THE ALICI SPINAL SYSTEM IN THE SURGICAL TREATMENT OF SCOLIOSIS

ALICI E., M.D. **PINAR H., M.D.**

The Alıcı spinal system is an instrumentation used for correction and fixation of various of the spine. Idiopathic scoliosis is the most important indication. Scoliosis in a complex deformity in the frontal, sagittal and axial planes, and this system provides perfect correction in all three planes. Frthermore, it permits stable fixation and can be used for both anterior and posterior spinal fusions.

The indications for the anterior Alıcı spinal system are: mature thoracolumbar or lumbar cursev of more than 40°, progressive immature thoracolumbar or lumbar curves of more than 35°, painful mature lumbar cursev, and mature lumbar cursev of more than 40° in thoracolumbar double cursev.

The indications for the posterior Alıcı spinal system are: immature thoracic cursev of more than 40°, progressive thoracic or thoracolumbar cursev of more than 35°, and paralytic and congenital cursev.

During the last two years, 92 scoliosis patients underwent spinal fusion whit Alıcı spinal instrumentation. scoliosis was idiopathic in 58, congenital in 20, paralytic in 12, and 2 cases were caused by neurofibromatosis. Twenty-four of the patiens underwent 2-stage anterior and posterior fusions. In the remaining 68 patiens only posterior fusion was performend.

The mean follow up 14 months (range, 6-24 months). Preoperatively, the mean cursev of the idiopatic, congenital, and paralytic groups were 54.7°, 57.8°, and 83°, respectively. In the idiopathic group the mean correction was 93% with anterior instrumentation, and 74.4% with posterior instrumentation. For the congenital and paralytic groups, the mean corrections obtained by surgery were 63.7% and 70%, respectively. Fusion was achieved in all cases.

Key words: *Scoliosis, Alıcı spinal system.*

INTRODUCTION

Scoliosis is a deformity of the vertebral coumn in the frontal, sagittal and axial planes. In 1974, Dwyer and Schafer (2) reported their results with Dwyer instrumentation in double-curve scoliosis. In 1975, O'Brein et al. (7) reported of the combined use of Dwyer and Harrington instrumentation for the treatment of paralytic pelvic obliquity. In 1978, Winter et al. (10) mentioned the application of the same method for adult scoliosis.

Zielke (11) reported his experience with a new method, the ventral derotation system (VDS), in the treatment of scoliosis in 1975. The combination of VDS and Harrington instrumentation was described by Hennemann and Zielke (3).

In 1977, Micheli et al. (5) noted that frequent comlaint of the adult patients in their clinic was intractable, unremitting back pain. they recommended the combined Dwyer-Harrington instrumentation, especially for balanced double curves.

With Harrington instrumentation and posterior fusion for a double structural right thoracic/left lumbar curve, only partial correction of each curve can be achieved. The correction of the thoracic curve is often much better than that of the more structural lumbar one. In the final evaluation, the end vertebra of the fusion area, usually 14, still remians tilted, thus increasing the possibilities for degeation at the L4-L5 and L5-S1 interspaces. For long-term mechanics, it woudl be preferable to maintain L4 as harizontal as possible. The L4 vertebra can be centralized and made horizontal above the midsacrum more effectively by comined VDS-Harrington technicque than by posterior instrumentation alone '4).

In this study, we present the short-term results of treatment of different types of scoliosis with a new instrumentation.

MATERIALS and METHODS

From July 1988 through July 1990, 92 patients with scoliosis underwent spinal fusion with Alıcı instrumentation in our hospital. Twenty-four of the patients underwent 2-stagi anterior and posterior fusions. In the remaining 68 patiets only posterior fusion was performed.

Department of Orthopedics and Traumatology,
Dokuz Eylül University, Izmir, Turkey

There were 60 females and 32 males. Their ages ranged from 10 to 23 years (means, 13.7 years). Scoliosis was idiopathic in 58, congenital in 20, paralytic in 12, and 2 cases resulted from neurofibromatosis. Curve patterns of idiopathic cases were: 36 right thoracic, 2 left thoracic, 8 left lumbar, 11 right thoracic/left lumbar, and 1 double thoracic.

Preoperative evaluation of the patients was standardiezed and included a careful neurological evaluation, routine blood chemistry, posteroanterior and lateral standing radio-graphs, and right and left supine maximum bending radiographs, pulmonary function tests, electrocardiogram, clinical photographs and computeriezed tomography.

