

EARLY RESULTS OF SPINAL DEFORMITIES AND DISEASES OPERATED WITH ALICI SPINAL SYSTEM

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From September 1989 to August 1990, 49 patients with 52 spinal diseases and deformities were operated at the Department of the Orthopaedic Surgery and Traumatology in Ege University Medicine Faculty and their early results were reviewed.

There were 27 females (55.1 %) and 22 males (44.9 %). Their ages ranged from 13 to 70 years with an average of 42.7.

Causes of the operations are listed in Table I.

We have used 9 anterior spinal instruments, 38 posterior spinal instruments, and 2 combined procedures of anterior and posterior instruments.

First review showed that diseases and deformities were corrected all, and instruments provide sound stability.

Key Words: *Degenerative disease, Kyphosis, Scoliosis, Spondylolysis, Spondylolisthesis, Fractures and fracture-dislocations of the spine, Vertebral tumors, Alici Spinal System.*

INTRODUCTION

Harrington system was the first internal fixator used in the operative treatment of spinal deformities (1, 3, 10, 11). It gained widespread international acceptance and it was be assented as an important advance in spinal surgery (1, 3, 4, 10, 11).

Although the application of Harrington instruments is quite easy, the requirement of external fixation post-operatively let orthopaedists to the search of new methods (1).

In the previous years, anterior instruments of Dwyer and Zielke, and posterior instruments of Luque and Cotrel-Dubousset were offered to use of surgeons (1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12).

These methods were modified by some researchers, and some of them used different anterior and posterior instruments together to enhance the efficiency of treatment (1, 2, 3, 11).

The Cotrel-Dubousset's segmental posterior instruments has added a new dimension in spinal surgery (1, 8, 9). This method could effect all dimensions of deformity and the application has removed the requirement for an external support (5, 8, 9).

Alici Spinal Instrumentation is different from the previous instruments by possessing some characteristics listed below;

1. To correct vertebral deformities in all dimensions,

2. It can be applied to all pathological processes,
3. It can be used in anterior and/or posterior interventions,
4. No requirement for an external support postoperatively.

In this study, the early results of Alici Spinal System from the view of application, reduction and stabilization on 14 groups of diseases and deformities were presented.

MATERIALS and METHODS

Alici Spinal System consists of 5 different parts;

1. Rods: They are made of stainless steel. Their lengths differ from 4 to 12 inches with two smooth and two grooved surfaces. They can be easily shaped from their smooth faces.

2. Hooks: There are 4 different types of hooks.

- The closed pedicle hook: They are placed between the facet joints and their tips grasp the pedicle. The rods can pass them through.
- The open pediclehook: These grasp the pedicles with their tips, but their tops are open for the insertion of the rods. They are attached to the rods with special telescopic nuts.
- The closed lamina hook: These hooks have short and blunted tips that can be attached to the lamina or transvers processes.
- The open lamina hook: They are like 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.

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

4. Nuts: There are two types of nuts, common nuts and telescopic nuts. Common nuts hold the closed hooks, while telescopic nuts are designed to hold the open hooks.

5. Transverse apparatus: These holders connect the rods that are attached to the sides of the vertebrae. They increase the stability and spread the stress evenly.

Alici spinal instruments can be applied anteriorly and/or posteriorly depending on the characteristics of the lesion. In the anterior application the rods are attached to corpus of the vertebrae by screws. In the posterior application the rods are attached to the lamina or pedicles by hooks.

Alici spinal system can be used in almost all vertebral pathologies. Main indications are idiopathic scoliosis, adolescent thoracic kyphosis, fractures and fracture-dislocations of the spine, burst fractures, vertebra tumors, congenital kyphosis, spinal stenosis and vertebral instability due to spondylarthrosis, and spondylolisthesis.

In our study we reviewed early results of 49 pa-

Table 1: Causes of operations

	Number of cases	Percentage
Spondylolisthesis	13	25
Thoracolumbar fractures	10	19.2
Metastatic Tumors	7	13.4
Tuberculosis of Spine	5	9.6
Spondylolysis	4	7.6
Scoliosis	3	5.7
Lumbar Disc Disease	2	3.8
Degenerative Disc Disease	2	3.8
Ankylosing Spondylitis	1	1.9
Scheuermann's Kyphosis	1	1.9
Spinal Stenosis	1	1.9
Atlantoaxial Instability	1	1.9
Lumbarization	1	1.9
Hemivertebra	1	1.9

tients with 52 deformities and diseases that were operated with Alici spinal instruments, between September 1989 to August 1990.

