THE EFFECT OF DIFFERENT INTERNAL FIXATION METHODS ON THE NEUROLOGICAL OUTCOME OF THORACOLUMBAR VERTEBRA FRACTURES *

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ABSTRACT :

Neurological status of 45 patients who were operated on for the treatment of thoracolumbar fractures were evaluated. Internal fixations included 19 SSI, 12 posterior CD or Alıcı instrumentation and 14 Kaneda instrumentation. No significant difference between these internal fixation methods regarding the difference between preoperative and postoperative neurological status of the patients could be found.

Key words: *spinal fracture, neurological outcome.*

Vertebra fractures have profound consequences for the patients, families and society because of acute spinal cord injuries they may lead to. A study by Tator et al. (7) showed that the affected population has become younger, arrived in a hospital sooner and had less severe cord injuries currently compared with the same group of patients of 3 or 4 decade ago. These findings also increase the importance of the selection of treatment modality. The controversy about whether the operative or non-operative management should be preferred has been on the agenda for long years and still is a matter of discussion (1, 4). The wide spectrum of operative treatment types and the variety of available internal fixation devices increase the complexity of the subject. Various methods of internal fixation in thoracolumbar fractures were described and each has its own advantages and disadvantages. An internal fixation method must provide adequate stability, and must not jeopardize the neurologic recovery but enhance it. According to our point of view, a vertebra fracture needs surgical treatment and internal fixation if it is with neurologic deficit (either stable or unstable) or if it is unstable (with or without neurologic deficit). Neurologic recovery is possible with appropriate surgery if the lesion is not complete. It is demonstrated with large series that, persons with complete cord injury lasting longer than 24 hours do not recover neurologic function, but those with incomplete lesions have some chance for useful recovery (2). We aimed to compare the effects of three different types of spinal instrumentation on the neurologic recovery of patients with thoracolumbar fractures, in this study.

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MATERIAL AND METHOD

Forty-five patients who were operated on for the treatment of thoracolumbar fractures between 1984 and 1995 in our institution were evaluated in this study. 15 (33%) of the patients were female and 30 (67%) were male. Mean age of the patients at operation was 31 years (range, 16-60 years) and mean follow-up of them was 49 months (range, 4-135 months). Regarding the type of the fracture 27 of the patients had burst fractures, 11 had compression fractures and 7 had fracture-dislocations. The mean period between the trauma and operation was 15 days (range, 0-52 days). Internal fixation was achieved with segmental spinal instrumentation in 19 patients (Group I), posterior CD or Alıcı instrumentation in 12 patients (Group II) and Kaneda instrumentation in 14 patients (Group III). Patient data for each group are given in Table 1.

12 of the patients from Group I had Luque procedure while remaining 7 of them underwent Harri-Luque procedure. In Group II; CD instrumentation was applied for 6 patients and Alıcı instrumentation for 6 patients. In Group III all patients had Kaneda instrumentation. 8 patients from Group I, 9 patients from Group II and all patients of Group III underwent anterior decompression either in the same or in a different anaesthetic session.

Table 1. Patient data for each group. (*: Female, **: Male, ***: Fracture-dislocation)

	Mean age at operation	Sex		Type of fracture			Mean period between trauma and operation	Mean follow up time
		F*	M**	Burst	Compression	Frac-disloc***		
Group I	34 (17-57)	4	15	7	5	7	12 days (0-31)	86 months (44-135)
Group II	29 (16-60)	6	6	6	6	–	21 days (7-32)	34 months (10-86)
Group III	29 (16-42)	5	9	14	–	–	14 days (2-46)	12 months (4-21)

