


# Clinical and Functional Outcomes of Thoracolumbar Spine Fractures Managed with Short Segment Pedicle Screw Fixation in a Tertiary Care Hospital

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## ABSTRACT

**Background:** Thoracolumbar spine fractures are one of the most common and potentially devastating spinal injuries in the world. Short-segment pedicle screw fixation (SSPF) has become the surgical technique of choice in the treatment of unstable thoracolumbar fractures. The study aimed to assess clinical, functional, and radiological outcomes of thoracolumbar spine fractures treated with SSPF in a tertiary care hospital in Bangladesh. **Methods & Materials:** This prospective observational study was carried out at National Institute of Traumatology and Orthopaedic Rehabilitation, Dhaka, Bangladesh from July, 2024 to December, 2024, recruiting 40 patients with thoracolumbar fractures (T11-L3) who underwent SSPF during an 18-month study period. The Visual Analogue Scale (VAS) of back pain and the Oswestry Disability Index (ODI) were used to measure functional outcomes preoperatively and at 3 and 6 months postoperatively. The ASIA Impairment Scale was used to assess neurological status. Prospective documentation of complications was done. Data were entered and analyzed on SPSS version 26. **Results:** The mean age was 36.4 years, with a high percentage of males (72.5%). The most common injury mechanisms were road traffic accidents (45%) and falls from height (40%). The most frequently fractured level was L1 (40%), and burst fractures were 60% of the cases. Significant improvements were recorded in VAS score (7.6 to 2.1) and ODI (61.8 to 23.4) at 6 months ( $p < 0.001$ ). Neurological improvement by at least one ASIA grade was observed in 14 patients, 35.0%, at 6 months. The Kyphotic angle decreased from 19.6 to 8.4 ( $p < 0.001$ ). There was no neurological worsening or death. **Conclusion:** SSPF is a safe and effective surgical procedure for treating unstable thoracolumbar fractures, offering significant functional recovery, neurological improvement, and reliable radiological correction with an acceptable complication profile.

**Keywords:** Thoracolumbar spine fracture, Short-segment pedicle screw fixation, ASIA Impairment Scale

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## INTRODUCTION

The most common location of vertebral column trauma, which is estimated to cause about 50-60% of all spinal injuries, is thoracolumbar spine fractures, especially those at the T11-L2 junction [1]. The thoracolumbar junction is where the rigid thoracic spine, which is supported by the rib cage, is replaced by the more flexible lumbar spine, creating a zone of maximum mechanical stress during high-energy loading events. In Bangladesh and other low- and middle-income countries, these injuries are mostly among young economically active males engaged in road transportation, construction, and agricultural labor populations with high exposure to high-energy trauma and limited occupational safety protection [2]. The pathological spectrum of thoracolumbar fractures is varied and includes stable compression fractures, unstable burst fractures, flexion-distraction injuries, and fracture-dislocations. Proper classification with the help of such systems as the AOSpine Thoracolumbar Classification is necessary to make

management decisions, distinguishing between fractures that can be treated conservatively and those that require immediate surgical stabilization to prevent progressive deformity and neurological damage [3]. Neurological involvement, graded based on the American Spinal Injury Association (ASIA) Impairment Scale, ranges between complete motor and sensory loss (ASIA A) and intact neurology (ASIA E), and is a critical determinant of surgical urgency, prognosis, and rehabilitation planning [4]. Short-segment pedicle screw fixation (SSPF), which is defined as pedicle screw instrumentation one level above and one level below the fractured vertebra, has become the gold-standard surgical procedure in the treatment of unstable thoracolumbar fractures. The technique restores spinal stability with three-column fixation, corrects kyphotic deformity with distraction and lordotic reduction, indirectly decompresses the neural canal with ligamentotaxis, and restores vertebral body height, all without compromising the maximum number of functional

