STABILIZATION OF ANTERIOR INSTABILITIES BY POSTERIOR INSTRUMENTATION

S. YALÇIN * O. GÜVEN **

ABSTRACT :

Spinal lesions like fractures, neoplasiae and infections decrease the mechanical resistance of the individual vertebrae and are likely to produce kyphosis, scoliosis or a combination of both which may produce pain, disability and neurological compromise. Between the years of 1988-1993, 43 patients (17 F, 26 M) were admitted to the Marmara University School of Medicine, Department of Orthopaedics and Traumatology with the diagnosis of anterior instability. Posterior fixation with mainly transpedicular screws ad combined hooks were performed in every case. A total of 234 screws and 71 hooks were applied. At the last control, the following results were obtained. 26 patients (60,5 %) were rated to have excellent results, 14 patients (32 %) good, 3 patients (7 %) fair results. There were no bad results.

Key Words: *Anterior instabilities, posterior instrumentation*

INTRODUCTION :

Spinal lesions like fractures, neoplasiae and infections decrease the mechanical resistance of the individual vertebrae and are likely to produce kyphosis, scoliosis or a combination of both. The deformities produced by these anterior instabilities are prone to progress and produce pain, disability and neurological compromise. Only one decade ago, the treatment for these disorders consisted of casting, bracing and palliative measures for pain. Rarely, in selected cases, anterior or posterior stabilization was performed, that were inadequate in many cases. The non-rigid posterior column fixation provided by Harrington instrumentation and similar devices did not produce favorable results in this patient group.

The introduction of CDI in 1988 has revolutionized this branch of orthopaedic surgery by accomplishing the rigid stabilization of the spine with a posterior approach. The three column fixation provided by transpedicular screws combined with multiple hooks and transverse traction devices (DTT's) may produce the required stability in most cases with anterior instability.

On the other hand, anterior fixation devices have also evolved and some authors suggest that almost every anterior instability is to be treated by anterior fixation. This study analyzes the results of posterior instrumentation in a patient group with anterior instabilities.

MATERIALS AND METHODS :

Between the years of 1988-1993, 43 patients were admitted to the Marmara University School of Medicine, Department of Orthopaedics and Traumatology with the diagnosis of anterior instability. Their ages were between 17 and 74 (mean = 54,95). There were 17 females and 26 males. The diagnoses were as follows: 14 unstable fractures of the thoracolumbar spine (5 burst fractures, 7 compression fractures, 2 fracture-dislocations), 15 tumors (5 primary, 10 metastatic), 14 tuberculous spondylitis. In three of the burst fracture patients anterior surgery and in two of the tumor patients laminectomy was performed elsewhere, these patients were referred to our clinic for treatment of their destabilized vertebral columnae. Further clinical information regarding these three patient groups are proposed in Tables 1, 2, 3.

The patients were followed up for 6 to 44 months (17, 48 months mean). Light braces were used for 2-6 months. Clinical examination, anteroposterior and lateral radiographies were taken every third month during the first year, once every year thereafter.

All patients were operated on a Relton-Hall frame with a standard posterior approach. Two to 11 segments were instrumented according to the level of invovement and severity of instability. Posterior fixation with mainly transpedicular screws and combined

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Table 1. Clinical details of patients with thoracal and lumbar fractures.

case	age	sex	segment	Frankel preop	Frankel postop	fused segment	anterior fusion	implant	screw no	hook no	follow up (months)
1	58	M	L2	D	D	L1-L3	-	CD	4	-	44
2	37	M	L1	D	D	T11-L3	-	CD	2	2	42
3	36	M	L1	D	D	T12-L2	-	Alıcı	4	-	42
4	40	F	T12	E	E	T11-L1	+	CD	4	-	26
5	34	M	T12	D	D	T11-L1	-	CD	4	-	24
6	72	F	T11	E	E	T9-T12	-	Alıcı	6	-	23
7	49	M	L1	E	E	T11-L3	+	CD	8	-	21
8	29	M	L2-L4	E	E	L1-L5	-	CD	10	-	16
9	35	M	L2	E	E	L1-L3	+	CD	6	-	15
10	20	F	L5	E	E	L4-S1	-	CD	6	-	13
11	36	M	T5-6-7	E	E	T4-T10	-	CD	3	8	12
12	25	F	T7	A	A	T5-T9	-	CD	4	7	8
13	17	F	T12	A	B	T10-L3	-	CD	9	-	7
14	25	M	L2-L3	E	D	L1-L5	-	CD	10	-	7

