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DOES EARLY SURGERY OF THORACOLUMBAR VERTEBRAL FRACTURES WITH NEURAL DEFICIT AFFECT THE TREATMENT RESULTS?

NÖROLOJİK DEFİSİT OLAN TORAKOLOMBER VERTEBRA KIRIKLARINDA ERKEN CERRAHİ TEDAVİ SONUÇLARINI ETKİLER Mİ?

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SUMMARY:

Purpose: The aim of this study was to determine whether early surgical intervention in unstable thoracolumbar vertebral fractures affects the restoration of the spinal canal, neurological recovery and clinical results.

Materials and methods: In this study, 58 cases were analyzed retrospectively. The follow-up duration was a minimum of three years. The patients were divided into three groups according to surgery times. Group I (n=31) consisted of patients who had surgery within the first 24 hours, group II (n=18) consisted of patients who had surgery within the first 24 to 96 hours, and group III (n=9) consisted of patients who had surgery after the 96th hour. The mean time interval between trauma and surgery was found to be 5.2 days (5 hours–19 days). Neurological evaluations of the cases were performed according to the Frankel classification. The patients' pain and occupational conditions were evaluated in their final follow-up using Denis' pain and work scale.

Results: The postoperative spinal canal compression rates were significantly decreased in all groups when compared to the preoperative period, but the most apparent decrease was observed in group I ($p<0.05$). While no recovery was observed in three of the ten patients who showed complete neurological deficit, seven patients who were classified as Frankel A showed some degrees of recovery, and it was observed that these patients were operated on within 6–24 hours.

Conclusion: This study shows that in unstable thoracolumbar vertebral fractures, early surgical treatment and adequate posterior stabilization significantly decrease the spinal canal compression, and provide some degree of neurological recovery and the early return of the patient to social activities.

Key words: thoracolumbar vertebral fractures, surgical treatment, neurologic deficit
Level of evidence: Retrospective clinical study, Level III

ÖZET:

Amaç: Bu çalışmada stabil olmayan torakolomber vertebra kırıklı olgularda erken cerrahi girişimin spinal kanal restorasyonu, nörolojik iyileşme ve klinik sonuçlar üzerindeki etkisinin olup olmadığının belirlenmesi amaçlanmıştır

Gereç ve Yöntemler: Çalışmamızda 58 olgu retrospektif olarak incelenmiştir. Takip süresi minimum 3 yıldır. Hastalar operasyona alınma sürelerine göre üç gruba ayrılmıştır. İlk 24 saatte operasyona alınanlar Grup I (n:31), 24-96. saatlerde alınanlar Grup II (n:18), 96. saatten sonra alınanlar ise Grup III (n:9) olarak belirlenmiştir. Olguların operasyona alınma süreleri ise ortalama 5.2 gün (5 saat-19 gün) olduğu saptanmıştır. Olguların nörolojik değerlendirmesi Frankel sınıflamasına göre yapılmıştır. Hastaların son kontrolünde Denis'in ağrı ve iş skalası kullanılarak ağrı ve mesleki durumları değerlendirilmiştir.

Bulgular: Tüm gruplarda, postoperatif spinal kanal bası oranları preoperatif döneme göre anlamlı şekilde azalmıştır, ancak en belirgin azalma grup I'de gözlenmiştir ($p<0.05$). Komplet nörolojik defisiti olan 10 hastanın 3'ünde hiç düzelme görülmezken, Frankel A olan 7 hastada birkaç derece düzelme görülmüştür ve bu hastaların 6-24 saatte opere edildikleri belirlenmiştir.

Sonuç: Stabil olmayan torakolomber vertebra kırıklarında erken cerrahi tedavi ve yeterli posterior stabilizasyon spinal kanal basısını anlamlı derecede azaltarak hem nörolojik defisitte belirli derecelerde düzelmelere hem de hastanın daha kısa sürede sosyal hayata geri dönmesine olanak sağladığı fikri elde edilmiştir.

