DOI: 10.24938/kutfd.1694734 Kırıkkale Üniversitesi Tıp Fakültesi Dergisi 2025;27(3):289-300
Original Article *Özgün Araştırma*

EFFECTS OF CONSERVATIVE TREATMENT ON SPINAL STABILITY IN UPPER LUMBAR VERTEBRAL FRACTURES: CLINICAL STUDY

Üst Lomber Vertebra Kırıklarında Konservatif Tedavinin Omurga Stabilitesi Üzerindeki Etkileri: Klinik Çalışma

Alemiddin ÖZDEMİR[1] Özge AYDIN[1] Sergen SİVUK[1]
Abdullah Baybars ÖKTEM[1] Ahmet Melih ERDOĞAN[1] Ulaş YÜKSEL[1]
Mustafa ÖĞDEN[1] Bülent BAKAR[1]

[1] *Department of Neurosurgery, Faculty of Medicine, Kırıkkale University, KIRIKKALE, TÜRKİYE*

ABSTRACT

Objective: This study aimed to evaluate the functional recovery in patients with upper lumbar vertebral fractures treated with thoracolumbar orthoses and the possible instability that may develop in the spine at the end of this follow-up.

Material and Methods: Patients with L1 or L2 vertebral fractures treated conservatively were included in the study. T12-L5 Cobb angle, T12 and S1 slope angles, disc heights, L1-L5 spine height, kyphosis angle of the fractured vertebra, Hounsfield Unit value of the fractured vertebra, and the height of the vertebra above and below the fractured vertebra were measured on the initial and post-treatment computed tomography images. "Karnofsky Performance Scale (KPS)" scores were recorded at the end of the follow-up.

Results: Initially measured T12-L5 Cobb angle, fractured vertebra height, and fractured vertebra subsidence rate were different from the values obtained at follow-up. The initial height of the fractured vertebra and the sagittal spinal canal diameter at the fracture level differed from follow-up values in female patients. Additionally, initial Hounsfield Unit and height values in fractured vertebrae measured in male patients differed from follow-up values.

Conclusion: Conservative treatment in patients with a collapse rate of less than 20% could not preserve the T12-L5 Cobb angle and the height of the fractured vertebra; however, it could prevent an increase in the kyphosis angle and collapse rate of the fractured vertebra and a decrease in the height of the T12-L5 vertebral column. Moreover, KPS scores of 90 (70-100) in these patients suggested that they could benefit from this treatment.

Keywords: *Upper lumbar vertebra, vertebral fracture, conservative treatment*

ÖZ

Amaç: Bu çalışmada torakolomber ortez ile tedavi edilen üst lomber vertebra kırığı olan hastalarda fonksiyonel iyileşmenin ve bu takip sonunda omurgada gelişebilecek olası instabilitenin değerlendirilmesi amaçlanmıştır.

Gereç ve Yöntemler: Konservatif olarak tedavi edilen L1 veya L2 vertebra kırığı olan hastalar çalışmaya dahil edildi. İlk ve konservatif tedavi sonrası çekilen bilgisayarlı tomografi görüntülerinde T12-L5 Cobb açısı, T12 ve S1 eğim açıları, disk yükseklikleri, L1-L5 omurga yüksekliği, kırık vertebra kifoz açısı, kırık vertebranın Hounsfield Ünitesi değeri ve kırık vertebranın üstündeki ve altındaki vertebra yüksekliği ölçüldü. Takip sonunda "*Karnofsky Performance Scale (KPS)*" skorları kaydedildi.

Bulgular: Başlangıçta ölçülen T12-L5 Cobb açısı, kırık vertebra yüksekliği ve kırık vertebra çökme oranı takipte elde edilen değerlerden farklıydı. Kadın hastalarda kırık vertebranın başlangıç yüksekliği ve kırık seviyesindeki sagital spinal kanal çapı takip değerlerinden farklıydı. Ayrıca, erkek hastalarda ölçülen kırık vertebradaki başlangıç Hounsfield Ünitesi değerleri ve bu vertebranın yüksekliği takip değerlerinden farklıydı.

Sonuç: Çökme oranı %20'den az olan hastalarda konservatif tedavi T12-L5 Cobb açısını ve kırık vertebranın yüksekliğini koruyamadı; ancak kırık vertebranın kifoz açısında ve çökme oranında artışı ve T12-L5 vertebral kolonun yüksekliğinde azalmayı önleyebildiği görüldü. Ayrıca, bu hastalarda KPS skorlarının 90 (70-100) olması bu hastaların bu tedaviden faydalanabildiğini düşündürdü.

Anahtar Kelimeler: *Üst lomber vertebra, vertebra kırığı, konservatif tedavi*

Correspondence / Yazışma Adresi: **Dr. Alemiddin ÖZDEMİR**
Department of Neurosurgery, Faculty of Medicine, Kırıkkale University, KIRIKKALE, TÜRKİYE
Phone / Tel: +90 542 551 51 82 **E-mail** / E-posta: alemozdemir@yahoo.com
Received / Geliş Tarihi: 08.05.2025 **Accepted** / Kabul Tarihi: 17.09.2025

KÜ Tıp Fak Derg 2025;27(3):289-300
Doi: 10.24938/kutfd.1694734

INTRODUCTION

Recent epidemiologic studies demonstrate that 2/3 of traumatic vertebral fractures occur at the thoracolumbar junction, most commonly the first lumbar vertebra (L1), with a 49% incidence.[1] Burst fractures of the thoracolumbar spine without neurologic deficit are a relatively common form of injury caused by compression loading without shear, rotation, or translation injury.[2] Both surgical and non-surgical treatment methods are considered equivalent in terms of pain reduction, preservation/improvement of neurological function, and early return to work.[3,4] Nowadays, ready-to-use adjustable thoracolumbar orthoses (TLO) are used in nonoperative (conservative) treatment, thus enabling early mobilization, short duration of stay in hospital, early rehabilitation, and earlier motor and neurological functional recovery.[5] However, very few studies in the literature investigate the changes in morphometric measurements of the spine at the end of the follow-up of these patients after conservative treatment.[6]

This study evaluated the functional recovery in patients treated with TLO for 3 months after a thoracolumbar burst fracture and the possible instability (such as kyphosis) that might develop in the spine at the end of this follow-up.

MATERIALS AND METHODS

Patients

The study included patients with a burst fracture of any vertebra between L1 and L2, who were neurologically intact and aged over 18-year-old. They had to present to the outpatient clinic within three days of the injury and not have received any treatment protocol for the fracture. Patients were mobilized in a TLO by a physiotherapist. Patients were recommended to wear the TLO for at least six weeks, except when lying in bed. Patients were informed that they had a 90-degree hip flexion precaution and a 5 kg lifting/carrying restriction for six weeks.

