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RESEARCH ARTICLE
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MANAGEMENT AND ITS PROGNOSTIC OUTCOMES IN FRACTURE THORACOLUMBAR SPINE WITH NEUROLOGICAL DEFICIT: A CASE SERIES

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Abstract:

Background: Thoracolumbar fractures with neurological deficits pose significant clinical challenges, often necessitating timely surgical intervention for spinal stabilization and neural decompression. This case series presents the clinical profile, surgical management, and neurological outcomes of four such patients treated with pedicle screw fixation at a tertiary care centre.

Case Presentation: Four patients presented with thoracolumbar fractures and varying neurological impairments due to traumatic falls. All underwent posterior pedicle screw fixation; and required additional decompressive laminectomy. Data were analyzed for preoperative status, intraoperative findings, postoperative recovery, and long-term outcomes.

Results: All patients exhibited clinical improvement. The young male with post-traumatic motor weakness showed progressive motor recovery with structured rehabilitation. The two elderly females experienced significant pain relief with stable and improved neurological function. The young female with motor weakness and bowel bladder involvement shows progressive improvement in her neurology and bowel bladder function. No perioperative complications occurred. At follow-up, all patients achieved functional independence with minimal residual deficits. The study underscored the pivotal role of preoperative neurological status , with patients presenting incomplete neurological deficit (ASIA C-D) exhibiting higher neurological improvement rate compared to those with near complete neurological injury (ASIA B).

Conclusion: Posterior pedicle screw fixation, with or without decompression, may be a viable and well-tolerated surgical approach for thoracolumbar fractures with neurological compromise. Early

diagnosis, individualized surgical planning, and structured rehabilitation appear crucial to favorable outcomes. Individuals with higher neurological disability shows lesser improvement in post-operative period and vis-versa

Keywords: *Thoracolumbar fracture, neurological deficit, pedicle screw fixation, spinal decompression, laminectomy, case series, spinal trauma, surgical outcomes.*

Introduction:

Thoracolumbar spine trauma significantly impacts patient quality of life, frequently resulting in neurological deficits, chronic pain, and spinal deformity. These injuries, most often caused by high-energy blunt trauma, account for approximately 70% of spinal trauma cases and nearly 90% of all traumatic spinal fractures. [1–6] Thoracic and lumbar injuries contribute to nearly half of all neurologically significant spinal traumas and may result in paraplegia or cauda equina syndrome, depending on the level of involvement.[7]

The thoracolumbar junction (T12–L1) is particularly prone to injury due to its transitional biomechanical role between the rigid thoracic and flexible lumbar spine, accounting for nearly half of thoracic and lumbar fractures. While less commonly affected, lumbosacral junction injuries pose a high risk of instability and neurological impairment. Moreover, up to 25% of vertebral fractures with neurological deficits involve multiple levels, highlighting the importance of comprehensive spinal evaluation.[8,9]

Early and accurate diagnosis using cross-sectional imaging—particularly MRI is critical to assess bony integrity and neural element compromise. **This case series presents four patients with thoracolumbar fractures who underwent timely surgical intervention after MRI evaluation, aiming to achieve mechanical stabilization and optimize neurological recovery.** The study emphasizes the importance of early diagnosis, individualized surgical planning, and timely intervention in improving outcomes for thoracolumbar spinal injuries.

Evidence from Recent Literature

Recent studies underscore the importance of early intervention, radiological predictors, and appropriate surgical decision-making in optimizing outcomes for thoracolumbar spine injuries.

Qadir et al. (2021) [10] conducted a retrospective analysis of 317 patients with traumatic thoracolumbar spinal cord injury (T11–L2) to evaluate neurological outcomes based on timing of surgical decompression and stabilization. Patients were stratified into three groups: within 24 hours (n = 144), 24–72 hours (n = 77), and beyond 72 hours (n = 96). A significantly higher proportion of patients in the early surgery group showed improvement of ≥1 ASIA grade compared to the delayed groups (80 vs. 45 vs. 33; $P = .001$). Multivariate analysis identified early surgery ($P = .004$) and baseline injury severity (ASIA A vs. B–D; $P < .0001$) as independent predictors of neurological recovery. These findings support the role of early decompression preferably within 72 hours for enhanced neuroprotection, particularly in incomplete spinal cord injuries at the thoracolumbar junction.

