

## Evaluation of vertebral fractures and associated injuries in adults

### *Erişkinlerdeki vertebra kırıklarının ve eşlik eden yaralanmaların değerlendirilmesi*

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**Amaç:** Acil servise travma etyolojisiyle başvuran erişkinlerde hasta profilinin belirlenmesi için vertebra kırıkları ve eşlik eden yaralanmalar değerlendirildi.

**Çalışma planı:** Çalışmada, 1988-2003 yılları arasında vertebra kırığı nedeniyle tedavi edilen 372 hasta (264 erkek, 108 kadın; ort. yaş 30.4; dağılım 18-65) demografik özellikler, travma mekanizması, eşlik eden yaralanmalar, kırık seviyesi ve tipi ile tedavi şekli açısından incelendi. Kırık tipleri Denis sınıflamasına göre sınıflandırıldı.

**Sonuçlar:** Denis sınıflamasına göre, 212 hastada (%57.0) kompresyon kırığı, 146'sında (%39.3) burst kırığı, sekizinde (%2.2) bel tipi emniyet kemeri kırığı, altısında da (%1.6) kırıklı çıkık saptandı. Olguların 290'ında (%77.9) tek seviyede, 61'inde (%16.4) iki seviyede, 15'inde (%4.0) üç seviyede, altısında da (%1.6) dört seviyede vertebra kırığı vardı. En sık yaralanmanın torakolomber bileşke bölgesinde (275 kırık, %57.2) olduğu görüldü. Kırık nedeni, 211 olguda yüksekte düşme (%56.7), 145 olguda trafik kazası (%39.0), 16 olguda (%4.3) direkt travma idi. Yüz on olguda (%29.6) başka bölgelerde kırık görüldü; en sık rastlanılan kalkaneus kırığıydı (35 hasta, %9.4). Ortopedik sorunların dışında 38 olguda (%10.2) diğer organ yaralanması ve/veya kafa yaralanması vardı. Hastaların 302'sinde (%81.2) konservatif tedavi, 70'inde (%18.8) cerrahi tedavi uygulanmıştı.

**Çıkarımlar:** Yüksek enerjili travma sonrasında acil servise başvuran her hastaya vertebra kırığı varmış gibi davranılmalıdır. Vertebra kırığı saptanan olgular başka seviyede kırık ve eşlik edebilecek diğer yaralanmalar açısından ayrıntılı olarak incelenmelidir.

**Anahtar sözcükler:** Lomber vertebra/yaralanma; omurga kırığı/epidemioloji; torasik vertebra/yaralanma.

**Objectives:** We evaluated vertebra fractures and associated injuries in adults to determine the profile of patients presenting with a trauma etiology.

**Methods:** The study included 372 patients (264 men, 108 women; mean age 30.4 years; range 18 to 65 years) who were treated for vertebra fractures from 1988 to 2003. Evaluations included demographic features of patients, trauma mechanisms, fracture levels and types, treatment modalities, and associated injuries. The types of fractures were assessed according to the Denis classification.

**Results:** The types of fractures were classified as follows: compression fractures (n=212, 57.0%), burst fractures (n=146, 39.3%), seat belt-induced fractures (n=8, 2.2%), and fracture-dislocations (n=6, 1.6%). Involvement was at one level in 290 patients (77.9%), two levels in 61 patients (16.4%), three levels in 15 patients (4.0%), and four levels in six patients (1.6%). The most common localization was the thoracolumbar spine (transition zone) with 275 fractures (57.2%). The causes of fractures were fall from height in 211 patients (56.7%), traffic accidents in 145 patients (39.0%), and direct trauma in 16 patients (4.3%). Associated fractures were detected in 110 patients (29.6%), the most common being calcaneus fractures in 35 patients (9.4%). Apart from orthopedic problems, 38 patients (10.2%) had other organ injuries and/or head trauma. Treatment was conservative in 302 patients (81.2%) and surgical in 70 patients (18.8%).

**Conclusion:** Every patient presenting after a high-energy trauma should be regarded as having a vertebra fracture until proven otherwise. When a vertebra fracture is detected, investigation should be extended for involvement at other levels and associated injuries.

**Key words:** Lumbar vertebrae/injuries; spinal fractures/epidemiology; thoracic vertebrae/injuries.

Vertebral difficulties often constitute difficulties both for physicians and patients. Although developments in the management of vertebral fractures parallel to the technological progress eliminate many problems, vertebral traumas increase each year and pathologies may arise for which no solution has been found in modern medicine.