First, to determine the effects of the conservative treatment, the data obtained from the patients at their initial examination were compared with the data received at the end of the follow-up period. Next, the patients were grouped by gender, and the data were compared. Additionally, considering the menopausal status of female patients, all patients were classified according to under-55 and over-55-year-old, and their data were compared.

The following patients were excluded: those who were unable to wear a brace due to pregnancy or a body mass index greater than 40; those who presented to our clinic three days after fracture occurrence or mobilized without a brace; those who underwent vertebroplasty or fusion surgery with instrumentation during conservative treatment; those with pathological fractures (e.g. tumor metastasis or osteomyelitis); those with open fractures; those with a history of alcohol or drug addiction; those with a previous injury or surgery in the thoracolumbar region; and children under 18 years of age.

Materials

The following were recorded for each patient: age, gender, duration of stay in hospital, fractured vertebra segment, “AOSpine Classification" score at admission and Karnofsky Performance Scale (KPS)" score at the end of the follow-up period.

“AO Spine Classification”: Thoracolumbar spine injuries are categorized as follows: A) compression injuries; B) distraction injuries; C) displacement/translational injuries. Type A injuries involve the vertebral body, except A0.

- A0: no fracture or clinically insignificant fracture
- A1: wedge compression or impaction fracture
- A2: split or pincer type fracture
- A3: incomplete burst fracture
- A4: complete burst fracture

"Karnofsky Performance Scale (KPS)": This scale has been designed to assess the impact of patients' back pain on their daily activities. Points are given for each answered question: A=0, B=1, C=2, D=3, E=4, F=5. Questions that patients do not answer are not evaluated. The evaluation is made by taking the answered questions into account as follows: Patient score = (Patient’s score/Possible maximum score)x100.

The interpretation of the obtained percentage values is as follows: If 80% to 100%, back pain does not constitute a significant problem in the patient’s life; if 60% to 80%, back pain slightly restricts the patient’s daily life; if 40% to 60%, back pain severely restricts the patient’s daily life; if 20% to 40%, the patient’s daily life is completely limited due to back pain; if 0% to 20%, the patient is bedridden (or the symptoms are exaggerated).

Radiological examination

The following morphometric measurements were taken from the lumbar CT images obtained during the initial examination (Figure 1) and the final follow-up visit (Figure 2):

- T12-L5 Cobb angle: The angle between the lower endplate of the T12 vertebra and the lower endplate of the L5 vertebra.
- T12 slope angle: The angle between the lower endplate of the T12 vertebra and a line drawn parallel to the ground.
- S1 slope angle: The angle between the upper endplate of the sacrum and a line drawn parallel to the ground.
- Intervertebral disc height: the distance between the lower endplate of the upper vertebra and the upper

KÜ Tıp Fak Derg 2025;27(3):289-300
Doi: 10.24938/kutfd.1694734

endplate of the lower vertebra in each intervertebral disc space.
- T12-L5 height: The sum of each disc height and each vertebral sagittal height.
- Angulation (kyphosis) angle of the fractured vertebra: The angle between the upper and lower end plates of the fractured vertebra.
- Height of the fractured vertebra: The widest distance between the upper and lower end plates of the fractured vertebra.
- Hounsfield Unit (HU) value of the fractured vertebra.
- The fractured vertebra collapse rate: The ratio of the height of the fractured vertebra to the average height of the vertebrae above and below it.
- Height of the vertebra below the fractured vertebra: The widest height of the vertebra below the fractured vertebra.
- The height of the vertebra above the fractured vertebra: The widest height of the vertebra above the fractured vertebra.

Figure 1: Photographs show the morphologic measurements obtained at the initial examination of a patient with an L2 fracture.

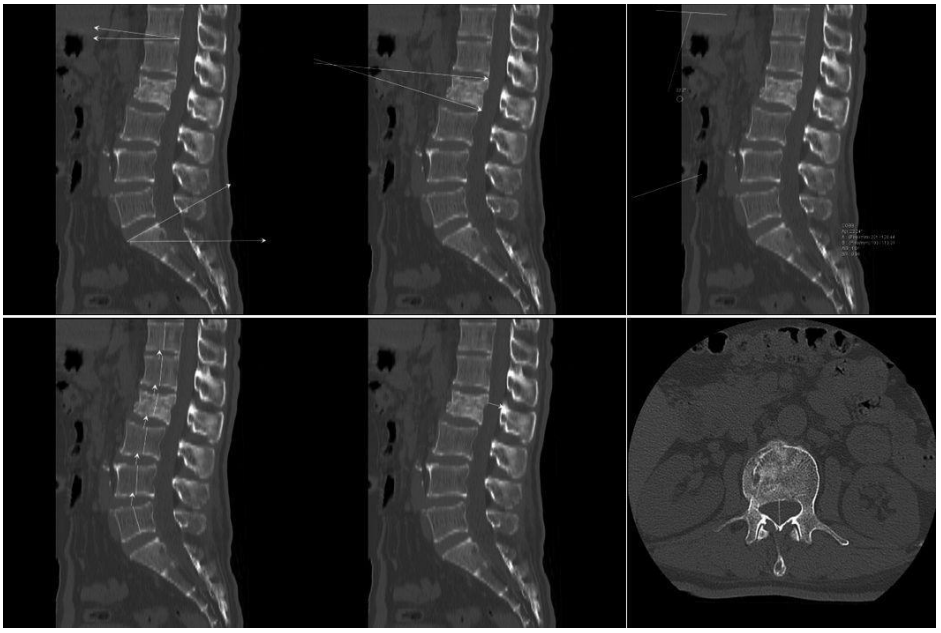

Figure 2: Photographs show the morphologic measurements obtained at the end of conservative treatment of a patient with an L2 fracture.

Statistical analysis

KÜ Tıp Fak Derg 2025;27(3):289-300
Doi: 10.24938/kutfd.1694734

SPSS 20.0v statistical program was used for statistical analysis. The Kolmogorov-Smirnov test was used to demonstrate the normal distribution of the study data. Categorical data was analyzed using the Pearson Chi-square test ($p<0.05$). An Independent Samples t-test was used to compare parametric data, and the Mann-Whitney U test was used to compare nonparametric data between groups ($p<0.05$). Spearman's rho correlation test was used to determine correlations among study parameters ($p<0.05$). Additionally, a paired samples t-test was performed to compare repeated parametric data, and a Wilcoxon Signed-Rank test was employed to analyze non-parametric data ($p<0.05$). The study protocol was approved by the Kırıkkale University Faculty of Medicine, Clinical Research Ethics Committee (Approval date: March 12th, 2025; meeting number: 2025/05; approval number: 2025.03.05).

