Journal of Surgical Sciences 2025;29(1): 43-49

https://doi.org/10.3329/jss.v29i1.91295

JOURNAL OF SURGICAL SCIENCES

Original Article

Outcome of Single-Level Surgical Fixation in Thoracolumbar Trauma with Complete Spinal Cord Injury

Islam MM[1*], Ovi MRA[2], Pramanik NK[3], Hoque M[4], Islam MN[5], Kumar SA[6], Ahmed MT[7]

Abstract

Introduction: Thoracolumbar trauma with complete spinal cord injury (SCI) is a devastating condition predominantly affecting young adults, resulting in permanent disability and significant socioeconomic burden. Surgical stabilization aims to restore spinal stability, enable early rehabilitation, and potentiate neurological recovery. The aim of the study was to evaluate functional, neurological, and radiological outcomes of single-level posterior surgical fixation in Thoracolumbar Trauma with complete SCI.

Methods: This quasi-experimental study was conducted at NITOR, Dhaka, from March 2021 to August 2023. Thirty-three consecutive patients aged 18-60 years with thoracolumbar (T10-L2) trauma, complete SCI (ASIA grade-A), single vertebra involvement, and TLICS score e"5 who underwent surgery within 14 days of injury were enrolled. All patients underwent posterior decompression, pedicle screw fixation, and posterolateral fusion. Outcomes were assessed at 12 months postoperatively using VAS, FIM motor score, ASIA scale, Cobb's angle, Bridwell fusion grade, and complications.

Results: Mean age was 34.03 ± 9.235 years with 84.8% male predominance. Fall from height (84.8%) was the predominant cause. D12 (54.5%) and L1 (36.4%) were most commonly fractured. Mean time to surgery was 10.55 ± 2.56 days. Significant improvements occurred in VAS score (7 to 1, $p < 0.001$), FIM motor score (50.39 to 94.18, $p < 0.001$), and Cobb's angle (30.58° to 5.61°, $p < 0.001$). Neurological improvement to ASIA-B occurred in only 3 patients (9.1%); 90.9% remained ASIA-A. No patient recovered bladder or bowel function. Bridwell fusion showed grade II (63.6%) and grade III (36.4%) with no non-unions. Complications occurred in 15.15% (UTI 9.09%, surgical site infection 3.03%, pressure sore 3.03%).

Conclusion: Single-level posterior fixation provides significant pain relief, functional improvement, kyphotic correction, and solid fusion with low complications. Although neurological recovery remains limited (9.1%) with delayed surgery, functional gains justify intervention. Early surgery within 24 hours is recommended to optimize neurological outcomes.

Keywords: Thoracolumbar trauma, complete spinal cord injury, ASIA grade-A, posterior fixation, neurological outcome

1. Dr. Md Mukhtarul Islam, Assistant Registrar, Department of Orthopaedic Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh.
2. Dr. Mir Rasekh Alam Ovi, Resident Surgeon, Dhaka Medical College Hospital, Dhaka, Bangladesh
3. Dr. Niloy Kumar Pramanik, Medical Officer, Upazila Health Complex (UHC), Niamotpur, Naogaon, Bangladesh
4. Dr. Mahfuzul Hoque, Assistant Registrar, National Institute of Traumatology and Orthopaedic Rehabilitation, Dhaka, Bangladesh
5. Dr. Md. Nazrul Islam, Resident Surgeon, Department of Orthopaedic Surgery, Dhaka Medical College, Dhaka, Bangladesh
6. Dr. Sree Ashok Kumar, Medical Officer, Bagmara UHC, Rajshahi, Bangladesh
7. Dr. Md. Tanvir Ahmed, Emergency Medical Officer, National Institute of Traumatology & Orthopaedic Rehabilitation, Dhaka.

