Section: Orthopaedics

Original Research Article

A STUDY ON CLINICORADIOLOGICAL OUTCOME OF THORACOLUMBAR FRACTURES TREATED BY POSTERIOR SHORT SEGMENT FIXATION AND PEDICLE SCREW AT THE FRACTURED VERTEBRA

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Received : 07/09/2025
Received in revised form : 30/10/2025
Accepted : 18/11/2025

Keywords:
Neurologic Manifestations; Fracture Fixation, Internal; Spinal Fusion; Spinal Fractures; Pedicle Screw Instrumentation.

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DOI: 10.47009/jamp.2025.7.6.69

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2025; 7 (6); 353-359

ABSTRACT

Background: Thoracolumbar fractures, particularly at the thoracolumbar junction, are common in high-energy trauma and carry a high risk of neurological deficits, spinal deformity, and chronic pain. **Aims and Objectives:** This study aimed to evaluate the clinical and radiological outcomes of unstable thoracolumbar fractures treated with posterior short-segment fixation incorporating pedicle screw augmentation at the fractured vertebrae. **Materials and Methods:** This prospective observational study included 24 patients aged 18–60 years with acute dorsolumbar fractures who were admitted between June 2010 and June 2012. The inclusion criteria were unstable fractures with or without neurological deficits and TLICS >5. All patients underwent posterior decompression, short-segment stabilisation, pedicle screw instrumentation at the fractured vertebra, and facet fusion. Clinical outcomes were assessed using Frankel's grading system, ambulation status, and bladder/bowel function. Follow-up was conducted at 1, 3, 6, and 12 months. **Result:** Most patients were male (83.3%) with a mean age of 34.75 years. Fractures predominantly involved L1 (58.3%) and D12 (37.5%) levels, with burst fractures in 79.1%. Vertebral height was maintained at ≥85% in most cases. Neurological improvement occurred in 15/24 patients (64%) of patients, while 20.8% with complete paraplegia remained static. Bladder and bowel function improved in 41%. By 12 months, 17/24 patients (71%) achieved independent ambulation, while the balance 8/24 patients (29%) walked with aids or remained wheelchair-dependent. Postoperative complications were minimal, including sacral bed sores (12.5%), wound infection (8%), and screw cut-out (4%). **Conclusion:** Posterior short-segment fixation with pedicle screw augmentation at the fractured vertebra is a safe and effective method for stabilising thoracolumbar fractures, promoting neurological recovery, preserving vertebral alignment, and facilitating early mobilisation.

INTRODUCTION

The thoracolumbar junction, where the rigid thoracic spine meets the mobile lumbar spine, is the most commonly injured region of the vertebral column. This injury can be due to high-impact trauma, such as road-traffic accidents and falls from height, and injuries at this level have a higher risk of neurological deficit, deformity, and chronic pain if not managed properly.[1] Thoracolumbar injuries are frequent in individuals aged between 15 and 29 years, with a median age of about 35, and nearly 75% of them occur in the T10-L2 region. Approximately 27% of patients with such injuries present with neurological deficits, which then result in long-term disability and socioeconomic burden. 70% of the cases do not have any initial neurological problems; however, 45% later develop deficits with either incomplete or complete injury.[2] Accurate clinicoradiological assessment is important for treatment planning because fracture pattern and anterior column damage determine mechanical stability and the need for surgical intervention.[1,3]

Classification systems such as the Denis three-column concept and the McCormack load-sharing classification are broadly used to measure vertebral body comminution, fragment spread, and kyphotic deformity. These classifications help guide clinicians

in choosing between posterior, anterior, or combined approaches.[3] Treatment of unstable thoracolumbar burst fractures includes anterior reconstruction, long-segment posterior fixation, or a combined anterior-posterior approach.[4] The anterior approach allows direct decompression of retropulsed fragments and superior correction of kyphosis, but has a higher risk of bleeding and visceral injury. The posterior approach, which utilises pedicle screw fixation, has a short operative time, minimal blood loss, adequate decompression, and enhances stability and correction. Combined anterior-posterior fixation provides maximal stability but increases operative morbidity and is now mostly replaced by advanced posterior techniques.[4,5]