Anahtar Kelimeler: Torakolomber omurga kırığı, cerrahi tedavi, nörolojik defisit
Kanıt Düzeyi: Retrospektif klinik çalışma, Düzey III

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INTRODUCTION:

Almost 5% of all injuries are spinal injuries, and more than 50% of those injuries are seen in the thoracolumbar (T11–L2) region[14,24]. Spinal injuries are usually neurological injuries, and in thoracolumbar injuries, the rate of neurological injury is 15–20% [22]. Determination of the stability of the injury plays a key role in the choice of treatment[4]. Whether a posterior ligamentous complex injury is present or not is a significant criterion in the evaluation of spinal stability. Also, the presence of a neurological deficit is one of the indications for surgical treatment.

In the literature, there are studies indicating that surgical treatment should be applied when the canal occupancy rate is more than 30% in blow-out fractures of the thoracolumbar area. However, it has been shown that the occupancy rate and the neurological deficit are not correlated with each other, and that there is no correlation between neurological recovery and the recovery of the canal occupancy rate [3,16,18,23,27]. Conversely, it has also been shown that surgical treatment positively affects the clinical results. However, there are no studies providing a high level of evidence regarding the relationship between surgery time, canal occupancy rates, and clinical results. In this study, the effects of early surgical intervention on spinal canal restoration and neurological recovery in patients who received surgical treatment due to an unstable thoracolumbar vertebral fracture were evaluated.

PATIENTS AND METHODS:

In this study, 58 cases that were surgically treated due to thoracic and lumbar vertebral fractures between January 1996 and January 2008 in Fırat University Medical Faculty Hospital Orthopedics and Traumatology clinics were analyzed retrospectively. 22 of the patients were female (38%) and 36 (62%) were male. The follow-up period was a minimum of three years and an average of 5.1 years (3–15 years).

The age distribution was 16–72 (an average of 40.5). When the mode of trauma formation was analyzed, 41 of the cases (70.6%) were due to falling from a height, 14 of them (24%) were due to in-car traffic accidents, and two of them (3.7%) were as a result of becoming trapped in the wreckage of a car accident.

It was observed that 65 vertebrae of the 58 patients included in the study had fractures. The fractures were detected in a single vertebra in 52 patients (89.6%), in two vertebrae of five patients (8.6%), and in three vertebrae of one patient (1.8%). It was thought that there was an unstable blow-out fracture in all of the patients[8,9].

25 patients (43%) were established to have additional injuries together with the vertebral fractures. In patients with additional injuries, there were seven (12%) calcaneus fractures, four (6.9%) tibia fractures, three (5.3%) radius fractures, two (3.5%) pelvic fractures, one (1.7%) shoulder dislocation, one (1.7%) humerus fracture, one (1.7%) clavicle fracture, one (1.7%) sacrum fracture, one (1.7%) ulna fracture, one (1.7%) scapula fracture, one (1.7%) femoral neck fracture, one (1.7%) navicular fracture, one (1.7%) sternoclavicular joint separation, and 15 (25.8%) rib fractures. In 11 of the patients who had rib fractures (19%) there was hemopneumothorax.

The neurological and physical examinations of the patients were completed after emergency action was applied in the preliminary

assessment. All the patients were analyzed with routine vertebral column direct radiography and computed tomography (CT). By analyzing their direct radiography, any height loss, angle value, and gliding, and which vertebrae were fractured, were evaluated. It was decided whether or not the patient would receive surgery according to the TLICS classification, the percentage shrinkage in the spinal canal, the type of the fracture, and the condition of the posterior ligamentous complex (PLC), which were determined with computed tomography[25,26].

After this evaluation, it was detected that all patients showing a blow-out fracture and a torn PLC had a score of 4 or more. The TLICS score was determined to be 5.2(4-7) on average.

Posterior surgical intervention was applied to all patients (Figure-1). For patients who received posterior intervention due to an unstable spinal fracture, to eliminate the instrumentation deficiency risk this was applied to the upper two and lower two levels of the fracture in the vertebra[1,17]. For fusion to the segments to which this technique was applied, spinous process fragments taken from the lesion level, bone fragments formed during decortication, and ready graft mixture were used.