Preoperative halo fermoral traction was used in 5 severe paralytic curves. In these patients, traction was resumed after the anterior operation, and was terminated only after the posterior fusion was performed.

INSTRUMENTATION

Alıcı instrumentation was designed to provide selective and 3-dimensional correction and strong fixation for various deformities of the spine. The system can be used for both anterior and posterior spinal fusion.

The instrumentation is basically composed of rods, hooks, screws and transverse connection devices (TCD). For the anteior instrumentation staples are also available.

The rod has threaded and flat surfaces and is available in lengths from 10 to 37cm. It is made of stainless steel, and can be bent throught the flat surfaces over its entire length without weakening. Because of these flat surfaces, the threaded portion is not damaged with bending.

Four kinds of hooks are available: closed laminar, open laminar, closed pedicular, and open pedicular hooks. the hooks are fixed to the rod with pairs of telescoping nuts. This design for the rod enables the nuts to glide over it even when it is bent.

The screws are available in lengths of 20 to 55mm. The rods are firmly conneted by two transverse connection devices (TCD) which give the system its rotational stability. The TCD's are also threaded.

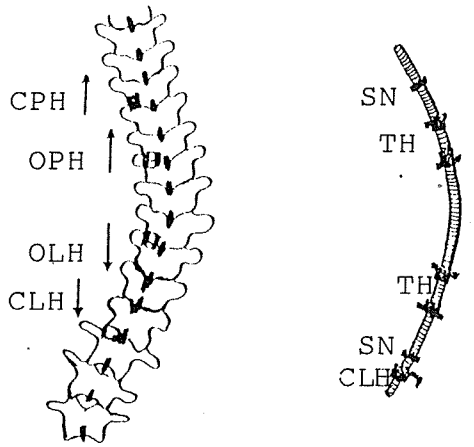
Staples are available for the anterior spinal instrumentation (ASI) which have holes through which screws are inserted. The same rods, screws, and nuts are used in the AST.

Operative procedure

In a single thoracic curve, the procedure begins from the concave side. A closed pedicular hook is inserted against the pedicle of the uppermost vertebra. In order to make the operation easier and to decrease the risk of comlications, the lamina and transverse process of the superior fecet of the lower vertebra should be decorticated. The second vertebrae above and below the apical verlebra are instrumented with open pedicular hooks and open laminar hooks, respectively.

Fig 1: The types and localization of the hooks on the concave side in a right thoracic sclosis. CPH: closed pedicular hook, OPH: open pedicular hook, OLH: open laminar hook, CLH: closed laminar hook.

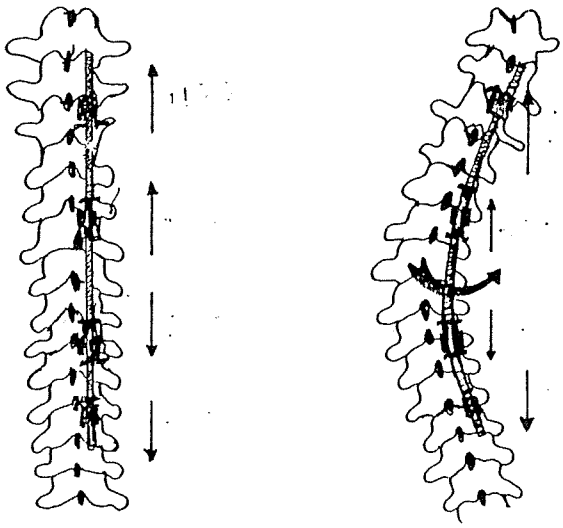
Fig 2: Pre-bent rod for the coneave side with the nuts in place. SN: small nut, Til: a pair of telescoping nuts.



Then a closed laminar hook is inserted in the lowermost vertebra of the curve (fig.1) The rod for the concave side is bent approximately 20°-30° over its entire length. In order to achieve this, the bending procedure should ba made at a different point for each degree so that the threads on the rod are not damaged, and the pair of telescoping nuts operate properly through the corresponding open hooks. For each of the open hooks a pair of telescoping nuts, and for each of the closed hooks a small nut is mounted on the prebent rod (fig.2) Then the proximal and of the rod is inserted inside the upper closed hook, and the distal end is slipped into the lower closed hook. Once th rod is placed in the hooks, the pairs of telescoping nuts are screwed to exert a distraction force on the open hooks (fig.3a). After sufficient distraction is achieved, the closed hooks are distracted by the small nuts. The rod is then gently and gradually rotted toward the concave

side. During this maneuver, the frontal curve turns into a physiological thoracic sagittal curve, and the rotation is corrected (fig.3b). In order to fix the rod in this position, the telescoping nuts for each open hook are screwed towards each other, and thus the is locked to the hooks. Further distraction may be applied by the