RESULTS

A total of 16 patients were included in the study. Demographic data were explored in Table 1. The T12-L5 Cobb angle (t=3.129, p=0.006), fractured vertebra HU values (t=-5.419, p<0.001), fractured vertebra sagittal height (t=3.557, p=0.003), and fractured vertebra collapse rate (Z=-2.637, p=0.008) measured at admission of the patients were different from the values obtained at the end of the follow-up (Table 2).

Table 1: Demographic data of the patients

Variable		Mean ± SD/ Median (min-max)/ N (%)
Age		55.43±17.10
Gender	Male	8 (50)
	Female	8 (50)
Trauma type	Fall from a height	14 (87.50)
	Traffic accident	2 (12.50)
Fractured vertebra	L1	10 (62.5)
	L2	6 (37.5)
AO Spine Classification score	A1	10 (62.5)
	A2	4 (25.0)
	A3	2 (12.5)
Hospitalization		0 (0-3)
Follow-up time		71 (33-919)
"Karnofsky Performance Scale" score		90 (70-100)

SD: standard deviation, min: minimum, max: maximum

Table 2: Comparative table of the results of morphologic measurements obtained at the initial examination and the end of conservative follow-up

Variable	ADMISSION Mean ± SD/ Median (min-max)	FOLLOW-UP Mean ± SD/ Median (min-max)	t/ Z	p
T12 slope angle	-7.91±3.92	-9.7 (-18.40-14.40)	-0.983†	0.326
S1 slope angle	25.15 (18.90-46.20)	26.55 (17-44.80)	-1.784†	0.074
L1-L5 Cobb angle	30.12±12.55	24.43±10.93	3.219*	**0.006**
T12-L5 height	160.51±21.08	152.87±20.52	1.296*	0.214
Kyphosis angle of the fractured vertebra	15.49±5.21	17.42±5.24	-1.676*	0.114
Hounsfield Unit of fractured vertebra	204.38±52.74	298.56±90.32	-5.419*	**<0.001**
Fractured vertebra height	17.68±3.20	14.75±4.79	3.557*	**0.003**
Vertebra height above the fractured vertebra	23.22±2.95	22.94±3.09	0.743*	0.469
Vertebra height below the fractured vertebra	24.56±2.54	24.27±2.68	1.167*	0.261
Sagittal spinal canal diameter	13.82±2.59	13.49±3.13	0.811*	0.430
Axial spinal canal diameter	17.23±3.45	17.41±4.10	-0.359*	0.725
Collapse rate of fractured vertebra	19 (15-20)	17 (6-19)	-2.637†	**0.008**

SD: Standard deviation, min: Minimum, max: Maximum
(*) t value, Paired Samples t-test; (†) Z value, Wilcoxon Signed Ranks test; p<0.05

A positive correlation was found between the trauma type and the follow-up sagittal diameter of the spinal canal (r=0.533, p=0.034), between the length of hospital stay and KPS score (0.658, p=0.006), between the T12 slope angle and the fractured vertebral follow-up kyphosis angle (r=0.693, p=0.003), between the S1 slope angle and the sagittal diameter of the spinal canal (r=0.592, p=0.016), between S1 slope angle and fractured vertebral follow-up kyphosis angle (r=0.614, p=0.011), between S1 slope angle and follow-up T12-L5 Cobb angle (r=0.518, p=0.018), between follow-up spinal canal axial diameter and KPS score (r=0.512, p=0.043) and between follow-up collapse ratio of the fractured vertebral and KPS score (r=0.684, p=0.003). A negative correlation was found between the type of trauma and the T12-L5 Cobb angle (r=-0.513, p=0.042). The T12-L5 height (t=2.351, p=0.034), the vertebra height above the fractured vertebra (t=2.165, p=0.020), and the vertebra height below the fractured vertebra (t=2.285, p=0.038) were different between the female

KÜ Tıp Fak Derg 2025;27(3):289-300
Doi: 10.24938/kutfd.1694734

and male patients at admission. Furthermore, the vertebra height above the fractured vertebra (t=4.107, p=0.001) and the vertebra height below the fractured vertebra (t=2.615, p=0.020) were different between the two groups at the end of follow-up (Table 3).

Table 3: Comparative table of the results of morphologic measurements obtained at the initial examination and the end of conservative follow-up for male and female patients

	Variable		MALE Mean±SD/ Median (min-max)	FEMALE Mean±SD/ Median (min-max)	t/ Z/ X^2	p
	Age		56.25±17.09	54.66±18.25	0.184*	0.857
	Fractured vertebra	L1	6 (37.5%)	4 (25.0%)	1.067‡	0.302
		L2	2 (12.5%)	4 (25.0%)		
	AO Spine Classification score	A1	4 (25.0%)	6 (37.5%)	1.400‡	0.497
		A2	3 (18.8%)	1 (6.2%)		
		A3	1 (6.2%)	1 (6.2%)		
	Hospitalization		1 (0-3)	1 (0-2)	-0.460†	0.646
	Karnofsky Performance Scale score		95 (80-100)	90 (70-100)	-1.485†	0.138
	Follow-up time		81.50 (36-919)	62 (33-584)	-0.631†	0.528
ADMISSION	T12 slope angle		-8.59±3.32	-7.23±4.56	-0.683*	0.506
	S1 slope angle		25.50 (18.90-40.70)	25.05 (20.60-46.20)	-0.053†	0.958
	L1-L5 Cobb angle		28.49±16.19	31.75±8.32	-0.507*	0.620
	T12-L5 height		171.37±21.70	149.65±14.56	2.351*	**0.034**
	Kyphosis angle of the fractured vertebra		15.28±6.07	15.70±4.60	-0.157*	0.878
	Hounsfield Unit of fractured vertebra		211.38±63.70	197.38±42.30	0.518*	0.613
	Fractured vertebra height		19.14±2.64	16.22±3.19	1.995*	0.066
	Vertebra height above the fractured vertebra		25.76±1.91	22.79±2.59	2.615*	**0.020**
	Vertebra height below the fractured vertebra		25.84±1.81	23.28±2.60	2.285*	**0.038**
	Sagittal spinal canal diameter		13.31±3.40	14.34±1.49	-0.785*	0.445
	Axial spinal canal diameter		17.16±4.44	17.30±2.39	-0.080†	0.937
	Collapse rate of fractured vertebra		19 (16-20)	19 (15-20)	-0.630†	0.529
FOLLOW-UP	T12 slope angle		-8.50 (-12.30-14.40)	-10.35 (-18.40-8.10)	-1.051†	0.293
	S1 slope angle		27.51±9.59	25.87±7.32	0.387*	0.705
	L1-L5 Cobb angle		23.13±11.11	25.73±11.35	-0.463*	0.650
	T12-L5 height		158.74±24.66	147.01±14.68	1.155*	0.267
	Kyphosis angle of the fractured vertebra		15.79±4.71	19.05±5.52	-1.270*	0.225
	Hounsfield Unit of fractured vertebra		283.38±80.44	313.75±102.40	-0.660*	0.520
	Fractured vertebra height		16.77±4.34	12.72±4.57	1.817*	0.091
	Vertebra height above the fractured vertebra		25.14±2.34	20.73±1.94	4.107*	**0.001**
	Vertebra height below the fractured vertebra		25.76±1.91	22.78±2.59	2.615*	**0.020**
	Sagittal spinal canal diameter		13.53±4.23	13.45±1.76	0.050*	0.961
	Axial spinal canal diameter		17.35±5.39	17.48±2.65	-0.063*	0.951
	Collapse rate of fractured vertebra		17 (16-20)	16 (6-19)	-1.155†	0.248