***Correspondence:** Dr. Md. Mukhtarul Islam, Assistant Registrar, Department of Orthopaedic Surgery, Dhaka Medical College Hospital, Dhaka, Bangladesh. E-mail: palash6632@gmail.com

Introduction

Spine trauma are devastating injuries that can result in serious disabilities and dire consequences, especially if managed inappropriately.[1] Spinal column injuries represent approximately 3% of all trauma cases, and 90% of these injuries involve the thoracolumbar spine.[2] Anatomically and functionally, the thoracolumbar spine is divided into the more cephalad rigid thoracic spine (T1-10), the transitional thoracolumbar junction or region (T10-L2), and the more flexible lower lumbar spine (L3-L5). The thoracolumbar segment represents one of the great transitions from the less mobile thoracic cage to the lumbar spine, making this an area of great

biomechanical stress and consequently the region most commonly involved in traumatic spinal fractures.[3-5] Nearly 50% of thoracolumbar spine injuries occur in the thoracolumbar junction.[6] Traumatic spinal cord injury (SCI) is a devastating event that can lead to lifelong disability. Since it usually occurs in younger individuals, the loss of productive life years has an enormous economic and social impact.[7] It is estimated that 10–30% of people with thoracolumbar fractures also have spinal cord injury, such as incomplete or complete neurologic deficit, or cauda equina syndrome depending on the region.[8,9] The relative lesser incidence of neurological injury in lumbar fractures can be attributed to the large size of the neural canal and greater resilience of cauda equina nerve roots.[10] The new AO system classifies thoracolumbar fractures into three major groups of increasing severity—compression injuries (which include burst fractures), tension band injuries, and displacement injuries (fracture-dislocations).[8] The Thoracolumbar Injury Classification and Severity System (TLICS), by incorporating posterior ligamentous complex (PLC) integrity and neurological status, has sought to objectively assess injury severity and thereby help establish treatment guidelines. PLC integrity is emphasized in TLICS. Once disrupted, the injured segment of PLC usually requires surgical intervention because of its poor healing potential. Without surgery, an injured PLC can result in kyphotic progression and subsequent vertebral collapse.[11] Appropriate management options depend on multiple factors, including the morphology of the fracture, patient profile, available infrastructure, and surgical expertise. Despite significant improvements in understanding and management of these injuries, the prognosis remains poor in a proportion of patients with significantly impaired neurological status.[1] Historically, thoracolumbar fractures were managed primarily nonoperatively. However, with recent technological improvements, management has transitioned from conservative to surgical treatment.[5] The decision whether to treat conservatively or surgically is based on clinical and radiological examinations.[11] In general, patients with stable fractures without gross deformity are treated conservatively, and operative treatment is indicated mainly for unstable spinal injuries such as flexion-distraction injuries, unstable burst fractures, fracture-dislocations, and significant neurologic deficits.[10,12,13] Primary goals of surgery in complete paraplegia patients are reinstating the structural integrity and stability of the damaged spine, achievement of a pain-free fracture site, maximizing neurological recovery, early rehabilitation, and prevention of subsequent deformity.[5,14] After surgery, complete thoracolumbar junction paraplegia can partially recover in approximately 20-30% of cases, with roughly half of these improving to ASIA-B and half to ASIA-C/D.[7,15-17] Even if neurological recovery does not occur, early surgery at least lessens respiratory and decubitus-related complications, eases nursing care, and facilitates early wheelchair rehabilitation.[9] Different surgical techniques and approaches are available for surgical management. However, posterior instrumentation with pedicle screws has become popular because it offers advantages over other fixation systems.[18]

The aim was to evaluate the outcome of single-level surgical fixation in thoracolumbar trauma with complete spinal cord injury.

Materials & Methods

This quasi-experimental study was conducted at the National Institute of Traumatology and Orthopedic Rehabilitation (NITOR), Dhaka, Bangladesh, from March 2021 to August 2023 to evaluate the outcomes of single-level surgical fixation in patients with thoracolumbar trauma and complete spinal cord injury. A total of 33 consecutive patients aged 18 to 60 years with thoracolumbar (T10 to L2) spine trauma, complete spinal cord injury (ASIA grade-A), single vertebra involvement, TLICS score of 5 or more, and who underwent surgery within 14 days of injury were enrolled using purposive sampling, while patients with polytrauma, previous spine surgery, pathological fractures, or unhealthy overlying skin were excluded. Following informed written consent, all patients underwent posterior decompression by laminectomy, reduction of dislocation when present, stabilization using pedicle screws and rods, and posterolateral fusion with autogenous cancellous bone graft. Data were collected preoperatively and postoperatively at 6 weeks, 12 weeks, 24 weeks, and 12 months using a semi-structured questionnaire to assess demographic variables, clinical characteristics, and outcomes including functional status using Visual Analogue Scale (VAS) and Functional Independence Measure (FIM) scores, neurological status using the ASIA impairment scale, radiological outcomes including Cobb's kyphotic angle and Bridwell fusion grade, bladder and bowel function, and postoperative

