

STABLE SPINAL INSTRUMENTATION, A NEW GROUP OF INSTRUMENTS USED IN DEFORMITIES AND DISEASES OF THE COLUMNA VERTEBRALIS

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The vertebral column is a mechanical structure which can move around the frontal, sagittal and axial axes and on combinations of these axes. The supportive elements of this structure consist of the vertebrae, the facet joints, the intervertebral discs, the ligaments which attach the vertebra to each other and the muscles which surround the vertebral column. Any disturbance of any these structures can cause instability and deformity of the columns vertebralis.

In order to be able to carry out daily vertebralis comfortably, it is necessary to correct the vertebral deformity and the vertebral instability and to alleviate the resulting pain.

Vertebra stabilization and correction is obtained by various methods. The oldest and most wide spread spinal instruments are Harrington's instruments and they should be accepted as an important advance in spinal surgery (2). Although the application of Harrington instruments is quite easy the requirement of external fixation postoperatively has led orthopaedists to the search of new methods.

Although Luque's segmental spinal instruments provide a stronger fixation and allow early mobilization postoperatively, their application has resulted with extreme correction loss. (3)

The Cotrel-Dubousset method has added a new dimension to internal spinal instrumentation and it has been suggested that this method could be effective to all dimensions of the deformity. The application has removed the requirement for an external support (1).

Stable spinal instrumentation is different from the previous instruments by possessing characteristics that affect the vertebral column in all dimensions and make them applicable to all pathological processes of

the columna vertebralis. These instruments are more advantageous than the other methods because they can be used both in anterior and posterior interventions the columna vertebralis and they provide sound fixation.

Stable Spinal Instrumentation (Dr. Emin Alici) System: SSI consists of mouldable apooled rods, special hooks to attach these rods to the vertebral column, screws and transverse apparatus that connect the rods to each other. Depending on the characteristics of the lesion they can be applied either anteriorly or posteriorly. In the anterior application the rods are fixed to the corpus of the vertebra by screws and in the posterior application the rods are attached to the vertebra with hooks.

Rods : They are made of stainless steel sticks of different lengths with two smooth and two grooved surfaces. They can be easily shaped due to their smooth faces. If the moulding is not too sharp but soft with round curves the grooves are not deteriorated and they allow free movement of the nuts.

Hooks : There are four different types of hooks. The closed pedicle hook : They are hooks through which the rods can pass and when they are placed between the facet joints their lips grasp the pedicle. The open pedicle hook : These are hooks that grasp the pedicles with their tips, but their tops are open for the insertion of the rods, and they are attached to the rods with special telescopic nuts. The closed lamina hook : These are hooks with short and blunted lips that can be attached to the lamina or transverse processes. Open lamina hook : They are like the closed lamina hooks except that they are open for the insertion of the rods from the top and they are attached to the rods with telescopic nuts.

Screwed holders : They are designed by placing screws to the distal portions of the open hooks. The screws have wide grooves like the spongios screws and they are used for the fixation of the rods to the vertebrae corpus. Besides its use in anterior approaches, it can also be placed transpedicly with a posterior approach. The screws are fixed to the rods with special telescopic nuts.

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Nuts : These are composed of common nuts and telescopic nuts. The telescopic nuts are designed to hold the open hooks and the common nuts are designed to hold the closed hooks.

Transverse apparatus : These are holders that serve to connect the rods that are attached to the sides of the vertebra with hooks, to each other, and to increase the stability. It provides stability to the system and causes the stress to spread evenly.

INDICATIONS

Idiopathic scoliosis : It establishes the most important indication area of the stable spinal instruments. The system is effective to the frontal, sagittal and axial plane deformity complex of the scoliosis and provides perfect correction.

For example ; in a right thoracic flexible curve a closed pedicle hook is inserted to the pedicle in the concave side of the vertebra at the top of the curve. In order that the procedure be carried out safely and easily the facet joint belonging to the superior vertebra below, the lamina and the transverse process should be decorticated. An open pedicle hook should be placed two spaces above the top vertebra of the curve, an open lamina hook should be placed two spaces below and a closed lamina hook should be placed to the lowest vertebra of the curve. A rod appropriate to the length of the curve should be chosen and it should be bent approximately 20-30 degrees, spreading the curvature evenly all along the rod. In order to achieve this result the rod should be curved from a different point for each degree. Thus the grooves on the rod will not be distorted, and the nuts will be able to function appropriately. For each open hook a pair of telescopic nuts, for each of the upper and lower hooks common nuts should be mounted on the rod. The lamina on the concave side of the curve should be decorticated. The top tip of the rod should be placed into the top hook, and the bottom tip should be slid into the lower hook. The telescopic nuts should be rotated in a way so that they will have the hooks in them, and the rod should be placed inside the two hooks in the middle : By rotation of the telescopic nuts the middle hooks should be moved away from each other. After obtaining a certain degree of correction at the top of the curve, the rod should be held from the middle portion, and it should be rotated toward the concave side. As a result of this procedure it will be observed that the frontal curvature has been converted to the physiological thoracic sagittal curve, and that the rotation has

been corrected. In order to stabilize the rod in this position the pair of telescopic nuts belonging to each hook should be tightened toward each other, and the rod should be locked to the hook. The lower and upper nuts should be rotated in order to move the lower and upper hooks away from each other.