SD: standard deviation, min: minimum, max: maximum
(*) t value, Independent Samples t-test; (†) Z value, Mann Whitney U test; (‡) X^2 value, Pearson Chi-square test; p<0.05

On the other hand, at admission of the female patients, fractured vertebra HU value (t=-4.519, p=0.003), fractured vertebra height (t=2.558, p=0.038), and the diameter of the spinal canal in the sagittal plane measured at the fracture level (t=3.403, p=0.011) were different from the values measured at the end of the follow-up. In addition, initial HU values (t=-3.250, p=0.014) and initial height of the fractured vertebra (t=2.428, p=0.046) in male patients differed from the values measured at the end of follow-up (Table 4).

KÜ Tıp Fak Derg 2025;27(3):289-300
Doi: 10.24938/kutfd.1694734

Table 4: Comparison table of the results of morphological measurements obtained at the first examination with the results obtained at the end of conservative follow-up in male and female patients

Gender	Variable	ADMISSION	FOLLOW-UP		
		Mean ± SD/ Median (min-max)	Mean ± SD/ Median (min-max)	t/ Z	p
MALE	T12 slope angle	-8.59±3.32	-8.50 (-12.30-14.40)	-0.210†	0.833
	S1 slope angle	25.50 (18.90-40.70)	27.51±9.59	-0.700†	0.484
	L1-L5 Cobb angle	28.49±16.19	23.13±11.11	2.148*	0.069
	T12-L5 height	171.37±21.70	158.74±24.66	1.068*	0.321
	Kyphosis angle of fractured vertebra	15.28±6.07	15.79±4.71	-0.457*	0.662
	Hounsfield Unit of fractured vertebra	211.38±63.70	283.38±80.44	-3.250*	**0.014**
	Fractured vertebra height	19.14±2.64	16.77±4.34	2.428*	**0.046**
	Vertebra height of above fractured vertebra	25.12±2.68	25.14±2.34	-0.034*	0.974
	Vertebra height of below fractured vertebra	25.84±1.81	25.76±1.91	0.257*	0.805
	Sagittal spinal canal diameter	13.31±3.40	13.53±4.23	-0.296*	0.776
	Axial spinal canal diameter	17.16±4.44	17.35±5.39	-0.416*	0.690
	Collapse rate of fractured vertebra	19 (16-20)	17 (16-20)	-1.820†	0.069
FEMALE	T12 slope angle	-7.23±4.56	-10.35 (-18.40-8.10)	-1.192†	0.233
	S1 slope angle	25.05 (20.60-46.20)	25.87±7.32	-1.752†	0.080
	L1-L5 Cobb angle	31.75±8.32	25.73±11.35	2.255*	0.059
	T12-L5 height	149.65±14.56	147.01±14.68	2.124*	0.071
	Kyphosis angle of fractured vertebra	15.70±4.60	19.05±5.52	-1.706*	0.132
	Hounsfield Unit of fractured vertebra	197.38±42.30	313.75±102.40	-4.519*	**0.003**
	Fractured vertebra height	16.22±3.19	12.72±4.57	2.558*	**0.038**
	Vertebra height of above fractured vertebra	21.34±1.81	20.73±1.94	1.377*	0.211
	Vertebra height of below fractured vertebra	23.28±2.60	22.79±2.59	1.288*	0.239
	Sagittal spinal canal diameter	14.34±1.49	13.45±1.76	3.403*	**0.011**
	Axial spinal canal diameter	17.30±2.39	17.48±2.65	-0.187*	0.857
	Collapse rate of fractured vertebra	19 (15-20)	16 (6-19)	-1.820†	0.069

SD: Standard deviation, min: Minimum, max: Maximum
(*) t value, Paired Samples t-test; (†) Z value, Wilcoxon Signed Ranks test; p<0.05

The initial T12 slope angles (t=2.330, p=0.035), time of the follow-up period (Z=-2.225, p=0.026), and follow-up T12-L5 vertebral column height values (t=-2.558, p=0.023) were different between patients under 55 years old and over 55 years old (Table 5).

KÜ Tıp Fak Derg 2025;27(3):289-300
Doi: 10.24938/kutfd.1694734

Table 5: Comparative table of morphologic measurements results obtained at admission and the end of follow-up for patients under 55 years and patients 55 years and older

