SURGICAL RESULTS OF UNSTABLE THORACOLUMBAR VERTEBRAL FRACTURES

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ABSTRACT

Twenty-six patients with unstable vertebral fractures were operated at Hospital of Fırat University Medical School between August 1995 and August 1999. 17 (65.3%) patients were male and 9 (34.7%) were female. The mean age was 40.8 (14-85). Levels of the 26 fractured vertebrae varied between T10 and L4. The mean follow-up period was 18 (6-52) months. The interval between the injury and surgery was 4.8 days (6 hours-35 days) and the mean operation time was 2.6 (2-3.5) hours. 23 (88.4%) cases were operated on with posterior approach, 1 (3.9%) case was operated on with anterior and 2 (7.7%) cases were operated on with combined approach by using "Alıcı Spinal System". We performed the short segment fusion in 24 patients and did not perform fusion in 2. The instrument was removed in two patients and mean removal time was 15.5 (11-20) months.

Preoperatively, Frankel A in 4 (15.4%), Frankel B in 0 (0%), Frankel C in 4 (15.4%), Frankel D in 6 (23.1%) and Frankel E in 12 (46.1%) cases were found. Postoperatively, none of the patients had progression of neurological status. 4 patients had complete and 10 had incomplete injuries. No recovery was observed in all of the complete injuries and 2 incomplete injuries. Partial recovery in 1 incomplete injury and complete recovery in 7 incomplete injuries were observed.

Key words: Thoracolumbar vertebral fractures, Surgical treatment, Alıcı Spinal System.

ÖZET

İNSTABİL TORAKOLUMBAR VERTEBRA KIRIKLARININ CERRAHİ SONUÇLARI

Ağustos 1995 - Ağustos 1999 arasında, Fırat Üniversitesi Tıp Fakültesi Hastanesi'nde instabil vertebra kırığı bulunan 26 hasta, opere edildi. 17 olgu (%65.3) erkek, 9 olgu (%34.7) kadındı. Ortalama yaş 40.8 (14-85) idi. 26 kırık omur seviyesi, T10-L4 arasında değişiyordu. Ortalama izlem süresi 18 (6-52) aydı. Yaralanma ve cerrahi arası süre, 4.8 gün (6 saat - 35 gün), ve ortalama operasyon süresi 2.6 (2-3.5) saatti. 23 (%88.4) olguda sadece posterior, 1 olguda (%3.9) anterior, 2 (%7.7) olguda ise "Alıcı Spinal Sistem" kullanılarak kombine girişim uygulandı. 24 olguda, kısa segment füzyon yapılırken 2 olguda füzyon uygulanmadı. 2 olguda, enstrüman çıkarıldı,ortalama çıkarma süresi 15.5 (11-20) aydı.

Olguların operasyon öncesi değerlendirilmesinde, 4 olgu (%15.4) Frankel (A) 0 olgu (%0) Frankel B, 4 olgu (%15.4) Frankel C, 6 olgu (%23.1) Frankel D ve 12 olgu (%46.1) Frankel E olarak değerlendirildi. Postoperatif dönemde, hiçbir hastada nörolojik progresyon saptanmadı. 4 olguda komplet, 10 olguda inkomplet yaralanma mevcuttu. Tüm komplet ve 2 inkomplet yaralanmada, iyileşme görülmedi. 1 komplet ve 7 inkomplet yaralanmada, parsiyel iyileşme sağlandı.

Anahtar sözcükler: Torakolumbar vertebra kırıkları, Cerrahi tedavi, Alıcı Spinal Sistem.

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INTRODUCTION

Making a decision of stability and instability of thoracolumbar vertebral fractures is an important factor for choosing the suitable treatment alternative (2,5,14,17,21). For this reason, different classification systems were improved.

Denis classified the vertebral fractures as stable and unstable and separated the unstable fractures as mechanical unstable, neurological unstable, mechanical and neurological unstable (17). Farcy and Weindenbaum made a classification system by evaluating the bone and soft tissue condition and decided the stability and instability of fractures (9).

Bone and soft tissue are together an important factor in stability. Most of the authors agree that, surgical treatment which had some advantages to conservative treatment must be preferred in unstable vertebral fractures (2,9,10).

Today, there is a lot of vertebral instruments which can be used with anterior or posterior route like CD, Kaneda etc. (7,21).

In 1989, Alıcı Spinal System was improved by Emin Alıcı and started to use in Turkey (4).