A 2020 retrospective study assessed the prognostic value of magnetic resonance imaging (MRI) in 76 patients undergoing surgical treatment for acute thoracolumbar spinal cord injury. Patients were categorized based on initial ASIA scores: group 1 (ASIA A), group 2 (ASIA B–D), and group 3 (neurologically intact). MRI parameters—including spinal cord compression (SCC), spinal cord swelling, length of swelling (LOS), length of edema (LOE), and hemorrhage—were analyzed for association with neurological outcomes. On univariate analysis, SCC ($P = .009$), LOS ($P = .021$), and

LOE (P = .002) were significantly correlated with complete neurological deficits. However, multivariate regression identified LOE as the sole independent predictor of both initial and follow-up neurology (P = .007). Increased rostrocaudal extent of edema was associated with worse baseline neurological status and diminished recovery potential. [11]

In a large retrospective cohort from Turkey, 218 patients with thoracolumbar fractures were evaluated to compare long-term clinical, radiological, and functional outcomes following operative (63.3%) versus non-operative (36.7%) treatment. Follow-up duration ranged from 13 to 82 months. Both groups demonstrated significant improvement in Visual Analog Scale (VAS) and Oswestry Disability Index (ODI) scores by final follow-up (P < .001). T11 fractures were associated with the greatest initial disability. Greater anterior vertebral body compression correlated with increased pain and functional limitation (P < .001). Surgical treatment was more frequently employed in patients with severe vertebral collapse, highlighting its role in correcting kyphotic deformities and enhancing long-term functional outcomes. [12]

Muratore et al. (2021) analyzed 101 cases of surgically treated traumatic thoracolumbar fractures (T3–L5), focusing on fracture classification (AO), neurological status (ASIA), timing of surgery, and approach. The majority of fractures involved the T11–L2 segment, with medullary involvement increasing with higher AO severity grades. Better functional outcomes—measured using the ODI and SF-36—were observed in patients with lower AOSIS scores, absence of neurological deficits, and no comorbidities. No neurological recovery was noted in ASIA A patients. Overall complication rate was 14%, with increased hospital stay and morbidity in more severe fractures. Posterior stabilization was effective across most cases, though anteroposterior approaches were recommended in fractures with Load Sharing Classification (LSC) scores >8. Early surgical intervention was associated with improved outcomes in neurologically impaired patients. [13]

Case Series

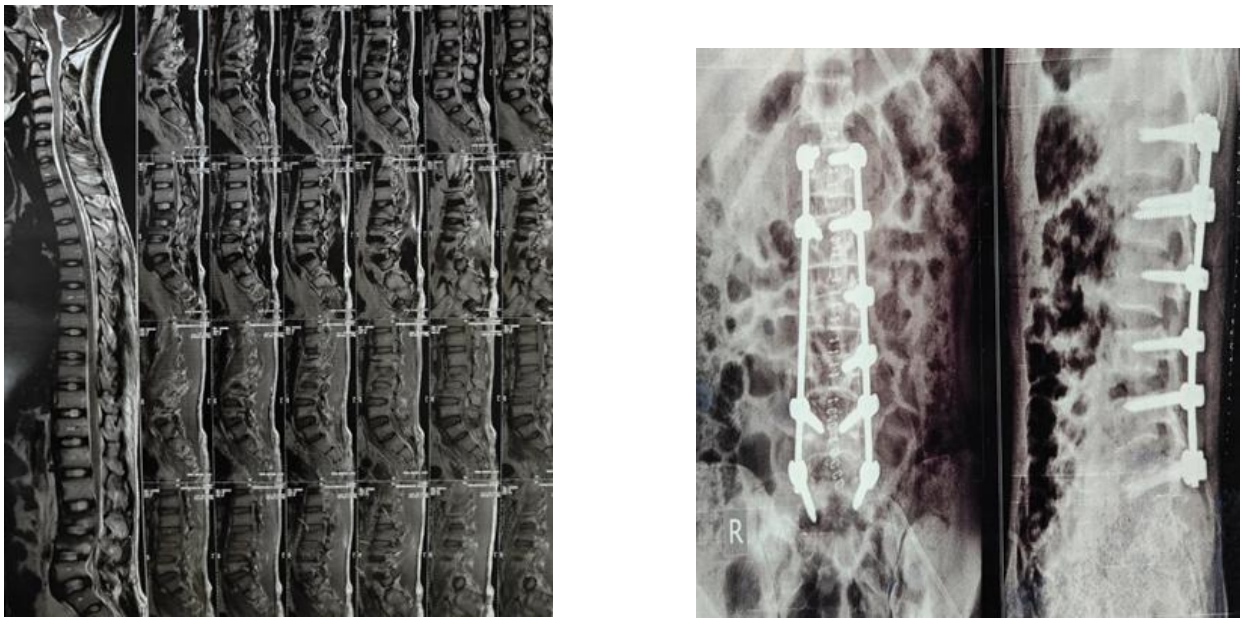
This case series highlights the clinical presentation, radiological findings, neurological status, and surgical management of three patients with thoracolumbar spine fractures treated at a tertiary care centre. Each case involved a distinct mechanism of injury and varying degrees of neurological impairment, assessed using the American Spinal Injury Association (ASIA) classification. All patients underwent posterior pedicle screw stabilization, with decompressive laminectomy performed selectively based on cross-sectional imaging and intraoperative findings. Functional outcomes were evaluated using the Oswestry Disability Index (ODI) preoperatively and at 18-month follow-up.