	Variable		Age <55 Mean ± SD/ Median (min-max)	Age ≥55 Mean ± SD/ Median (min-max)	t/ Z	p
	Age		39.33±15.93	65.10±8.35	-	-
	Gender	Male	3 (18.8%)	5 (31.2%)	0.000‡	1.000
		Female	3 (18.8%)	5 (31.2%)		
	Fractured vertebra	L1	4 (25.0%)	6 (37.5%)	0.071‡	0.790
		L2	2 (12.5%)	4 (25.0%)		
	AO Spine Classification score	A1	4 (25.0%)	6 (37.5%)	0.427‡	0.808
		A2	1 (6.2%)	3 (18.8%)		
		A3	1 (6.2%)	1 (6.2%)		
	Hospitalization		0.50 (0-2)	1 (0-3)	-0.237†	0.812
	Karnofsky Performance Scale score		90 (90-100)	90 (70-100)	-0.059†	0.953
	Follow-up time		217 (62-919)	57 (33-206)	-2.225†	**0.026**
ADMISSION	T12 slope angle		-5.32±4.69	-9.46±2.49	2.330*	**0.035**
ADMISSION	S1 slope angle		30.50 (23.40-46.20)	25.05 (18.90-40.70)	-1.194†	0.232
ADMISSION	L1-L5 Cobb angle		27.08±9.29	31.94±14.31	-0.738*	0.473
ADMISSION	T12-L5 height		156.21±26.71	163.09±18.02	-0.620*	0.546
ADMISSION	Kyphosis angle of the fractured vertebra		17.37±5.53	14.36±4.94	1.131*	0.277
ADMISSION	Hounsfield Unit of fractured vertebra		228.83±51.16	189.70±50.42	1.495*	0.157
ADMISSION	Fractured vertebra height		17.07±3.98	18.04±2.81	-0.570*	0.578
ADMISSION	Vertebra height above the fractured vertebra		23.32±4.16	23.17±2.20	0.094*	0.927
ADMISSION	Vertebra height below the fractured vertebra		24.28±3.71	24.73±1.73	-0.337*	0.741
ADMISSION	Sagittal spinal canal diameter		13.53±2.37	13.99±2.82	-0.334*	0.743
ADMISSION	Axial spinal canal diameter		17.02±2.84	17.35±3.91	-0.177*	0.862
ADMISSION	Collapse rate of fractured vertebra		18 (15-20)	19 (15-21)	-0.759†	0.448
FOLLOW-UP	T12 slope angle		-8.50 (-18.40-8.10)	-10 (-16.70-14.40)	-0.380†	0.704
FOLLOW-UP	S1 slope angle		28.13±7.39	25.82±9.04	0.528*	0.606
FOLLOW-UP	L1-L5 Cobb angle		22.40±10.82	25.64±11.39	-0.561*	0.584
FOLLOW-UP	T12-L5 height		138.40±18.78	161.56±16.80	-2.558*	**0.023**
FOLLOW-UP	Kyphosis angle of the fractured vertebra		19.50±4.16	16.17±5.61	1.254*	0.230
FOLLOW-UP	Hounsfield Unit of fractured vertebra		316.83±86.26	287.60±95.43	0.614*	0.549
FOLLOW-UP	Fractured vertebra height		14.62±4.95	14.82±4.96	-0.079*	0.939
FOLLOW-UP	Vertebra height above the fractured vertebra		22.55±3.32	23.17±3.10	-0.376*	0.713
FOLLOW-UP	Vertebra height below the fractured vertebra		23.48±3.40	24.752.21	-0.912*	0.377
FOLLOW-UP	Sagittal spinal canal diameter		13.99±2.89	13.19±3.37	0.484*	0.636
FOLLOW-UP	Axial spinal canal diameter		17.97±3.30	17.08±4.66	0.406*	0.691
FOLLOW-UP	Collapse rate of fractured vertebra		16 (8-19)	17 (6-19)	-0.108†	0.914

SD: Standard deviation, min: Minimum, max: Maximum
(*) t value, Independent Samples t-test; (†) Z value, Mann Whitney U test; (‡) X^2 value, Pearson Chi-square test; p<0.05

On the other hand, in patients under 55 years, the initial S1 slope angle (t=1.033, p=0.039) and fractured vertebra HU (t=-3.160, p=0.025) values differed from the follow-up values. In addition, in patients over 55 years, initial T12-L5 Cobb angle (t=-2.497, p=0.034), fractured vertebra HU value (t=-4.201, p=0.002), fractured vertebra height (t=3.580, p=0.006), and fractured vertebra collapse rate (t=-2.599, p=0.009) values were different from the follow-up values (Table 6).

KÜ Tıp Fak Derg 2025;27(3):289-300
Doi: 10.24938/kutfd.1694734

Table 6: Comparative table of morphologic measurements results obtained at admission and follow-up in patients under 55 years and 55 years and older

Variable		ADMISSION Mean ± SD/ Median (min-max)	FOLLOW-UP Mean ± SD/ Median (min-max)	t/ Z	p
Age <55	T12 slope angle	-5.32±4.69	-7.32±8.69	1.033*	0.349
	S1 slope angle	32.25±9.36	28.13±7.39	2.783*	**0.039**
	T12-L5 Cobb angle	27.08±9.29	22.40±10.81	1.978*	0.105
	T12-L5 height	156.21±26.71	138.40±18.78	1.147*	0.303
	Kyphosis angle of fractured vertebra	17.37±5.53	19.50±4.16	-1.207*	0.281
	Hounsfield Unit of fractured vertebra	228.83±51.16	316.83±86.26	-3.160*	**0.025**
	Fractured vertebra height	17.07±3.98	14.62±4.95	1.432*	0.212
	Vertebra height of above fractured vertebra	23.32±4.16	22.55±3.32	1.802*	0.131
	Vertebra height of below fractured vertebra	24.28±3.71	23.48±3.40	1.728*	0.145
	Sagittal spinal canal diameter	13.53±2.37	13.99±2.89	-0.522*	0.624
	Axial spinal canal diameter	17.02±2.84	17.97±3.30	-0.959*	0.381
	Collapse rate of fractured vertebra	17 (15-20)	16 (8-19)	-0.943†	0.345
Age ≥55	T12 slope angle	-9.46±2.49	-7.72±8.34	-0.547*	0.598
	S1 slope angle	26.51±7.18	25.82±9.04	0.563*	0.587
	T12-L5 Cobb angle	31.94±14.31	25.64±11.39	2.497*	**0.034**
	T12-L5 height	163.09±18.02	161.56±16.80	1.447*	0.182
	Kyphosis angle of fractured vertebra	14.36±4.94	16.17±5.61	-1.147*	0.281
	Hounsfield Unit of fractured vertebra	189.70±50.42	287.60±95.43	-4.201*	**0.002**
	Fractured vertebra height	18.04±2.81	14.82±4.96	3.580*	**0.006**
	Vertebra height of above fractured vertebra	23.17±2.20	23.17±3.10	0.012*	0.991
	Vertebra height of below fractured vertebra	24.73±1.73	24.75±2.21	-0.076*	0.941
	Sagittal spinal canal diameter	13.99±2.82	13.19±3.37	2.261*	0.050
	Axial spinal canal diameter	17.35±3.91	17.08±4.66	0.461*	0.656
	Collapse rate of fractured vertebra	19 (15-21)	17 (6-19)	-2.599†	**0.009**

SD: Standard deviation, min: Minimum, max: Maximum
(*) t value, Paired Samples t-test; (†) Z value, Wilcoxon Signed Ranks test; p<0.05

Additionally, vertebra height above the fractured vertebra (t=4.073, p=0.015) and vertebra height below the fractured vertebra (t=2.787, p=0.049) measured at admission differed between male and female patients under 55 years old. Furthermore, at the end of follow-up, vertebra height above the fractured vertebra (t=3.008, p=0.040) and below the fractured vertebra (t=4.073, p=0.015) also showed differences between male and female patients under 55. However, in patients aged over 55 years, the height of the vertebra above the fractured vertebra (t=2.677, p=0.028) differed between male and female patients. (Table 7).