complications. Statistical analysis was performed using SPSS version 25.0, with qualitative data presented as frequencies and percentages, quantitative data as means and standard deviations, and inferential statistics including paired t-test and Wilcoxon signed-rank test applied with statistical significance set at $p < 0.05$. The study was conducted following ethical approval from the Institutional Review Board of NITOR and in compliance with the Helsinki Declaration.

Results

This study evaluated the outcomes of single-level surgical fixation in thoracolumbar trauma patients with complete spinal cord injury. Conducted as a quasi-experimental study at the National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR) in Dhaka, Bangladesh, it took place from March 2021 to August 2023. The aim was to determine the effectiveness of this surgical approach in such cases.

A total of 33 consecutive patients with thoracolumbar trauma and complete spinal cord injury (ASIA Impairment Grade-A) who met the inclusion and exclusion criteria participated in this study. All of them received posterior decompression, pedicle screw fixation, and posterolateral fusion. The demographic and injury-related details of these patients are shown in Tables I and II.

Patients were prospectively monitored at 6 weeks, 12 weeks, 24 weeks, and 12 months after surgery. Functional results were measured with the Visual Analogue Scale (VAS) and the Functional Independence Measure (FIM) motor scores, while neurological function was assessed using the ASIA impairment scale (Table V). Radiological outcomes encompassed Cobb's kyphotic angle and Bridwell fusion grade (Tables IV and VI). Postoperative complications were also recorded during the follow-up period (Table VI).

Table I shows the demographic characteristics of the study patients. The majority of patients (72.8%) were in the 21-40-year age group, with a mean age of 34.03 ± 9.235 years. There was a strong male predominance (84.8%). Day laborers (33.3%) and farmers (27.3%) constituted the majority of the study population.

Table I: Demographic characteristics of the study patients (n=33)

Demographic Variables	Categories	Frequency (n)	Percentage (%)
Age group (years)	< 20	2	6.1
	21-30	12	36.4
	31-40	12	36.4
	41-50	6	18.2
	51-60	1	3
	Mean ± SD	34.03 ± 9.235	
	Range	19 – 55	
Gender	Male	28	84.8
	Female	5	15.2
Occupation	Service holder	4	12.1
	Businessman	3	9.1
	Day laborer	11	33.3
	Farmer	9	27.3
	Student	2	6.1
	House wife	4	12.1

Table II presents the injury-related characteristics. Fall from height (84.8%) was the predominant cause of injury. The most commonly fractured vertebrae were D12 (54.5%) and L1 (36.4%). Most patients (84.8%) underwent surgery during the second week post-injury, with a mean time to surgery of 10.55 ± 2.563 days.

Table III shows the distribution of fracture types according to the AO classification. AO A4 and AO C types were the most common, each occurring in 14 (42.4%) patients, together comprising 84.8% of all cases.

Table IV demonstrates significant improvement in all functional and radiological outcome measures at 12 months follow-up compared to preoperative values. The median VAS score improved from 7 to 1 ($p < 0.001$). The mean FIM motor score improved by 43.79 points ($p < 0.001$), and the mean Cobb's kyphotic angle improved by 24.48° ($p < 0.001$).

Table 5 shows the neurological and sphincter function outcomes. Neurological status remained unchanged in 30 (90.9%) patients, while only 3 (9.1%) showed improvement to ASIA grade-B. No patient achieved ASIA grade-C, D, or E. Complete recovery of bladder and bowel function was not observed in any patient.

