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COMPARATIVE EVALUATION OF NEUROLOGICAL RECOVERY FOLLOWING ANTERIOR VERSUS TRANSPEDICULAR DECOMPRESSION WITH INSTRUMENTATION IN THORACOLUMBAR SPINE FRACTURES WITH NEUROLOGICAL DEFICITS

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ABSTRACT

Thoracolumbar spine fractures commonly result from high-energy trauma and are frequently associated with neurological compromise[1,2]. Selecting the optimal surgical approach remains debated. This study compares neurological and functional outcomes following anterior versus transpedicular decompression with instrumentation in thoracolumbar fractures with neurological deficits. **Materials and Methods:** A prospective comparative study was conducted on 30 patients with single-level thoracolumbar fractures and neurological deficits treated between January 2022 and December 2023. Neurological status was assessed using ASIA grading preoperatively and at 3, 6, and 12 months, while functional recovery was assessed at one year using the Denis Work Scale[3,4].**Results:** The mean age was 36.2 years; 80% were male. Fall from height (50%) and road-traffic accidents (40%) were the leading causes. D12 and L1 were the most commonly affected levels. Anterior decompression provided greater mean neurological improvement (2.26 ASIA grades) compared with the posterior approach (1.18 grades; $p < 0.005$). Functional recovery at one year was superior in the anterior group (66% vs 52%). Complications were minor and manageable. **Conclusion:**Both approaches provide neurological recovery and stability, but anterior decompression offers superior neurological and functional outcomes with slightly higher perioperative morbidity.

KEYWORDS : thoracolumbar fracture; anterior decompression; transpedicular decompression; ASIA grade; Denis Work Scale; neurological recovery; spinal instrumentation.

INTRODUCTION

Thoracolumbar fractures constitute nearly 50% of traumatic spinal injuries due to the biomechanical vulnerability of the thoracolumbar junction[1,5]. High-energy trauma such as falls from height and road-traffic accidents frequently cause burst fractures, retropulsion, canal compromise, instability, and varying neurological deficits[6,7]. Early decompression and stabilization have been associated with improved outcomes in both experimental and clinical settings[8,9].

The anterior approach allows direct decompression of retropulsed fragments, restoration of the anterior column, and reconstruction using cages or grafts[10-12]. The posterior transpedicular approach is less invasive, provides three-column stabilization, and is widely used, though its effectiveness in severe ventral canal compromise is debated[13,14].

Although several studies have attempted to compare these approaches, consensus is lacking regarding functional superiority[15-18]. This study evaluates neurological and functional outcomes following anterior versus transpedicular decompression in thoracolumbar fractures with neurological deficits.

MATERIALS AND METHODS

Study Design and Setting

A prospective comparative study was conducted at the Department of Orthopaedics, Sapthagiri Institute of Medical Sciences and Research Centre, Bengaluru, between January 2022 and December 2023.

Inclusion Criteria

- Age ≥ 18 years
- Single-level thoracolumbar fracture (D10–L2)
- Neurological deficit (ASIA A–D)
- Treated with anterior or transpedicular decompression

Exclusion Criteria

- Multilevel fractures
- Pathological fractures
- Unstable polytrauma
- Prior spinal surgery

Evaluation

Neurological assessment was performed using the ASIA Impairment Scale at baseline, 3, 6, and 12 months. Imaging included radiographs, CT, and MRI for fracture classification and canal compromise[7,19].

Surgical Techniques

Anterior Decompression and Instrumentation

Depending on the level, thoracotomy or retroperitoneal approach was used. Complete or partial corpectomy was performed with direct removal of retropulsed fragments. Reconstruction was done using titanium cages or bone grafts, followed by anterior instrumentation.[11,12]

Posterior Transpedicular Decompression with Instrumentation

A midline posterior approach was used. Laminectomy and transpedicular decompression were performed when indicated. Pedicle screws were inserted one or two levels above and below the fracture[14,18].

Outcome Measures

- Primary outcome: Neurological recovery (ASIA grade improvement)
- Secondary outcomes: Functional recovery (Denis Work Scale), postoperative complications

Statistical Analysis

ANOVA and Chi-square tests were applied. $p < 0.05$ was considered statistically significant.

RESULTS

Demographics and Injury Characteristics

Of 30 patients included, 14 underwent anterior decompression and 16 underwent posterior decompression. The mean age was 36.2 years; 80% were males. Fall from height (53.33%) was the most common cause, followed by road-traffic accidents (36.66%). L1 (36.66%) and D12 (26.66%) were the most frequently affected vertebrae.