Fig.3a: The pre-bent rod after insertion on the concave side. The arrows indicate rotational and distractional forces.
Fig.3b: The correction of the curve after rotation and distraction are complated.



end (small) nuts, and the procedure on the concave side is comleted. The alignment of the hooks on the convex side is as follows (fig.4a): The uppermost vertebra is instrumented with a closed laminar hook placed at the transverse process, and a closed pedicular hook placed at the fecet joint. These two hooks face aech other, and the closedlaminar hook is the more proximal one. The vertebrae one above and one below the apical vertebra are instrumented at the transverse processes with two open laminar hooks facing each other. A rod of appropriate length is bent about 20°, and the following are mounted from proximal to distal: a small nut, two pairs of telescoping nuts facing each other, a closed laminar hook facing cranially (the lowemost hook), and a small nut. Compression betwen the hooks is achieved by turning the nuts. Then, to improve stabilization, the two rods are connected to each other at their upper and lower ends by TCD's (fig.4b). The procedure is comleted by grafts taken from the iliac bone.

Fig.4a: The types and localization of the hooks on the convex side. The arrows indicate the direction of the forces.
Fig.4b: Final form of the curve with two rods and two transverse connection devices (TCD).

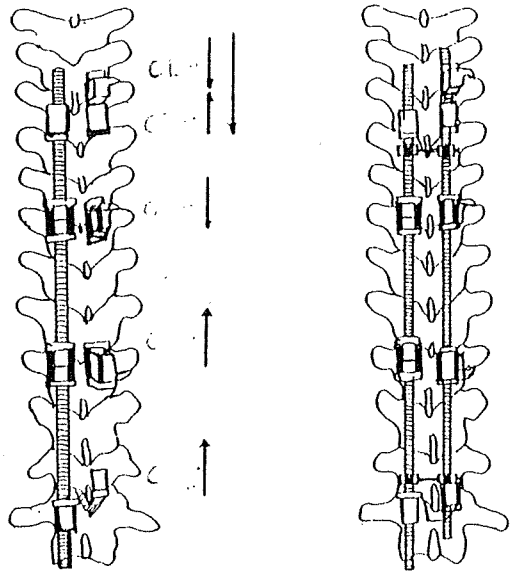


Fig.5: A thoracolumbar curve. Insertion of the staples and the screws on the convex side by the anterior approach. The small figure illustrates the pre-bent rod (as well as the degree of lumbar mordosis) with the telescoping nuts mounted in place.

If the curve is of the double thoracolumbar type, first a retroperitaneal approach from the convex side of the lumbar curve is performed so that the lumbar verterea are exposed. The intervertebral discs and the endplates which remain with in the curve are removed. Thus the curve gains flexibility. ..one grafts are placed in the intervertebral spaces, and staples are inserted on the convex side the vertebral bodies. Then screws are in the middle of the staples so that they remain within the cortex on the other side (fig.5). A rod of appropriate lenght is bent to a maximum of 20° over its entire length. After the pairs of tlescoping nuts are mounted on the rod, the rod is inserted throught the screws with open bodies. The nuts are roteted towards each other in such a way that the convex side of the curve is compressed (fig.6). Then, by rotation of the rod by 90° around itself, the curve of the rod on the frontal plan is converted to physiological lordiosis (fig.7a, b). The rod is locked by rotating the nuts in each pair towards each other inside the bodies of the screws. With this method, a flexible lumbar curve of up to 60° can be corrected completely in a single session.

In a thoracolumbar scliosis, if the lumbar curve is less then 35°, both curves can be corrected in a single session by posterior intervention. A rod of appopriate length should be bent in a manner to from the physiological thoracic kyphosis and lumbar lordosis (fig.8a, b, c, d).

The avarage operating times for the posterior and antrior approaches were 160 min. and 225 min., respectively. The avarage intraoperative blood loss was 3 units.

Fig.6: The rod as inserted though tne bodies of the screws.
Fig.7a and b: Correction and lumbar lordosis have been achieved.

