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FUNCTIONAL OUTCOMES OF POSTERIOR STABILIZATION WITH PEDICLE SCREW FIXATION FOR DORSO-LUMBAR SPINE FRACTURES: A PROSPECTIVE OBSERVATIONAL STUDY

Neurosurgery

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ABSTRACT

Background and Rationale: The increasing incidence of driving and occupational injuries has led to a rise in spine fractures, particularly at the Dorso-lumbar junction, which connects the highly mobile lumbar spine to the less mobile thoracic spine. Timely treatment is crucial for preventing significant morbidity and mortality. This study aims to evaluate the functional outcomes of posterior stabilization with pedicle screw fixation for Dorso-lumbar spine fractures.**Objectives:** To assess the functional outcomes of Dorso-lumbar spine fractures treated with posterior stabilization, and to describe the clinical and demographic characteristics associated with these fractures.**Study Procedure:** After obtaining Institutional Review Board approval and informed consent, 64 patients diagnosed with Dorso-lumbar spine instability were evaluated through clinical and radiological assessments, including X-rays, CT, and MRI. They underwent posterior stabilization based on the TLICS score, with functional outcomes measured preoperatively and at 6 weeks and 6 months postoperatively using the Frankel grading and ASIA score.**Results:** The age range of patients was 22 to 67 years, predominantly male (56 males, 8 females). Falls from height accounted for 76.6% of injuries, with L1 vertebra fractures being most common (30.37%). Statistical analysis revealed significant improvements in neurological recovery and pain management ($p < 0.001$), with complications noted in only 16 patients.**Conclusion:** Early evaluation and intervention are essential in promoting neurological recovery and minimizing complications in traumatic spine injuries.

KEYWORDS

Dorso-lumbar spine fractures, posterior stabilization, pedicle screw fixation, functional outcomes, neurological recovery.

INTRODUCTION

Traumatic injuries of the thoracolumbar (dorso-lumbar) spine are a major cause of morbidity worldwide, driven largely by high-energy mechanisms such as road-traffic collisions and falls from height. The thoracolumbar junction (T11–L2) is disproportionately affected because it transitions from the rigid, kyphotic thoracic spine to the more mobile, lordotic lumbar segments, concentrating mechanical stress during trauma.1,2 Epidemiologically, these fractures show a bimodal pattern—high-energy injuries in younger adults and low-energy osteoporotic fractures in older individuals—creating a heterogeneous clinical spectrum from simple compression to unstable burst and distraction injuries.3 Neurological compromise occurs in a substantial subset, and when present, is strongly associated with prolonged hospitalization, reduced functional recovery, and increased early mortality.[4]

Timely, appropriate stabilization is central to management goals: restoring and maintaining alignment, protecting neural elements, enabling early mobilization, and minimizing complications associated with recumbency such as pressure injury, thromboembolism, pulmonary infection, and deconditioning.5 Posterior pedicle-screw constructs have become the workhorse approach in many settings due to their biomechanical strength and the ability to combine stabilization with decompression as indicated.[6,7]

Structured injury stratification informs the operative versus conservative decision. Historical systems (e.g., Denis three-column concept and AO/Magerl morphology) remain valuable for describing fracture patterns and instability, but contemporary treatment triage often relies on composite tools such as the Thoracolumbar Injury Classification and Severity Score (TLICS), which integrates morphology, neurological status, and posterior ligamentous complex integrity.[8,9,10]

Against this background, the present study evaluates clinical and functional outcomes following posterior stabilization for dorso-lumbar fractures at our tertiary center. Specifically, we (i) describe the epidemiological and injury profile of affected patients; (ii) assess neurological recovery and pain/function using validated scales; and (iii) examine short-term peri-operative parameters relevant to safety and rehabilitation.[15]

METHODOLOGY

Study Design and Setting. This was a prospective observational study conducted at a tertiary care teaching hospital. We enrolled consecutive patients presenting with traumatic dorso-lumbar (T11–L2) fractures who were managed with posterior pedicle-screw stabilization. The protocol complied with institutional ethics requirements, and written informed consent was obtained from all participants or legal guardians.

Eligibility Criteria. Inclusion criteria were: age ≥18 years; acute traumatic fracture at T11–L2 confirmed on imaging; and a clinical-radiological indication for operative stabilization. Exclusion criteria were: pathological fractures (malignancy or infection), prior instrumentation at the index levels, polytrauma precluding definitive spinal surgery during the index admission, and inability to complete scheduled follow-up assessments.