Table 2. Clinical details of patients with tuberculous spondylitis.

case	age	sex	segment	primary focus	duration of symptoms	abcess drainage	kyphosis	last kyphos	implant	screw no	hook no	follow up (months)
15	74	M	L2-3	?	24	-	-17	-31	Alıcı	5	---	40
16	48	F	L4-5	?	12	+	-5	-5	CD	5	---	35
17	68	F	L2-3	uterus	12	-	2	-14	CD	4	---	32
18	62	M	T10-11	?	2	-	25	19	CD	4	2	32
19	21	F	T12	?	3	-	23	22	CD	4	---	29
20	50	M	T11	?	3	-	54	13	Alıcı	2	4	26
21	58	M	T8-9	?	6	+	25	20	CD	2	4	24
22	54	M	L4-5	?	18	+	9	9	CD	2	---	21
23	30	M	L3	?	3	+	-29	-25	CD	5	---	19
24	21	F	T10-11	pleura	6	-	34	16	CD	10	---	13
25	50	M	L3-4	?	2	+	18	26	CD	7	---	11
26	27	M	L2	?	4	+	8	2	CD	4	2	9
27	27	M	L4-5	lung	4	+	28	17	CD	4	---	8
28	31	F	T11-12	?	9	-	36	9	CD	12	---	6

hooks were performed in every case. A total of 234 screws and 71 hooks were applied. The planned correction and stabilization were achieved with Cotrel rods. Three patients with metastatic tumors were rated to have a survival of less than one year, fusion was found unnecessary in these patients. The remaining 40 patients had posterior or posterolateral fusion, seven patients had augmentation of the fusion by anterior intervertebral autogenous bone chips.

RESULTS :

At the last control, the following results were obtained. 26 patients (60,5 %) were rated to have excellent results, 14 patients (32 %) good, 3 patients (7 %) fair results. The were no bad results. The functional success rate grading scale shown on Table 4 was employed (9).

Two patients had late screw bending, one patient had late screw breakage, one patient had a screw mis-

Table 3. Clinical details of patients with tumors of the vertebral body.

case	age	sex	diagnosis	Harrington grade	Frankel grade preop-postop		segment	excision	system	screw no	hook no	follow up
29	45	F	L5 schwannoma	II	D	C	L4-S2	+	Alici	4	---	42
30	62	M	T11 plasmacytoma	III	D	D	T9-L1	+	CD	8	---	26
31	32	F	L4 lung ca	IV	D	M	L3-L5	-	CD	6	---	24
32	66	M	L1-2 prostat ca	III	C	M	T10-L4	+	CD	6	2	18 ex
33	25	F	T12 giant cell	I	E	E	T6-L4	+	CD	6	13	14
34	44	F	T10-T12 over ca	IV	E	E	T10-T12	-	CD	6	12	14
35	46	M	L4 plasmacytoma	III	D	D	L2-L5	+	CD	7	---	14
36	73	M	T9 multipl myelom	IV	D	D	T3-L1	-	CD	2	12	7 ex
37	24	F	T12 hemangioma	I	E	E	T11-L1	+	CD	4	1	13
38	33	M	anaplastic ca	IV	E	E	L1-S1	+	CD	10	---	12
39	57	M	sacral myelom	IV	D	C	L3-ilium	+	CD	6	---	11 ex
40	67	F	L1-2 lung ca	III	M	M	T12-L3	+	CD	6	---	10 ex
41	67	M	L3 prostat Ca	I	D	D	L2-L5	-	CD	4	---	8 ex
42	52	M	T7 larynx ca	IV	E	E	T1-L1	-	CD	6	9	8 ex
43	71	F	L5 gastric ca	IV	D	D	L3-S1	-	CD	5	---	6 ex

placement that was revised early, two patients had a superficial infection that responded to short term antibiotics, another patient had deep infection requiring long term parenteral antibiotics and debridement without implant removal.

There were no pseudoarthroses in the series. All patients regained sufficient stability of the thoracolumbar spine. The minimal development of late kyphosis was seen (1,4° mean, 0°-14°). Late neurologic deterioration which is the natural history of tumoral involvement was not encountered despite the adjuvant oncologic treatment.