The older method of short-segment construction has been reported with the loss of kyphotic correction and higher rates of implant failure in the presence of severe anterior column comminution. To prevent this failure, clinicians enhanced short-segment constructs by placing pedicle screws in the fractured vertebra.[6] This method increases construct stiffness, improves load sharing across the injured vertebral body, supports restoration of vertebral height and kyphosis correction, and has been associated with lower hardware failure.[6,7] Short-segment posterior pedicle-screw fixation limits the number of fused levels, reduces operative time and blood loss, and preserves spinal mobility compared with long constructs.[8]

Systematic reviews and a recent prospective study suggest that short-segment fixation provides better radiological and functional outcomes than long-segment fixation.[9,10] However, regional data on the indications and predictors of failure are still limited. This emphasises the need for clinicoradiological studies that report neurological recovery, pain and function, radiographic correction, and fusion status following posterior decompression, stabilisation, fusion, and instrumentation. Hence, this study evaluated the clinical and radiological outcomes of acute dorsolumbar fractures treated with posterior decompression, stabilisation, fusion, and pedicle screw instrumentation at the fractured vertebra.

Aims and objectives

The primary objective was to assess neurological recovery and independent ambulation at 12 months postoperatively. Secondary objectives included radiographic correction of kyphotic deformity, maintenance of vertebral body height, fusion status, postoperative complications, and improvement in bladder and bowel function.

MATERIALS AND METHODS

This prospective observational study included 24 patients with posttraumatic acute dorsolumbar fractures who were admitted to the Department of Orthopaedics in the Madurai Medical College, Madurai, Tamil Nadu between June 2010 and June 2012. Institutional ethical committee approval was obtained before the beginning of the study, and informed consent was obtained from all the patients.

Inclusion Criteria

Patients aged between 18 and 60 years presenting within three weeks of injury, with dorsolumbar fractures associated with neurological deficit, dorsolumbar fractures without neurological deficit but having a Thoracolumbar Injury Classification and Severity Score (TLICS) >5, and all cases of unstable dorsolumbar burst fractures.

Exclusion Criteria

Patients unfit for anaesthesia due to comorbid conditions, those with old fractures >1 month, fractures with a Vaccaro score < 3, open vertebral fractures, and pathological fractures.

Methods

Each patient underwent a detailed clinical evaluation, beginning with a thorough history of the mode and mechanism of injury, followed by general, systemic, and neurological examinations to assess spinal stability and neurological status. The skeletal system was examined to rule out associated injuries, and the spine was inspected for swelling, tenderness, contusions, haematoma, gibbus deformity, or step-off deformity. A comprehensive neurological assessment, including motor, sensory, and anal tone evaluations, was performed at admission and repeated daily during hospitalisation. The pattern and level of neurological injury were recorded and graded according to Frankel's classification. The Frankel grading system classifies spinal cord injury from A to E (A: complete motor and sensory paralysis; B: motor paralysis with preserved sensation; C: some motor function, but not useful (<3/5); D: useful motor function allowing ambulation (≥3/5); E: normal motor and sensory function). All patients received immediate spinal immobilisation and protective measures upon diagnosis.

Radiological evaluation included anteroposterior and lateral X-rays, CT scans, and MRI of the dorsolumbar spine. CT scans were used to assess pedicle integrity, canal compromise, and bony fragments, whereas MRI was used to identify soft tissue injuries, spinal cord compression, and disc or ligamentous disruption. Fractures were classified according to the Denis and McAfee classification system. Before surgical intervention, spinal stability, neurological status (complete or incomplete cord injury), patient factors such as age, comorbidities, associated injuries, and the Vaccaro (TLICS) score were carefully considered. The indications for surgery included a TLICS score of 3 to 5, vertebral body collapse > 50%, canal compression by bony fragments > 50%, Cobb's angle > 30°, or involvement of all three vertebral columns. Patients meeting any of these criteria were selected for surgical stabilisation.

All patients underwent surgery under general anaesthesia in the prone position on a fracture table, with intraoperative anteroposterior and lateral fluoroscopic imaging used to identify the pedicles, end plates, and disc spaces. The surgical procedure

ISSN (O): 2687-5365; ISSN (P): 2753-6556

included posterior stabilisation and decompression using transpedicular screw and rod instrumentation, additional transpedicular screw insertion at the fractured vertebra, vertebral body reconstruction via posterolateral or transpedicular decompression, facet joint fusion using autologous bone grafting, and short-segment instrumentation involving one level above and below the fracture.