Causes of the operations are listed in Table I.

There were 27 females (55.1 %) and 22 males (54.9 %). Distribution of deformities and diseases according to sex are listed in Table II.

Table 2: Distribution of diseases and deformities according to sex

	Number of cases	Percentage
FEMALE		
Spondylolisthesis	11	37.9
Spondylolysis	4	13.7
Fractures and fr-dislocations	4	13.7
Tuberculosis of spine	3	10.3
Lumbar disc disease	2	6.8
Degenerative disc disease	2	6.8
Scoliosis	1	3.4
Lumbarization	1	3.4
Scheuermann's kyphosis	1	3.4

MALE

Metastatic tumors	7	30.4
Fractures and fr-dislocations	6	26.1
Tuberculosis of spine	2	8.7
Spondylolisthesis	2	8.7
Scoliosis	2	8.7
Ankylosing spondylitis	1	4.3
Spinal stenosis	1	4.3
Atlantoaxial instability	1	4.3
Hemivertebra	1	4.3

The ages of the patients ranged from 13 to 70 years, with an average of 42.77. Average age was 44.13 in females and 40.94 in males. Average ages of the diseases groups are listed in Table III.

We used 9 anterior, 38 posterior instruments and both anterior and posterior instruments in two operations.

In two patients, who have gone under combined anterior and posterior operations had metastatic vertebrae tumors. In four of seven of the metastatic tumor patients anterior instruments were used. With anterior approach, tumor mass was extirpated and anterior decompression was made. Rods are attached to one below and one above vertebrae with screws and staples,

Table 3: Average ages of the disease groups

Spondylolisthesis	42.1
Spondylolysis	39
Fractures and fr-dislocations	33.8
Metastatic tumors	52.4
tuberculosis of spine	51.7
Scoliosis	28.3
Lumbar disc disease	52.5
Degenerative disc disease and spinal st.	53
Scheuermann's kyphosis	16
Atlantoaxial instability	42
Ankylosing spondylitis	24

Table 4: Average ages of the disease groups

Name	Sex	Level of the lesion	Type of instrument (s)
M.T.	m	T-6	A
A.Ç.	m	T-7	A
M.S.	m	T-10	A
N.A.	m	T-10	A + P
Ş.B.	m	T-10, 11, 12	A + P
A.Ö.	m	L-1	A
H.T.	m	L-2, 3	P

and enough distraction was applied. Then the empty space is filled with the bone cement. In two of the patients anterior instruments couldn't stabilize perfectly the vertebral bodies, and so we added posterior instruments. In only one patient, posterior instruments are applied alone. The levels of the tumors and applied instruments are listed in Table IV.

Histological examinations are showed that the primary foci of the tumors were kidneys and postates.

In the postoperative period, the patients were assessed according to pain complaints, sitting and walking times, and radiographic findings.

Table 5: The patients of the tuberculosis of spine

Name	Sex	Levels of the disease
M.D.	m	T-8, 9
S.K.	m	T,9
N.K.	f	T-9, 10
N.T.	f	T-11
N.D.	f	T-12, L-1

Five patients who had tuberculosis of spine had antituberculosis treatment first, and then operations were performed. Anterior decompression, anterior instru-

mentation, and bone grafting were made. Patients and levels of diseased vertebrae are listed in Table V.

In postoperative controls of these patients, sitting and walking times, and radiological findings are evaluated.

The largest group in the study was spondylolisthesis with 13 cases. For this purpose, grooved, pointed, short armed rods are used. The rods are attached to the columna vertebralis by hooks and screws. The distal hooks are wide enough to encircle the wings of the sacrum. The proximal hooks are designed to grasp the lamina and facet joints. The hooks are placed, and then the rod is first attached to the proximal, and then to the distal hook, and the distraction is achieved with the help of a nut. From a screw nut located on the wedge, a 60 mm long spongious screw is directed toward the vertebra corpus. The same procedure is performed for other side too. The screws will serve reduction by pulling back tyhe sliding vertebra. Interbody fusion, and posterior fusion, or only posterior fusion should be added to the method.