Patient One

An 18-year-old male presented with acute lumbar pain and progressive neurological deficits following a fall from height at a construction site. Initial care was provided at a peripheral hospital before referral for further evaluation and definitive management. He reported worsening lumbar pain exacerbated by movement, along with bowel and bladder disturbances.

Neurological examination revealed **ASIA grade C** with bilateral lower limb weakness affecting hip and knee flexion and ankle dorsiflexion, accompanied by sensory loss below the L3 level. His medical history was unremarkable aside from tobacco and alcohol use. Clinical examination showed lumbar tenderness, bilaterally restricted straight leg raising, and intact distal vascular status.

MRI scans revealed burst fractures at the L3–L4 levels with canal compromise. The patient underwent posterior spinal stabilization with multi-level pedicle screw fixation (ten screws, two rods), achieving good alignment. As significant posterior compression was identified intraoperatively, decompression was performed. Postoperatively, neurological recovery was progressive. At 12 months, he had fully regained motor and sensory function, with ASIA grade improving to **E**. His ODI improved from **76%** preoperatively to **18%** , and he reported a full return to daily activities without assistance.



Case 1. (A) Pre-operative MRI and (B) post-operative X-ray

Patient Two

A 67-year-old woman with a history of hypertension and type 2 diabetes mellitus presented with history of road traffic accident 2 days back , persistent lower back pain aggravated by movements. She also noted bilateral lower limb weakness. On examination, she had limited mobility and bilaterally restricted straight leg raise, with preserved sensations and distal pulses. Neurologically, she was **ASIA grade D**, with bilateral extensor hallucis longus weakness (MRC graded 4/5).

MRI revealed spinal cord compression at L-4 L-5 junction. Surgical management involved posterior decompressive laminectomy and pedicle screw fixation (6 screws and 2 rods). Postoperatively, she experienced steady neurological recovery. By her 12-month follow-up, she had achieved **ASIA grade E**, with ODI improving from **70%** to **24%,** and she reported complete return to normal functional activity and significant pain relief.