In our study, we aimed to perform the demographic assessment of patients with vertebral fractures and define the patient profile so that we can determine the priorities in evaluation of emergency room patients.

### Patients and methods

In this study, 372 patients (264 male, 108 female; average age 30.4; range 18-65), treated for thoracolumbar vertebral fractures between 1998 and 2003, were investigated for demographic characteristics.

The data were collected retrospectively, searching the patient files in the relevant department protocols. They were found in the hospital archives and evaluated for age, sex, mechanism of trauma, level and type of fracture, and type of treatment. Associated injuries were identified. Types of fractures were classified according to Denis classification.<sup>(1)</sup>

**Table 1.** Distribution of the fractures according to vertebra

Fracture level	Number	Percentage	
Thoracal	T <sub>3</sub>	4 0.8	
	T <sub>4</sub>	4 0.8	
	T <sub>5</sub>	7 1.5	
	T <sub>6</sub>	8 1.7	
	T <sub>7</sub>	9 1.9	
	T <sub>8</sub>	10 2.1	
	T <sub>9</sub>	6 1.3	
	T <sub>10</sub>	11 2.3	
	Thoracolumbar	T <sub>11</sub>	34 7.1
		T <sub>12</sub>	82 17.1
Lumbar	L <sub>1</sub>	159 33.1	
	L <sub>2</sub>	60 12.5	
	L <sub>3</sub>	40 8.3	
	L <sub>4</sub>	35 7.3	
	L <sub>5</sub>	12 2.5	

### Results

According to Denis classification, of 372 patients 212 (57.0%) had compression fractures, 146 (39.3%) had burst fractures, 8 (2.2%) had seat belt fractures, and 6 patients (1.6%) had fracture-dislocations. Vertebral fractures were observed at only one level in 271 subjects (58.7%), at two levels in 61 subjects (16.4%), at three levels in 15 subjects (1.6%). When the distribution of the fractures according to vertebrae was studied, the most frequent injuries (275 fractures) were at the thoracolumbar junction (57.2%) (Table 1). The causes of the fractures were high fall in 211 subjects (56.7%), motor vehicle accident in 145 subjects (39.0%), and direct trauma in 16 subjects (4.3%). Associated fractures of other sites were present in 110 subjects (29.6%). The most frequently observed fracture type was calcaneus fracture and 6 subjects had bilateral calcaneus fractures (Table 2).

**Table 2.** Orthopedic pathologies associated with vertebral fractures

Pathologies	no. of patients	percentage
Calcaneus fractures	35	9.4
Pelvic Fractures	14	3.8
Ankle fractures	10	2.7
Fractures of the distal end of the radius	7	1.9
Fractures of the femoral diaphysis	9	2.4
Scaphoid fractures	8	2.2
Fractures of the Tibia	8	2.2
Costal fractures	6	1.6
Metacarpal-phalangeal fractures	5	1.3
Scapular fractures	4	1.1
Humerus fractures	3	0.8
Clavicular fractures	3	0.8
Olecranon fractures	2	0.5
Metatars fractures	2	0.5
Tibial plateau fractures	2	0.5
Fractures of the Forearm	2	0.5
Symphysis pubis diastasis	2	0.5
Shoulder dislocation	1	0.3
Patellar fracture	1	0.3
Talus fracture	1	0.3
Radius neck fracture	1	0.3
Elbow dislocation	1	0.3
Knee ligament lesion	1	0.3

Apart from orthopedic pathologies, 38 subjects (10.2%) presented with injuries of other organs and/or head traumas. We detected head trauma in 22 subjects (5.9%), intraabdominal injuries requiring laparotomy in 18 subjects (4.8%), and urological lesions in 16 subjects (4.3%). Three hundred and two patients (81.2%) were treated conservatively and 70 patients (18.8%) underwent surgery.

