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A new technic for segmental spinal osteosynthesis using the posterior approach☆

Y. Cotrel , J. Dubousset*

Orthopédie infantile, hôpital Saint-Vincent-de-Paul, 74, avenue Denfert-Rochereau, 75014 Paris, France

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ABSTRACT

The authors have designed a new method of instrumentation aimed at obtaining surgical fixation of the scoliotic curve without any postoperative external immobilisation. It is particularly strong and rigid and allows adequate reduction of the curve. This technique avoids the sublaminar space and thus prevents excessive blood loss and diminishes the danger of cord damage. The instrumentation is made of two parallel rough cylindrical rods inserted independently in the convexity and concavity of the curve. If necessary, they can be bent pre-operatively. They are attached to hooks placed on the laminae or pedicles, which are locked by bolts, thus allowing progressive straightening of the curve. They are joined by two transverse bars, one above and one below, to provide better rigidity to the device and to allow correction of rotation. The parts of the vertebrae left free by the device are denuded to allow the addition of grafts. Laboratory tests have demonstrated that this type of fixator is more rigid than the Harrington or Luque rods. Fifteen patients, either idiopathic or paralytic cases, were operated on without any neurological impairment. No loss of correction was observed since the hooks have been locked.

1. Introduction

Increased stability of extensive spinal instrumentations, particularly those designed for scoliosis and kyphosis, has been obtained by improving the fixation points of the Harrington instrumentation system [1] (rods and square-ended hooks, addition of a transverse traction device connecting the concave and convex rods). Further improvement was achieved by segmental sub-laminar fixation of each vertebra to the rods using the system designed by Luque [2].

However, this last technique carries an increased risk of bleeding and neurological compromise. We therefore developed a new technique for posterior segmental instrumentation that considerably decreases the risk of bleeding and neurological compromise, as none of the fixation components is entirely located within the sub-laminar space. We have used this new technique in 15 patients.

Although follow-up is short (6 months), the good quality of the immediate results in terms of deformity reduction and maintenance of reduction stability (without casting or bracing), functional outcomes (immediate resumption of walking and of other physical activities such as swimming), patient comfort, and return to normal everyday activities within 10 to 15 days postoperatively warrants the present publication.

2. Principles

The goals are to achieve the best possible correction and, above all, the stiffest possible fixation of a spinal segment of variable length (depending on the length of the deformity), while allowing arthrodesis if needed. These goals are achieved by distributing the vertebral purchase points so that each vertebra included in the segment of interest is instrumented and therefore secured on at least one side, with the other side left free for arthrodesis. The vertebrae are connected by two parallel rods that can be contoured to replicate the physiological antero-posterior curvatures. These two parallel rods are connected to each other by several transverse systems, giving the overall assembly a rigid frame configuration.

3. Material

a – Two types of *hooks attached to the spine* are used.

– *Classical closed hooks*: the rod is top-loaded through the barrel then secured by directly tightening a hexagon-head bolt onto the rod.

These hooks are used at one end of the assembly, for both distraction and compression, and can be placed either under the lamina or under the transverse process. The tip of the hook is blunt

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* Corresponding author.
E-mail address: rco@sofcot.fr (J. Dubousset).

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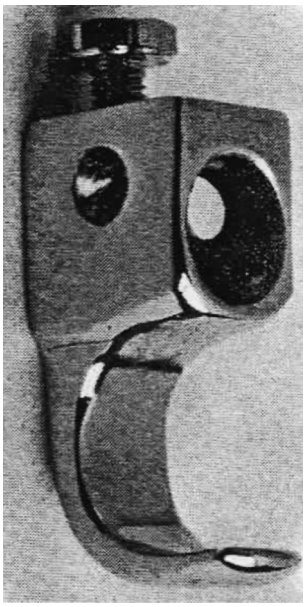

Fig. 1. Closed hook placed under the lamina or transverse process.

to prevent injury to the epidural space or intertransverse space (Fig. 1).

– *Open hooks* allow passage of the rod (Fig. 2). The contour of the opening is conical at the upper half and cylindrical at the lower half. The rod is secured to the hook using a cylindrical-conical set screw that fits into the opening in the hook; an upper projection of the set screw has a square cross-section that locks the rod onto the hook in the desired position by means of a hexagon-head bolt. The square cross-section prevents rotational movements.