spinal motion segments [5]. Compared to long-segment constructs, SSPF is linked to shorter operative time, less intraoperative blood loss, shorter hospital stay, and similar clinical outcomes in properly selected cases [6]. The measurement of the results after SSPF should be based on validated, multi-dimensional measures. The Visual Analogue Scale (VAS) and the Oswestry Disability Index (ODI) are internationally recognized measures of quantifying the intensity of pain and functional disability, respectively, and have been widely validated in populations with spinal trauma [7]. Radiological outcome measures, such as kyphotic angle correction and restoration of vertebral body height over time, are objective measures of mechanical reconstruction and implant durability over time [8]. The correlation between functional and radiological recovery is an important area of ongoing investigation in the management of thoracolumbar fractures [9]. Although the amount of research conducted in high-income environments is substantial, there is still a lack of prospective institutional data on SSPF outcomes in Bangladesh. The differences in injury demographics, trauma mechanisms, pre-hospital delay, neurological presentation, and perioperative infrastructure can have an impact on outcomes that cannot be fully generalized based on the studies carried out elsewhere [10]. It is thus necessary to generate locally relevant evidence to inform evidence-based surgical decision-making, optimize patient selection, and enhance the quality of care provided to spinal trauma patients within the local healthcare system [11]. Therefore, the study aimed to prospectively assess the clinical, functional, neurological, and radiological outcomes of thoracolumbar spine fractures treated with SSPF in a tertiary care hospital in Bangladesh.

## METHODS & MATERIALS

This prospective observational study was carried out at National Institute of Traumatology and Orthopaedic Rehabilitation, Dhaka, Bangladesh from July, 2024 to December, 2024. The 40 patients with traumatic thoracolumbar spine fractures at the T11-L3 vertebral levels who underwent short-segment pedicle screw fixation (SSPF) during the study period were recruited consecutively after

signing written informed consent. Patients aged 18 years and older who presented with acute or subacute thoracolumbar fractures (within three weeks of injury), including compression fractures, burst fractures, flexion-distraction injuries, and fracture-dislocations, were included. The exclusion criteria included pathological fractures due to malignancy or spinal infection, pre-existing spinal deformity, previous surgery at the same level of the spine, severe osteoporosis, and significant medical comorbidities contraindicating general anesthesia. Functional outcomes (pain intensity measured by the Visual Analogue Scale (VAS)) and disability (measured by the Oswestry Disability Index (ODI)) were the primary outcome variables, which were recorded at the preoperative stage and at 3 and 6 months after surgery. At the same time points, neurological status was assessed using the American Spinal Injury Association (ASIA) Impairment Scale. Radiological parameters, such as kyphotic angle and loss of height of the vertebral body, measured on plain radiographs and CT images preoperatively and at the 6-month follow-up, were used as secondary outcome variables. Prospective data collection was done on operative data such as operative time, estimated blood loss, hospital stay, type of fixation, performance of decompression, mobilization timeline, and need for blood transfusion. All the perioperative and postoperative complications were recorded systematically. Data for this study were entered and analyzed on SPSS version 26. Continuous variables were presented as mean  $\pm$  standard deviation, and categorical variables as frequency and percentage. The paired t-test was used to compare pre- and postoperative scores, with statistical significance being defined as  $p < 0.05$ .

## RESULTS

Table 1 shows the demographic data of the 40 participants in the study. The age group of 31-40 years (32.5%) was the largest age group among the victims of spinal trauma. The ratio of males to females was 2.6:1 (72.5% vs 27.5%). The majority of patients (65%) were rural residents, and 42.5% were manual workers, farmers, or laborers.

**Table I: Demographic Profile of the Study Population (n = 40)**

Variable	Category	Frequency	Percentage
Age group	18-30 years	11	27.5%
	31-40 years	13	32.5%
	41-50 years	9	22.5%
	>50 years	7	17.5%
Sex	Male	29	72.5%
	Female	11	27.5%
Residence	Urban	14	35.0%
	Rural	26	65.0%
Occupation	Manual worker/farmer/laborer	17	42.5%
	Service holder	8	20.0%
	Student	6	15.0%
	Homemaker	5	12.5%
	Business/others	4	10.0%

Table 2 elaborates the mechanisms and circumstances of injury. The leading cause was road accidents (45%), followed by falls from height (40%), which constituted 85% of the total. Most patients (80% of the total) presented within 72 hours of injury, but 20% of the total presented after 72 hours, which

may reflect delays in pre-hospital recognition and referral. In 22.5% of patients, the associated injuries were present, which demonstrates the polytraumatic nature of a significant portion of this cohort.