1 g of cefazolin sodium IV was given to all patients 30 min before the operation as a prophylactic antibiotic. All patients were analyzed with direct radiography and CT after surgery. Low molecular weight heparin was administered postoperatively to all patients for deep vein thrombosis. 1 g cefazolin sodium 2x1 IV was administered postoperatively to all patients for an average of three days.

The classification by Frankel et al.[9] was used for the neurological evaluation of the patients before and after surgery.

Patients whose general status was well and who did not have other systemic injuries were mobilized with a steel underwiring corset on the first day after the surgery, while patients with neurological deficits were mobilized with a steel underwiring corset in a wheelchair, and physical therapy was started.

The hospitalization times of the patients ranged from 0 to 15 days. The operation time of the patients ranged from the fifth hour of hospitalization to the nineteenth day of hospitalization. The patients were classified into three groups on the basis of their operation times: patients who received surgery in the first 24 hours were Group I (n=31), after 24–96 hours were Group II (n=18), and after the 96th hour were Group III (n=9). The average time at which the patients received surgery was 5.2 days (Table-1). The hospitalization period of the patients ranged between 6 days and 70 days. The average hospitalization time was 16.6 days.

The patients with thoracolumbar spinal fractures were called for follow-up at 1, 3, 6 and 12 months after discharge. As well as neurological examination, the formation of fusion and stabilization of the system were evaluated with direct radiography and CT examination, and compared with previous results. In the final follow-ups, patients received CT scans and the canal shrinkage rates were re-evaluated. The patients' pain and occupational conditions were evaluated in their final follow-up using Denis' pain and work scale[10].

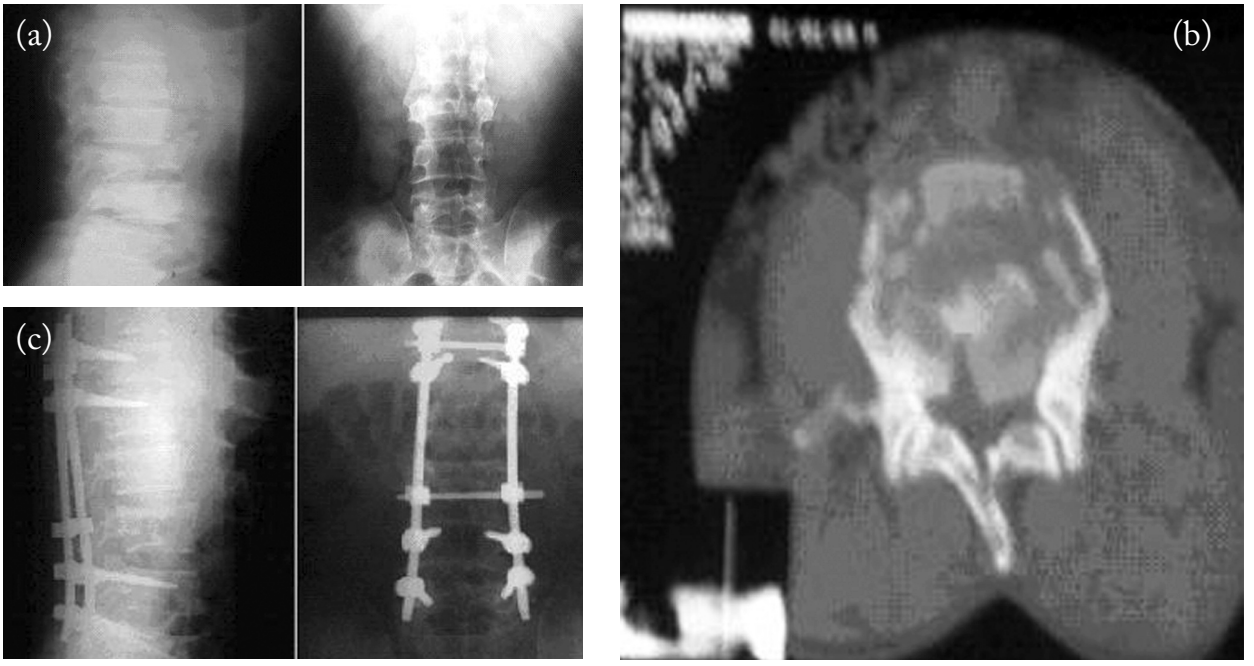

Figure-1. a. Preoperative direct radiography of the L3 vertebral blow-out fracture, **b.** Preoperative CT image of L3 vertebral blow-out fracture, **c.** Postoperative direct radiography of L3 vertebral blow-out fracture.