The primary objectives of surgery were to decompress the neural elements, restore sagittal and coronal spinal alignment, and achieve stable internal fixation to facilitate early mobilisation. Postoperatively, patients received intravenous antibiotics for five days, and sutures were removed on the twelfth postoperative day. Patients were discharged after receiving detailed instructions regarding back care, bladder management, and rehabilitation exercises. Follow-up evaluations were performed at one month and subsequently at regular intervals for up to two years, including neurological assessment using Frankel's grading and radiographic evaluation to assess spinal alignment and implant integrity. Data were presented as means, frequencies and percentages.

RESULTS

Of the 24 patients, 20 (83.3%) were male and 4 (16.7%) were female, with a mean age of 34.75 years. The majority of injuries resulted from falls from a height (79%), followed by road traffic accidents (RTA) (16%) and wall collapses (5%). At the time of admission, 20.8% had complete paraplegia, 41.6% had incomplete paraplegia, and 37.5% had no neurological deficit (Table 1).

Table 1: Patient demographics and admission characteristics

Variable	Category	Count (%)
Gender	Male	20 (83.3%)
	Female	4 (16.7%)
Mode of Injury	Fall from height	19 (79%)
	RTA	4 (16%)
	Wall collapse	1 (5%)
Neurological deficit on admission	Complete paraplegia	5 (20.8%)
	Incomplete paraplegia	10 (41.6%)
	Without any deficit	9 (37.5%)

Several patients had multiple fracture types and levels; the most common vertebral fracture level was L1 (58.3%), followed by D12 (37.5%) and D11 (12.5%). The burst fracture pattern was predominant (79.1%), followed by compression fractures (25%) and fracture dislocation (12.5%) (Figures 1 to 4). At the time of injury, vertebral body collapse ranged from 40-50% in 45.8% of the patients, 50–60% in 41.6%, and >60% in 8.3% of the patients. Associated injuries were present in nine patients (36%), with the most common being calcaneal fractures (16%), followed by tibial pilon (8%), pubic rami (4%), distal radius (4%), and metatarsal (4%) (Table 2).

Table 2: Fracture details

Variable	Categories	Count (%)
Level of vertebral fracture	D11	3 (12.5%)
	D12	9 (37.5%)
	L1	14 (58.3%)
Type of fracture	Burst fracture	19 (79.1%)
	Fracture dislocation	3 (12.5%)
	Compression fracture	6 (25%)
	Flexion distraction fractures	2 (8%)
Vertebral body collapse (at injury) (n = 23)	40–50%	11 (45.8%)
	50–60%	10 (41.6%)
	>60%	2 (8.3%)
Associated injuries (n=9)	Calcaneal fracture	4 (16%)
	Tibial pilon fracture	2 (8%)
	Pubic rami fracture	1 (4%)
	Distal radius fracture	1 (4%)
	Metatarsal fracture	1 (4%)

Of all patients, 37.5% underwent surgery within the first week, 33.3% within the second week, and 29.1% within the third week. Postoperative complications included sacral bed sores (12.5%), wound infection (8%), and screw cut-out (4%). All bedsores healed after flap coverage, and infections resolved with debridement and secondary suturing. No intraoperative complications were observed. Vertebral height was maintained at ≥85% in most cases, and bladder and bowel function improved in 41% of patients. By 12 months, 71% of the patients achieved independent ambulation, 8% walked with aids, and 21% required a wheelchair. Patients were followed up at 1, 3, and 6 months, and at 1 year, for both clinical and radiological assessments, with a mean follow-up of 16 months (range: 8-24 months) (Figures 5 to 8) (Table 3).

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Table 3: Treatment and outcomes

Variable	Categories	Count (%)
Timing of surgery	Within the first week	9 (37.5%)
	Second week	8 (33.3%)
	Third week	7 (29.1%)
Post-operative complications (n = 6)	Sacral bed sores	3 (12.5%)
	Surgical site wound infection	2 (8%)
	Screw cut out	1 (4%)
Vertebral body height maintenance (at 16 months)	95%	7 (29%)
	90%	7 (29%)
	85%	6 (25%)
	80%	4 (16%)
Bladder and bowel function (at 8 months) (n = 15)	Sensation improved	10 (41%)
	Trained for self-intermittent catheterisation/condom drainage	5 (20%)
Ambulation status (at 12 months)	Able to walk independently	17 (71%)
	Able to walk with aids	2 (8%)
	Able to ambulate using a wheelchair	5 (21%)

On admission, 20.8% of patients were Frankel grade A, 41.6% grade C, and 37.5% grade E. At 6 months (n = 14), 21% of those initially C improved to grade E, 43% to grade D, while patients initially graded A (20.8%) showed no neurological recovery (Table 4).