In our clinic, we are using Alıcı Spinal System for reduction and stabilization in surgery indicated patients with unstable thoracolumbar vertebral fractures.

MATERIAL AND METHOD

51 cases of vertebral fractures were seen between August 1995 and August 1999. 26 cases were evaluated as unstable vertebral fractures and operated on by using Alıcı Spinal System.

17(%65.3) cases were male, 9(%34.7) cases were female. The mean age was 40.8(14-85) years and mean follow-up period was 18 (6-52) months.

We observed the cause of vertebral fractures as falling from a height in 14(%53.8), traffic accident in 9 (%34.6), falling of a material on the back of the patient in 2 (%7.7) and gunshot injury in 1 (%3.9) case.

The levels of fractured vertebrae varied between T10 and L4 and found as T10 in 1 (%3.9), T12 in 9 (%34.6), L1 in 12 (%41.6), L2 in 3 (%11.5) and L4 in 1 (%3.9) case.

Vertebral fractures were classified by using the Denis's Classification System and fracture-dislocation was found in 3 cases (Table 1).

Table 1. Types of vertebral fractures.

Compression fracture	Burst fracture		Fracture - dislocation		Seat-belt
----	Type A	5 (%19.2)	Type A	1 (%3.8)	----
	Type B	14 (%53.8)	Type B	2 (%7.7)	
	Type C	0 (%0)	Type C	0 (%0)	
	Type D	3 (%11.5)			
	Type E	1 (%3.8)			

Neurological status was evaluated by using Frankel's Classification System and neurological deficit was found in 14(%53.9) cases (Table 2).

Table 2. Preoperative neurological status of patients.

Preoperative neurological status		
Frankel A	4	%15.4
Frankel B	0	%0
Frankel C	4	%15.4
Frankel D	6	%23.1
Frankel E	12	%46.1
Total	26	%100

Accompanied injuries were found in 9 (%34.6) cases. Two patients had 2 accompanied injuries (tibia+colles fractures in 1 and pelvis fracture+intraperitoneal bleeding in another) and others had 1 accompanied injuries (Table 3).

Table 3. List of injuries accompanied with vertebral fractures.

Clavicula fracture	2	%7.7
Hemopneumothorax	2	%7.7
Colles fracture	1	%3.8
Tibia+colles fracture	1	%3.8
Rib fracture	1	%3.8
Pelvic fracture + intraperitoneal bleeding	1	%3.8
Duodenal rupture	1	%3.8
Total	9	%34.6

The period between the accident and operation time of the patients varied from 6 hours to 35 days (mean: 4.8 days); 8 (%30.8) cases in first 24 hours, 10 (%38.4) between 24 and 96th hours and 8 (%30.8) after the 96th hours. The mean operation time was 2.6 (2-3.5) hours and the mean hospitalization time was 20 (8-64) days.

Posterior instrumentation and fusion in 21 (%80.7) of 26 cases, only posterior instrumentation in 2 (%7.7),

posterior and anterior instrumentation and fusion in 2 (%7.7) and anterior instrumentation and fusion in 1 (%3.9) were performed (Figure 1).

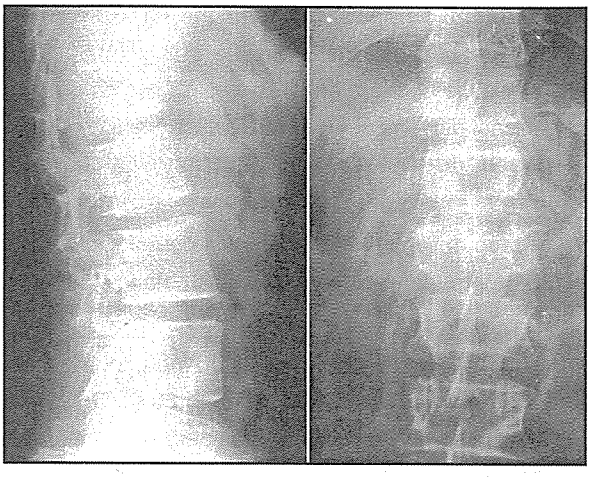

Figure 1a. Preoperative AP and lateral x-ray of 18 years old woman with L1 burst fracture.