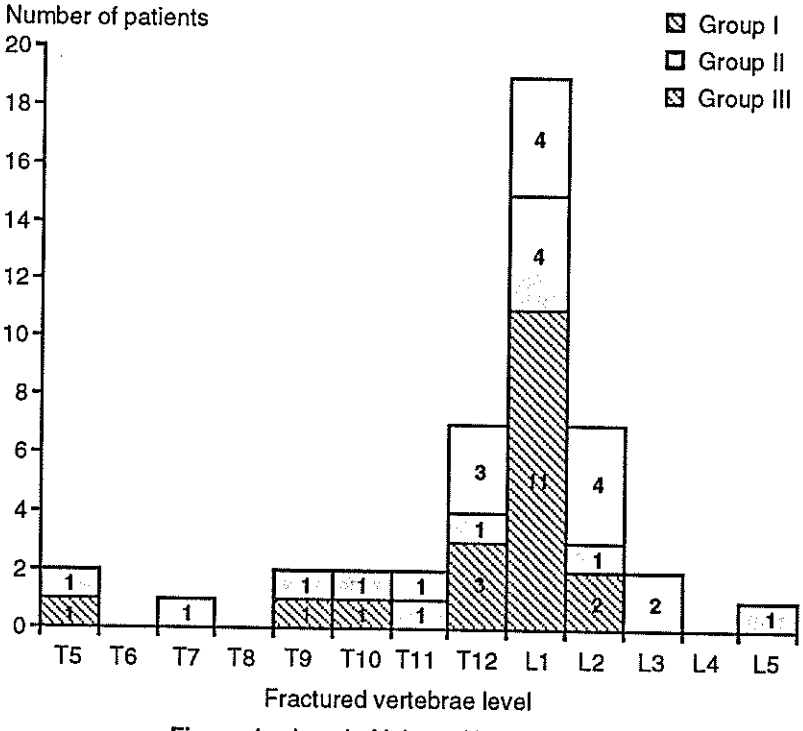

Figure 1: Level of injury of burst fractures

Seven (15.6%) of the fractures were at the cord level (T1-T10), 28 (62.2%) of them were at conus medullaris level (T11-L1), and 10 (22.2%) of them were at the cauda equina level (L2-L5). Distribution of level of the injured vertebrae is given in Figure 1.

The patients' neurologic assessments were made according to the Frankel's Scale, because preoperative neurological evaluation of most of the patients were available only with this scale. 5 grades of function were described in this scale: According to the system of Frankel, A = complete spinal-cord lesion, B = sensory sparing only; C = motor function present, but not useful; D = motor function preserved and useful, but not normal; and E = normal neurological function (3). Preoperative Frankel Grades of the patients are given in Figure 2.

Numeric values were given for each Frankel grade (A: 0, B:1, D:3, E:4). Preoperative and postoperative values of the patients were compared in each group by using Wilcoxon test to understand that if there is a significant difference between the preoperative and postoperative status of the patients. Then the difference between the preoperative and postoperative neurologic status was calculated for each patient (Example: Preoperative Frankel grade B, postoperative Frankel grade D, The difference is 4 – 2 = +2). If the patient's neurologic status had not changed then the difference was 0, and if it worsened then the difference was a negative value. These differences for each group was compared with the differences of other groups by using Kruskal-Wallis nonparametric ANOVA Test.

The effects of initial Frankel Grade and fracture level on the neurological outcome of the patients were also evaluated.

RESULTS

Postoperatively, 23 patients (12 with Frankel Grade A, 4 with Frankel Grade B, 2 with Frankel Grade C, and 5 with Frankel Grade E) remained at the same Frankel Grade; 10 patients (1 with Frankel Grade B, 3 with Frankel Grade C and 6 with Frankel Grade D) improved 1 Frankel Grade and; 12 patients (5 with Frankel Grade B and 7 with Frankel Grade C) improved 2 Frankel Grades.

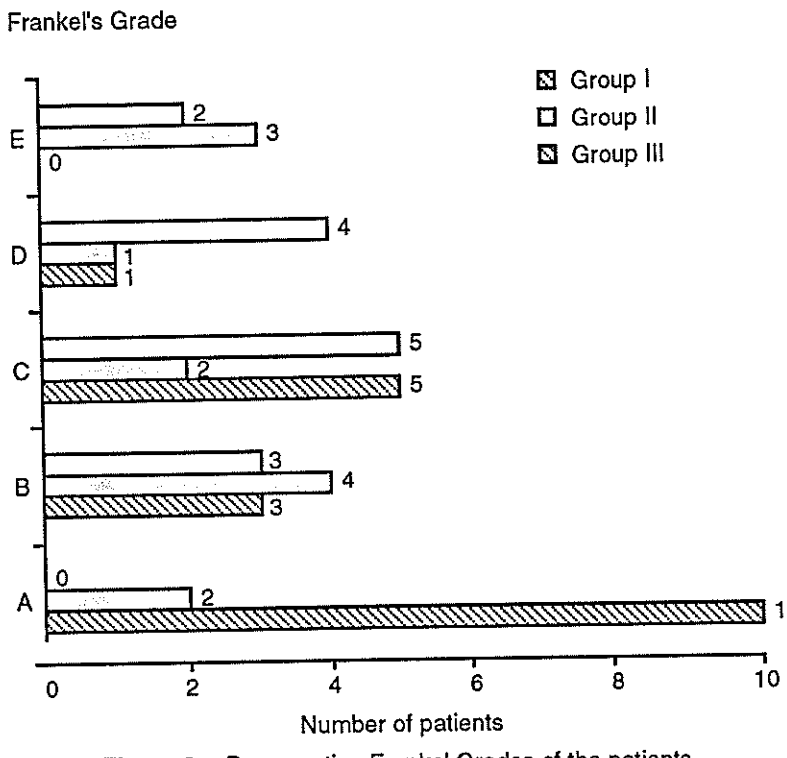

Figure 2: Preoperative Frankel Grades of the patients.