Table 4: Neurological improvement

Variable	Categories	Count (%)
Frankel's grade on admission (n = 24)	A	5 (20.8%)
	C	10 (41.6%)
	E	9 (37.5%)
Frankel's grade at 6 months (n = 14)	E (from C)	3 (21%)
	D (from C)	6 (43%)
	Remained static (A)	5 (20.8%)

Figure 1: L2 Burst with incomplete neurological deficit

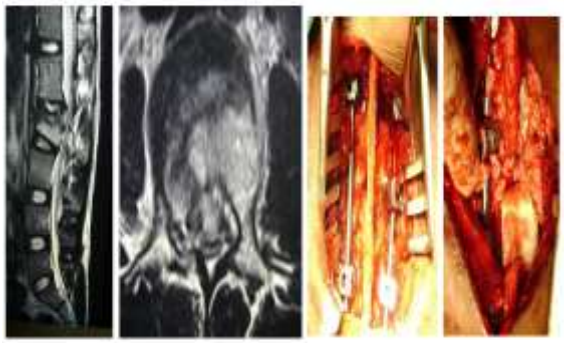

Figure 2: MRI – Cord compression, PLC injury intraoperative

Figure 3: L1 Burst fracture without deficit, immediate post op

Figure 4: L1 Burst and T12 AWC fracture clinical photo

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Figure 5: Postoperative X-rays

Figure 6: Immediate post-operative and 1-year post-operative

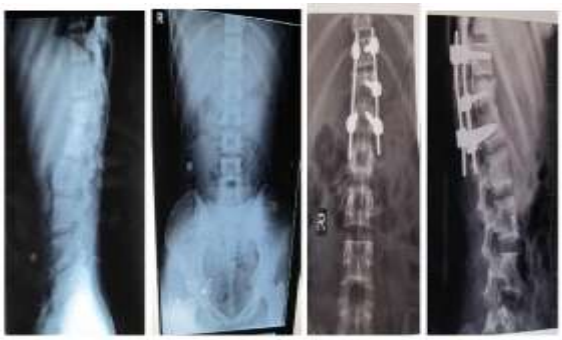

Figure 7: T12 Fracture subluxation with incomplete paraplegia post-operative

Figure 8: 1-year postoperative

DISCUSSION

Thoracolumbar fractures are one of the most common spinal injuries, often caused due to high-energy trauma such as falls from height or RTA. This study evaluated the clinicoradiological outcomes of thoracolumbar fractures managed with posterior short-segment fixation combined with pedicle screw placement at the fractured vertebra. We assessed its effectiveness in achieving fracture stabilisation, neurological recovery, and maintenance of vertebral alignment during follow-up.

The majority of patients were male, with an average age of 34.75 years, and most injuries were due to falls from height, followed by RTA and wall collapses. At admission, 20.8% had complete paraplegia, 41.6% had incomplete paraplegia, and the remaining had no neurological deficit. Similarly, Jain et al. reported a majority of males (69.2%), and the most frequent cause of injury was a fall from a height (61.54%), followed by RTA (38.46%).[11] Chokshi and Shah reported a male-to-female ratio of 1.9:1, with a mean age of 33.4 years. Falls from a height were the cause of injury in 66% of cases, and the remaining were caused by RTA (34%).[12] These findings highlight that spinal injuries predominantly affect young males, with falls from height being the most reported cause.