DISCUSSION :

Extensive development of spinal fixation devices has occurred in recent years. The emphasis was on posterior fixation devices (2). Some anterior fixation systems although introduced earlier have not found general acceptance because of their relative insufficiencies and limitations in surgical techniques. Reports on major complications of anterior instrumentation like failure on the bone-implant interface, late disrup-

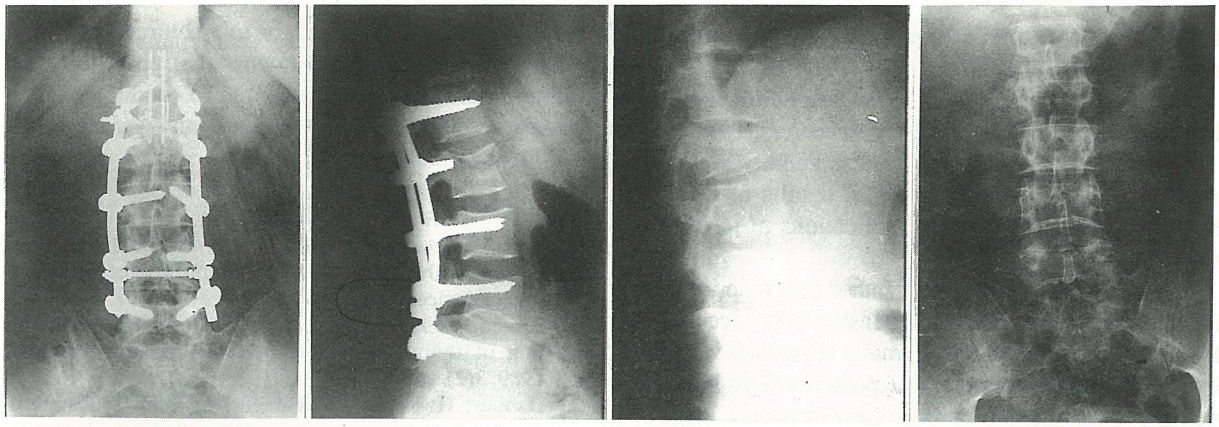

Figure I: Preoperative and postoperative anteroposterior and lateral x-rays of a fracture patient.

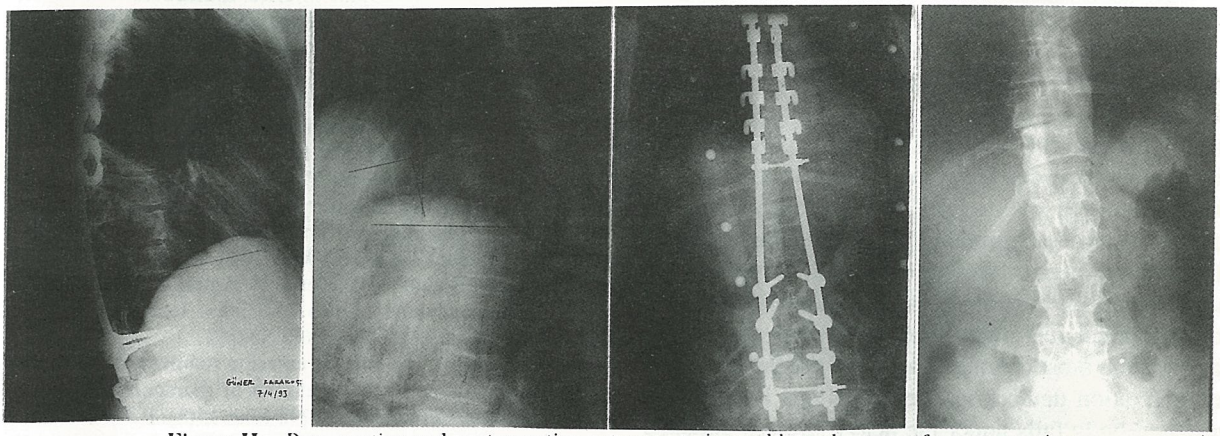

Figure II: Preoperative and postoperative anteroposterior and lateral x-rays of a tumor patient.