Preoperative Assessment. Baseline data included demographics, mechanism of injury, time from trauma to hospital arrival, and relevant comorbidities. Neurological status was graded at admission and preoperatively using a standardized impairment scale. Pain and work/functional capacity were recorded using predefined ordinal scales. Radiographic evaluation comprised anteroposterior and lateral radiographs, with CT obtained to assess fracture morphology, canal compromise, and pedicle integrity.

Operative Protocol. All procedures were performed under general anaesthesia with patients positioned prone on a radiolucent table. A midline posterior approach with subperiosteal dissection exposed the posterior elements. Pedicle screws were inserted using a freehand technique with fluoroscopic confirmation. Short-segment fixation (one level above and one below the fracture) was preferred for most compression and burst patterns, while long-segment constructs were used for multi-level or highly unstable injuries at the surgeon's discretion. Rods were contoured to restore physiological sagittal alignment; distraction and ligamentotaxis were applied when appropriate to aid indirect reduction.

Outcomes. The primary outcome was functional improvement from baseline to final follow-up, measured by change in neurological grade and changes in pain and work/functional scales. Secondary outcomes included radiographic correction, time to mobilization, length of hospital stay, and perioperative complications.

Statistical Analysis. Data were analyzed using standard statistical

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software. Continuous variables were summarized as mean ± standard deviation and compared using paired or independent t-tests. Categorical variables were compared using chi-square or Fisher's exact tests. Repeated measures across time points were assessed with Friedman's test. Two-sided $p < 0.05$ was considered statistically significant.

RESULTS

A total of 64 patients with traumatic dorso-lumbar fractures underwent posterior stabilization and completed follow-up. The cohort was predominantly middle-aged: the mean age was 45.25 years (range 22–67), and the most common age band was 41–50 years (21/64, 32.8%). Males comprised 87.5% (56/64) and females 12.5% (8/64) of cases. Falls from height were the dominant mechanism (49/64, 76.6%), followed by road-traffic accidents (15/64, 23.4%), indicating a high proportion of vertical-energy injuries in this setting.

Across the 64 patients, 79 vertebral body fractures were identified because 12 patients sustained two-level injuries. The L1 vertebra was most frequently involved (24/79, 30.37%), closely followed by D12 (22/79, 27.84%). By morphology, AO/Magerl Type-A injuries predominated (46/64, 71.9%), with Type-B in 12/64 (18.8%) and Type-C in 6/64 (9.4%).

Neurological and functional outcomes improved significantly after surgery. Friedman's test demonstrated a statistically significant difference across time points ($\chi^2=26.235$, df=2, $p<0.001$), indicating progressive neurological gains during follow-up. Pain improved substantially on the Denis scale by 6 months: 39/64 (60.9%) reported no pain (P1), 21/64 (32.8%) had only occasional minimal pain (P2), and 4/64 (6.3%) had moderate pain requiring intermittent medication (P3); importantly, no patients reported P4–P5 at final review.

Return-to-work outcomes captured at 6 months showed 27/64 (42.2%) resumed previous heavy work (W1), 9/64 (14.1%) returned to previous sedentary work or heavy work with restrictions (W2), 11/64 (17.2%) were employed in new sedentary roles (W3), 6/64 (9.4%) could not return to full-time work (W4), and 11/64 (17.2%) were completely disabled (W5). Overall, 36/64 (56.3%) achieved return to previous or near-previous work capacity (W1–W2).

Spearman's correlation indicated a weak-to-moderate positive association between fracture type and duration of hospitalization ($\rho=0.302$, $p=0.015$), whereas complications and age showed non-significant associations with length of stay.

Table 1. Baseline Demographics (N=64)

Variable	Category	n (%)
Age group	21–30	10 (15.6)
	31–40	10 (15.6)
	41–50	21 (32.8)
	51–60	17 (26.5)
	61–70	6 (9.4)
Mean age	—	45.25 years
Sex	Male	56 (87.5)
	Female	8 (12.5)

Table 2. Mechanism of Injury

Mechanism	n (%)
Fall from height	49 (76.6)
Road-traffic accident	15 (23.4)

Table 3. Vertebral Levels Involved (Total Fractures = 79)

Level	n (%)	Level	n (%)
D5	5 (6.33)	D12	22 (27.84)
D6	4 (5.06)	L1	24 (30.37)
D7	2 (2.53)	L2	5 (6.33)
D8	1 (1.26)	L3	4 (5.06)
D9	2 (2.53)	L4	1 (1.26)
D11	9 (11.39)	—	—

Note: 12 patients had two-level fractures; no fractures at D1–D4, D10, or L5.

