CIRUGIA Y CIRUJANOS

Check for updates

ORIGINAL ARTICLE

# Predictors of postoperative neurological deficits in traumatic thoracolumbar fractures

## *Predictores de déficits neurológicos posoperatorios en fracturas toracolumbares traumáticas*

*Alp Karaaslan*

*Department of Neurosurgery, Sancaktepe Training and Research Hospital, Istanbul, Turkey*

## Abstract

**Objective:** *The goal of this retrospective study was to assess the outcomes of vertebral stabilization following acute traumatic thoracolumbar (TL) fractures.* **Methods:** *The study examined the mechanism and location of trauma, pre-operative and post-operative neurological deficits, stabilization level, screw malposition, cerebrospinal fluid fistula, development of post-operative infections, additional pathological findings, mobilization times, and follow-up durations.* **Results:** *The study included 55 patients. Falls were the leading cause of trauma (75%), and L1 was the most common fracture site (30.9%). A4 was the most common fracture type (61.8%), with T11-L3 being the most frequently stabilized level (32.7%). Screw malposition occurred in 3.6% of cases, and CSF fistula was more common in types B and C. The presence of pre-operative neurodeficits and TL American Orthopedic Spine Injury Score (AOSIS) type B and C significantly increased the risk of post-operative neurological complications. Univariate analysis showed that pre-operative neurodeficits (odds ratio [OR]: 396, 95% confidence intervel [CI]: 22-6935, p < 0.001) and TL AOSIS types B (OR: 11.78, 95% CI: 1.88-73.58, p = 0.008) and C (OR: 9.9, 95% CI: 1.31-74.73, p = 0.026) significantly increased the risk of post-operative neurodeficits.* **Conclusions:** *This study, therefore, takes into consideration the strong impact of pre-operative neurological deficit and injury severity with respect to TL classifications on post-operative outcomes for patients undergoing surgical stabilization for traumatic fractures.*

***Keywords:*** *Traumatic spine fracture. Thoracolumbar fracture. Trauma.*

## Resumen

**Objetivo:** *Evaluar los resultados de la estabilización vertebral tras fracturas traumáticas agudas toracolumbares.* **Métodos:** *Se evaluaron el mecanismo y la localización del trauma, los déficits neurológicos preoperatorios y posoperatorios, el nivel de estabilización, la mala posición de los tornillos, la fístula de líquido cefalorraquídeo, el desarrollo de infecciones posoperatorias, los hallazgos patológicos adicionales, los tiempos de movilización y las duraciones del seguimiento.* **Resultados:** *El estudio incluyó 55 pacientes. Las caídas fueron la principal causa de trauma (75%), L1 fue el sitio de fractura más común (30.9%), el tipo de fractura más frecuente fue A4 (61.8%) y T11-L3 fue el nivel estabilizado con mayor frecuencia (32.7%). La mala posición de los tornillos se observó en el 3.6% de los casos y la fístula de líquido cefalorraquídeo fue más común en los tipos B y C. La presencia de déficits neurológicos preoperatorios y tipo B, C de la clasificación TL AOSIS aumentó significativamente el riesgo de complicaciones neurológicas posoperatorias. El análisis univariado mostró que los déficits neurológicos preoperatorios (OR: 396; IC 95%: 22-6935; p < 0.001) tipo B (OR: 11.78; IC 95%: 1.88-73.58; p = 0.008) y tipo C (OR: 9.9; IC 95%: 1.31-74.73; p = 0.026) de TL AOSIS aumentaron significativamente el riesgo de déficits neurológicos posoperatorios.* **Conclusiones:** *Este*

**Correspondence:**
Alp Karaaslan
E-mail: alpkaraaslan44@gmail.com

Date of reception: 04-04-2025
Date of acceptance: 07-08-2025
DOI: 10.24875/CIRU.25000193

Cir Cir. 2026;94(3):246-253
Contents available at PubMed
www.cirugiaycirujanos.com

0009-7411/© 2025 Academia Mexicana de Cirugía. Published by Permanyer. This is an open access article under the terms of the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

*estudio toma en consideración el fuerte impacto del déficit neurológico preoperatorio y la gravedad de la lesión con respecto a clasificaciones toracolumbares en resultados posoperatorios de pacientes sometidos a estabilización quirúrgica por fracturas traumáticas.*

