (111, 121) intended to grip the spinal osteosynthesis bar (2), and at least one bearing surface (120) intended to support the transverse bar (3), with the device (1) being characterised in that it includes:
   - a first part (11) that has a first jaw (111), and a fixing head (112) that mates with clamping resources (13) pressing onto the transverse bar (3),
   - a second part (12) that has a second jaw (121) and a fixing body that includes a passage (123) of dimensions that are larger, at least in the approach axis of the jaws, than the fixing head (112) of the first part (11) on which it is intended to be threaded, along a so-called vertical axis which is substantially orientated in the direction of the osteosynthesis bar (2),
   - the clamping resources (13), the first part (11) and the second part (12) being arranged so that the clamping action of the clamping resources (13) induces their descent in relation to the head (112) of the first part (11), with this descent causing the transverse bar (3) to press against the bearing surface (120) of the second part (12), which causes the descent of the second part (12) in relation to the first part (11), thereby causing the fixing and/or the locking of the transverse bar (3) and the fixing and/or the locking of the device (1) on the osteosynthesis bar (2) thanks to at least one sliding surface (114) of the first part (11), which is inclined in relation to the vertical axis, and which mates with at least one sliding surface (124) of the second part (12) so that the descent of the second part (12) results in an approach of the jaws (121, 111).

2. A device according to claim 1, characterised in that the two jaws (111, 121) are of shapes and dimensions that are suitable to grip the osteosynthesis bar (2) while leaving free a substantial part of its periphery even during the fixing and/or the locking of the device (1).
3. A device according to either of claims 1 and 2, characterised in that at least one of the first (11) and second (12) parts includes at least one stop element limiting the approach of the two jaws (111, 121) so that they form between them, in the maximum approach position, sufficient space so that a thrust exerted on the device (1) in the position bearing onto the osteosynthesis bar (2) causes the opening of the jaws (111, 121) and allows the threading of the device (1) onto the osteosynthesis bar (2).

4. A device according to one of claims 1 to 3, characterised in that the two jaws (111, 121) are substantially symmetrical, and each includes a clamping surface acting in an opposing manner on the osteosynthesis bar (2) and enabling them to be fitted to osteosynthesis bars (2) of different diameters.

5. A device according to one of claims 1 to 4, characterised in that the first jaw (111) is extended, at its link to the fixing head (112), by a surface that is substantially horizontal and flat, and able to mate with a flat area (20) on the osteosynthesis bar (2), in order to stabilise the device (1) on the latter.

6. A device according to one of claims 1 to 5, characterised in that the fixing head (112) of the first part (11) is of substantially cylindrical shape, and the passage (123) in the fixing body of the second part (12) is of substantially oblong or elongated shape, so as to create transverse play of the second part (12) in relation to the first (11) and to allow the approach of the jaws (111, 121) during the clamping action of the clamping resources (13).

7. A device according to one of claims 1 to 6, characterised in that the first part (11) includes a passage (130) that is substantially oblong or elongated along the vertical axis, in order to accept the transverse bar (3) and to allow its descent during the clamping action of the clamping resources (13) liable to project in this passage (130).
8. A device according to claim 7, characterised in that the second part (12) includes a passage (120bis) that is intended to accept the transverse bar (3) and that includes the bearing surface (120) of this bar (3) on the second part (12).

9. A device according to one of claims 7 and 8, characterised in that the fixing head (112) of the first part (11) includes a vertical conduit (113a) opening onto the passage (130), and in which the clamping resources (13) are inserted in order to fix the transverse bar (3).

10. A device according to claim 9, characterised in that the vertical conduit (113a) includes a tapping that mates with a thread located on the periphery of at least one portion of the clamping resources (13).

11. A device according to one of claims 7 to 10, characterised in that the two passages (120bis, 130) are orientated so as to allow fixing of the transverse bar (3) substantially perpendicular to the osteosynthesis bar (2).

12. A device according to one of claims 7 to 10, characterised in that the shapes and dimensions of the two passages (120bis, 130) are arranged so as to allow movement of the transverse bar (3) around at least one axis perpendicular to the osteosynthesis bar (2).

13. A device according to one of claims 1 to 7, characterised in that the fixing head (112) of the first part (11) includes a stud (113b) projecting from passage (123) of the second part (12) when the latter is threaded onto the fixing head (112) and intended to receive the clamping resources (13), with this passage (123) opening onto the bearing surface (120).

14. A device according to claim 13, characterised in that the transverse bar (3) includes, close to at least one of its ends, at least one passage (30) intended to be threaded onto the stud (113b) so as to bring the transverse bar (3) into contact with the bearing surface (120) of the second
part (12) and to allow the descent of the transverse bar (3) and of the second part (12) during the clamping action of the clamping resources (13).

15. A device according to one of claims 13 and 14, characterised in that the stud (113b) includes a thread on the periphery of its top end, intended to mate with a tapping located on at least one portion of the clamping resources (13).

16. A device according to one of claims 13 to 15, characterised in that the shapes and dimensions of the stud (113b) and of the passage (30) of the transverse bar (3) are arranged so as to allow movement of the transverse bar (3) in relation to the rest of the device (1).

17. A device according to one of claims 1 to 16, characterised in that the bearing surface (120) is substantially flat and intended to mate with a substantially flat bottom surface of the transverse bar (3).

18. A spinal stabilisation system that includes at least one transverse bar (3) and at least one osteosynthesis bar (2), characterised in that it includes at least one device (1) for fixing these bars (2, 3) together and in accordance with one of the preceding claims.