A greater incidence of complete neurologic deficit was found in fractures at the cord level compared with the fractures at lower levels. The ratio of complete neurologic deficit with fractures at the cord level was 57.1 % (4/7) while the same ratios were 25 % (7/28) and 10% (1/10) with fractures at conus medullaris and cauda equina levels respectively.

The Frankel Grade of 4 out of 7 patients with fractures at the cord level (T1-T10) was A and their neurological status remained unchanged postoperatively. One patient with Frankel Grade B could not improve postoperatively, either. Remaining two patients were in Grade E and their situation did not change.

Twenty-eight patients had lesions at conus medullaris level (T11-L1). 12 of them (7 with Frankel Grade A, 2 with Frankel Grade B, 2 with Frankel Grade C, and 1 with Frankel Grade E) remained at the same Frankel Grade after the operations. Two out of 13 patients with initial Frankel Grade of B or C improved 1 Frankel Grade and remaining 11 improved 2 Grades. Two patients at Grade D improved to Grade E.

Ten patients' lesions were at cauda equina level (L2-L5). Four of them (1 with Frankel Grade A, 1 with Frankel Grade B and 2 with Frankel Grade E) remained at the same grade. Five of them (1 with Frankel Grade C and 4 with Frankel Grade D) improved 1 Frankel Grade and 1 of them with Frankel Grade C improved two grades.

Postoperative Frankel Grades of patients in each group are given in Figure 3.

In 22 of the patients an advance in the neurological status according to the Frankel's Scale was obtained. 1 patient from Group I, 3 patients from Group II and 6 patients from Group III had improved one Frankel grade; 5 patients from Group I, 3 patients from Group II and 4 patients from Group III had improved two Frankel grades. 23 patients had remained the same Frankel grade, 13 from Group I (10 in Grade A, 1 in Grade B, 2 in Grade C), 5 from Group II (2 in Grade A, 1 in Grade B, 3 in Grade E) and 4 from Group III (2 in Grade B, 2 in Grade E). None of the patients' neurological status deteriorated postoperatively. Comparison between preoperative and postoperative neurologic status of the patients is given in Table 2.

Compasion of preoperative and postoperative neurologic status of the patients in each group by using Wilcoxon test gave results of significant differences in every group. That means with each of these three fixation methods a statistically significant improvement can be achieved postoperatively ($p<0.05$ for Group I and Group II and $p<0.01$ for Group III). According to the comparison of the results between these three groups with the Kruskal-Wallis nonparametric ANOVA test, p value was equal to 0.2729. No statistically significant differenece exists between the three groups according to this result regarding the neurological outcome of the patients.

Distribution of complications for each group of patients is given in Table 3.

Implant failures encountered in Group I included rod breakage in 1 patient and wire breakage in 2 patients. The deep infection seen in 2 patients (1 from Group I and 1 from Group II) was cured by antibiotic therapy and extraction of the implants after the bony fusion occurred.