Eight patients had L-5, S-1, and Five had L-4, 5 spondylolisthesis. Etiologically, 10 cases were isthmic, 1 case traumatic, 1 case degenerative, and 1 case displastic (congenital) type.

Slip amount according to Meyerding classification was Grade I in 11 cases, and Grade II in 2 cases. Percentage of slip, according to Taillard classification was 20 % in 11 patients, and 40 % in 2 patients. The patients of spondylolisthesis are listed in Table VI.

All patients had severe and increasing low back

Table 6: The patients of Spondylolisthesis

Name	Sex	Level of the lesion	Etiology	Slip amount. (Meyerding)
S.E.	m	L-5, S-1	Disp.	Grade I
F.D.	f	L-4, 5	Deg.	I
Ş.Ş.	f	L-4, 5	İsth.	I
H.G.	f	L-5, S-1	Traum.	I
Ş.N.	f	L-5, S-1	Isth.	II
A.B.	f	L-4, 5	Isth.	I
M.A.	f	L-5, S-1	Isth.	I
H.U.	f	L-5, S-1	Isth.	I
M.Ö.	f	L-5, S-1	Isth.	I
A.A.	m	L-5, S-1	Isth.	II
A.N.	f	L-5, S-1	Isth.	I
G.A.	f	L-4, 5	Isth.	I
A.S.	f	L-4, 5	Isth.	I

pain. Neurologically 3 patients had no Achilles reflex, and 1 patients had no Achilles and patella reflex. Also 4 patients had hypoesthesia in L-5, S-1 dermatom, and another patient had thigh atrophy.

Postoperatively, patients were reviewed according to pain, walking time and radiological appearance.

4 patients had spondylolysis. 2 of them had L-4, 5, while the other 2 had L-5, S-1 bilaterally pars interarticularis defect. All complained of severe pain. 1 case had hypoesthesia in L-5, S-1 dermatoma. Postoperatively, they were evaluated clinically and radiologically.

Posterior instruments were applied to 10 patients with fractures and fracture-dislocations of the spine. The causes of lesions were motor vehicle accident in 6 patients (56 %) and falls from heights in 4 (40 %). 2 cases (20 %) had burst fracture, 8 cases (80 %) had compression fracture, and 4 cases (40 %) had fracture-dislocation. Levels of lesions were between T-10, L-2 in 9 cases (90 %) and T-5 in 1 case (10 %). Neurological situation, according to Frankel classification was A in 3 patients, B in 2 patients, C in 3 patients and D in 2 patients. There was no patients in E group.

Preoperatively, local kyphosis angle was 12 to 46 degrees, with a mean of 29.2, and anterior compression angle was 4 to 32 degrees with a mean of 18.6.

Posterior instrumentation was used in all interventions. At the operation, fractured vertebra and one above and one lower vertebrae processus spinosus are excised. To the second proximal vertebra in relation to fracture site an open pedicle hook and to the distal second vertebra a closed lamina hook are placed. With the rods in appropriate sizes, a sufficient distraction is obtained. Same procedure is performed to the other side. Rods are connected with two transverse apparatus, to increase the stability.

These patients are evaluated according to neurological status, radiological appearance, and sitting and walking times.

3 patients are operated because of scoliosis. 2 cases had idiopathic and 1 case functional scoliosis. The scoliotic patients and the characteristics of the curvatures are listed in Table VII.

A halofemoral traction for 5 days, is carried out preoperatively in 1 patient who had a thoracic curvature with 87 degrees. The degree of curvature was diminished to 52 degrees after traction, and then he is operated in this situation.

Table 7: Scoliotic patients

Name	Age	Sex	Etiology	Curvature degree.	Localisation of the curvature
A.S.	13	m	Idiopathic	87	Thoracic
G.Ç.	14	m	Idiopathic	52	Thoracolumbar
F.U.	58	f	Functional	46	Lumbar

A pair of posterior instruments were utilized in operations. Instrument in the concave side provided the distraction, and in the convex side the compression. Two transvers connectors on the proximal and the distal segments of the rods straightened the rotational stability and spreaded the total stress. And finally the fusion is completed by iliac grafts.

The postoperative assessment of the patients was made by sitting and walking times, neurologically, and radiologically.