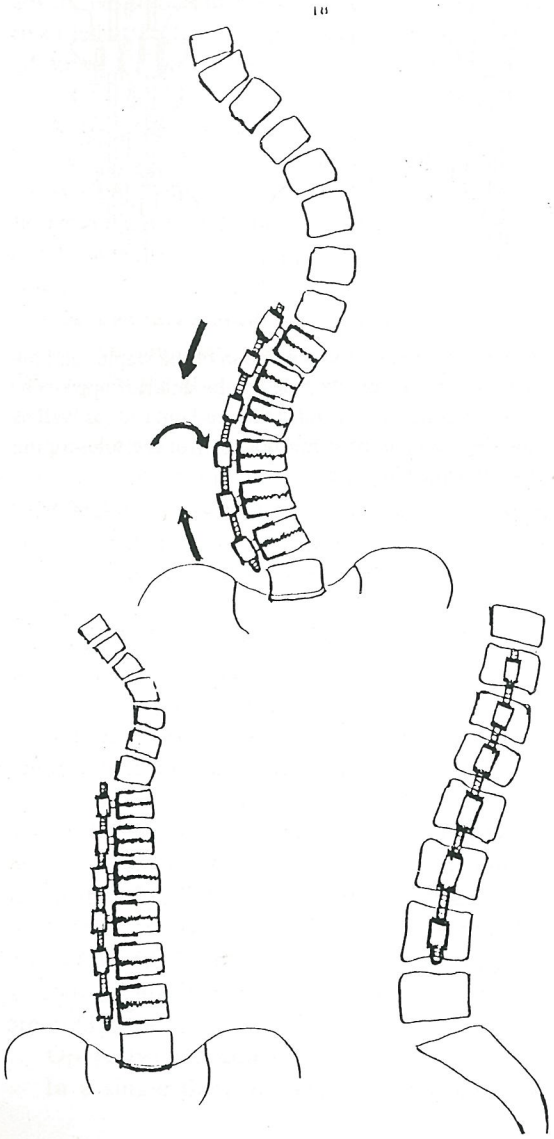
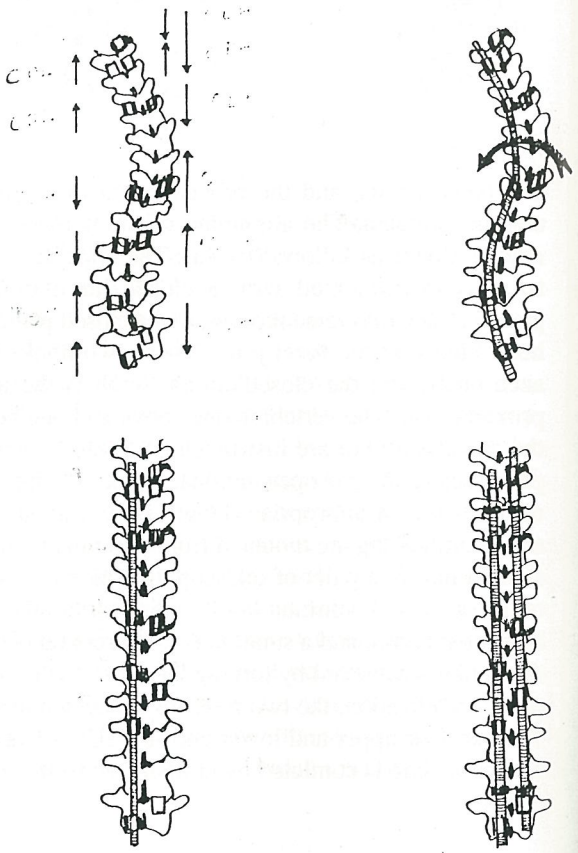


Fig. 8a, b, c, d: Correction and stabilisation of a right thoracic/left lumbar double curve.



No postroperative external immobilization was used. Ambulation began on the second or third postopertive day. Patients were discharged 5 to 7 days after surgery. Gradual return to normal activities in 6 to 8 weeks was encouraged.

RESULTS

The avarage followup was 14 months (range, 6 to 24 months). Preoperatively, the mean curves of idiopathic, congenital, and paralytic groups were 54.7°, 57.8°, and 83°, respectively. In the idiopathic group the correction rate was 93% with anterior instrumentation, and 74.4% with posterior instrumentation. For the congenital and paralytic groups the correction rates were 63.7% and 70%, respectively. Preoperative rotation dagrees as measured by computerized tomography were mean 19° (range, 6.9°-37.8°) for idiopathic group; mean 25.5° (range, 16.6°-35.5°) for the congenital grouph; and mean 66.1° (range, 78.3°-78.3°), for the paralytic grouph (according to RA-ANI). The avarage corrections of rotation for the same groups wre 10.3°(44%), 1,7° (4%), and 23.6° (33.4%), respectively. No preoperative or postoperative radiologcal measurements were performed in the sagittal plane because vertebral rotation can mask the curves in this plane.