Table II: *Injury-related characteristics of the study patients (n=33)*

Injury Variables	Categories	Frequency (n)	Percentage (%)
Cause of injury	Fall from height	28	84.8
	Motor vehicle accident	5	15.2
Fractured vertebra	D11	2	6.1
	D12	18	54.5
	L1	12	36.4
	L2	1	3.0
Time from injury to surgery	1-7 days	5	15.2
	8-14 days	28	84.8
	Mean ± SD	10.55 ± 2.56 days	
	Range	5 – 14 days	

Table III: *Distribution of fracture types according to AO classification (n=33)*

AO Fracture Type	Frequency (n)	Percentage (%)
A3	4	12.1
A4	14	42.4
B1	1	3.0
C	14	42.4
Total	33	100

Table IV: *Functional and radiological outcomes at pre-operative and 12 months follow-up (n=33)*

Outcome Measures	Pre-operative	Post-operative at 12 months	Mean Improvement	p-value
VAS score [Median (IQR)]	7 (6 – 8)	1 (0 – 1)	-	< 0.001
FIM motor score (Mean ± SD)	50.39 ± 0.747	94.18 ± 5.732	43.79 ± 5.876	< 0.001
Cobb's kyphotic angle(Mean ± SD)	30.58° ± 8.070°	5.61° ± 2.783°	24.48° ± 4.942°	< 0.001

Table V: *Neurological and sphincter function outcomes at 12 months follow-up (n=33)*

Outcome Measures	Pre-operative	Post-operative at 12 months	Mean Improvement	p-value
VAS score[Median (IQR)]	7 (6 – 8)	1 (0 – 1)	-	< 0.001
FIM motor score (Mean ± SD)	50.39 ± 0.747	94.18 ± 5.732	43.79 ± 5.876	< 0.001
Cobb's kyphotic angle(Mean ± SD)	30.58° ± 8.070°	5.61° ± 2.783°	24.48° ± 4.942°	< 0.001

Table VI: *Bridwell fusion grade and post-operative complications (n=33)*

Variables	Categories	Frequency (n)	Percentage (%)
Bridwell fusion grade at 12 months	Grade I	0	0
	Grade II	21	63.6
	Grade III	12	36.4
	Grade IV	0	0
Post-operative complications	None	28	84.85
	Surgical site infection	1	3.03
	Urinary tract infection	3	9.09
	Pressure sore	1	3.03

Table VI presents the fusion grades and postoperative complications. At 12 months follow-up, 63.6% of patients achieved grade II fusion and 36.4% achieved grade III fusion. The majority of patients (84.85%) had no postoperative complications. Urinary tract infection (9.09%) was the most common complication, followed by surgical site infection (3.03%) and pressure sore (3.03%).

Discussion

This study evaluated the outcomes of single-level posterior surgical fixation in 33 patients with thoracolumbar trauma and complete spinal cord injury (ASIA grade-A) over a 12-month follow-up period. The findings demonstrate that while neurological recovery remains limited, significant improvements in functional status, pain relief, and radiological parameters can be achieved with surgical stabilization.[1]

The demographic profile revealed that thoracolumbar fractures with complete SCI predominantly affect young adult males, with 72.8% of patients in the 21-40 years age group (mean age 34.03 years) and 84.8% male predominance. These findings align closely with recent literature. Perna et al. (2024) reported a mean age of 35.7 years with 79.8% male patients[19], while Ambulgekar and Ghag (2023) documented 73.33% male predominance in their Indian population study.[3] The predominance of young males reflects their engagement in high-risk occupations, with day laborers (33.3%) and farmers (27.3%) constituting the majority in this series.[7]

Fall from height was the predominant cause of injury (84.8%), consistent with epidemiological studies from developing countries where occupational hazards remain common.[3] Thorat et al. (2024) reported similar findings with 61.54% of injuries from falls.[20] The thoracolumbar junction, particularly D12 (54.5%) and L1 (36.4%), was the most frequently injured region, reflecting the biomechanical vulnerability of this transitional zone.[6] AO A4 (complete burst) and AO C (translation) fractures were the most common types (42.4% each), representing the unstable injury patterns requiring surgical intervention.[10]