1 patient who had hemivertebrae on L-4, 5 level, showed the findings of a sciatalgy syndrome, and was treated surgically by posterior instruments of spondylolisthesis.

A patient with Scheuermann's kyphosis, and who was not get better with Milwaukee brace, was operated by posterior instruments. The pectoral and hamstring muscles were found tight in physical examination, and there was no neurological deficit. Kyphosis angle, according to Cobb's method was 62 degrees and the wedge angles of the vertebrae were 18 degrees.

During the operation, the physiological kyphosis angle is obtained by bending the rods in 30 degrees. The distraction is achieved by these rods and the operation was finished by adding the iliac grafts.

Postoperative evaluation was made by sitting and walking times of the patient, clinical findings, and measuring the kyphosis angle.

A posterior wedge osteotomy of 52 degrees, of the L-2 vertebra, was carried out in a patient with lumbar kyphosis due to ankylosing spondylitis. The vertebrae were stabilized by a pair of posterior instruments and the transverse apparatus were increased the stability.

2 patients with lumbar disc disease, and suffering from sciatalgy syndrome, are operated with posterior Alici instruments. level of the lesion was L-4, 5 in 1 patient and L-5, S-1 in the other. The case of L-4, 5 disc disease was also operated first in another center, and because of continuity of his complaints is operated for a second time. The same person had a hypoesthesia in L-5 dermatoma and weakness in dorsiflexion

of the toe. The other person had a hypoesthesia in S-1 dermatoma, weakness in the dorsiflexion of the toe, and 2 cm muscular atrophy of the leg. The Lasègue test was positive at 60 degrees in the first, and at 70 degrees in the second.

The procedure of the operation was hemilaminectomy, discectomy, and corticospinous iliac grafting. Distraction was be protected by a pair of instruments, and the stability was secured with two transverse apparatus.

Postoperative period was be evaluated by complaining of pain and clinical findings.

2 female patients of degenerative disc disease are operated in the same procedure. Level of the lesion was L-4, 5. In the one it was determined a lumbalization of the S-1 vertebra.

Increasing pain was the first complaining of the patients. In physical examination, the positive Lasègue test in 70 degrees, and hypoesthesia of the L-5 dermatoma were established.

A degenerative vertebral stenosis was diagnosed in a male patient in 62 years old. Principal complaint of the patient was the vague leg pain. He was also defined disesthesia and paresthesia with ambulation, and the excellent relief of their symptoms by sitting or lying supine.

In the neurological examination, the Achilles reflex was negative in right, after stress.

At the operation hemilaminectomy, discectomy, and posterior fusion with a pair of instruments and iliac grafts, were carried out. Postoperative evaluations are performed according to the patient's complainings.

An atlantoaxial instability and subluxation due to rheumatoid arthritis was diagnosed in a male patient, who was 30 years old. In radiographic examination, atlantodens interval was measured 11 mm. At the operation, a pair of transverse apparatus were be used like rods and iliac grafts are added for fusion.

Postoperative evaluation was be done by measuring the atlantodens interval.

RESULTS

13 patients with spondylolisthesis are followed-up for 2 to 10 months, with a mean of 5 months. The complaining of pain is disappeared in all patients and it was not recurred.

2 patients with the absence of reflex was defined the same complaints after 6 weeks of the operation. In the radiological controls the slip amount "O" in all patients according to Meyerding and to Taillard. 1 pa-

tient had a superficial wound infection, and recovered with suitable antibiotherapy. There were no failure or breaking in the instruments.

The cases of spondylolysis were followed-up for 6 to 10 months, with a mean of 8 months. The complaint of pain is disappeared in all patients and it was not recurred. A patient with hypoesthesia got better in 2 weeks postoperatively.

The patients with fractures and fracture-dislocations were assessed neurologically in 6 weeks postoperatively. The return of functions, according to Frankel classification, and the comparison between preoperative and postoperative radiographical findings are listed in Table VIII and IX.

The rehabilitation program was began on the third day and the mobilization was permitted on the fourteenth day.