***Palabras clave:*** *Fractura traumática de columna. Fractura toracolumbar. Trauma.*

## Introduction

Traumatic thoracolumbar (TL) fractures are one of the most significant causes of disability, deformity, and neurological deficits among working-age individuals in both industrialized and developing countries.[1-4] These fractures most commonly affect men between the ages of 20 and 40, and in approximately 50% of cases, they can lead to significant medical, social, and economic consequences.[2,3,5] It is estimated that 50-60% of TL fractures occur in the transition zone between T11 and L2, 25-50% in the thoracic region, and only 10-14% in the lumbar and sacral regions.[6-8] According to various studies, compression fractures (type A) account for 63-82% of all traumas, distraction injuries (type B) for 14-21%, and rotational injuries (type C) for 4-16%.[9,10] The likelihood and extent of neurological deficits vary depending on the type of fracture, with an incidence of up to 55% in the latest AO classification's type C fractures.[7,11] Spinal cord injuries are often the result of high-energy blunt trauma, with 56-67% associated with motor vehicle accidents and falls from great heights. These injuries are commonly associated with other injuries, such as rib fractures and pneumothorax, due to the high-speed nature of the trauma.[11,12] In addition, the incidence of concurrent intra-abdominal injuries can be as high as 50%. Over time, many classifications have been developed to assist clinicians in treatment selection; however, while there is consensus on surgery for flexion-distraction and rotational injuries, a definitive recommendation on how to treat compression injuries is still lacking.[11,13] Although various approaches and surgical techniques have been described for the treatment of TL fractures, scientific evidence is still insufficient to support the selection of one surgical technique as being more effective than others.[7,14,15]

The goal of this retrospective study was to assess the outcomes of vertebral stabilization following acute traumatic TL fractures. We aimed to examine these outcomes with patient clinical data, the type and location of the fracture, the presence of neurological damage, and neurodeficit risk factor analysis.

## Methods

A retrospective analysis was conducted on 55 patients who underwent surgery in our clinic between 2018 and 2024 (Fig. 1). The study examined the mechanism and location of trauma, pre-operative and post-operative neurological deficits, stabilization level, screw malposition, cerebrospinal fluid (CSF) fistula, development of post-operative infections, additional pathological findings, mobilization times, and follow-up durations. All patients underwent an imaging study of the vertebral column, which included anteroposterior and lateral X-rays, computed tomography, and magnetic resonance imaging. The purpose was to outline the exact morphology of the lesion and the possible spine involvement. Fractures were radiologically classified using the AO spine injury scores, and the findings were evaluated in the context of the existing literature (Fig. 2).

This study was approved by the non-interventional ethics committee of Sancaktepe Training and Research Hospital. This study was conducted in accordance with the principles of the Declaration of Helsinki, as revised in 2013. Before surgery, written informed consent was obtained from all patients or their legal guardians.

Patients who presented to the emergency department due to trauma and were determined to require surgery were included in the study. Patients diagnosed with osteoporosis who developed fractures, as well as those who sustained fractures due to trauma but did not require surgical intervention, were excluded from this study.

In this study, spine injuries were classified according to the AOSpine TL spine injury classification system. In response to the limitations of previous classification systems in gaining global acceptance, Vaccaro et al. developed the AOSpine TL spine injury classification system in 2013.[16] This new system incorporates elements from both the Magerl classification and the TL injury classification and severity score. The morphologic classification is a simplified version of the Magerl system, featuring a total of nine injury patterns. These injuries are categorized into three