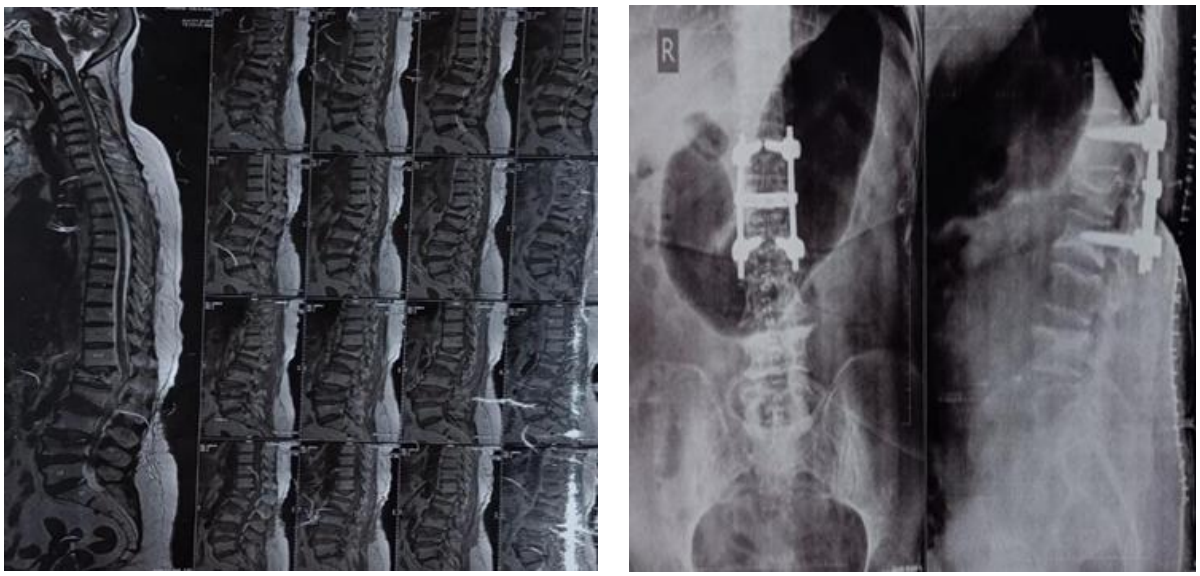
Case 2. (C) Pre-operative MRI and (D) post-operative X-ray

Patient Three

A 65-year-old woman presented with severe lower back pain and progressive bilateral lower limb weakness after a slip and fall in bathroom on back at home, with symptoms persisting for 5 days. Apart from a history of cataract surgery, she had no significant comorbidities.

Clinical examination revealed limited lumbar mobility, bilateral motor weakness without sensory loss, and normal distal vascular status. Neurological assessment indicated **ASIA grade D**.

Imaging revealed a burst fracture at the L1 vertebral body with bilateral Lower limb weakness. She underwent posterior stabilization with pedicle screws and but decompression was not done. Her postoperative course was uneventful, and she was discharged with physiotherapy guidance. At 12 months, she had regained full neurological function **(ASIA grade E)**, and her ODI had improved from **70%** to **24%**, enabling independent ambulation without support.



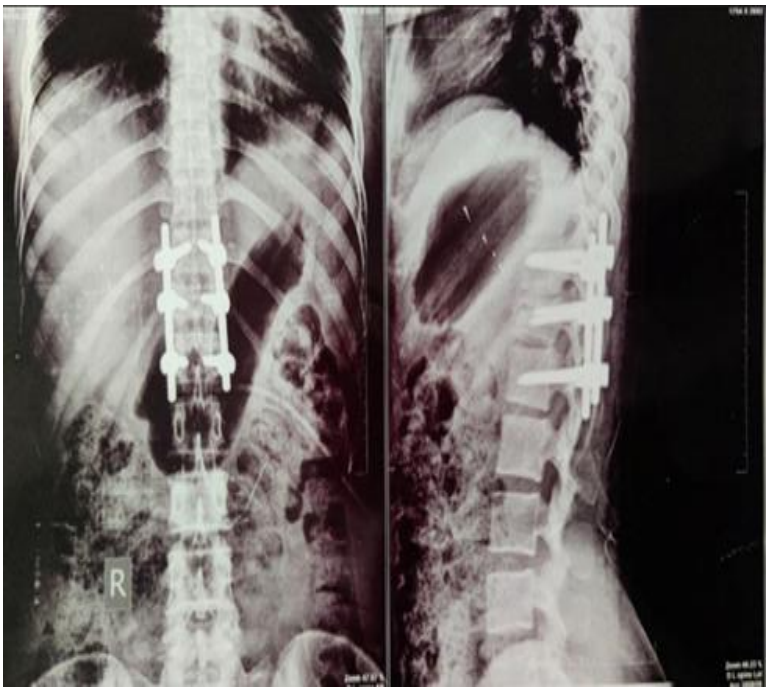
Case 3. (E) Pre-operative MRI and (F) post-operative X-ray

Case four:

A 20-year-old woman presented with severe mid back pain and progressive bilateral lower limb weakness with bowel bladder involvement after a road traffic accident, with symptoms persisting for 2 days.