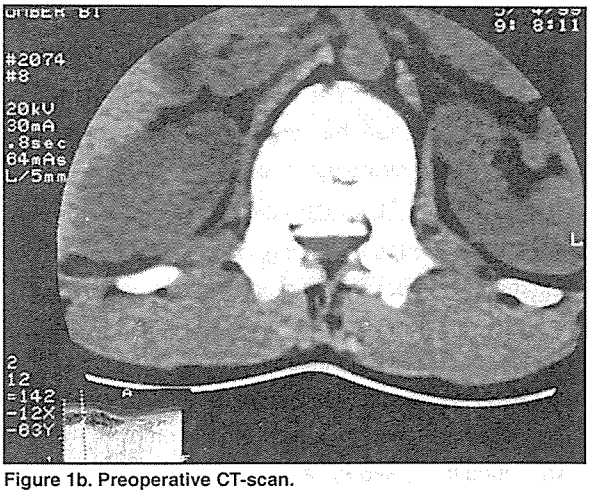

Figure 1b. Preoperative CT-scan.

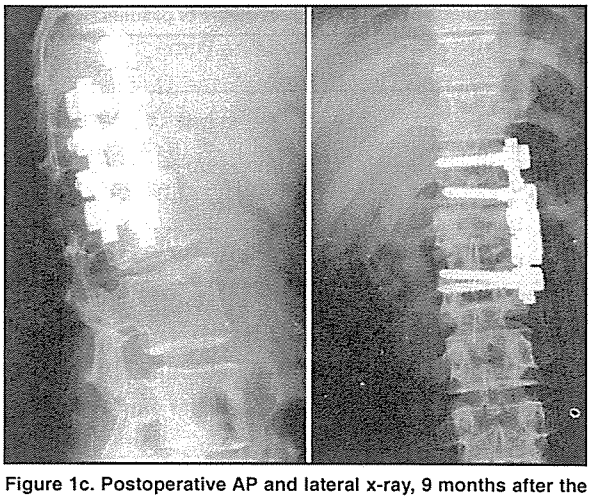

Figure 1c. Postoperative AP and lateral x-ray, 9 months after the operation with anterior approach.

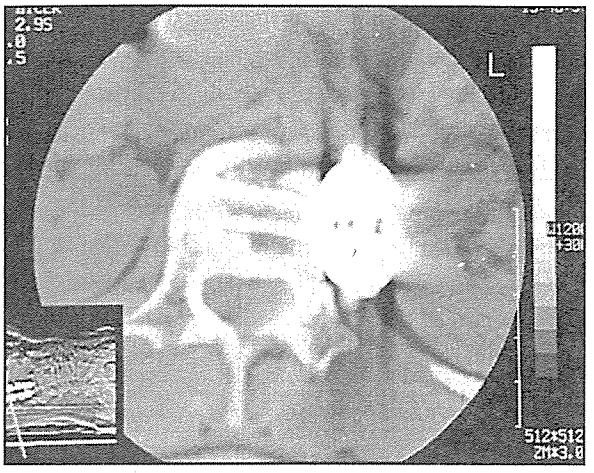

Figure 1d. Postoperative CT-scan.

Proximally, we used pedicle hook on two levels and distally laminar hook or transpedicular screw on two levels with posterior approach. In only 1 case, we used transpedicular screw on one level.

We determined the medullar canal compression in all cases as an average of %47.2 (%10-%75) and created total laminectomy in 2, posterolateral direct decompression in 3 and indirect decompression in 18 cases with posterior approach and direct decompression in 3 cases with anterior approach.

We performed short segment fusion (2 segment) in 24 cases by using iliac wing otogen graft in 19 (%73.1) and allograft in 5 (%19.2) cases. No fusion was done in 2 cases.

Rehabilitation was started in postoperative 3rd day in the bed when the patients had no neurological deficit and started to walk in postoperative 5th day. In rehabilitation period, patients used corset (toracolumbar, lumbosacral and Jewet type according to the fracture level). When the patients had neurological deficit, we started the rehabilitation in the 1st postoperative day in the bed. Follow-up period was 1 month for first 3 months, 3 months for first 1 year and after that, in 6 months periods. The corset using time was 6 months.

As a radiologic evaluation, AP and lateral x-ray and CT-scan of the vertebral column was performed in preoperative, early postoperative and late postoperative

period.

The spinal canal compression ratio was measured by using the Hashimoto's method. In the last control, pain and occupational condition of patients were evaluated by using the Pain and Work Scale of Denis.

We performed the statistical analysis with Mann-Whitney U test.

RESULTS

The percentage of anterior vertebral height loss, anterior compression angle, local kyphosis angle and the compression percentage of spinal canal were evaluated with radiologic measurements in preoperative, early postoperative and late postoperative periods (Table 4).