Table-1. Distribution of the patients according to their operation times

OPERATION TIME	NUMBER OF PATIENTS
0–24 hours	27
24–96 hours	16
16 96 hours and above	15

Table-2. Preoperative and postoperative radiological data of patients

Radiological criteria	Preoperative	Postoperative
Spinal canal shrinkage (%)	41.1	13.3
Kyphosis Angle	22.0°	7.1°
Anterior Column Collapse %	51.0	13.5

The SPSS (Statistical Package for Social Sciences) for Windows 12.0 programme was used for the statistical analyses. The Mann-Whitney U test was used for the samples independent from the parametric tests, and the paired t-test and Wilcoxon rank sum test were used for the dependent samples in the continuous variables as an average ± SD (Standard Deviation). A p-value<0.05 was considered statistically significant.

RESULTS:

The average results of the radiological measurement values of patients from the preoperative and postoperative periods are seen in Table-2.

In all three groups, a statistically significant decrease in the spinal canal shrinkage rates

was seen in the postoperative period (Table-3) ($p<0.05$). It was detected quantitatively that there was significantly more recovery in Group I when compared to the other two groups ($p<0.05$), and the recoveries in Group II and Group III were found to be statistically similar ($p>0.05$).

The neurological conditions of the patients in the preoperative and postoperative periods are given in Table-4. It was detected that three patients who were Frankel A and who did not show any recovery after the operation received surgery 72 hours after the injury, on average. However, it was understood that seven Frankel A patients who did show recovery in the neurological deficits after the operation were operated on 6–24 hours after trauma.

The Denis' pain and work scale results of the patients after the surgery are shown in Table-5.

It was detected that complications were seen in 17 of the patients (29.5%) in the postoperative period. Revision surgery was applied to four patients (6.9%). This was due to deep infection in one patient (1.7%), implant deficiency in one patient (1.7%), and due to grafting from the anterior in one patient (1.7%). Revision surgery was performed for the fourth patient (1.7%) because laminectomy was not performed in the initial operation. There were no complications in the postoperative follow-ups of the patients who received revision surgery.

Table-3. Preoperative and postoperative averages of spinal canal shrinkage

Operation time	Preop.	Postop.	p
Group I (n=27)	38.9 ± 17.6	11.1 ± 6.4	< 0.05
Group II (n=16)	41.3 ± 16.0	19.1 ± 11.4	< 0.05
Group III (n=15)	43.3 ± 15.0	20.5 ± 9.5	< 0.05

Table-4. The distribution of the patients according to preoperative and postoperative Frankel classification.

FRANKEL CLASSIFICATION	PREOPERATIVE	POSTOPERATIVE
A	10	3
B	15	8
C	11	10
D	22	17
E	0	20
Total	58	58

Table-5. The distribution of the patients according to the Denis' pain and work scale

DENIS' PAIN AND WORK SCALE	NUMBER OF PATIENTS
P1: No pain	40
P2: Rare mild pain, no need for treatment	10
P3: Rare mild pain; rarely needs treatment; it does not block working or cause obvious changes in daily activities	4
P4: mid-serious pain, frequent treatment need; it rarely blocks working or leads to obvious changes in daily activities	3
P5: Constant or serious pain blocking activity, chronic treatment	1
DENIS' WORK SCALE	**NUMBER OF PATIENTS**
W1: Back to work (heavy duty)	40
W2: Back to work (sedentary) or lifting limitations or back to the heavy work needing modifications	5
W3: Back to work is impossible but, a new full-time job	2
W4: Back to work is impossible, part-time job due to the pain	3
W5: No work, fully disabled	8

