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**ORIGINAL ARTICLE**

# Clinical Characteristics of Pediatric Thoracolumbar Spinal Injuries: A Retrospective Study

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## ABSTRACT

**Aim:** To determine the clinical characteristics of pediatric thoracolumbar spinal injuries
**Study design:** A retrospective study
**Place and Duration:**This study was conducted at Pakistan Institute of Medical Sciences Islamabad from Jan 2021 to Jan 2022
**Methodology:**An analysis of pediatric thoracolumbar (TL) injuries was conducted to determine the epidemiology, risk factors, mechanisms, patterns, and management of pediatric TL injuries. A plain radiograph (anteroposterior and lateral view) was taken on all patients for diagnosis. In the case of surgical intervention or doubtful skeletal abnormalities observed on plain radiographs, thin-slice computerized tomography (CT) scans were obtained. In patients with neurological deficits or those who were scheduled for surgical intervention, magnetic resonance imaging (MRI) was performed.
**Results:**A total of 90 children were treated at our institute for TL spine injuries, representing 2% of all spine injuries. Males predominate (3:1) with a mean age of 15.9 plus 3.2 years (range: 2–18 years). Falling from a height was the most common mode of injury. Most children (71.1%) sustained injuries after falling from height, 18/90 (20%) after a motor vehicle accident, and the rest after a heavy object fell over their neck. A total of 27.8% of the patients (the majority) had Grade A injuries. The most common spinal level injured was the lumbar spine (53.3%), and fractures accounted for 93.3% of all injuries. A total of 18/90 (20%) children underwent surgical fixation. There were 21 children available for follow-up, of which 13 (62%) were ambulant.
**Conclusion:**The lumbar area is most affected by TL injuries, which are uncommon and most often occur in youth older than 10 years. When necessary, a surgical fusion of the affected vertebrae is a secure and reliable procedure.
**Keywords:** Pediatrics, epidemiology, spine, thoracolumbar, injury

## INTRODUCTION

Spine injuries made up 4.3% of all injuries in children (under 18 years), whereas thoracolumbar spine injuries made up just 2% of all spine injuries (60% burst fractures and 24.4% compression fractures). Only 20% of patients had surgical intervention because patients with full cord injuries were not treated during the acute phase. Children's pedicles and spinal canals are smaller, which reduces the margin of error during surgery. Future physiological development should be taken into account while correcting the malformation. It was safe and successful to fuse an unstable spine surgically, whether employing a combined anteroposterior or only posterior technique. Although uncommon, paediatric thoracolumbar (TL) spinal injuries are a key cause of morbidity in this age range. According to the research, paediatric spinal injuries occur 1–10% of the time. (1-3) Between 5.4% and 34% of all paediatric spine injuries are thoracic and lumbar injuries.(4-6)Thoracic, lumbar, and sacral injuries in paediatric patients have very seldom been particularly recorded in research, and the majority of those that have been published are from developed nations. (7-10)Studies on the paediatric population are rare in underdeveloped nations. In this study, we examine the epidemiology, risk factors, mechanisms, patterns, and management of TL spine injuries in children.

## METHODOLOGY

We conducted a review of medical records for all of the children who had TL spine injuries. We identified every child between the ages of 0 and 18 years old who had suffered spinal trauma, which included fractures, dislocations, disco ligamentous lesions, and/or spinal cord injuries. The data came from medical records and were gathered by us. The ethical review committee of the institute permitted the study. Data were gathered on the patients, which included their ages, genders, mechanisms of damage, patterns and levels of injury, clinical presentation, presence or absence of neurologic impairments, concomitant injuries, modes of treatment, functional outcomes, and death rates.

A plain radiograph (anteroposterior and lateral view) was taken on all patients for diagnosis. In the case of surgical intervention or doubtful skeletal abnormalities observed on plain radiographs, thin-slice computerized tomography (CT) scans were obtained. In patients with neurological deficits or those who were scheduled for surgical intervention, magnetic resonance imaging (MRI) was performed. SPSS version 22 was used for data computation and analysis.