Table 4. Preoperative and postoperative radiologic evaluation of vertebral fractures.

	Preoperative	Early postop.	Late postop.
Loss of anterior column height (%)	%54.3	%19.2	%21.7
Anterior compression angle	21.4°	6°	7.4°
Kyphosis angle	15.3°	1.7°	1.8°
Compression of spinal canal (%)	%47.2	%15.4	---

According to the period between the accident and operation time, three groups were created. First 24 hours was Group 1, between the 24 and 96th hours was Group 2 and after the 96th hours was Group 3. Decompression percentage was estimated between these groups with CT-scan preoperatively and postoperatively (Table 5).

Table 5. Preoperative and postoperative compression percentage of spinal canal between the three groups.

Time between the accident and operation		Compression percentage of spinal canal	
		Preoperative	Postoperative
Group 1	First 24 hours	%46.2	%12.1
Group 2	Between the 24-96 hours	%47.1	%14.4
Group 3	After the 96th hours	%47.3	%19.7

Preoperative and postoperative compression percentage of spinal canal were compared between the three groups by using the Mann-Whitney U test.

In preoperative period, between the Group 1 and Group 2 (p=0,213) and between the Group 1 and 3 (p=-0,065) and between the Group 2 and 3 (p=0,688), we did not determine any significant difference. In postoperative period, between the Group 1 and 2 (p=0,001), between the Group 1 and 3 (p=-0,001) and between the Group 2 and 3 (p=0,000), we determined significant difference. As a result; when the time interval between the accident and operation was short, the success of decompression was increased.

Preoperative and postoperative neurological status of three groups were compared with Mann-Whitney U test.

In preoperative period, between the Group 1 and 2 (p=0,062) and between Group 2 and 3 (p=0,129), no significant difference was determined. In preoperative period, between the Group 1 and 3 (p=0,002) and in postoperative period, between the group 1 and 2 (p=0,001), between the Group 1 and 3 (p=0,003) and between the Group 2 and 3 (p=0,000), significant difference was determined. As a result; there was a direct correlation between the early surgical intervention and recovery of the neurological deficit.

By using Frankel's Classification System, when we created the groups according to the neurological status and made the observation postoperatively, we could not find any recovery in 4 cases of complete neurological injuries. In 10 cases of incomplete neurological injuries, no neurologic recovery was found in 2 (%7.7) and partial recovery was found in 1 (%3.8) and complete recovery was found in 7 (%26.9) cases (Table 6).

Table 6. Postoperative neurological status of patients.

Preoperative		Postoperative
A=4		A=4
B=0		B=0
C=4	1 to D and 2 to E	C=1
D=6	5 to E	D=2
E=12		E=19

Neurological status of each case did not worsen in early postoperative and follow-up period. The cases were evaluated according to the Pain and Work Scale

of Denis (Table 7,8).

Table 7. Evaluation of the cases with Pain Scale of Dennis.

Pain Scale of Dennis	Case Number
P1 No pain	23 (%88.4)
P2 Sometimes pain, which needs no treatment	2 (%7.7)
P3 Pain, which needs treatment but can work	1 (%3.8)
P4 Moderate pain, which prevents working	----
P5 Excessive pain, which needs continuous treatment	----

Table 8. Evaluation of the cases with Work Scale of Dennis.

Work Scale of Dennis	Case Number
W1 Return the old heavy work	12 (%46.1)
W2 Return the old easy work	5 (%19.2)
W3 Not return the old work and study in easier work	3 (%11.5)
W4 Not working every day	2 (%7.7)
W5 Not working	4 (%15.5)

In 11(%42) cases, 5 various types of complications occurred (Table 9).

Table 9. Types of complications.

Complications	Case Number
Laminar fracture (intraoperative)	1 (%3.8)
Distal laminar hook loosening	4 (%15.3)
Soft tissue infection	3 (%11.5)
Reduction loosening	1 (%3.8)
Urinary infection	2 (%7.7)

Only 1 case with soft tissue infection had no recovery with antibiotherapy and instrument in the postoperative 11th month. Other complications were treated with chemotherapy and observation.

In the follow-up period, 2 instruments were removed and mean removal time was 15.5 (11-20) months.

DISCUSSION

Arguements about the treatment of thoracolumbar vertebral fractures are stability and instability of fractures, treatment approach, surgery timing and techniques (2,5,14,17,21). By the development of the instrumentation systems, many orthopaedic surgeons turned towards the surgery (2).