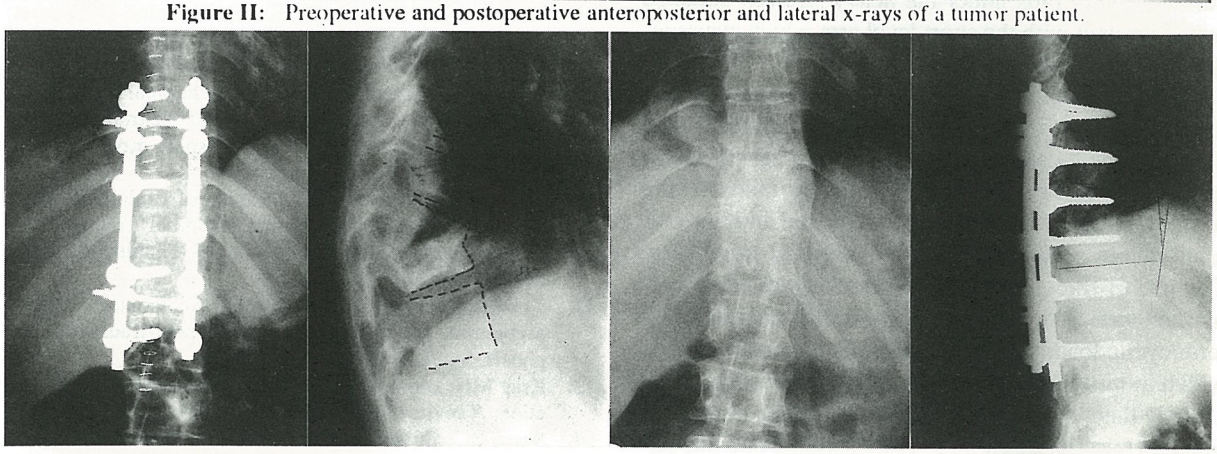

Figure III: Preoperative and postoperative anteroposterior and lateral x-rays of a tuberculosis patient.

tion of major vessels have led to inpopularity of anterior fixation devices (11). The Dunn device has been withdrawn from the market (11). There has been a general trend towards the use of posterior fixation devices and posterior fusion, rarely augmentation with anterior fusion is indicated in selected patients that are prone to have pseudoarthrosis.

The developments in posterior spinal instrumentation have enabled the orthopaedic surgeon to treat a multitude of spinal pathologies. The experience based on the treatment of large patient groups with unstable fractures, tumors, infections and spondylolisthesis has been presented in the literature abundantly (1, 3, 5, 8, 14, 15). The vast majority of these articles report of

the satisfactory results of treatment with posterior instrumentation (3, 5, 6, 10).

On the other hand the evolution of anterior fixation devices are still going on in some centers. (Kaneda (10), Haas (7), Kostuik (12)) These authors are constantly reporting of the successful results of biomechanical testing and clinical applications of these devices.

It is safer to use a posterior rather than anterior spinal dissection. First, anterior extension may necessitate division of the diaphragm and many segmental vessels. Second the relative strength of posterior/arch bone is greater (16). Either a bilaminar claw or pedicle screws provide better fixation than anterior screws into the cancellous vertebral body (4).

The forces required for stabilization must not exceed the strength of bone-implant interface. The extension moment (M) needed for stabilization is the product of the force (F) applied to the bone times the distance (D) between the point of bony attachment and the fulcrum (M = F x D). Thus we can reduce the amount of force required by lengthening the level arm (the rod) in posterior devices (4). But long rods are not a component of anterior instrumentation systems due to anatomical restraints. The two above mentioned facts are the most common causes of the failure of anterior fixation devices ie. the cancellous bone of the vertebral body fails under the heavy stresses imposed by the implant with the short level arm which eventually is led to loosening (16).

The infrequent observation of screw bending and breakage as seen in our cases is the result of a new phenomenon incoherent with bone and joint physiology; after posterior fusion there is bony union in the posterior column whereas the middle and anterior columns retain a part of their physiological mobilities. The use of transpedicular screws executes three column fixation with one column (posterior) fusion. Long term cyclic loading produces excessive bending forces which in turn leads to screw bending or breakage (13). Usually there are no adverse effects of these complications. In our two cases with screw bending and one patient with screw breakage there were only 4.5° of loss of correction and no problems of fusion.

There were two patients which had screw pull-out due to preexisting osteoporosis. Thus we changed our strategies in this risk group to the addition of hooks and sublaminar wires or long instrumentation to prevent screw pull-out.

As also shown in our series of 43 patients having anterior instabilities secondary to fractures, infection and tumors posterior instruments that provide three column fixation have the potential to produce the required stability in almost all cases of anterior instability with only minor complications.

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