## RESULTS

A review of the patient data showed that 90 of the 196 children who had severe spine injuries over the course of five years had TL spine injuries. Children under the age of ≤18 had a spine injury rate of 4.3% (n = 196), whereas children with TL spine injuries made up 2% of all spine injuries treated across all age groups (n = 90). The cohort for this research consisted of the 90 children (90/196; 46% had a TL spine damage). The population under study had a mean age of 15.9± 3.2 years (range: 2–18 years). In the cohort as a whole, males suffered injuries more often than girls (3:1) [As shown in Table 1].

Of 90 children, 64 (71.1%) suffered injuries due to falls from heights greater than 10 feet, 18 (20%) suffered injuries due to motor vehicle accidents, and 6 (6.7%) due to objects such as sandbags or metal pipes falling from heights greater than 10 feet. A fracture (1.1%) was sustained by one patient as a result of a fall while playing, and a fracture (1.1%) was sustained by another patient as a result of diving into a well from a height of more than 30 feet. Thirteen individuals out of 90 (14.4%) suffered comorbid injuries. The long bone fracture was the most frequent complication. A total of 3/90 (3.3%) patients had just head injuries, whereas only long bone fractures were seen in 8 out of the total 90 individuals. Two patients were found to have had polytrauma; one had a head injury and a fractured femur, while the other had a head injury, a fractured humerus, several cracked ribs, and a right

hemothorax with numerous fractures. Frankel's grading system was used to evaluate the injuries [As shown in Table 1]. One in every 27.8 patients had a Grade A injury (complete cord injury).

The most often injured spinal section was the lumbar spine (As shown in Table 2). Twenty-five (27.5%) of the thirty-one children with thoracic spine injuries had fractures, four (4.4%) had subluxations, and the remaining two had spinal cord injuries without radiographic abnormalities (SCIWORA). A total of 44 (40.8%) of the 48 children who had lumbar spine injuries were fractured, and four more suffered subluxations. Ten people were found to have injuries to the dorsolumbar junction, including five with fractures, one with D12-L1 subluxations, one with translation injuries, and three with injuries that had both subluxations and fractures.

There were a total of 14 instances of multilevel damage, 11 of which were contiguous, meaning that they included nearby vertebrae, and three of which were noncontiguous, meaning that there was at least one normal vertebra present in between the affected vertebrae. One patient had a type II C2 fracture with body fractures in the D6, D7, and D8 vertebrae at the craniovertebral junction. This patient was one of three patients who had sustained a multilevel injury. Sixty-two out of ninety patients, (68.9 percent), had radiological instability.

Table 1: clinical features of the study participants

| Clinical features | Frequency | Percentage |
|---|---|---|
| Age (Years) | 15.9 + 3.2 | |
| Male | 68 | 75.6 |
| Female | 22 | 24.4 |
| Mode of Injury | | |
| Fall | 66 | 73.3 |
| Motor Vehicles accident | 18 | 20 |
| Others | 6 | 6.6 |
| Frankel grading | | |
| A | 25 | 27.8 |
| B | 13 | 14.4 |
| C | 16 | 17.8 |
| D | 13 | 14.4 |
| E | 21 | 23.3 |
| Associated injury | | |
| Long bone fractures | 10 | 11.1 |
| Head injury | 5 | 5.6 |
| Chest injury | 1 | 1.1 |

Table. 2: Radiological characteristics of the study participants

| Radiological features | Frequency | Percentage |
|---|---|---|
| Level of Injury | | |
| Dorsal | 32 | 34.4 |
| Lumbar | 48 | 53.3 |
| Dorsolumbar | 10 | 11.1 |
| Multilevel | 14 | 12.2 |
| Type of injury | | |
| Fracture | 84 | 93.3 |
| Subluxation | 13 | 14.4 |
| SCIWORA | 2 | 2.2 |
| Radiological instability | 62 | 68.9 |
| SCIWORA = Spinal cord injury without radiographic abnormality | | |