A closed pedicle hook should be inserted to the facet joint of the upper tip vertebra of the convex side of the curve, an open lamina hook should be inserted to the two upper and two lower transverse processes of the tip (apex) vertebra in a way to lighten each other and a lamina hook should be placed to the lamina of the lower most vertebra again in a squashing direction : The laminae on the convex side of the curve should be decorticated. A rod of appropriate length given approximately a curve of 20 degrees should be mounted on the hooks after inserting appropriate nuts to the hooks. The nuts should be rotated in a tightening direction. Both of the rods should be connected to each other their upper and lower ends with transverse apparatus. The fusion should be completed with grafts obtained from the iliac bone.

If the curve is a thoracic and lumbar double curve, first the lumbar vertebrae are exposed by a retractor approach from the convex side of the lumbar curve. The intervertebral discs which remain inside the curve are extirpated including their end plates. In this manner the curve gains flexibility. Bone grafts are placed into the intervertebral spaces. Staples are placed to the convex lateral sides of the vertebrae. Through the hole in the middle of the staples screws are placed so that they will not spall the opposite cortex. A rod of appropriate length is chosen and curved not be more than 20 degrees. A pair of telescopic nuts for each grooved screw are placed on the rod. The rod is inserted into the grooved heads of the screws, and the nuts are rotated in a direction to tighten the convex side of the curve. As a result the lumbar curve fits the 20 degree curve of the rod. By rotating the rod around its axis by 90 degrees, the curve of the rod on the frontal plane is converted to the normal lumbar lordosis. The rod is locked by encroaching the nuts toward each other. The wound is closed. By using this method, a flexible lumbar curve up to 60 degrees can be completely corrected in a single session.

In a lumbar and thoracic double curve if the lumbar curve is less than 20 degrees the thoracic and lumbar curves can be corrected in a single session by a posterior approach. For this purpose a rod of appropriate length should be curved so that the physiological thoracic kyphosis and lumbar lordosis will be formed.

In addition to the thoracic curve hooks open lamina hooks should be placed on the upper tip, and closed lamina hooks should be placed on the lower tip of the curve.

Adolescent thoracic kyphosis : It constitutes another important indication area of SSI. After the subperiosteal dissection of the vertebra the processes spinosus are excised. A 20-30 degrees curve is given to a pair of rods of appropriate length. Three closed lamina hooks are placed proximally, three closed lamina hooks are placed distally facing each other. After each lamina hook nuts that will press them toward the center of the rod arc placed, starting from the top tip vertebra of the curve closed lamina hooks are placed to the transverse processes of the proximal 5., 4., 3. vertebra and transverse processes of the distal 5., 4., 3., vertebra By squeezing the nuts behind the hooks, the hooks are brought closer to each other and the curve is corrected. The same process is performed for the other side too, and the two rods are connected to each other by transverse apparatus distally and proximally. As a result the thoracic kyphosis is converted to a 20-30 degree physiological kyphosis.

Fractures, and dislocations with fractures of the vertebra : After subperiosteal vertebral dissection the processus spinosus are excised and to the 3. and 2. proximal (cephalad) vertebra in relation to the fracture site an open pedicle hook and to the distal (caudal) 3. and 2. vertebra closed lamina hooks are placed. On rods of appropriate lengths two pairs of telescopic nuts are mounted proximally, and a pair of normal nuts are placed distally. The rod is first inserted into the distal closed hooks then inserted to the proximal open hooks. The nuts are rotated so that they will be distracted. After sufficient distraction is obtained the nuts are squeezed and locked. The same procedure is applied to the other side, too. The lateral apparatus are put in place and with the grafts obtained from the processus spinosus, the fusion encompassing three vertebra is completed.

Burst fractures of the vertebra, vertebra tumours and congenital kyphosis: With these pathologies, first the vertebra with the lesion is extirpated by an anterior approach, and anterior decompression is performed. To the upper and lower sound vertebral grooved screws are placed via staples. On top of rod of appropriate length two pairs of telescopic nuts are mounted. The rod is placed into grooved screws, and it is distracted until the physiological shape of the columnar vertebral is obtained. The rod is locked by tightening the nuts. In fractures, kyphosis and benign

tumours the empty space is filled with bone grafts, in malignant tumours it is filled with bone cement. In cases where the posterior elements aren't sound, similarly to vertebra fractures, posterior spinal instrument is added to the system. **Vertebra stenosis and vertebral instability due to spondylarthrosis.** : Stabilization with short rods can be performed in order to remedy the instability encountered during an intervertebral dischernia operation or following radical laminectomy in the late period of degenerative disc disease in the lower lumbar region interbody fusion or posterior fusion can be added with a posterior approach.

Spondylolisthesis : For this purpose grooved, pointed, short armed open rods are used. The rods are attached to the columnar vertebral by hooks and screws. The distal hooks are wide enough to encircle the wings (alae) of the sacrum. The proximal hooks are designed to grasp the lamina and facet joints. There is a wedge which can slide on the pointed part of the rods, through which a spongy screws can pass.

After the exposition of the lumbo-sacral region with a wide incision, the lower hook is positioned in the lamina of the 2. vertebra. The rod is first attached to the proximal and then to the distal hook and distraction is achieved with the help of a nut. From a screw nut located on the wedge, a 60 mm long spongy screw is directed toward the vertebra corpus. The same procedure is performed for the other side too. The screws will secure reduction by pulling back the sliding vertebra. Interbody fusion and posterior fusion or only posterior fusion with a posterior approach should be added to the method.

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