

5 The present invention relates to a device making it possible, by using tuning-fork screws to implant a spinal appliance, to contain, reduce, adapt, and reestablish the physiological curvature of the spine, by means of a plurality of screws whose U-shaped heads enable an element to be received for interconnecting the various screws.

10 Generally, it has been the practise to implant pedicular screws that are connected to one another by plates. The system has thus been dependent on the spacing between the holes in the plates. That gives rise to good setting but to poor reduction.

15 Hooks have also been implanted, placed on the posterior arches and moving along the rods with complex locking systems. Such systems enable both good reduction and good setting to be obtained, but they require firstly that the posterior vertebral arches be complied with, and secondly they require difficult back-and-forth maneuvers to be performed that are dangerous to the patient and not practical for the operator (see 5th Proceeding of the International Congress on Cortell-Dubousset, p. 237, Figure 17 and document GB-A-2 173 104).

25 The device of the invention makes it possible to remedy all of those drawbacks.

It comprises a plurality of screws each made up of three segments: special tip-body-head; a bolt, a cap, and a homolateral securing element.

30 The structure and the shape of this equipment has been specially created for this purpose.

The screw is made of materials that are approved for surgery so as to avoid equipment breaking where it penetrates into the vertebral body.

35 The tip of the screw is in the form of an upside-down square pyramid. The body of the screw is conical in shape and carries a cortical type thread which improves locking of the implant in the most fragile region of the vertebral pedicle.

40 In addition, the conical shape reinforces the strength of the screw body at the head of the screw.

45 The head of the screw has a U-shaped tuning fork shape for receiving the element for securing the various screws to one another. The bottom of the U-shape is slightly rounded to enable the securing element to be fixed in a plurality of positions; which also facilitates locking of the securing element.

The U-shape is threaded on the inside portions of its branches to enable a bolt to be screwed in situ to lock the securing element.

50 Since the risk in such a system is that the branches of the U-shape will splay apart during tightening of the screw, this is remedied by installing a cap that fits closely over the smooth outside portions of the branches of the U-shape. The cap includes a circular orifice to

enable final tightening and locking to be applied to the bolt which locks the securing rod in place.

The bolt is characterized by a threaded cylindrical shape having a male conical tip at one end suitable for fitting closely in female conical notches in the securing rod. The opposite end of the bolt includes a hexagonally-shaped socket enabling it to receive a tightening key.

The securing element is made of a material that is approved for being surgically implanted. It is a rod of cylindrical section of sufficient diameter to withstand the constraints and forces of the spinal column, and it is notched to enable micrometric adjustment of the various screws relative to one another. Each notch is in the form of a female cone for receiving the tip of a bolt. Depending on the adjustment to be obtained, the notching may be variable in pitch.

The diameter of the securing element is sufficient to make it strong while still allowing it to be shaped easily so as to match or reestablish physiological curvature of the spine. In addition, its circular section enables it to be rotated prior to being locked in place which is done after the securing element has been properly positioned by tightening the bolts in the various homolateral screws.

The rod is easily installed because of the shape of its screw heads since it can be positioned directly in the bottoms of the U-shapes without forced motion and without requiring any back-and-forth sliding.

The very structure of the tuning fork implant makes it possible, by modifying the size of the screw or by fitting the screw head to other systems, for osteosynthesis of the posterior arch to practice vertebral fixing over the entire length of the spine regardless of the level or type of vertebrae that are fitted with the appliance, and while continuing to use the same securing element.

The device shown in Figure 1 includes two conical screws (1) each having a tip (2), a body (1), a U-shaped tuning fork (3), a bolt (4), a cap (5), and a securing element (6).

The device shown in Figures 2a and 2b includes a cortical type conical screw (1) having a square tip (2) at its bottom end.

The body of the screw (1) includes two different tapers: namely the conical taper of the core of the screw (7) which is different from the conical taper of the tops of the threads (8).

The U-shaped tuning fork head (3) is connected to the body of the screw via a spoke (9) that reinforces the strength of the body of the screw at its junction with the vertebral pedicle. The bottom of the U-shape is slightly rounded (10) to enable multi-axial locking of the securing element (6). The top diameter of the U-shape (3) is smaller at its top end than at its bottom

end. This makes it possible to receive the cap (5) as a sliding fit.

5 The inside portion of the U-shape is threaded (11) and it receives a bolt (4) enabling the securing element to be locked in place.

 The device shown in Figure 3 includes a bolt (4) having a conical portion (12) at its bottom end; a threaded cylindrical portion (13) screws into the U-shaped body (3) meshing with the threads (11).

10 The conical portion (12) fits in the female conical portion (14) of the securing element (6).

 The top portion of the bolt (4) includes a hexagonal socket (15) enabling it to receive a tightening key.

15 The device shown in Figure 4 includes a securing element (6) for the various screws of Figures 2, 3, and 4.

 This securing element (6) is of cylindrical section.

20 This securing element (6) is notched (14) to enable micrometer adjustment between the various screws by means of their respective bolts (4).

 The notches in the form of female conical portions (14) receive the tips of the bolts (12).

25 The device shown in Figures 5a and 5b includes a cylindrical cap (5) that is a tight sliding fit on the top of the U-shape (3).

 The top portion includes an orifice (16) enabling the key for clamping the bolt (4) to pass therethrough.

**CLAIMS**

- 1/ A supporting device for the spinal column, the device comprising a plurality of screws (1) each having a U-shaped head (3) within which a securing rod (6) is placed and is held by a bolt (4), which is screwed into threads provided on the inside portions (11) of the branches of the U-shape and which is provided with a socket (15) for receiving a tightening key, the device being characterized in that the top portion of the head receives a cap (5) installed as a sliding fit on the smooth outside portions of the branches of the U-shape and provided with an orifice (16) allowing said tightening key for said bolt (4) to pass through.
- 2/ A device according to claim 1, characterized in that said top portion of the screw head (3) has a diameter smaller than that of its bottom portion, said cap (5) being installed as a sliding fit onto the smaller diameter portion of said screw.
- 3/ A device according to claim 1 or 2, characterized in that the securing rod (6) includes female conical notches (14) situated on the periphery of the rod, which notches are machined at different pitches, and in which the conical bottom ends of said bolts (4) are held.
- 4/ A device according to any one of claims 1 to 3, characterized in that each screw (1) exhibits different tapers for the core of the screw (7) and for the tops of its threads (8).
- 5/ A device according to any one of claims 1 to 4, characterized in that the bottom of each U-shape (3) is slightly rounded (10) in both planes to allow for said securing rod (6) to be held multi-axially.