Table 2: Compares the Frankel grade at follow-up to the Frankel grade at start.

| Preoperative | Postoperative | | | | |
|---|---|---|---|---|---|
| | A | B | C | D | E |
| A | 4 | | 1 | | |
| B | | | 1 | 1 | |
| C | | | 1 | 3 | 1 |
| D | | | | 2 | 3 |
| E | | | | | 3 |
| CNBT | | | | 1 | |
| CNBT = Could not be tested | | | | | |

A total of 21 patients (23.3%) had access to follow-up, with a median follow-up time of 5 months (range: 1–72 months). A total of 15 of these individuals had received surgical fixation. Frankel's grading improved in ten out of 21 patients (47.6%), and 13/21 (62%) were ambulant at follow-up, whereas there was no change in the remaining five patients (23.8%) [As shown in Table 3]. Frankel's grade, the kind of damage, the surgical method, and the outcome were all compared, but none of the examined factors had a statistically significant impact on the result.

## DISCUSSION

A child's anatomical and physiological features change dramatically as they grow and develop, despite the perception that they are smaller adults. Children's spinal columns vary from adults' in that they have a higher cartilage/bone ratio, more soft tissue hyperelasticity, and secondary ossification sites. As the children grow, the ossification centre expands, causing the cartilage/bone ratio to reverse. (11) These variations affect the biomechanical features of the spine, particularly the occurrence of secondary ossification centres. In children, physeal damage causes physeal growth arrest, which leads to higher deformity compared to individuals who do not have physeal arrest. Pediatric spine injuries constituted 4.3% of all spine injuries treated in the current research (n = 90), whereas TL spine injuries in children composed 2%. Children's TL injuries were less frequent than cervical spine injuries. In other investigations, other researchers have also seen a comparable rise in the incidence of children cervical spine injuries as compared to TL injuries. (12)However, 52.9% of paediatric spinal injuries described by Dogan et al. were TL injuries. [8] Due to the cervical spine's greater range of motion than the TL spine, there is a higher prevalence of cervical spine injuries. The protection provided by the rib cage is responsible for the reduced prevalence of TL spine injuries. The TL junction is where the somewhat more mobile lumbar segment joins the more fixed thoracic spine, and this is where injuries often happen.According to the findings of our research, the ages 15–18 years old represented 81% of the children who had had TL injuries. Only four members out of ninety in our group were less than ten years old. Even while some authors had observed higher rates of 17–21% in children less than 10 years, the majority of the published research found that teenagers had a greater prevalence of TL injuries. Because the nucleus pulposus of the intervertebral disc in younger children has a higher hydrophilic nature and the vertebral body has a higher cancellous content, the vertebral body and the disc are able to endure a greater amount of compression before they fracture. Additionally, as was discussed before, the rib cage contributes to the protection of the thoracic spine. These characteristics may help to explain why there is a decreased frequency of TL injuries among children and teenagers.

Children's injury etiologies reflect the societal variations between industrialized and developing nations. Our series of research found that falls from height (71.1%) were the most frequent causes of injury, contrary to the bulk of studies from the West that cite motor vehicle accidents as the leading cause of injuries. This likely means that in our demographic, high-velocity motor vehicle injuries are less common among children. This emphasizes how likely inadequate awareness and safety measures are in places where people live, work, and play to stop unintentional accidents and injuries to children.