**Table II: Mode of Injury and Trauma Characteristics of the Study Population**

Variable	Category	Frequency	Percentage
Mode of injury	Road accident	18	45.0%
	Fall from height	16	40.0%
	Fall of a heavy object	4	10.0%
	Assault/others	2	5.0%
Injury setting	Occupational injury	14	35.0%
	Non-occupational injury	26	65.0%
Time from injury to admission	≤24 hours	15	37.5%
	25-72 hours	17	42.5%
	>72 hours	8	20.0%
Associated injury	Present	9	22.5%
	Absent	31	77.5%

The preoperative clinical presentation is summarized in *Table III*. All 40 patients (100%) had back pain, with local tenderness in 95% and restricted spinal movement in 90%. A significant proportion of 30%, 25%, 32.5%, and 12.5%, respectively, had neurological symptoms. Preoperatively, 50% were

neurologically intact (ASIA E), and the remaining 50% had deficits ranging from complete injury (ASIA A: 5%) to incomplete deficit (ASIA B-D: 45%).

**Table III: Baseline Clinical Profile of the Study Population**

Variable	Category	Frequency	Percentage
Back pain	Present	40	100.0%
Local tenderness	Present	38	95.0%
Restricted spinal movement	Present	36	90.0%
Radicular pain	Present	13	32.5%
Motor weakness	Present	12	30.0%
Sensory impairment	Present	10	25.0%
Bladder/bowel involvement	Present	5	12.5%
Preoperative ASIA grade	ASIA A	2	5.0%
	ASIA B	4	10.0%
	ASIA C	6	15.0%
	ASIA D	8	20.0%
	ASIA E	20	50.0%

The radiological fracture profile is described in *Table IV*. The most frequently fractured vertebra (40%) was L1, which is well-established as vulnerable at the thoracolumbar junction under axial loading. The most common type of fracture was burst fractures (60%), then compression fractures (22.5%). The most common canal compromise group was 25-50%

(47.5%), but with 17.5% having >50% canal narrowing, indicating significant neural risk. The mean preoperative kyphotic angle of  $19.6 \pm 6.8^\circ$  and the loss of vertebral body height of  $42.3 \pm 11.5\%$  measured the extent of structural disruption requiring surgical repair.

**Table IV: Radiological Profile of Fracture**

Variable	Category	Frequency	Percentage
Fracture level	T11	5	12.5%
	T12	10	25.0%
	L1	16	40.0%
	L2	7	17.5%
	L3	2	5.0%
Fracture type	Compression fracture	9	22.5%
	Burst fracture	24	60.0%
	Fracture-dislocation	5	12.5%
	Flexion-distraction injury	2	5.0%
Canal compromise	<25%	14	35.0%
	25-50%	19	47.5%
	>50%	7	17.5%
Kyphotic angle	Mean $\pm$ SD	$19.6 \pm 6.8^\circ$	-
Vertebral body height loss	Mean $\pm$ SD	$42.3 \pm 11.5\%$	-

*Table V* shows the intraoperative and perioperative profile. The mean operative time was  $132.5 \pm 24.7$  minutes with an estimated blood loss of  $360 \pm 120$  ml. The mean length of stay of  $8.2 \pm 2.4$  days incorporated early mobilization in 75% of patients within 72 hours, which facilitated rapid rehabilitation.

In 85% of cases, standard one-above-one-below fixation was used, and in 15% of cases. Posterior decompression was done in 35% of patients with significant canal compromise or neurological deficit, and blood transfusion was necessary in 20%.