Clinical examination revealed limited mobility, bilateral motor weakness with paraesthesia below knee and normal distal vascular status. Neurological assessment indicated **ASIA grade B.**

Imaging revealed a burst fracture at the D12 vertebral body with bilateral Lower limb weakness. She underwent posterior stabilization with pedicle screws and decompressive laminectomy. Her postoperative course was uneventful, and she was discharged with physiotherapy guidance. At 12 months, she had regained partial neurological function **(ASIA grade D**), and her ODI had improved from **70%** to **24%**, enabling dependent ambulation with support.



Case 4 G – Preop MRI **H – Post Op X-ray**

Surgical Management

Procedure Steps:

1. Anaesthesia and positioning: The patient induced under general anaesthesia and in prone position with two long roll pillows , one under lower chest and one under iliac crests with adequate padding under both knee (Fig. I).

Fig. I Anaesthesia and positioning.

2. Incision: A surgical incision is made in the midline of the back (standard posterior approach) over the affected vertebrae depend on short segment or long segment fixation (Fig. J).

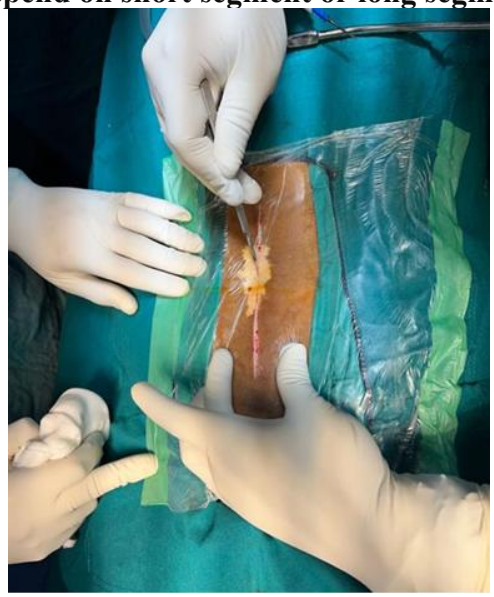


Fig. J Incision

3. Exposure: The muscles and soft tissues are carefully retracted to expose the spinal Column (Fig. K)

4. Surgical Intervention: Depending on the condition, the surgeon may remove a portion of the vertebra, disc material and place screws and rods for stabilization (Fig K). Also if there is ruptured dura seen (bad prognosis =ASIA-A) then it has to be repaired.

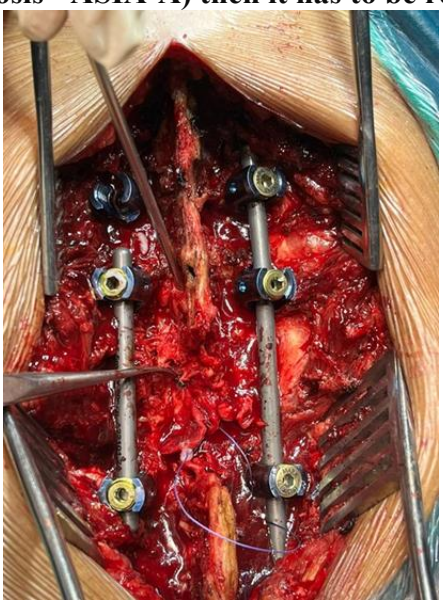


Fig. K Shows screw and rods instrumentation of D12 Burst fracture with ruptured dura

5. Closure: The incision is closed with sutures or staples, and the patient is monitored in recovery.

Advantages

• Direct Access: Provides direct access to the spinal column and posterior structures.

• Less Risk to Major Organs: Avoids major abdominal organs and major blood vessels.