KÜ Tıp Fak Derg 2025;27(3):289-300
Doi: 10.24938/kutfd.1694734

Table 7: Comparison table of morphologic measurements results obtained at admission with the results obtained at follow-up in male and female patients under 55 years of age and 55 years and older

Variable		Age <55				Age ≥55			
		MALE	FEMALE			MALE	FEMALE		
		Mean ± SD/ Median (min-max)	Mean ± SD/ Median (min-max)	t/Z	p	Mean± SD Median (min-max)	Mean ± SD/ Median (min-max)	t/ Z	p
ADMISSION	T12 slope angle	-5.63±2.02	-5.00±7.11	-0.148*	0.889	-10.36±2.60	-8.50±2.27	-1.164*	0.278
	S1 slope angle	35.90 (25.10-38.50)	24.40 (23.40-46.20)	-0.655†	0.513	21.10 (18.90-40.70)	25.20 (20.60-34.20)	-0.629†	0.530
	L1-L5 Cobb angle	21.60±4.47	32.57±10.27	-1.696*	0.165	32.62±19.79	31.26±8.22	0.142*	0.891
	T12-L5 height	173.25±27.63	139.16±12.19	1.955*	0.122	170.24±20.93	155.94±12.83	1.303*	0.229
	Kyphosis angle of fractured vertebra	19.88±7.08	14.87±2.75	1.142*	0.317	12.52±3.75	16.20±5.69	-1.208*	0.261
	Hounsfield Unit of fractured vertebra	246.33±71.39	211.33±23.01	0.808*	0.464	190.40±55.56	189.00±51.31	0.041*	0.968
	Fractured vertebra height	19.95±3.13	14.19±2.22	2.599*	0.060	18.65±2.54	17.43±3.23	0.661*	0.527
	Vertebra height of above fractured vertebra	26.30±3.55	20.34±1.99	4.073*	**0.015**	24.41±2.13	21.94±1.59	1.016*	0.340
	Vertebra height of below fractured vertebra	27.03±1.89	21.52±2.86	2.787*	**0.049**	25.13±1.51	24.33±2.02	0.707*	0.500
	Sagittal spinal canal diameter	13.50±3.09	13.57±2.12	-0.031*	0.977	13.19±3.92	14.80±0.97	-0.890*	0.399
	Axial spinal canal diameter	18.03±2.60	16.01±3.22	0.846*	0.445	16.63±5.49	18.07±1.70	-0.560*	0.591
	Collapse rate of fractured vertebra	19 (16-20)	17 (15-19)	-1.091†	0.275	19 (16-20)	20 (15-21)	-0.313†	0.754
FOLLOW-UP	T12 slope angle	-7.40 (-9.06- -6.10)	-10.50 (-18.40-8.10)	-0.655†	0.513	9.80 (-12.30-14.40)	-10.20 (-16.70- -6.50)	-0.731†	0.465
	S1 slope angle	29.30±8.13	26.97±8.10	0.351*	0.743	26.44±11.12	25.20±7.71	0.205*	0.843
	L1-L5 Cobb angle	17.10±5.78	27.70±13.22	-1.273*	0.272	26.74±12.48	24.54±11.54	0.289*	0.780
	T12-L5 height	141.19±27.62	135.60±9.79	0.330*	0.758	169.26±17.71	153.86±13.16	1.561*	0.157
	Kyphosis angle of fractured vertebra	19.50±3.06	19.50±5.81	0.000*	1.000	13.56±4.20	18.78±6.01	-1.589*	0.151
	Hounsfield Unit of fractured vertebra	304.00±82.27	329.67±106.49	-0.330*	0.758	271.00±86.18	304.20±111.24	-0.528*	0.612
	Fractured vertebra height	17.91±3.22	11.33±4.31	2.116*	0.102	16.09±5.12	13.55±5.00	0.793*	0.451
	Vertebra height of above fractured vertebra	25.07±2.54	20.03±1.41	3.008*	**0.040**	25.19±2.53	21.15±2.23	2.677*	**0.028**
	Vertebra height of below fractured vertebra	26.26±1.68	20.70±1.70	4.073*	**0.015**	25.46±2.15	24.04±2.27	1.016*	0.340
	Sagittal spinal canal diameter	15.18±3.20	12.80±2.54	1.013*	0.368	12.54±4.80	13.84±1.31	-0.588*	0.585
	Axial spinal canal diameter	18.00±3.12	17.93±4.18	0.023*	0.983	16.95±6.74	17.21±1.83	0.082*	0.937
	Collapse rate of fractured vertebra	16 (16-19)	16 (8-19)	-0.655†	0.513	18 (7-19)	16 (6-19)	-1.149†	0.251

SD: Standard deviation, min: Minimum, max: Maximum
(*) t value, Independent Samples t-test; (†) Z value, Mann-Whitney U test, p<0.05

On the other hand, initial HU values of the fractured vertebra differed from follow-up values in male patients under 55 years (t=-8.783, p=0.013). Fractured vertebrae HU values (t=-3.676, p=0.021), fractured vertebrae sagittal height (t=3.654, p=0.022), sagittal spinal canal diameter at the fracture level (t=2.960, p=0.042), and fractured vertebrae collapse rate (t=-2.023, p=0.043) values measured at admission differed from follow-up values in female patients aged over 55 years (Table 8).

KÜ Tıp Fak Derg 2025;27(3):289-300
Doi: 10.24938/kutfd.1694734

Table 8: Comparison table of morphologic measurements results obtained at admission with the results obtained at follow-up in male and female patients under 55 years of age and 55 years and older