Postoperatively, two patients had a superficial wound infection which responded to antibiotics. A psoab abscess in one patient was managed successfully by surgical drainage and antibiotics. There were no postoperative neurological or instramentational complications.

DISCUSSION

The correction and fusion of scloitic deformities is performed by various mthods. The oldest and the most widely used instrumentation in the correction of scoliosis is the Harrington instrumentation (1949), and it has intiated a new era in spinal surgery. Although Harrington insrumentation is easy to apply, it has the following disadcantages. It does not have sufficient effect on the rotational component of the deformity, and it does not provide sufficient rotational stability, so that external immobilization is needed post-operativety.

Luque's segmental spinal instrumentation has achieved stronger stabilization, and early mobilization is possible in the postroperative period, but its application rusults in extreme loss of correction.

Intrernal spinal instrumentation has gained new dimensions with the Cotrel-Dubousset method. This method has been reported to be effective for all copo-nents of the deformity. Further more, external support is not required (1). However, thir instrumentation fails to achieve anterior spinal correction and fusion.

Besides providing all the advantages of the CD system, Alıcı instrumentation is also suitable for anterior correction and fusion of lumbar curves of up to 60°. The present system is superior to the anterior instrumentation of Dwyer and Zielke in that, by rotation of the pre-bent rods, leteral curves of up to 20° can be converted to physiological lumbar lordosis.

In the idiopathic group, 93% and 74.4% corrections were obtained with the anterior and posterior instrumentations, respectively. The lower rate of success in the correction of paralytic scliotic curves as compared to idiopathic curves resulted from the heigher mean age (17 years) and from the higher degree of deformity (mean, 83°, range 50°-135°) in the former group. The correction rate obtained for congenital group was lower than the other groups. This was cased by loosening of resection of the congenitally malformed vertebra by the anterior approach.

The results of the present study appear to be better than those reported in the literature (6, 8, 9). Although the most important factor in this high success rate is the application of anterior spinal instrumens together with posterior instrumints, especially, for the idiopathic group, an avarage age of 13.5 years, and an avarage curvature of 52.4° seem to have played a substantial role.

REFERENCES

1. Cotrel Y. Dubousset J. New universal instrumentation in spinal surgery. Clin. Orthop. 1988, 227, 10-23.
2. Dwyer A.F. Schafer M.F. Antreior approach to scoliosis. J. Bone Joint Surg., 1974, 56-B, 218-225.
3. Hennemann S. Zielke K. Ist die Behandlung der kombinierten Scoliosen durch Operationen von ventralen und dorsalenzungung gerechtfertight. Presented at the Orthopedic Congress, Basel, 1979.
4. Korovessis P. Combined VDS and Harrington instrumentation for treatment of idiopathic double mawor curve. Spine, 1987, 71-A, 1170-1177.
5. Micheli B.J., Riseborough E.J., Hall J.E. Scoliosis in the adult. Orthop. Rev., 1977, 6, 27-32.
6. Mielke C.H., Lonstein J.E., Denis F., vandenbrink K., Winter R.B. Surgical treatment of adolesdent idiopathic scoliosis. A comparative analysis. J. bone Joint Surg., 1989, 71-A, 1170-1177.
7. O'Brien J. P., Dwyer A.P., Hodgson A.R. Paralytic obliquitty: Its prognosis and management and the development of a technique for full correction of the deformity. J. Bone oint Surg., 1975, 57-A, 626-631.

8. VanDam B., Brodford D., Lonstein J.E., Moe J.H., Ogilvie J. W., Winter R.B. Adult idiopathic scolisis treated by posterior spinal fusion and Harrington instrumentation. Spine 1978, 12, 32-36.
9. Winter R.B., Lonstein J.E. Adult idiopathic scoliosis treated with Luque or Harrington rods and sublaminar wiring. J. Bone Joint Surg., 1989, 71-A, 1308-1313.
10. Winter R.B. Combined Dwyer and Harrington instrumentation and fusion in the treatment of the selected patients with painful adult idiopathic scoliosis. Spine, 3, 1978, 135-141.
11. Zielke K., Pellin B. Ergebnisse operativer skoliosen und kyphoskoliosen, Behandlung beim adoleszenten uber 18 jahre und beim erwachsenen. Z. Orthop., 1975, 113-157.