The mean time from injury to surgery was 10.55 ± 2.56 days, with 84.8% of patients undergoing surgery during the second week post-injury. This delayed intervention reflects real-world challenges in developing countries but falls significantly short of current recommendations advocating for surgery within 24 hours to optimize neurological recovery.[21] Qadir et al. (2020) demonstrated that neurological improvements were more common and of greater grade with early intervention.[15]

Functional outcomes showed significant improvement, with median VAS scores decreasing from 7 preoperatively to 1 at 12 months ($p < 0.001$), and mean FIM motor scores improving from 50.39 to 94.18 ($p < 0.001$). These findings are comparable to Thorat et al. (2024), who reported VAS improvement from 7.50 to 1.42 at 24 weeks.[20] The functional gains in self-care and wheelchair mobility are clinically significant, reducing caregiver burden even without neurological recovery.[9]

Neurological recovery was limited, with only 3 patients (9.1%) improving to ASIA grade-B, while 90.9% remained ASIA-A. No patient achieved ASIA grade-C, D, or E, and all patients had persistent bladder and bowel dysfunction. This recovery rate is lower than the 26.7-45.5% reported in studies with early surgical intervention.[15,22] The delayed timing of surgery in this series likely contributed to the limited neurological recovery, as secondary injury mechanisms progress significantly within 72 hours of trauma.[21,23]

Radiological outcomes demonstrated excellent correction of kyphotic deformity, with mean Cobb's angle improving from 30.58° preoperatively to 5.61° at 12 months (mean improvement 24.48°, $p < 0.001$). This compares favorably with recent literature. Perna et al. (2024) reported postoperative angles of 3.4°-8.3°², and Deng et al. (2014) documented improvement from 17.2° to 8.42°.[24] Fusion assessment showed grade II in 63.6% and grade III in 36.4% of patients, with no non-unions observed.

Postoperative complications occurred in only 15.15% of patients, with urinary tract infection (9.09%) being most common, followed by surgical site infection (3.03%) and pressure sore (3.03%). This compares favorably with historical complication rates of 40% reported in some series[14], supporting the role of surgical stabilization in facilitating early mobilization and reducing complications associated with prolonged bed rest.[9]

This study has several limitations, such as a small sample size, lack of a control group, postponed surgery timing, being conducted at a single institution, and having a limited follow-up period. Future multicenter prospective studies with standardized protocols that compare early and delayed interventions, along with long-term follow-up, are essential to further validate these results and improve management strategies for patients with complete thoracolumbar SCI.

Conclusion

In conclusion, single-level posterior surgical fixation in thoracolumbar trauma with complete spinal cord injury offers benefits like pain relief, functional improvement, spinal alignment restoration, and solid fusion with low complication rates. Despite limited neurological recovery (9.1% to ASIA-B), functional gains and reduced complications from prolonged immobilization justify surgery. Delayed surgery likely contributed to limited recovery, highlighting the importance of early intervention. These findings support surgical stabilization's role in complete thoracolumbar SCI and stress the need for systems improvement to enable prompt treatment and multidisciplinary rehab in resource-limited settings.

References

1. Khurjekar K, Hadgaonkar S, Kothari A, Raut R, Krishnan V, Shyam A, et al. Demographics of Thoracolumbar Fracture in Indian Population Presenting to a Tertiary Level Trauma Centre. Asian Spine J. 2015;9(3):344-351.
2. Islam MA, Sakeb N, Mahmood E. Evaluation of the Results of Posterior Decompression, Corpectomy and Instrumentation in Traumatic Unstable Thoraco-Lumbar Burst Fractures. Bangabandhu Sheikh Mujib Med Univ J. 2012;5(1):35-41.
3. Ambulgekar RK, Ghag NS. Epidemiological study of thoracolumbar spine fracture patients reported to tertiary care center of Central India. Int J Res Orthop. 2023;9(2):261-266.
4. Woo JH, Lee HW, Choi HJ, Kwon YM. Are 'Unstable' Burst Fractures Really Unstable? J Korean Neurosurg Soc. 2021;64(6):944-949.
5. Peev N, Zileli M, Sharif S, Arif S, Brady Z. Indications for Nonsurgical Treatment of Thoracolumbar Spine Fractures: WFNS Spine Committee Recommendations. Neurospine. 2021;18(4):713-724.
6. Meena S, Sharma P, Chowdhury B. Management of Thoracolumbar Fractures. Indian J Neurosurg. 2015;4:56-62.
7. Wengel PVT, Haan YD, Feller RE, Oner FC, Vandertop WP. Complete Traumatic Spinal Cord Injury: Current Insights Regarding Timing of Surgery and Level of Injury. Global Spine J. 2020;10(3):324-331.