	Variable	Age <55				Age ≥55			
		ADMISSION	FOLLOW-UP			ADMISSION	FOLLOW-UP		
		Mean ± SD/ Median (min-max)	Mean ± SD/ Median (min-max)	t/Z	p	Mean ± SD/ Median (min-max)	Mean ± SD/ Median (min-max)	t/ Z	p
Male	T12 slope angle	-5.63±2.02	-7.40 (-9.06- -6.10)	-1.069†	0.285	-10.36±2.60	9.80 (-12.30-14.40)	-0.271†	0.786
	S1 slope angle	35.90 (25.10-38.50)	29.30±8.13	-1.604†	0.109	21.10 (18.90-40.70)	26.44±11.12	-0.674†	0.500
	L1-L5 Cobb angle	21.60±4.47	17.10±5.78	2.178*	0.161	32.62±19.79	26.74±12.48	1.470*	0.215
	T12-L5 height	173.25±27.63	141.19±27.62	1.016*	0.416	170.24±20.93	169.26±17.71	0.569*	0.600
	Kyphosis angle of fractured vertebra	19.88±7.08	19.50±3.06	0.152*	0.893	12.52±3.75	13.56±4.20	-0.858*	0.439
	Hounsfield Unit of fractured vertebra	246.33±71.39	304.00±82.27	-8.783*	**0.013**	190.40±55.56	271.00±86.18	-2.225*	0.090
	Fractured vertebra height	19.95±3.13	17.91±3.22	1.916*	0.195	18.65±2.54	16.09±5.12	1.690*	0.166
	Vertebra height of above fractured vertebra	26.30±3.55	25.07±2.54	2.088*	0.172	24.41±2.13	25.19±2.53	-0.884*	0.427
	Vertebra height of below fractured vertebra	27.03±1.89	26.26±1.68	1.532*	0.265	25.13±1.51	25.46±2.15	-1.083*	0.340
	Sagittal spinal canal diameter	13.50±3.09	15.18±3.20	-1.175*	0.361	13.19±3.92	12.54±4.80	0.968*	0.388
	Axial spinal canal diameter	18.03±2.60	18.00±3.12	0.065*	0.954	16.63±5.49	16.95±6.74	-0.451*	0.675
	Collapse rate of fractured vertebra	19 (16-20)	16 (16-19)	-0.535†	0.593	19 (16-20)	18 (7-19)	-1.753†*	0.080
Female	T12 slope angle	-5.00±7.11	-10.50 (-18.40-8.10)	-0.535†	0.593	-8.50±2.27	-10.20 (-16.70- -6.50)	-1.214†	0.225
	S1 slope angle	24.40 (23.40-46.20)	26.97±8.10	-1.069†	0.285	25.20 (20.60-34.20)	25.20±7.71	-1.483†	0.138
	L1-L5 Cobb angle	32.57±10.27	27.70±13.22	0.999*	0.423	31.26±8.22	24.54±11.54	1.897*	0.131
	T12-L5 height	139.16±12.19	135.60±9.79	1.319*	0.318	155.94±12.83	153.86±13.16	1.500*	0.208
	Kyphosis angle of fractured vertebra	14.87±2.75	19.50±5.81	-2.617*	0.120	16.20±5.69	18.78±6.01	-0.839*	0.449
	Hounsfield Unit of fractured vertebra	211.33±23.01	329.67±106.49	-2.192*	0.160	189.00±51.31	304.20±111.24	-3.676*	**0.021**
	Fractured vertebra height	14.19±2.22	11.33±4.31	0.782*	0.516	17.43±3.23	13.55±5.00	3.654*	**0.022**
	Vertebra height of above fractured vertebra	20.34±1.99	20.03±1.41	0.523*	0.653	21.94±1.59	21.15±2.23	1.215*	0.291
	Vertebra height of below fractured vertebra	21.52±2.86	20.70±1.70	0.916*	0.456	24.33±2.02	24.04±2.27	0.784*	0.477
	Sagittal spinal canal diameter	13.57±2.12	12.80±2.54	1.469*	0.280	14.80±0.97	13.84±1.31	2.960*	**0.042**
	Axial spinal canal diameter	16.01±3.22	17.93±4.18	-0.999*	0.423	18.07±1.70	17.21±1.83	0.944*	0.399
	Collapse rate of fractured vertebra	17 (15-19)	16 (8-19)	-0.535†	0.593	20 (15-21)	16 (6-19)	-2.023†	**0.043**

SD: Standard deviation, min: Minimum, max: Maximum
(*) t value, Paired Samples t-test; (†) Z value, Wilcoxon Signed Ranks test, p<0.05

DISCUSSION

Conservative treatment is considered for patients with compression fractures with minimal height loss, stable burst fractures with minimal displacement of bone fragments and no significant impairment of spinal stability, an absence of associated neurological deficits with kyphotic deformities of less than 20 degrees and scoliotic deformities of less than 10 degrees, provided they have an intact posterior ligament complex and no general health issues or comorbidities, and wish to undergo this treatment.[7–11] On the other hand, radiological parameters, especially angulation measurement in the sagittal plane of the fractured vertebral segment, are widely used to evaluate treatment and follow up with patients postoperatively.[12]

In this study, at the end of conservative treatment, T12-L5 Cobb angles decreased, lumbar lordosis angles flattened, the sagittal height of the fractured vertebra

KÜ Tıp Fak Derg 2025;27(3):289-300
Doi: 10.24938/kutfd.1694734

decreased slightly, and HU values of the fractured vertebra increased. Interestingly, there was also a decrease in the collapse rate of the fractured vertebra. No significant changes were observed in the T12 and S1 slope angles, fractured vertebral kyphosis angle, T12-L5 height, and spinal canal diameters. Therefore, it could be said that conservative treatment, especially in patients with a collapse rate of less than 20%, could not maintain the T12-L5 Cobb angle, and the Cobb angles could decrease during the follow-up period; the fractured vertebra could not maintain its height, and therefore, the vertebra could lose more height during the follow-up period. However, this conservative treatment was able to prevent an increase in the kyphosis angle of the fractured vertebra. It could also prevent a decrease in the height of the T12-L5 vertebral column and an increase in the collapse rate of the fractured vertebra. On the other hand, KPS scores of 90 points (70-100) in these patients after conservative treatment suggested that these patients benefited from this treatment.

This study found that the heights of the vertebrae above and below the fractured vertebrae differed between female and male patients at admission and at the end of the follow-up period. Additionally, the T12-L5 vertebral column height was lower in female patients than in male patients at the conclusion of the initial examination. It was hypothesized that this difference might be due to female patients having a smaller body mass than male patients. The sagittal height of the fractured vertebrae decreased slightly in both sexes, and the diameter of the spinal canal, as measured in the sagittal plane, narrowed slightly in women by the end of the follow-up period. However, no significant changes were observed in the collapse rates of fractured vertebrae or other radiological parameters in either gender following conservative treatment. Furthermore, lumbar lordosis, vertebral column height, and KPS scores were preserved in both genders. Therefore, it can be concluded that conservative treatment preserves the neurological status and quality of life of these patients. Thus, conservative treatment was considered an effective regimen for both male and female patients.

When the patients' age groups were analyzed, it was found that the follow-up period was shorter for patients aged 55 years and over. T12 slope angles measured at the initial examination were higher for this patient group, as were T12-L5 vertebral column height values. These results are thought to be due to the traumas experienced by this patient group being low-energy (e.g., falling from a standing height), and the higher T12 slope angles being due to age-related spinal degeneration. However, no change was observed in lumbar lordosis angles, fractured vertebral heights, or subsidence rates at the end of conservative treatment in either age group. It was therefore concluded that conservative treatment could preserve vertebral column alignment and prevent further collapse of the fractured vertebrae in both age groups. Furthermore, there was no difference in T12-L5 Cobb angles, fractured vertebral height, fractured vertebral kyphosis angles, or collapse rates between males and females in either age group at admission or at the end of conservative treatment. Therefore, conservative treatment was considered beneficial for both male and female patients with vertebral fracture collapse rates below 20% in both age groups.

However, in patients under 55 years, it was found that the S1 slope angle decreased slightly following conservative treatment and that the HU values increased. Based on these findings, it was hypothesized that vertebral fractures in this age group do not result in a decrease in bone strength and that a significant improvement in the fractured vertebra is possible. There was also no deterioration in lumbar lordosis. In patients aged 55 and over, it was observed that the Cobb angle decreased, lumbar lordosis increased, and the height of the fractured vertebrae decreased slightly following conservative treatment. Based on these findings, it was hypothesized that the bone structure in this age group was somewhat weaker (possibly due to osteoporosis, etc.) and that the decrease in height of the fractured vertebra could continue despite conservative treatment. Nevertheless, it was found that HU values increased and the collapse rate of fractured vertebrae decreased following conservative treatment in this patient group. These results showed that, in patients aged 55 and over, while lumbar lordosis increased, there was a significant improvement in the fractured vertebrae.