The most frequently affected vertebral level in our study was L1, followed by D12 and D11, with burst fractures being the predominant type. At presentation, most patients had moderate vertebral body collapse, ranging from 40% to 60%. Other associated injuries include calcaneal, tibial pilon, pubic rami, distal radius, and metatarsal fractures. In contrast, Aoui et al. reported that 44% of fractures happened at the T11, T12, L1, and L2 levels, and 76.7% of them were compression or burst type.[13] However, Khare and Sharma reported that 18 of 25 cases had fractures at the D12-L1 level, while 6 had compression fractures and 5 had burst fractures. They also reported that 28% of cases had other associated injuries, and calcaneal fracture was the most commonly reported injury.[14] Thus, indicating that the L1 and D12 levels are the most vulnerable sites for spinal fractures, with burst fractures being the most common type. But the fracture site and level can vary according to the patient demographics and trauma mechanisms.

In our study, postoperative complications included sacral bed sores, wound infection, and screw cut-out. All bedsores healed after flap coverage, and infections resolved with debridement and secondary suturing. At admission, the majority belonged to Grades C and E according to the Frankel classification. After six months, 21% improved to Grade E (from C), 43% improved to Grade D (from C), and 20.8% with Grade A remained static. Vertebral height was maintained at ≥85% in most cases, and 71% achieved independent ambulation, while others required aids and wheelchairs.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Similarly, Jain et al. used the American Spinal Injury Association (ASIA) scale and reported that most patients belonged to Grade A (30.7%), followed by E (26.9%) and D (19.2%). They also observed that most neurological improvements occurred in grades B-D.[11] Dobran et al. reported that 85.36% of patients with type A fractures and nearly 80% with type B fractures had significant neurological improvement according to the ASIA scale ($p = 0.002$). They observed a few postoperative complications, such as wound infection in 4.44%, hardware failure in 3.7% and cerebrospinal fluid leak in 2.22% of the patients. However, all of these complications were resolved with antibiotic therapy and subdural drainage.[15] While we used the Frankel grading system due to its simplicity and routine use at our centre, most studies use the ASIA scale. Though this might cause an inconsistency in classification, the overall pattern in neurological recovery is comparable (B-D) between all the studies.

Yadav et al. concluded that they achieved effective restoration of anterior vertebral height and correction of the local kyphotic angle in the early postoperative phase after short-segment posterior fixation using pedicle screw augmentation. They reported that the mean final anterior vertebral body height maintained was 72% ± 11.0%, while the mean loss of correction at the final follow-up was 10.5% ± 5.3%.[16] Supporting our findings, Patidar et al. reported that the posterior approach provides similar functional and surgical outcomes with minimal deviations in Cobb angle and vertebral height compared to long-segment fixation. They concluded that short-segment pedicle screw fixation provides a short operative time and reduced blood loss, with radiological and clinical outcomes comparable to those of long-segment fixation without compromising motion segments.[17] These findings highlight that short-segment posterior fixation with pedicle screw augmentation is associated with acceptable neurological and radiological outcomes with minimal complications.

Our findings highlight the advantages of early surgical stabilisation using the posterior approach for managing unstable thoracolumbar fractures with spinal cord injuries. This approach promotes better fracture reduction, restoration or preservation of neurological function, early mobilisation, and fewer complications related to prolonged bed rest. Instrumentation at the fractured vertebra prevents postoperative vertebral collapse, late postoperative kyphosis, and instrument failure.

Limitations

The small sample size and single-centre design may restrict the generalisability of the findings. The 2-year follow-up of patients may be insufficient to evaluate late complications, implant longevity, and continued functional outcomes. Unmeasured confounders, such as comorbidities and severity of associated injuries, may have affected clinical and radiological outcomes. The ASIA scale was not used for neurological assessment, which may limit comparisons with other studies.

CONCLUSION

Posterior short-segment fixation with pedicle screw augmentation at the fractured vertebra is an effective technique for managing unstable thoracolumbar fractures. It provides satisfactory restoration and maintenance of vertebral height, correction of kyphotic deformity, and helps in neurological recovery with minimal complications. Future studies should include larger multicentre samples or randomised controlled trials to validate these findings and assess long-term functional and radiological outcomes (up to 10 years).

Acknowledgment

We sincerely thank the faculty and staff of the Department of Orthopaedics in the Madurai Medical College, Madurai, Tamil Nadu, India, for their guidance and support. We are deeply grateful to all the patients for their valuable participation. We also thank our senior and junior faculty members, colleagues, and families for their constant encouragement throughout this study.

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ISSN (O): 2687-5365; ISSN (P): 2753-6556

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ISSN (O): 2687-5365; ISSN (P): 2753-6556