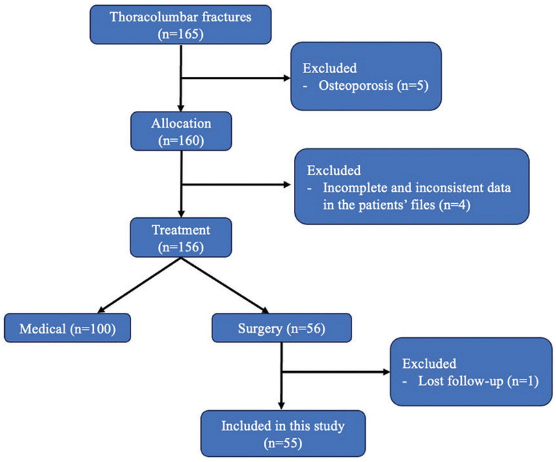


**Figure 1.** *Patient flow chart.*

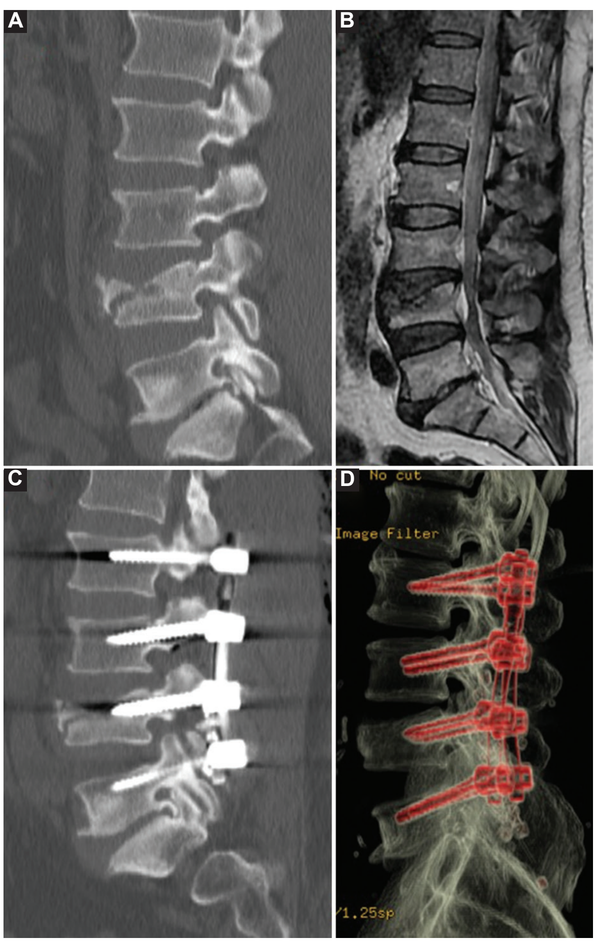


**Figure 2.** *Radiological image.* **A** *and* **B:** *pre-operative magnetic resonance imaging image.* **C:** *post-operative MRI image,* **D:** *post-operative 3D computed tomography image.*

primary types: Type A – compression injuries, Type B – tension band injuries, and Type C – translation injuries. Type A and Type B injuries are further divided into five and three subtypes, respectively (Table 1).

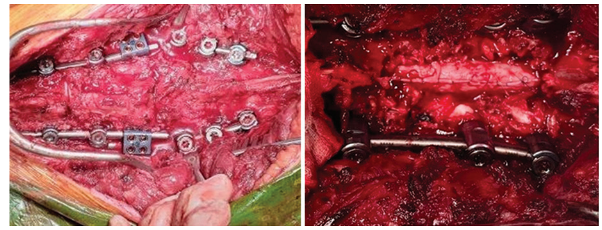

**Figure 3.** *Intraoperative view.*

All patients underwent surgical stabilization of the fracture site, utilizing a posterior approach under general anesthesia.[7,11,14,17] The number of levels fused varied depending on the type and location of the fracture, as well as the difficulty in realigning the spinal column, with the goals of restoring sagittal alignment and ensuring implant stability. In cases involving spinal canal compromise with neurological deficits, spinal cord decompression was also performed. For patients where pedicle screws alone could not provide sufficient stability due to osteoporosis, bone cement and fenestrated screws were used (Fig. 3).

The data for our study were analyzed using Jamovi software version 2.4.1. Descriptive statistics were presented as counts and percentages for categorical variables and as means with standard deviations for continuous variables. The Pearson Chi-square test was applied to determine differences between groups for categorical variables. To assess the normality of the distribution for continuous variables, the Shapiro–Wilk test was utilized. For comparisons between two groups, the independent t-test was employed. A binary logistic regression test was used to test the predictors. A $p < 0.05$ was considered statistically significant.

## Results

The study included 55 patients with a mean age of 42.1 years (min-max: 12-83). The majority of the patients were male (69%). The primary cause of trauma was falls, accounting for 75% of the cases, followed by motor vehicle accidents at 18%, and other injuries at 7%. Vertebral fractures were most commonly observed at the L1 level, representing 30.9% of the cases. Other frequently affected levels included L2 (16.3%), T12 (14.6%), L3 (14.4%), and L2-L4 (7.2%). Preoperatively, 18.2% of the patients presented with neurodeficits, with 5.5% having paraparesis and 12.7% experiencing plegia. Postoperatively, the incidence of neurodeficits remained consistent, with 18.2% of the patients displaying neurological