Table 8: Return of neurological function

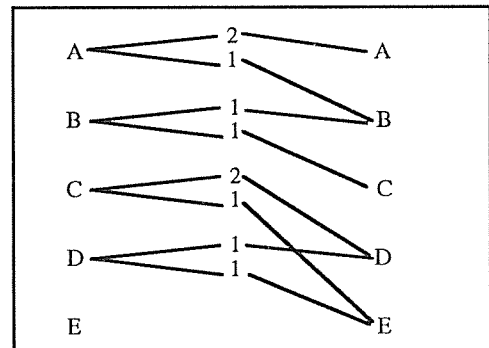


Table 9: Radiographical findings

	Preoperatively		Postoperatively	
	Mean	Range	Mean	Range
Local kyphosis angle	29.2	12-46	8.2	3-23
Ant. Comp. angle	18.6	4-32	4.3	0-16

An operated patient for a vertebra metastasis was died on the postoperative seventh day, because of the lung problems. 4 patients of them were satisfied of the pain complaints and they were not required analgesia. A morphin therapy by an epidural catheterism was carried out for one patient.

The rehabilitation program in bed was began on the third day and all patients were sat on bed with a lumbosacral brace.

The operated tuberculous patients are began to rehabilitation on the third day and mobilized at the fourteenth day. In the follow-up period for 7 months there was no failure in reduction and stabilization.

The mean time of postoperative controls was 3 months in operated scoliotic patients. In idiopathic scoliosis, the curvature diminished to 20 and 14 degrees. The other patient who had a functional scoliosis had a 9 degrees of curvature postoperatively. There was no failure in reduction.

The postoperative curvature amount was 30 degrees in the patient who was operated for Scheuermann's kyphosis. This was the degree procured by bending the rods preoperatively. In the follow-up period during 5 months, there was no changes in the physiological kyphosis. The patient had no pain and he could be walking on fourteenth day.

The operated patients for lumbar disc disease are lain for 48 hours and then the rehabilitation in bed was began. In postoperative examination on the third week, the pain complaining, hypoesthesia, and muscle weakness were disappeared in one patient. In the other continued partially.

2 other patients who were operated for degenerative disc disease had no complainings in the postoperative examination on sixth week. There was no loss of correction during the follow-up period.

An operated patient for degenerative spinal stenosis was mobilized at the first day. All complaints of pain were disappeared on the second week.

A patient with lumbar kyphosis due to ankylosing spondylitis and who was operated with posterior wedge osteotomy of 42 degrees, was mobilized on fourteenth day and he could walk in erect position. In the follow-up period for 1 month he had not any complainings, and there was not any loss in reduction and stabilization.

Atlantodens interval was 3 mm in the patient who was operated for atlantoaxial instability due to rheumatoid arthritis. In the follow-up period during 3 weeks, the patient had no complaints, and there was no failure in stabilization.

DISCUSSION

The vertebral column is a mechanical structure which can move around the frontal, sagittal, and axial axes, and on combinations of them. The supportive elements of this structure consist of the vertebrae corpi, the facet joints, the intervertebral discs, the ligaments which attach the vertebrae to each other, and the mus-

cles which surround the vertebral column. Any disturbance of these structures can cause instability and deformity of the columna vertebralis (1).

stabilization and correction of the vertebrae is obtained by various methods. The oldest and most common method in spinal surgery is Harrington instrumentation, and it is accepted as an important advance in surgical treatment (1). Although the application of Harrington instruments is quite easy, the requirement for an external support postoperatively, has led orthopaedists to the search of modifications and new methods. (Scaglietti, Frontino and Bartolozzi-1976; De Wald et al.-1981; Sijbrondij-1983). (1, 3, 10, 11, 12).

Luque's segmental spinal instrumentation provide a stronger fixation and allow early mobilization postoperatively (1, 2). In the long term follow-up results there were extreme loss of correction (1, 12).

The Cotrel-Dubousset method has added a new dimension to internal spinal fixation. It can be effective in all dimensions of the deformity, and its application has removed the requirement for an external support (1, 87, 9).

Alıcı Spinal System differs to the previous methods by possessing all characteristics required for an internal spinal fixation,

- it can correct deformities in all dimensions,
- can be applied to all pathological processes,
- it can be used in anterior and/or posterior interventions,
- There is no requirement for an external support postoperatively (1).

In this study, the early postoperative radiographical controls showed that the instruments procured complete reduction. In spite of the early mobilization of the patients, on the fourteenth day, there was not any loss of reduction and stabilization during the follow-up period, with a mean of 5 months. These are the advantages of the system.

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