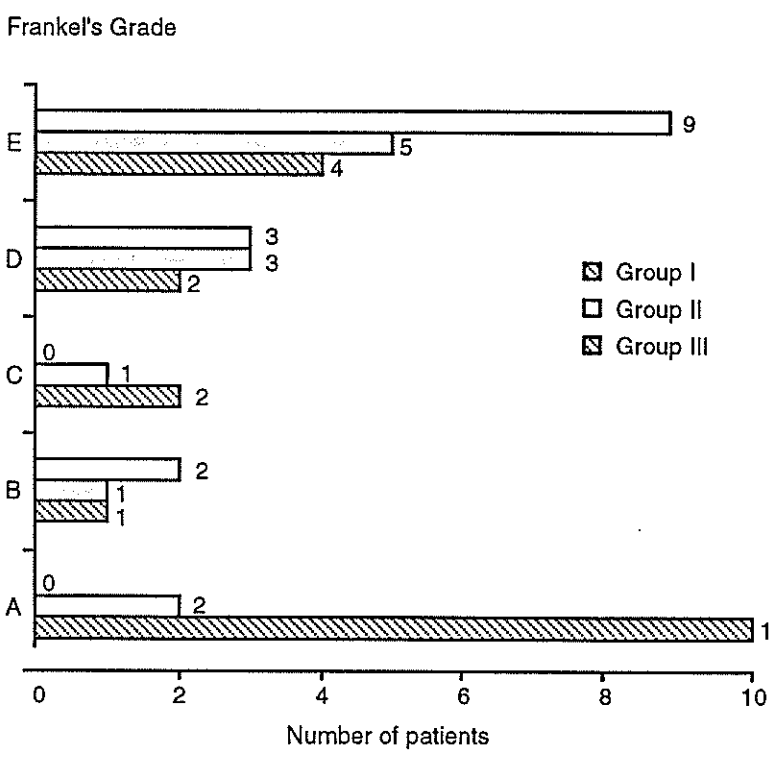

Figure 2: Postoperative Frankel Grades of the patients.

DISCUSSION

There are some very basic questions still remained unanswered in the management of thoracolumbar fractures. Differing results exists in some important points such as whether operative or nonoperative treatment is superior; or anterior or posterior surgery is more effective. The aim of our study was not to compare the results of anterior and posterior surgery, because there were patients who underwent anterior decompression in all groups. We tried to find that if there is a significant difference between the 3 main system we used for the treatment of thoracolumbar fractures regarding the neurological outcome of the patients.

The patients' neurologic assessments were made according to the Frankel's Scale. It is a reliable, simple and widely used system. It corresponds to total sensory and motor function but is insensitive to walking and bladder function (2). Although we could not find any significant difference between

Table 2: Preoperative and postoperative neurological status of the patients in each group according to the Frankel's Scale.

		Postoperative Neurological Status				
		A	B	C	D	E
Preoperative Neurological Status	A	Group I: 10 Group II: 2				
	B		Group I: 1 Group II: 1 Group III: 2	Group II: 1	Group I: 2 Group II: 2 Group III: 1	
	C			Group I: 2	Group II: 1 Group III: 2	Group I: 3 Group II: 1 Group III: 3
	D					Group I: 1 Group II: 1 Group III: 4
	E					Group II: 3 Group III: 2

Table 3: Distribution of complications

	Group I	Group II	Group III
Implant failure	3	2	–
Superficial Infection	–	1	–
Deep infection	1	1	–
Decubitis ulcer	1	–	–
Pseudoarthrosis	–	–	–
Exitus	1	–	–

different instrumentation system it may be possible to detect differences with more detailed and accurate scaling systems.

In a study by Gertzbein et al. (5) it was shown that there is a clear relationship between the level of injury and Frankel grades, that is neurologic lesions at the level of the spinal cord tend to be more severe than lesions in the cauda equina. The greater incidence of complete neurologic deficit with fractures at the cord level (T1-T10) and decreased incidences at the conus medullaris (T11-L1) and cauda equina (L2-L5) levels in our patients is parallel to this finding. No patient recovery could be obtained in our patients with fractures at the cord level because 4 of them had complete lesions (Frankel A) and 2 of them were neurologically normal (Frankel E). The only patient with incomplete lesion was in Frankel Grade B and he did not recover. Regarding the lesions at conus medullaris level, 80% (16/20) of patients with incomplete lesions improved 1 or 2 Frankel Grades. In patients with fractures at cauda equina level, 85.7 % (6/7) incomplete lesions improved 1 or 2 Frankel Grades.

In our patients, complete neurologic lesions did not improve, incomplete lesions generally improved, and all of the neurologically intact patients remained intact. This situation was observed in all three groups without a prominent difference. Patient recovery by at least 1 Frankel Grade of incomplete lesions (i.e. Frankel Grade B, C and D) after the operations was 78.6% (22/28). This value was 55.5% for Group I, 85.7% for Group II and 83.3% for Group III. Although a statistical analysis is not possible, patients in Group II and III seems to improve the neurological status better than Group I.

In a comparative study of three fixation devices in 70 patients Sasso and Cotler reported that three posterior devices in the study -Harrington rods and hooks, Luque rods with sublaminar wires and A-O dynamic compression plates with pedicle screws- did not differ with regard to neurologic recovery and this was in agreement with similar studies in the literature (6). We also could not find any significant difference between the two posterior systems included in our study.

We believe that decompression of spinal canal is most effective and reliable with the anterior surgical approach and neurologic recovery seems to be related with the adequacy of spinal canal decompression rather than the type of instrumentation method used.

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