Conservative or surgical treatment of burst fractures are important arguement and the basis of this arguement is about the burst fractures (2, 17). Some authors accepted the burst fractures as stable and preferred conservative treatment (2). The indications of conservative treatment are less than 50% anterior vertebral height loss, less than %20 local kyphosis angle and less than 30% spinal canal compression (2). In conservative treatment, deformity and neurological deficit due to the loss of reduction were found too high and immobilization time was between 4-12 months. In conservative treatment, returning to the pretraumatic activity falls due to the spinal deformity and pain (2).

In the surgical treatment of the unstable vertebral fractures, there are some advantages like preventing the late deformity and pain with the direct and indirect decompression techniques, short hospitalization time, early mobilization and early returning to the daily activity (2). Generally, indications of the surgical treatment are insufficient conservative treatment, more than 50% anterior vertebral height loss, more than 20% local kyphosis angle, more than 30% spinal canal compression, neurological deficit and unstable burst fracture (1,2,24).

There are some investigations about the correlation between the bone and soft tissue compression in spinal canal and neurological deficit. Some says there is and others say there is not any correlation (2,13).

Hashimoto informed that; more than 35% spinal canal compression in T11-T12 levels, more than 45% canal compression in L1 level and more than 50% canal compression in L2-L5 levels had a risk of neurological deficit (19).

Improved neurological status for sufficient daily activity was expected in the cases of the incomplete neurological deficit (13). We had 10 cases with incomplete neurological deficit, 1 of them had partial recovery and 7 of them had complete recovery. 2 cases had no recovery.

Decompression may be done by direct and indirect techniques and achieving to release the spinal canal compression in unstable vertebral fractures (8,12,13,21).

Some authors say that decompression is unnecessary and the fragments within the canal may be resorbed in the follow-up period (6,16). Direct decompression could be done by anteriorly or posteriorly and anterior approach is the effective decompression technique. Posterior decompression is separated to the direct and indirect types (10). Laminectomy, posterolateral or transpedicular decompression techniques are the posterior direct decompression techniques (10,17). When there are epidural hematom, dural tear and posterior medullary canal compression, laminectomy is preferred (11). We performed laminectomy in 2 cases with posterior medullary canal compression.

Indirect decompression may be done successfully with ligamentotaxis in the cases of undamaged posterior longitudinal ligament (14,22). This technique can not be used when there is damage in the posterior longitudinal ligament and excessive medullary canal compression. At this position, posterolateral or transpedicular direct decompression must be done (22). We performed posterolateral direct decompression in 2 cases.

Indirect decompression must be done as an early surgical procedure in first 48th or 96th hours in unstable vertebral fractures (22). Edward found that, spinal canal decompression rate with indirect decompression is 32% when surgery is done within the first 2 days, 23% between the 3rd and 10th days and 1% after 2 weeks (8). Decompression with ligamentotaxis may not be possible after 96th hours (22). We created the indirect decompression for 21 cases and found 34.1% canal decompression in first 24 hours, 32.7% between the 24 and 96th hours and 27.6% after the 96th hours. The significant statistical difference was found between these groups.

Some authors do not make fusion and some make fusion in Alıcı Spinal System applications (3,4,15,18,25). Jacobs performed long segment rod and short segment fusion (1.4 segment) and tried to increase the mobile segment number for normal function of vertebrae and to prevent the back pain (20). We performed long segment instrumentation and short segment fusion (2 segment) and also short segment instrumentation and short segment fusion (2 segment) with posterior approach. The average local kyhposis angle is 15.3° preoperatively and 1.8° in the follow-up period. These groups are not comparable because of the few cases.

Akseki and Tiner investigated 62 cases by using Alıcı Spinal System instrumentation and found the complications as wound infection in 3, pedicle screw breakage in 1 and rod breakage in 1 case (3). Alıcı published 43 cases and found the complications as wound infection in 1, transpedicular screw breakage in 1 and rod breakage in 1 case (4). Kutluay investigated 17 cases and found the complications as wound infection in 3, urinary infection 2 and atelectasia in 1 case (23). We found the complications as wound infection 3, urinary infection in 2, hook luxation in 4, laminar fracture in 1 and loss of reduction in 1 case.

As a result; Alıcı Spinal System instrumentation is enough to make the stabilization and correction by posterior, anterior and combined approaches and early surgical intervention is the most important factor for treatment success.

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