DISCUSSION:

The diagnosis and treatment of fractures and/or dislocations with fractures of the vertebral column related to neurological injuries are very important. Since restoration of the medulla spinalis is currently impossible, the restoration and stabilization of the vertebral column is vital. The stabilization of the vertebral column and the restoration of the canal are very important for early rehabilitation. Although it is rare, there may be recovery in the neurological condition[2,11,15]. Therefore, it is known that early surgical stabilization is important. In this study, we also aimed to test whether there is a correlation between the decrease in spinal canal shrinkage rates and remodeling of the canal with early surgery. This study shows that there is a statistically significant decrease in the canal occupation rates for patients operated on after less than 24 hours compared to patients operated on later ($p<0.05$).

Table-6. Postoperative complications seen in the patients

COMPLICATIONS	NUMBER OF PATIENTS
Soft tissue infection	7
USI	2
Pedicle screw break	1
Implant deficiency	1
Decubitus ulcer	3
DVT	1
Depression	1
Hook release	1

The general idea regarding the effect of the time of surgery on neurological recovery is that there is no relationship between the surgical intervention time and the neurological recovery. Roy-Camille et al.[19] stated that surgical treatment should be done as soon as possible, as the bleeding in the operation will increase when the operation is 24–48 hours after the

injury if the cord injury is incomplete and there is no increase in the neurological symptoms, and that if the cord injury is complete, there is a need for emergency surgery. If the cord is not cut completely and is just exposed to compression, it has been indicated that the neurological recovery chance increases with early decompression[15]. Conversely, Burke and Murray have argued the opposite of this approach, and stated that surgical treatment does not make any additional contribution to the recovery of neurological deficits[5]. Dendrinos et al. studied patients who had thoracolumbar blow-out fractures with complete neurological deficit, and found that patients who received either surgery or corset treatment showed statistically similar neurological recovery rates, and indicated that surgical treatment does not have any effect on the neurological deficit[7]. Stadhouder et al. compared the mid-period results of surgical and conservative treatments applied to 190 patients between 1991 and 2001 in two big vertebral centers, and stated that the clinical and radiological results were similar, but the operative group showed better results in terms of the neurological recovery[21]. It is certainly difficult to say that recovery is directly related to surgical treatment for the patients included in our study who showed neurological recovery. However, although it is not definitively proven that patients showing obvious neurological deficits were the ones who received early surgery, early surgery is thought to be important in this regard.

Dai stated that canal remodeling is related to the canal occupancy rate in the fracture area, and that whether the applied treatment is surgical or conservative is not important[6]. The findings of Wessberg et al. are in concordance with this. In this study, it was shown that there was no correlation between the residual fragment in the canal and the canal "remodeling" with either open instrumentation or closed reduction[29]. Although our study raises doubts about the accuracy of the data we obtained, due to the fact that it is a retrospective study and that it includes a limited number of cases, it indicates that the spinal canal "remodeling" was better in the patients who received surgical treatment.

Siebenga et al., in their multi-centered randomized prospective study with Level I evidence in 2006, found that all the clinical evaluations were better in an operative group who received posterior instrumentation in Type A thoracolumbar fractures without neurological deficit, and that the hospitalization and back to work periods were shorter[20].

On the other hand, Giele et al. stated that there was no apparent evidence for the efficiency of corset treatment in thoracolumbar area fractures, in a meta-analysis in which they analyzed seven retrospective studies[13]. Van der Roer et al. stated that insufficient evidence could be obtained regarding which patients should receive surgical treatment and which should receive conservative treatment, in a retrospective meta-analysis that also included four prospective studies[27]. In our study, it was determined that 70% of the patients who received surgical treatment were back to work, and the majority of those patients were the ones who received early surgical treatment.

In conclusion, although this study has some important limitations, such as only including a few cases and being retrospective, it shows that early surgical treatment decreases the canal shrinkage rates and contributes positively to neurological and clinical recovery.

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