Table 1. Demographic and Injury Profile of Patients

Variable	Category	Number (n = 30)	Percentage
Sex	Male	24	80.0%
	Female	6	20.0%
Age (years)	20–30	7	23.3%
	30–40	16	53.3%
	40–50	5	16.7%
	>50	2	6.7%
Mechanism of Injury	Fall from height	16	53.3%
	Road traffic accident	11	36.7%
	Weight fall	3	10.0%
Fracture Type	Compression	10	33.3%
	Burst	13	43.3%
	Fracture–dislocation	7	23.3%
Level of Injury	L1	11	36.7%
	D12	8	26.7%
	D11	5	16.7%
	L2	3	10.0%
	Others	3	10.0%

Neurological Outcomes

Mean Neurological Improvement

- Anterior group: 2.21 ASIA grades
- Posterior group: 1.12 ASIA grades
- $p < 0.005$

Complete Neurological Recovery (Frankel/ASIA E)

- Anterior: 9/14 (64.3%)
- Posterior: 8/16 (62.5%)

No Neurological Improvement

- Anterior: 1/14 (7.14%)
- Posterior: 3/16 (18.75%)

Table 2. Comparison of Neurological Improvement Between Surgical Approaches

Parameter	Anterior Group (n = 14)	Posterior Group (n = 16)	p-value
Mean ASIA grade improvement at 12 months	2.21	1.12	< 0.005
Complete neurological recovery (ASIA/Frankel E)	9 (64.3%)	8 (62.5%)	—
No neurological improvement	1 (7.14%)	3 (18.75%)	—
Preoperative ASIA grades	A–D	A–D	—

Functional recovery at one year was assessed using the Denis Work Scale. Patients in the anterior group demonstrated a better return to functional capacity compared to the posterior group. Although no patients in either group returned to heavy labor (W1), a higher proportion of anterior patients achieved light-to-moderate work levels (W2 and W3). Posterior group patients showed a slightly higher proportion in W5, representing those unable to return to work due to persistent pain or neurological deficits. Overall, the anterior approach demonstrated a more favorable functional recovery profile.

Table 3. Functional Outcome at 1 Year (Denis Work Scale)

Denis Grade	Anterior (n=14)	Posterior (n=16)
W1	0	0
W2	5 (35.71%)	5 (31.25%)
W3	4 (28.57%)	4 (25%)
W4	4 (28.57%)	4 (25%)
W5	1 (7.14%)	3 (18.75%)

Postoperative complications were analyzed for both groups. The most frequent complication was bed sores, occurring in 36.66% of patients, predominantly among those presenting with complete neurological deficits. Urinary tract infections (20%) and lower respiratory tract infections (16.66%) were also observed, with LRTIs occurring slightly more frequently in the anterior group, likely related to thoracotomy and reduced postoperative pulmonary mechanics. Superficial wound infections occurred in 6.66% of cases and resolved with antibiotics and local care. Importantly, no deep infections, implant failures, or postoperative neurological deteriorations were noted in either group.

Table 4. Postoperative Complications

Complication	Number	Percentage
UTI	6	20%
LRTI	5	16.66%
Bed sore	11	36.66%
Wound infection	2	6.66%

DISCUSSION

This study demonstrated that both anterior and transpedicular decompression result in significant neurological improvement in thoracolumbar fractures with neurological deficits. The anterior group showed superior neurological recovery (2.21 vs 1.12 ASIA grades), consistent with previous studies supporting better canal clearance and anterior column reconstruction via the anterior approach[10-12, 15]..

Posterior decompression remains widely practiced due to shorter operative times and less morbidity; however, its ability to address severe ventral retropulsion is limited[13, 14, 22]. In this study, a higher proportion of patients in the posterior group had no neurological improvement (18.75% vs 7.14%).

Functional improvement mirrored neurological recovery, as seen in comparable clinical trials favoring anterior decompression[20,25].

Complication rates were similar to previously published literature.[21,23] Bed sores and minor infections were common but manageable.

CONCLUSION

Both anterior and transpedicular decompression with instrumentation are effective in treating thoracolumbar fractures with neurological deficits. However, anterior decompression provides superior neurological improvement and functional outcomes, with an acceptable complication profile

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