**Table 1. TL AOSIS types**

| Subgroup | Description | TL AOSIS |
|---|---|---|
| Type A: compression fractures | | |
| A0 | An injury that has no possibility of affecting the structural integrity of the spine (ie, fracture of the spinous or transverse process) | 0 |
| A1 | A fracture through a single endplate that does not extend into the posterior wall | 1 |
| A2 | A fracture through both endplates that does not extend into the posterior wall | 2 |
| A3 | A fracture through a single endplate that does extend into the posterior wall (incomplete burst) | 3 |
| A4 | A fracture through both endplates that does extend into the posterior wall (complete burst) | 5 |
| Type B: Tension band injury | | |
| B1 | A completely osseous tension band injury (ie, a bony chance fracture) | 5 |
| B2 | An injury that disrupts the posterior tension band | 6 |
| B3 | An injury that disrupts the anterior tension band | 7 |
| Type C: Translational injuries | | |
| C | Any injury that results in translation of the vertebral body | 8 |

TL: thoracolumbar.

impairment, distributed equally between paraparesis (5.5%) and plegia (12.7%). Screw malposition was noted in 3.6% of the cases, while a CSF fistula and infections occurred in 1.8% of the patients. The mean time to mobilization post-surgery was 1.2 days (min-max: 1-5). The mean follow-up period was 3.3 years (min-max: 1-6), during which the outcomes of the surgical interventions were closely monitored. During the follow-up period, no patients required reintervention (Table 2).

The TL injury classification for the 55 patients included in the study revealed that the majority of cases were categorized as A4, accounting for 61.8% of the total. This was followed by B2 injuries, which comprised 21.8% of the cases, and C injuries, representing 14.5%. A2 injuries were the least common, with only 1.8% of the cases falling into this category (Table 3).

The analysis of stabilization levels among the 55 patients revealed that the most common stabilization level was T11-L3, accounting for 32.7% of the cases. This was followed by the L1-L5 stabilization level, which was observed in 9.1% of the patients. Other frequently stabilized segments included T10-L2 (7.3%), T12-L4 (5.5%), and L2-L5 (5.5%) (Table 4).

The average age differed among the groups, with patients classified as type A having a mean age of 45.8 years, while those in groups B and C were younger, with mean ages of 38.3 years and 31.5 years, respectively, though this difference was not statistically significant ($p = 0.059$). Gender distribution did not differ significantly across the groups ($p = 0.546$). A significant difference was observed in the presence of pre-operative neurodeficits, which were rare in type A injuries (2.9%) but more common in types B (41.7%) and C (50%) ($p < 0.001$). Post-operative neurodeficits followed a similar pattern, with higher rates in type B (41.7%) and C (37.5%) compared to type A (5.7%) ($p = 0.006$). The cause of trauma did not show a significant difference across the injury types ($p = 0.617$). Screw malposition was only observed in the type A group (5.7%) ($p = 0.553$). However, CSF fistula occurrence showed a significant difference, being more common in types B (25%) and C (25%) compared to type A (2.9%) ($p = 0.040$). Infection rates did not differ significantly among the groups ($p = 0.748$) (Table 5).

The univariate analysis revealed that the presence of pre-operative neurodeficit and the TL AOSIS type were significantly associated with post-operative neurodeficit occurrence. Specifically, having a pre-operative neurodeficit significantly increased the risk of developing a post-operative neurodeficit (OR: 396, 95% CI: 22-6935, $p < 0.001$). In addition, patients with TL AOSIS type B had a significantly higher risk of post-operative neurodeficit compared to those with type A (OR: 11.78, 95% CI: 1.88-73.58, $p = 0.008$). Similarly, those with type C also demonstrated an increased risk (OR: 9.9, 95% CI: 1.31-74.73, $p = 0.026$) (Table 6).

## Discussion

In this study, we found that pre-operative neurodeficits and the type of TL injury, as classified by the AOSpine