Children who have had many injuries present major diagnostic and treatment challenges. A total of 19% of the children with numerous injuries in a study by Dai et al. experienced a delay in TL injury diagnosis. However, in our dataset, 11.1% (10/90) of the patients had long bone fractures whereas only 5.6% (5/90) had head damage, contrary to earlier research that had showed head injury to be the most prevalent concomitant injury with TL spine injury. This could be caused by variations in the causes and aetiology of injury. While head injuries from car accidents may be more common, spinal fractures from falls from a height might increase the risk of long bone fractures in limbs.In this investigation, the most often affected level was the lumbar spine (53.3%). In contrast, the thoracic spine has been identified as the most often damaged level in several earlier research. (13) The

spinal injuries in our study varied in severity from mild ones like posterior element fracture to serious ones like burst fracture and translation. Burst fractures made up the majority of these injuries (60%) and were followed by compression fractures (24.4%). In contrast to our research, Dogan et al. and Santiago et al. found a greater incidence of compression fractures. (9) Since the development of MRI, several cases that have been labelled as SCIWORA in the literature have actually included injury to the spinal cord, soft tissue regions of the spinal column, or plainly visible vertebral body endplates. (14)

Between 3.3% and 34% of reported series had SCIWORA as an occurrence. The thoracic cord is involved in around 13% of instances with SCIWORA (15, 16)(17)In comparison to the cervical cord, the thoracic cord has a reduced incidence of SCIWORA. Similar to what was seen in the previous investigations, the incidence of SCIWORA of the thoracic cord in the current series was 6.4% (2/34).As a result of our selection criteria for surgical intervention, which excluded patients with full cord damage from consideration for surgery during the acute phase, 20% (18/90) of the patients in our research had surgical intervention. Most Western studies have indicated a comparable percentage of surgical intervention (16–33%) in their cohort. The TL injury categorization and severity score have been described by Lee et al. The categorization method is based on three main factors: the patient's neurologic condition, the integrity of the posterior ligamentous complex, and the anatomy of the injury. The surgical therapy of TL spine injuries may be guided by this score. (18) There are several other categories for instability. Our institute's decision-making was influenced by the management of many surgeons, the existence of a total cord damage, and the patients' desire to have surgery.

In our study, the majority of children (16–18) received posterior transpedicular fusion, which included the vertebrae above and below the broken one. A combined anterior and posterior approach & 360° fusion were performed on two patients. For the treatment of spinal fractures, Dogan et al. have also developed an anterior technique and a combination anterior and posterior method. [8]

The surgical therapy of juvenile spinal trauma must take a variety of special factors into account. Prior to surgery, it is important to thoroughly examine the smaller vertebral body and pedicles to determine the proper screw size. Pedicles and spinal canals that are narrower have lower error margins. Future physiological development of the patient should be taken into account while correcting the abnormality.

It is believed that children with SCI heal neurologically more quickly than adults do. Incomplete lesions offer the greatest prognosis for neurological recovery after SCI, according to many studies, while severe complete damage may still get better with time. [19] Frankel's grading improved in 16 out of 21 patients (76.2%) in the current research, and 13 out of 21 (62%) patients were ambulatory at the time of the follow-up. The relatively short follow-up in our group, however, raises the possibility of bias in the selection of the outcome measures since patients who may not have improved may not have been lost to follow-up.

Progressive kyphosis at the affected vertebra is frequent, and the frequency is higher after laminectomy and in patients receiving conservative treatment for unstable spinal fractures. (20) In our dataset, over 50 percent of the patients who had posterior fusion also had the lamina of the affected vertebra removed. However, there was no difference between those who received a laminectomy and those who did not in terms of the neurological result or delayed deformity. In individuals who were treated medically or surgically, there were no instances of delayed deformity. The follow-up in our population, however, was insufficient to draw firm conclusions concerning the emergence of delayed kyphosis.

## CONCLUSION

According to reports in the literature, TL spine injuries in pediatric patients are uncommon. In the setting of a developing nation, the genesis of the damage is distinctive. Children over the age of 10 are more prone to TL injuries, which mostly affect the lumbar area. Many of the patients get concomitant long bone fractures or head injuries. Injury to the TL is linked with a low mortality rate. When necessary, surgical fusion of the affected vertebra is a secure and efficient procedure.

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