The posterior approach is a common and effective method for addressing various spinal conditions, but the choice of approach depends on the specific diagnosis and the overall health of the patient.

Parameters	Case 1	Case 2	Case 3	Case 4
Age	18 years	67 years	65 years	20 years
Sex	Male	Female	Female	Female
Duration & Chief Complaint	Lower back pain for 1 day	Lower back pain for 2 days	Lower back pain for 15 days	Mid back pain since 2 days
Fracture Location	L3–L4 burst fracture	L4 burst fracture	L1 burst fracture	D12 burst fracture
Aetiology	Fall at construction site	Road traffic accident	Fall in the bathroom	Road traffic accident
Surgical Treatment	Pedicle screw fixation with decompression (laminectomy)	Pedicle screw fixation with decompression (laminectomy)	Pedicle screw fixation with decompression (laminectomy)	Pedicle screw fixation and (laminectomy)
Neurological Findings (pre-operative)	- Hip flexion & extension: 3/5 bilaterally - Knee flexion & extension: 3/5 bilaterally - EHL: 3/5 bilaterally with bowel bladder disturbance	B/L lower limb muscle power was MRC grade :4/5 EHL: 4/5 bilaterally -	- B/L Lower limb muscle power : 4/5 and B/L EHL: 4/5	B/L Lower limb MRC grade -2/5 with bowel bladder involvement
Physical Examination	- Local tenderness at L3-L4 present - Increased local temperature - Distal pulses, nail bed circulation++, DND: Present	-Local tenderness at L4 , local temperature rise - Distal pulses, nail bed circulation++, DND: Present	-Local tenderness L1, local temperature rise - Distal pulses, nail bed circulation++, DND: Present	Local tenderness at D-12 , local rise temperature ++, distal pulse ,nail bed circulation ++, DND: Present
Follow-Up Findings	- 12 weeks: Improved strength (MRC 3–4/5), mobilizing with assistance - 6 months: Independent ambulation, resumed activities - 12 months: Full neurological recovery - 18 months: Maintained spinal alignment and function	- 12 weeks: Pain relief, ambulatory - 6 months: No new neurological findings - 12 months: Full return to daily activities - 18 months: Stable spine, functionally independent	- 12 weeks: Improved EHL power, mobilizing with walker - 6 months: Strength 4/5 in all tested groups - 12 months: Ambulating without aid - 18 months: Stable, functionally independent	-12 weeks : Pain relief , neurological improvement , regained bowel and bladder functions , 6 months: Strength 3/5 regained in lower limb muscles,12 months - ambulatory with aid, 18 months - Stable and partial functional independence

Table 1: Summary of Thoracolumbar Spinal Fracture Cases

Postoperatively, the patient exhibited progressive neurological improvements within next 1-2 days to 15 days . The drain was removed on postoperative day two, and follow-up radiographs confirmed satisfactory spinal alignment. Mobilization with a thoracolumbar orthosis was initiated on day three.

Recovery was uneventful, and the patient was discharged on postoperative day 15 with preserved neurological status.

The brace was discontinued at the end of the third postoperative month. At the 12 months and 18 months follow-up, the patient remained neurologically intact and functionally independent.

Functional outcomes:

Functional disability was assessed using the Oswestry Disability Index (ODI) at baseline and at 12-month follow-up. Preoperatively, all patients had severe disability, with a mean ODI score of **72%**. At 12 months post-surgery, the mean ODI score improved to **22%**, reflecting a transition to minimal disability. This improvement correlates with regained mobility, pain relief, and return to daily activities, further supporting the role of surgical stabilization in functional recovery after thoracolumbar fractures with neurological deficit. All four patients demonstrated significant neurological and functional recovery following timely surgical intervention. ASIA grades improved from **C or D to E**, and ODI scores decreased substantially over the 12-month period, indicating marked reduction in disability. These cases emphasize the importance of early diagnosis, individualized surgical planning, and structured rehabilitation in achieving favourable outcomes for thoracolumbar spine fractures. Also the patients with high grade neurological injury has poor prognosis.