**Table 2. Basic characteristics of the patients**

| Basic characteristics | n = 55 | % |
|---|---|---|
| Age (year; mean ± SD, min-max) | 42.1 ± 18.3 | 12-83 |
| Gender (M) | 34 | 69 |
| Cause of trauma | | |
| Falls | 41 | 75 |
| Motor vehicle accidents | 10 | 18 |
| Other injuries* | 4 | 7 |
| Vertebral fracture levels | | |
| T4-T5 | 1 | 1.8 |
| T7 | 1 | 1.8 |
| T10-T11 | 1 | 1.8 |
| T12 | 8 | 14.6 |
| T12-L1 | 1 | 1.8 |
| L1 | 17 | 30.9 |
| L2 | 9 | 16.3 |
| L2-L4 | 4 | 7.2 |
| L3 | 8 | 14.4 |
| L3-L4 | 1 | 1.8 |
| L3-L5 | 1 | 1.8 |
| L4 | 3 | 5.5 |
| Pre-operative neurodeficit (yes) | 10 | 18.2 |
| Type of neurodeficit (pre-operative) | | |
| Paraparesis | 3 | 5.5 |
| Plegia | 7 | 12.7 |
| Post-operative neurodeficit | 10 | 18.2 |
| Type of neurodeficit (post-operative) | | |
| Paraparesis | 3 | 5.5 |
| Plegia | 7 | 12.7 |
| Screw malposition (yes) | 2 | 3.6 |
| Infections | 1 | 1.8 |
| CSF fistula (yes) | 1 | 1.8 |
| Time for mobilization (day; mean ± SD, min-max) | 1.2 ± 0.6 | 1-5 |
| Follow-up (year; mean ± SD, min-max) | 3.3 ± 1.5 | 1-6 |

*Other injuries: assault, epileptic seizure, gunshot.
SD: standard deviation; CSF: cerebrospinal fluid; M: male; T: thoracal; L: lumbar.

**Table 3. TL AOSIS type of fracture**

| TL AOSIS | n | % | Cumulative % |
|---|---|---|---|
| A2 | 1 | 1.8 | 1.8 |
| A4 | 34 | 61.8 | 63.6 |
| B2 | 12 | 21.8 | 85.5 |
| C | 8 | 14.5 | 100 |
| Total | 55 | 100 | 100 |

TL: thoracolumbar.

**Table 4. Frequencies of stabilization level**

| Stabilization level | n | % |
|---|---|---|
| L1-L3 | 1 | 1.8 |
| L1-L4 | 2 | 3.6 |
| L1-L5 | 5 | 9.1 |
| L2-L5 | 3 | 5.5 |
| L2-S1 | 1 | 1.8 |
| L3 | 1 | 1.8 |
| L3-L5 | 1 | 1.8 |
| T10-L1 | 1 | 1.8 |
| T10-L2 | 4 | 7.3 |
| T10-L3 | 2 | 3.6 |
| T10-T12 | 1 | 1.8 |
| T10-l2 | 1 | 1.8 |
| T11-L5 | 2 | 3.6 |
| T11-L6 | 1 | 1.8 |
| T11-L3 | 18 | 32.7 |
| T11-L3 | 1 | 1.8 |
| T11-L4 | 1 | 1.8 |
| T12-L3 | 1 | 1.8 |
| T12-L4 | 3 | 5.5 |
| T12-L5 | 2 | 3.6 |
| T2-T7 | 1 | 1.8 |
| T5-T9 | 1 | 1.8 |
| T8-T12 | 1 | 1.8 |

system, were significant predictors of post-operative outcomes. Patients presenting with pre-operative neurodeficits had a markedly higher risk of developing post-operative neurodeficits, emphasizing the critical impact of early neurological impairment on surgical outcomes. Furthermore, injury types B and C were associated with significantly higher risks of post-operative neurodeficits compared to type A injuries, underscoring the severity of these injury patterns.

Despite significant advancements in diagnostic techniques and spinal instrumentation, there remains no clear consensus on the optimal treatment approach for TL fractures.[11,18-20] Treatment options vary widely, ranging from conservative management with orthotic external bracing to more invasive surgical procedures, such as instrumented fusions.[11,13,15] Recently, percutaneous fixation has emerged as a minimally invasive alternative, providing a middle ground between these two extremes. Neeley et al. compared deformity correction and surgical outcomes between

**Table 5. Comparative analysis of items regarding TL AOSIS**

| Characteristics | A (n = 35) | B (n = 12) | C (n = 8) | p |
|---|---|---|---|---|
| Age (year) | 45.8 ± 18.6 | 38.3 ± 17.8 | 31.5 ± 13 | 0.059 |
| Gender (M), n (%) | 20 (57) | 9 (75) | 5 (62.5) | 0.546 |
| Any pre-operative neurodeficit, n (%) | 1 (2.9) | 5 (41.7) | 4 (50) | < 0.001 |
| Any post-operative neurodeficit, n (%) | 2 (5.7) | 5 (41.7) | 3 (37.5) | 0.006 |
| Cause of trauma, n (%) | | | | 0.617 |
| Falls | 26 (74.3) | 8 (66.7) | 7 (87.5) | |
| Motor vehicle accidents | 7 (20) | 2 (16.7) | 1 (12.5) | |
| Other injuries* | 2 (5.7) | 2 (16.7) | 0 (0) | |
| Screw malposition | 2 (5.7) | 0 (0) | 0 (0) | 0.553 |
| CSF fistula | 1 (2.9) | 3 (25) | 2 (25) | 0.040 |
| Infections | 1 (2.9) | 0 (0) | 0 (0) | 0.748 |

*Other injuries: assault, epileptic seizure, gunshot.
CSF: cerebrospinal fluid; M: male.