Table 4. Functional Outcomes at 6 Months — Denis Pain Scale

Category	Definition	n (%)
P1	No pain	39 (60.9)
P2	Occasional minimal pain	21 (32.8)
P3	Moderate pain (intermittent meds)	4 (6.3)
P4–P5	Moderate-severe to constant severe	0 (0)

Table 5. Functional Outcomes at 6 Months — Denis Work Scale

Category	Status	n (%)
W1	Return to heavy/previous work	27 (42.2)
W2	Previous sedentary / heavy with restrictions	9 (14.1)
W3	New sedentary work	11 (17.2)
W4	Unable to work full-time	6 (9.4)
W5	Completely disabled	11 (17.2)

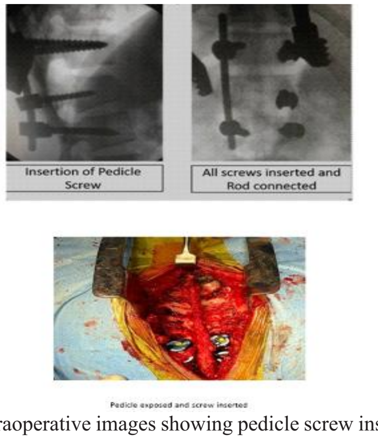

Figure 1: Intraoperative images showing pedicle screw insertion (top left), all screws inserted with rod connected (top right), and pedicle exposed with screw inserted (bottom)

DISCUSSION

Our prospective series of operatively managed dorso-lumbar fractures highlights three consistent themes: (i) injury concentration at the thoracolumbar junction with predominance of AO Type-A morphology, (ii) clinically meaningful improvements in neurology and pain after posterior pedicle-screw stabilization, and (iii) heterogeneity in functional reintegration driven by baseline neurological status and fracture complexity.

The anatomical and morphological distribution we observed—peaking at D12–L1 with a majority of compression/burst patterns—parallels the foundational AO/Magerl schema. Magerl and colleagues codified morphology-based instability constructs that remain the reference standard for fracture description and operative planning, especially at the transition zone where the rigid thoracic spine meets the mobile lumbar spine.1 The TLICS introduced by Lee et al. integrates morphology, neurological status, and posterior ligamentous complex integrity, providing a pragmatic triage tool.[2,3]

Construct selection in our series favored short-segment posterior fixation with inclusion of the fracture-level screw where feasible, reflecting both biomechanical rationale and current evidence. The McCormack load-sharing classification emphasizes comminution, apposition, and kyphosis as determinants of anterior column load; higher scores predict greater risk of failure with posterior-only short constructs and may prompt extended fixation or anterior support.[4,5]

Clinical endpoints in our cohort—improvement in neurological grade and a shift toward favorable Denis pain categories—are congruent with the literature and society guidance. Across WFNS Spine Committee recommendations, Bajamal et al. and Costa et al. emphasize that neurological status, canal compromise, and PLC integrity should anchor both indication and expected recovery.[6,7,8,9]

Strengths include prospective capture of functional outcomes using standardized scales and a consistent posterior protocol by consultant-led teams. Limitations include single-centre design, absence of a non-operative comparator, and relatively short follow-up that may underappreciate adjacent-segment degeneration or late hardware issues. Nevertheless, our findings support a practical algorithm: classify morphology (AO/Magerl), stage instability and neurology (TLICS/PLC), estimate load-sharing demands (McCormack LSC), then select the least-invasive construct that safely restores alignment.

CONCLUSION

In this prospective series of operatively managed dorso-lumbar fractures, patients were predominantly middle-aged men injured by falls, with injuries clustering at D12–L1 and largely AO Type-A morphology. Posterior pedicle-screw stabilization delivered clinically meaningful benefits: neurological grades improved across follow-up, pain shifted markedly toward Denis P1–P2, and more than half of patients returned to previous or near-previous work by 6 months. Radiographic correction was maintained, and peri-operative complications were acceptable for a tertiary setting.

Take-home Messages: Thoracolumbar trauma concentrates at the D12–L1 junction; posterior fixation is a dependable, scalable solution. Early, protocol-driven surgery plus mobilization translates radiographic correction into tangible gains in pain, neurology, and work capacity. Fracture complexity drives resource use—plan longer stays and rehabilitation intensity for unstable or multilevel injuries. Standardized assessment using neurology scales and Denis pain/work scoring should anchor follow-up and quality improvement.

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