Footnotes

- **EHL**: Extensor Hallucis Longus strength
- **DND**: Distal Neurological Deficit
- **L**: Lumbar vertebra
- **D**: Dorsal (thorasic) vertebra
- **MRC**: Medical Research Council muscle strength grading

Discussion:

Thoracolumbar spine fractures associated with neurological deficits present significant clinical challenges due to the risk of biomechanical instability and potential for long-term functional impairment. Early recognition, accurate radiological assessment, and prompt surgical intervention—typically involving pedicle screw fixation with or without decompressive laminectomy—are essential for restoring spinal alignment and optimizing neurological recovery. [14]

In this case series, we describe three patients with distinct presentations of thoracolumbar spinal trauma, each illustrating the clinical variability and the role of individualized surgical management. The first case involved a young male with an L3–L4 burst fracture and neurological deficits following a fall from height. The second case, by contrast, featured an elderly female with degenerative pathology and gradually progressive lower back pain but minimal neurological involvement. The third case involved another elderly female who sustained an L1 burst fracture with bilateral radiculopathy after a domestic fall. All patients underwent posterior surgical stabilization, and follow-up assessments revealed favourable neurological and functional outcomes.

Our findings are consistent with those reported by **Mulumba Ilunga et al**. [15], who documented a case of L3–L4 fracture-dislocation in a 30-year-old male following a traffic accident. Despite radiologically evident instability, neurological function was preserved. The patient underwent long-segment posterior instrumentation; however, his recovery was complicated by a postoperative infection requiring surgical debridement and antibiotics. Their case highlights that high-energy thoracolumbar injuries, even in the absence of neurological deficits, warrant early surgical stabilization due to inherent instability.

Zeng et al. [16] reported a similar instance of complete L1–L2 fracture-dislocation without neurological compromise, attributing the preserved function to spontaneous decompression from bilateral pedicle and facet fractures. Likewise, Enishi et al.[17] presented two cases of thoracolumbar fracture-dislocation without neural deficits, where bilateral pedicle fractures and vertebral collapse led to canal widening and dural sparing. These reports emphasize that specific anatomical injury patterns can protect neural structures, even in severe trauma.

From a technical standpoint, **Kanna et al.[18]** proposed a structured intraoperative protocol for managing complex thoracolumbar injuries. Their recommendations include staged exposure, use of temporary stabilization, precise screw trajectory planning, laminectomy before reduction, and cautious rod manipulation under direct visualization—all aimed at minimizing iatrogenic neural injury in unstable fractures.

This case series contributes to the broader body of literature on thoracolumbar injuries by demonstrating a spectrum of aetiologies ranging from high-energy trauma in younger individuals to low-impact falls and degenerative changes in elderly patients. Importantly, it underscores that successful outcomes depend not only on the timing of surgical intervention but also on careful preoperative imaging, intraoperative technique, and postoperative rehabilitation.

Despite the positive outcomes observed, this series is limited by its small sample size and lack of postoperative imaging to confirm spinal fusion in one case due to financial constraints. Future multicenter studies with larger cohorts and standardized protocols are necessary to further refine surgical strategies and improve prognostic prediction.

Conclusion:

In conclusion, posterior pedicle screw fixation with selective decompression—guided by preoperative imaging and intraoperative assessment—achieved effective realignment and stabilization in thoracolumbar spine fractures presenting with varying neurological deficits. This surgical approach resulted in favourable neurological and functional recovery, particularly in patients excluding those with complete or near complete paraplegia (ASIA Grade A and Grade B).

Despite variation in patient age, mechanism of injury, and fracture morphology, early operative intervention consistently restored spinal alignment, preserved neurological function, and enabled early mobilization. Intraoperative strategies focused on achieving stable fixation while minimizing neural manipulation were key to improved clinical and radiological outcomes.

Both short- and long-segment fixation techniques provided reliable spinal support when selected according to fracture characteristics, supporting functional independence postoperatively. However, the small sample size and absence of fusion-confirming imaging in one case limit the generalizability of these results. Larger multicenter studies with standardized surgical protocols and long-term follow-up are warranted to confirm these findings and inform evidence-based guidelines for thoracolumbar spine trauma management.

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