**Table 6. Binary logistic regression analysis**

| Characteristics | Univariate analysis | | p | OR | 95% CI | Multivariate analysis | | p |
|---|---|---|---|---|---|---|---|---|
| | Estimate | SE | | | | Estimate | SE | |
| Age (year) | −0.0163 | 0.0202 | 0.419 | 0.984 | 0.945-1.02 | | | |
| Gender (ref: Female) | 1-0.442 | 0.754 | 0.558 | 0.643 | 0.147-2.189 | | | |
| Any pre-operative neurodeficit | 5.98 | 1.46 | < 0.001 | 396 | 22-6935 | 39.44 | 6763 | 0.995 |
| Cause of trauma | | | | | | | | |
| Motor vehicle accidents - falls | −0.617 | 1.133 | 0.586 | 0.540 | 0.058-4.970 | | | |
| Other injuries* - falls | 1.580 | 1.083 | 0.144 | 4.857 | 0.581-40.55 | | | |
| Screw malposition | −15.11 | 1696 | 0.993 | | 0.39-16.44 | | | |
| CSF fistula | 0.942 | 0.948 | 0.321 | 2.563 | | | | |
| Infections | −15.08 | 2399 | 0.995 | | | | | |
| TL AOSIS type (ref: A) | | | | | | | | |
| B-A | 2.47 | 0.934 | 0.008 | 11.78 | 1.88-73.57 | −16.33 | 4619 | 0.997 |
| C-A | 2.29 | 1.031 | 0.026 | 9.9 | 1.31-74.73 | −34.85 | 6763 | 0.996 |

*Other injuries: assault, epileptic seizure, gunshot.
CSF: cerebrospinal fluid. OR: odds ratio; SE: standard error; CI: confidence interval.

percutaneous instrumentation and open fusion in patients with traumatic TL fractures, highlighting the evolving landscape of treatment options.[15] Reinhold et al. reported using a posterior approach in approximately half of their cases, with the remainder divided between combined anteroposterior and exclusively anterior approaches.[14] Similarly, Muratore et al. emphasized a tailored approach, choosing between posterior and combined anteroposterior methods based on the anatomical and overall clinical status of each patient.[11] In our study, we employed a uniform strategy, performing surgical stabilization using the posterior approach in all patients. This choice was guided by our clinical experience and the specific characteristics of the fractures observed, reinforcing the utility of a consistent approach in achieving reliable outcomes.

According to a meta-analysis, the most commonly injured vertebra was L1, with an incidence rate of 34.4% (95% CI 18.2%, 50.3%).[21] The most frequently injured non-junctional vertebra was T7, at 3.9% (95% CI 2.81%, 4.99%), while T2 was the least affected, with an incidence of 0.26% (95% CI 0, 0.56%). The same meta-analysis found that the leading cause of TL fractures was motor vehicle collisions, accounting for

36.7% (95% CI 31.35%, 42.0%) of cases, followed by high-energy falls at 31.7% (95% CI 25%, 38.4%). Motorcycle collisions accounted for 10.05%, other causes for 9.06%, and pedestrian accidents for 4.83%. Muratore et al.[11] reported that fractures predominantly involved the TL region, between T11 and L2, while Neeley et al.[15] found the highest incidence at the T12-L1 level. In contrast, our study identified falls as the most common cause of fractures, with the most frequent fracture levels occurring between T11 and L3.

Katsuura et al. identified type A3 or A4 fractures as the most prevalent trauma patterns.[21] Similarly, Reinhold et al. demonstrated that type A fractures were the most common, with over half of their patients presenting with polytrauma.[14] Their findings also revealed an increasing incidence of neurological deficits as the fracture severity escalated from type A to type C. Neeley et al. also observed a predominance of type A fractures.[15] In our study, type A fractures were the most frequently encountered. In addition, post-operative neurodeficits in our cohort exhibited a comparable trend, with significantly higher rates observed in type B (41.7%) and type C (37.5%) fractures compared to type A fractures (5.7%).