8. Cook E, Scantlebury A, Booth AL, Turner EL, Ranganathan A, Khan A, et al. Surgery versus conservative management of stable thoracolumbar fracture: the PRESTO feasibility RCT. Health Technol Assess. 2021;25(62):1-126.

9. Charles YP, Steib JP. Management of thoracolumbar spine fractures with neurologic disorder. Orthop Traumatol Surg Res. 2015;101(1 Suppl):S31-S40.

10. Rajasekaran S, Kanna RM, Shetty AP. Management of thoracolumbar spine trauma: An overview. Indian J Orthop. 2015;49(1):72-82.

11. Khurana B, Sheehan SE, Sodickson A, Bono CM, Harris MB. Traumatic Thoracolumbar Spine Injuries: What the Spine Surgeon Wants to Know. RadioGraphics. 2013;33(7):2031-2046.

12. Aziz MM, Kotb A, Anwer H, Khattab MF. Thoracolumbar Fractures, Posterior versus Anterior Management: A Case Series and Literature Review. Egypt Spine J. 2019;30(1):12-22.

13. Patel CK, Truumees E, Fischgrund JS, Herkowitz HH. Evaluation and Treatment of Thoracolumbar Junction Trauma. Univ Penn Orthop J. 2002;15:7-12.

14. Prabhakar MM, Rao BS, Patel L. Thoracolumbar burst fracture with complete paraplegia: rationale for second-stage anterior decompression and fusion regarding functional outcome. J Orthop Traumatol. 2009;10(2):83-90.

15. Qadir I, Riew KD, Alam SR, Akram R, Waqas M, Aziz A. Timing of Surgery in Thoracolumbar Spine Injury: Impact on Neurological Outcome. Global Spine J. 2020;10(7):826-831.

16. Kirshblum S, Snider B, Eren F, Guest J. Characterizing Natural Recovery after Traumatic Spinal Cord Injury. J Neurotrauma. 2021;38(9):1267-1284.

17. Khorasanizadeh MH, Yousefifard M, Eskian M, Lu Y, Chalangari M, Harrop JS, et al. Neurological recovery following traumatic spinal cord injury: a systematic review and meta-analysis. J Neurosurg Spine. 2019;30(5):683-699.

18. Dai L. Principles of Management of Thoracolumbar Fractures. Orthop Surg. 2012;4(2):67-70.

19. Perna F, Borghi R, Pilla F, et al. Comparison of percutaneous versus open posterior stabilization in thoracolumbar junction fractures. Eur J Orthop Surg Traumatol. 2024;34(2):1051-1058.

20. Thorat JD, Nene AM, Bhojraj SY, et al. Functional and radiological outcomes of short-segment fixation. J Orthop. 2024;48:102-108.

21. Fehlings MG, Tetreault LA, Aarabi B, et al. Clinical practice guideline for acute spinal cord injury. Brain Spine. 2025;5:102892.

22. Dobran M, Iacoangeli M, Di Somma LGM, et al. Neurological outcome in operated thoracolumbar spinal cord injuries. Surg Neurol Int. 2014;5(8):S329-S332.

23. Launay O, Charles YP, Steib JP. Should post-traumatic thoracolumbar Frankel A paraplegia be operated as an emergency? Orthop Traumatol Surg Res. 2012;98(3):352-358.

24. Deng Z, Zou H, Cai L, et al. Posterior short-segment pedicle instrumentation for thoracolumbar burst fracture. Scientific World Journal. 2014;2014: 457634.