## Discussion

Vertebral fractures are usually severe injuries caused by high-energy traumas.<sup>[2-6]</sup> Vertebral injuries may be due to isolated traumas or multiple traumas. Vertebral colon injuries should always be considered for each patient with a high-energy trauma or multiple traumas and these patients should be treated accordingly until its absence is confirmed.<sup>[5, 6]</sup>

Vertebral colon fractures are mainly seen in adolescents and middle-aged adults (15-35). The mean age for vertebral trauma was reported as 31.7 (range; 11-88) in a multi-centered study of Scoliosis Research Society on 1019 vertebral fractures<sup>[5]</sup>, 32.2 in a study by McAfee et al.<sup>[7]</sup>, 34.6 in a study by Kropfingier et al.<sup>[8]</sup>, and 35.5 by Özyalçın et al<sup>[9]</sup>. In our study, the mean age was 30.4 (range, 18-65). Patients above 65 years of age with osteoporosis fractures were not included in compression fractures treated conservatively.

Men are 2-4 times more likely to have these fractures compared to women.<sup>[2,5,7-9]</sup> In our study, 108 patients were women (29.0%), 264 were men (71.0%); women-to-men ratio was 0.41.

In a study by Scoliosis Research Society, thoracolumbar junction, i.e. T11-L1 level, was reported to be the most frequently affected site (52%) in spine injuries, followed by lumbar site (L2-L5) with a rate of 32% and thoracal site (T1-T10) with a rate of 16%.<sup>[5]</sup> Kropfingier et al. reported that most frequently injured sites were thoracolumbar junction (48%), lumbar region (34%) and thoracal region (18%), respectively. Thoracolumbar junction was once more the site most frequently involved in a study by Keen.<sup>[10]</sup> Again, it was the level of most frequent fracture involvement in our study (57.2%). It was followed by lumbar region with 147 fractures (30.6%) and thoracal region with 59 fractures (12.3%).

The reasons for the frequent injury at the level of thoracolumbar junction were the absence of protective role of rib cage at this site, progression of lumbar lordosis to thoracal kyphosis and the location of facet joints coronally in thoracic region and sagittally in lumbar region, resulting with facet joint maladjustment.<sup>[3,11-13]</sup>

In studies on the etiologies of spine traumas, motor vehicle accidents were by far most common among other injury mechanisms. In our study, the most frequently observed reason was high fall (56.7%). In motor vehicle accidents, one of the most frequently occurring reasons of trauma, vertebral fracture and neurological injury risks can be reduced to a great extent simply by wearing the vehicle safety belts. It has been reported that vehicle safety belts were not used in 67% of the motor vehicle accidents resulting in injuries with vertebral fractures. On the other hand, waist-level vehicle safety belts are also closely related with flexion-distraction fractures. Recently, with the decreasing use of these type seat belts, flexion-distraction fractures decreased. With the use of safety belts with shoulder-waist components, anterolateral compression fractures occur in vehicle accidents and the risk of tear involving posterior elements is high.<sup>[11,14,15]</sup> For this reason, instability is more frequently observed in vertebral fractures due to vehicle accidents, increasing the rate of surgical treatments.

Vertebral fractures are usually due to high-energy traumas and the risk of associated injuries is high.<sup>[2,6,9,13]</sup> Their frequency is 43-78%. One half of these associated injuries are composed of skeletal traumas and the other half, of various organ injuries. Visceral injuries mostly occur (15%) associated with fractures of thoracal region. The rate of these injuries raise to 63% in flexion-distraction fractures particularly due to the use of wrist-level safety belts and 34% of these cases involve children.<sup>[5,7,11,14,17]</sup> In our study, skeletal and visceral injuries were identified in 158 subjects (42.5%).

While head trauma, rib and sternum fractures frequently accompany the thoracal vertebra fractures, associated calcaneous and pilon tibia fractures often coexist in high falls.<sup>[5,6,16]</sup> In our study, the most common associated injury was calcaneous fracture, six of which were bilateral (n=35, 9.4%). We think that calcaneous fracture was the most common injury

among other associated lesions just because the trauma due to high falls occurred more.

In summary, regarding age and sex, middle-aged men and regarding type of fracture, compression type fractures predominated our study. High fall was number one among fracture mechanisms. Throcolumbar transition site was the most effected level. Eighty two subjects (22.0%) had multilevel vertebral fractures, 110 subjects (29.6%) had associated fractures at other sites and 38 of them (10.2%) had other organ injuries and/or head trauma. The results of our study show that, each patient applying to emergency room with high-energy trauma should be treated as if he/she has vertebral fracture until its absence is confirmed using routine bilateral vertebral radiographies. We recommend careful physical and radiographic examination of patients with vertebral fractures for the potential of associated secondary injuries.

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