In their meta-analysis, Azizi et al. reported a pooled spinal cord injury (SCI) event rate of 15.81% among patients with TL fractures.[22] Similarly, Muratore et al. found that the probability of medullary involvement increased with the severity of the primary fracture type, showing a significant difference between type A and type C fractures, but not between type A and type B.[11] Katsuura et al. conducted a meta-analysis involving seven studies, which included 3,146 patients, to assess the rate of neurologic SCI in TL fracture patients.[21] One study, which differentiated between a polytrauma group and a specific TL trauma group, was analyzed as two separate cohorts.[23] The overall rate of SCI in these patients was found to be 26.5% (95% CI 15.8%, 37.2%).[21] In our study, neurological deficits were observed in 18.2% of the patients. Furthermore, univariate analysis revealed that the presence of pre-operative neurodeficits and the TL AOSIS type were significantly associated with the occurrence of post-operative neurodeficits.

While this study provides valuable insights into the surgical outcomes of traumatic TL fractures, it is not without limitations. First, the retrospective nature of the study introduces potential biases, including selection and recall bias, which may affect the accuracy of the data. Second, the relatively small sample size limits the generalizability of the findings, particularly when stratifying patients by injury type and analyzing subgroup outcomes. The study did not account for potential confounding factors such as the patients' comorbidities, the timing of surgery, and variations in surgical techniques, all of which could influence the outcomes. In addition, the follow-up period, though adequate, varied among patients, which might have affected the assessment of long-term outcomes such as late-onset complications and functional recovery. Finally, the lack of randomization and a control group limits the ability to establish causality between the interventions and observed outcomes.

## Conclusions

This study, therefore, takes into consideration the strong impact of pre-operative neurological deficit and injury severity with respect to TL classifications on post-operative outcomes for patients undergoing surgical stabilization for traumatic fractures. Patients who have pre-operative neurological deficits and those whose injury types are more serious, the B and C types, have a higher likelihood of having post-operative neurological deficits. This study's results bring out the importance of early and accurate assessment of injuries, further pinpointing the need for individualized surgical approaches to improve patient outcomes. However, more prospective studies on larger populations are needed to confirm these observations and sharpen clinical decision-making.

## Funding

The authors declare that they have not received funding.

## Conflicts of interest

The authors declare no conflicts of interest.

## Ethical considerations

**Protection of human subjects and animals.** The authors declare that the procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation and with the World Medical Association and the Declaration of Helsinki. The procedures were authorized by the Institutional Ethics Committee.

**Confidentiality, informed consent, and ethical approval.** The authors have followed their institution's confidentiality protocols, obtained informed consent from all patients, and secured approval from the Ethics Committee. SAGER guidelines have been followed as applicable to the nature of the study. Ethical approval was obtained from the Sancaktepe local ethical committee.

**Declaration on the use of artificial intelligence.** The authors declare that no generative artificial intelligence was used in the writing or creation of the content of this manuscript.