Open hooks have two different tip configurations:

- *the pedicular hook* (Fig. 2) has a bevelled upper edge with a midline anterior notch; this notch ensures firm support on the lower edge of the pedicle by directly embracing the pedicle, thus conferring resistance not only to compression and distraction forces, but also to transverse and rotational forces;

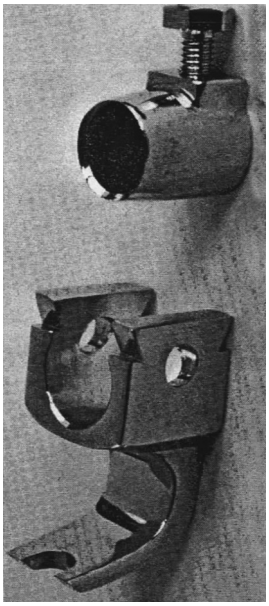

Fig. 2. Open hook for placement in a pedicle, with the cylindrical-conical set screw. Note the square cross-section of the upper projection of the set screw.

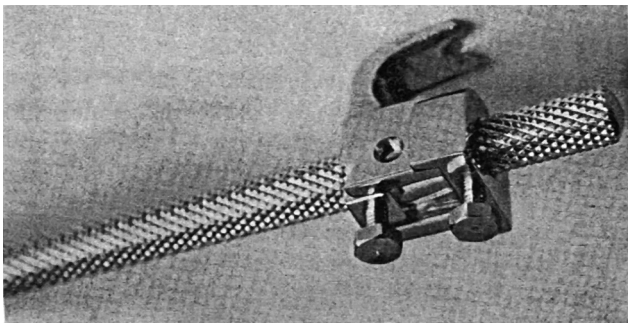

Fig. 3. Hook secured onto the knurled rod by the hexagon-head bolt, and safety locking system for the uppermost concave hook.

- *the laminar hook* has a blunt, rounded, upper edge to avoid injuring the peri-dural space. Two types are available: for the lumbar spine, the anterior aspect of the hook body is straight (Fig. 1); whereas for the thoracic spine, the anterior aspect is oblique superiorly and anteriorly to ensure that the hook moves backward as it is driven under the lamina.

The uppermost hook of the distraction assembly is always a pedicular hook. Strong fixation of this hook is crucial to preclude loosening, particularly when the non-instrumented spinal segment above the assembly is placed in kyphosis. This hook is therefore secured using a *safety locking system* that fits exactly over its upper aspect and is held in place by a hexagon-head bolt (Fig. 3).

b – *The rods have been considerably simplified* and now exist as a single type.

They measure 7 mm in diameter and are entirely covered by 1-mm diamond-shaped knurls (Fig. 4) that allow hook fixation using a hexagon-head bolt at any level of the rod (*knurled rod*, Figs. 4 and 5).

The rod can be contoured according to the desired antero-posterior spinal curvatures, either before or during implantation. Rod contouring allows passage of the set screw up to a radius of 6 cm (Fig. 6). If needed, the rod can be cut after implantation, using a standard rod-cutting tool.

Several rod lengths are available. The rods no longer have a top and a bottom or a front and a back, which simplifies ordering, stock management, storing, classification and, above all, use, as any rod can serve for distraction, compression, or rotation, by virtue of the firm fixation of the hooks bolted onto the rod in the desired position (Fig. 6).

c – *Device for transverse traction*

The two parallel rods are connected to each other at the top and bottom of the assembly by two transverse traction systems. The throats of the hooks on the transverse systems are shaped to fit exactly onto the diamond pattern of the knurled rods (Fig. 7). This feature allows direct de-rotation on the rod if needed.

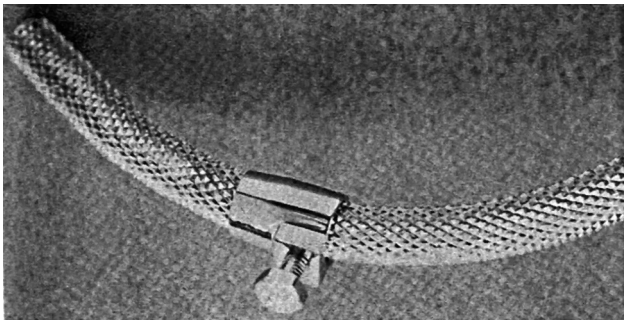

Fig. 4. The rod can be bent, even to a considerable extent, without hindering the passage of the blocked cursor.