Conversely, bone healing was observed at the end of conservative treatment in female patients over 55 years of age. However, some loss of bone height in the fractured vertebra, subsidence rates, and narrowing of the spinal canal at the fracture level occurred in this patient group. However, the height of the T12-L5 vertebral column and the lumbar lordosis angle, as measured at the initial examination, remained unchanged in these patients. Therefore, it was concluded that, while conservative treatment may be somewhat inadequate for this patient group, it can still be used effectively.

This study had some limitations: *First*, the study was retrospective, and the study group consisted of a small number of patients. Therefore, there was a risk of bias in the study results. *Second*, since the study did not have X-ray images of the patients at standing positions at the initial examination, the spinal stability in the patients could not be evaluated optimally. *Third*, it is well known that in older patients, low bone density and osteoporosis can increase the risk of vertebral fractures and negatively affect bone healing.[13] However, because this

study was retrospective, bone mineral density measurements were unavailable for some patients. Consequently, it was not possible to determine or discuss the relationship between bone mineral density results and study parameter results, or the effect of these values on the healing of vertebral fractures. Nonetheless, based on these study results, although elderly female patients showed a slight decrease in fractured vertebral height and increased spinal canal narrowing compared to males, they still experienced healing of the fractured vertebrae and did not require surgical intervention. *Fourth*, there are conflicting opinions in the literature regarding the effect of body weight on healing vertebral fractures. While some studies suggest that increased body weight may negatively affect healing, others argue that no such effect exists.[14,15] As most patients in this study lacked BMI data, it was not possible to examine the relationship between BMI values and study parameter results, or the effect of these values on the healing of vertebral fractures. *Finally*, the results of patients who underwent conservative treatment were not compared with those of patients who underwent surgical treatment. In conclusion, despite the limitations of this study, the results are interesting and could inform and lead to more advanced, detailed studies in the future.

In conclusion, following conservative treatment, the T12-L5 Cobb angle and the height of the fractured vertebra decreased slightly in patients with a collapse rate of less than 20%. However, this treatment could prevent an increase in fractured vertebral kyphosis and collapse rates. Additionally, KPS scores of 90 (70–100) in these patients indicated that they could benefit from this treatment. Conversely, it was concluded that conservative treatment may be inadequate for female patients over 55 years of age, although it can still be used effectively.

Conflict of Interest: The authors have no conflicts of interest to declare.

Researchers' Contribution Rate Statement: Concept/Design: BB, AÖ, UY, MÖ; Analysis/Interpretation: BB, AÖ, AME; Data Collection: AME, OA, ABO, SS; Writer: BB; Critical Review: BB, AÖ; Approver: AÖ, OA, SS, ABO, AME, UY, MÖ, BB.

Support and Acknowledgement: No financial support was received from any institution or person.

Ethics Committee Approval: The study protocol was approved by the Kırıkkale University Faculty of Medicine, Clinical Research Ethics Committee (Approval date: March 12th, 2025; meeting number: 2025/05; approval number: 2025.03.05)

REFERENCES

1. Schuller A, Payr S, Pichler L et al. Radiographic outcomes of conservative and operative treatment in isolated L1 fractures. *Medicina (Kaunas).* 2023;59(4):695.
2. Bailey CS, Urquhart JC, Dvorak MF et al. Orthosis versus no orthosis for the treatment of thoracolumbar burst fractures without neurologic injury: A multicenter prospective randomized equivalence trial. *Spine J.* 2014;14(11):2557-2564.
3. Linhares D, Pinto BS, Ribeiro da Silva M, Neves N, Fonseca JA. Orthosis in thoracolumbar fractures: A systematic review and meta-analysis of randomized controlled trials. *Spine (Phila Pa. 1976).* 2020;45(22):E1523-E1531.
4. Urquhart JC, Alrehaili OA, Fisher CG et al. Treatment of thoracolumbar burst fractures: Extended follow-up of a randomized clinical trial comparing orthosis versus no orthosis. *J Neurosurg Spine*. 2017;27(1):42-47.
5. Wallace N, McHugh M, Patel R, Aleem IS. Effects of bracing on clinical and radiographic outcomes following thoracolumbar burst fractures in neurologically intact patients: A meta-analysis of randomized controlled trials. *JBJS Rev.* 2019;7(9):e9.
6. Mulcahy MJ, Dower A, Tait M. Orthosis versus no orthosis for the treatment of thoracolumbar burst fractures: A systematic review. *J Clin Neurosci*. 2021;85:49-56.
7. Bakhsheshian J, Dahdaleh NS, Fakurnejad S, Scheer JK, Smith ZA. Evidence-based management of traumatic thoracolumbar burst fractures: A systematic review of nonoperative management. *Neurosurg Focus*. 2014;37(1): E1.
8. Hitchon PW, Abode-Iyamah K, Dahdaleh NS et al. Nonoperative management in neurologically intact thoracolumbar burst fractures: Clinical and radiographic outcomes. *Spine (Phila Pa 1976).* 2016;41(6):483-489.
9. Nau C, Pape HC, Jug M, Wendt K, Komadina R, Bloemers F. Thoracolumbar injuries: Nonoperative treatment: indications, management. *Eur J Trauma Emerg Surg.* 2024;50(5):1951-1957.
10. Soultanis K, Thano A, Soucacos PN. Outcome of thoracolumbar compression fractures following non-operative treatment. *Injury.* 2021;52(12):3685-3690.
11. Stadhouder A, Buskens E, Vergroesen DA, Fidler MW, de Nies F, Oner FC. Nonoperative treatment of thoracic and lumbar spine fractures: A prospective randomized study of different treatment options. *J Orthop Trauma.* 2009;23(8):588-594.
12. van der Roer N, de Lange ES, Bakker FC, de Vet HC, van Tulder MW. Management of traumatic thoracolumbar fractures: A systematic review of the literature. *Eur Spine J.* 2005;14(6):527-534.
13. Rajasekaran S, Kanna RM, Schnake KJ, et al. Osteoporotic thoracolumbar fractures-how are they different? Classification and treatment algorithm. *J Orthop Trauma*. 2017;31 Suppl 4:S49-S56.
14. Rinonapoli G, Pace V, Ruggiero C, et al. Obesity and bone: A complex relationship. *Int J Mol Sci.* 2021;22(24):13662.
15. An Y, Li JN, Wang Y, Tian W, Li N. Association of overweight and obesity with vertebral fractures: A systematic review and meta-analysis. *Minerva Endocrinol (Torino).* 2023;48(4):459-472.