## References


1. Azam MQ, Sadat-Ali M. The concept of evolution of thoracolumbar fracture classifications helps in surgical decisions. Asian Spine J. 2015;9:984-94.
2. Haq MI, Khan SA, Aurangzeb A, Ahmed E, Bhatti SN, Noman A. Radiological outcome of transpedicular screws fixation in the management of thoracolumbar spine injury. J Ayub Med Coll Abbottabad. 2015;27:171-3.
3. Cengiz SL, Kalkan E, Bayir A, Ilik K, Basefer A. Timing of thoracolomber spine stabilization in trauma patients; Impact on neurological outcome and clinical course. A real prospective (rct) randomized controlled study. Arch Orthop Trauma Surg. 2008;128:959-66.
4. Hatakeyama Y, Hongo M, Kido T, Urayama M, Kasukawa Y, Sasaki H, et al. Neurological analysis based on the terminal end of the spinal cord and the narrowest level of injured spine in thoracolumbar spinal injuries. Acta Med Okayama. 2023;77:499-509.
5. Rodriguez-Morales J, Méndez-Viveros A, Pineda-Hernández C, Parra-Romero G, Ariñez-Barahona E, Guartazaca-Guerrero S, et al. Incidence of neurosurgical pathology of the spine in population of Mexico City. Cir Cir. 2021;89:806-10.
6. Ruiz Santiago F, Tomás Muñoz P, Moya Sánchez E, Revelles Paniza M, Martínez Martínez A, Pérez Abela AL. Classifying thoracolumbar fractures: role of quantitative imaging. Quant Imaging Med Surg. 2016;6:772-84.
7. Reinhold M, Knop C, Beisse R, Audigé L, Kandziora F, Pizanis A, et al. [Operative treatment of traumatic fractures of the thoracic and lumbar spinal column. Part I: epidemiology]. Unfallchirurg. 2009;112:33-42, 44-5.
8. Durel R, Rudman E, Milburn J. Clinical images - a quarterly column: chance fracture of the lumbar spine. Ochsner J. 2014;14:9-11.
9. Smith PP, Hurtado EA, Appell RA. *Post hoc* interpretation of urodynamic evaluation is qualitatively different than interpretation at the time of urodynamic study. Neurourol Urodyn. 2009;28:998-1002.
10. Schömig F, Taheri N, Kalaf H, Muellner M, Becker L, Pumberger M. Validation of the TLICS and AOSpine injury score for surgical management of paediatric traumatic spinal injuries. Arch Orthop Trauma Surg. 2023;143:2011-7.
11. Muratore M, Allasia S, Viglierchio P, Abbate M, Aleotti S, Masse A, et al. Surgical treatment of traumatic thoracolumbar fractures: a retrospective review of 101 cases. Musculoskelet Surg. 2021;105:49-59.
12. Villarreal-García FI, Martínez-Gutiérrez OA, Reyes-Fernández PM, Saavedra-Badillo LA, Avalos RM, Acosta-Olivo CA, et al. Two-year prevalence of spinal gunshot injuries in Mexico: a single center experience. Cir Cir. 2022;90:467-72.
13. Zhang C, Liu Y. Combined pedicle screw fixation at the fracture vertebrae versus conventional method for thoracolumbar fractures: a meta-analysis. Int J Surg. 2018;53:38-47.
14. Reinhold M, Knop C, Beisse R, Audigé L, Kandziora F, Pizanis A, et al. Operative treatment of 733 patients with acute thoracolumbar spinal injuries: comprehensive results from the second, prospective, internet-based multicenter study of the Spine study group of the German association of trauma surgery. Eur Spine J. 2010;19:1657-76.
15. Neeley OJ, Kafka B, Tecle NE, Shi C, El Ahmadieh TY, Sagoo NS, et al. Percutaneous screw fixation versus open fusion for the treatment of traumatic thoracolumbar fractures: a retrospective case series of 185 patients with a single-level spinal column injury. J Clin Neurosci. 2022;101:47-51.
16. Vaccaro AR, Oner C, Kepler CK, Dvorak M, Schnake K, Bellabarba C, et al. AOSpine thoracolumbar spine injury classification system: fracture description, neurological status, and key modifiers. Spine (Phila Pa 1976). 2013;38:2028-37.
17. Jaafarpour M, Hatefi M, Vasigh A, Khani A, Njafi F, Shafiei E. Comparison between general and spinal anesthesia for lumbar disc surgery: a randomized clinical trial. Acad J Health Sci Med Balear. 2023;38:41-6.
18. Qureshi S, Dhall SS, Anderson PA, Arnold PM, Chi JH, Dailey AT, et al. Congress of neurological surgeons systematic review and evidence-based guidelines on the evaluation and treatment of patients with thoracolumbar spine trauma: radiological evaluation. Neurosurgery. 2019;84:E28-31.
19. Ghobrial GM, Jallo J. Thoracolumbar spine trauma: review of the evidence. J Neurosurg Sci. 2013;57:115-22.
20. Gertzbein SD. Scoliosis research society. Multicenter spine fracture study. Spine (Phila Pa 1976). 1992;17:528-40.
21. Katsuura Y, Osborn JM, Cason GW. The epidemiology of thoracolumbar trauma: a meta-analysis. J Orthop. 2016;13:383-8.
22. Azizi A, Azizzadeh A, Tavakoli Y, Vahed N, Mousavi T. Thoracolumbar fracture and spinal cord injury in blunt trauma: a systematic review, meta-analysis, and meta-regression. Neurosurg Rev. 2024;47:333.
23. Hsu JM, Joseph T, Ellis AM. Thoracolumbar fracture in blunt trauma patients: guidelines for diagnosis and imaging. Injury. 2003;34:426-33.