**Table V: Operative and Hospital Profile of the Study Population**

Variable	Category	Mean ± SD / n (%)
Operative time	Mean ± SD	132.5 ± 24.7 minutes
Estimated blood loss	Mean ± SD	360 ± 120 ml
Hospital stay	Mean ± SD	8.2 ± 2.4 days
Fixation level	One above and one below	34 (85.0%)
	Additional screw at the fracture level	6 (15.0%)
Decompression	Done	14 (35.0%)
	Not done	26 (65.0%)
Mobilization	Within 72 hours	30 (75.0%)
Blood transfusion	Required	8 (20.0%)

Table VI shows the serial functional and neurological outcomes. VAS back pain demonstrated a progressive and statistically significant reduction between 7.6 preoperative and 3.4 at 3 months and 2.1 at 6 months ( $p < 0.001$ ). Similarly, ODI improved significantly, from 61.8 to 23.4 at 6 months ( $p < 0.001$ ), falling

below the moderate-severe disability threshold. Neurologically, the percentage of ASIA E patients increased by 50% preoperatively to 65% at 6 months, with 35% of the neurologically impaired patients showing improvement of 1 or more ASIA grades.

**Table VI: Functional and Neurological Outcome After Surgery**

Variable	Category	Preoperative / Mean ± SD, n (%)	3 Months / Mean ± SD, n (%)	6 Months / Mean ± SD, n (%)	p-value
VAS back pain score	Mean ± SD	7.6 ± 1.0	3.4 ± 1.1	2.1 ± 0.9	<0.001
ODI score	Mean ± SD	61.8 ± 9.7	34.5 ± 8.6	23.4 ± 7.8	<0.001
ASIA grade	ASIA A	2 (5.0%)	2 (5.0%)	2 (5.0%)	-
	ASIA B	4 (10.0%)	3 (7.5%)	2 (5.0%)	-
	ASIA C	6 (15.0%)	4 (10.0%)	3 (7.5%)	-
	ASIA D	8 (20.0%)	9 (22.5%)	7 (17.5%)	-
	ASIA E	20 (50.0%)	22 (55.0%)	26 (65.0%)	-
Neurological improvement	Improved by ≥1 ASIA grade	-	9 (22.5%)	14 (35.0%)	-

Table VII (A) records the radiological correction that was attained at 6 months. The kyphotic angle was significantly improved with a mean of 19.6 ± 6.8° before the operation and 8.4 ± 3.9° after the operation ( $p < 0.001$ ). The loss of vertebral

body height was reduced to 21.7 ± 8.2% from 42.3 ± 11.5% ( $p < 0.001$ ). Technical accuracy of pedicle screw placement was found to be satisfactory in 95% of the patients.

**Table VII (A): Postoperative Radiological Correction of the Study Population**

Variable	Category	Preoperative	Postoperative / 6 Months	p-value
Kyphotic angle	Mean ± SD	19.6 ± 6.8°	8.4 ± 3.9°	<0.001
Vertebral body height loss	Mean ± SD	42.3 ± 11.5%	21.7 ± 8.2%	<0.001
Implant position	Satisfactory	-	38 (95.0%)	-

The postoperative complications are summarized in Table VII (B). The most common complication was superficial wound infection (7.5%), followed by implant failure (5%) and screw loosening (5%). One patient (2.5%) was found to have a deep infection that necessitated prolonged antibiotic treatment. Notably, none of the patients experienced neurological decline after surgery, which is a key safety outcome of spinal trauma

surgery. A single patient (2.5%) had to undergo reoperation because of the complications associated with the implants. No perioperative mortality was observed, which confirms the overall safety of SSPF conducted under the conditions of standard tertiary care.

**Table VII (B): Postoperative Complications of the Study Population**

Variable	Category	Frequency	Percentage
Implant failure	Present	2	5.0%
Superficial wound infection	Present	3	7.5%
Deep infection	Present	1	2.5%
Screw loosening	Present	2	5.0%
Neurological deterioration	Present	0	0.0%
Reoperation required	Present	1	2.5%
Mortality	Death	0	0.0%

## DISCUSSION

This prospective observational study assessed the clinical, functional, neurological, and radiological outcomes of 40 patients with thoracolumbar spine fractures treated by short-segment pedicle screw fixation (SSPF) over a 6-month follow-up period. The results consistently indicate that SSPF offers meaningful and long-term benefits in all the assessed outcome parameters, and with an acceptable safety profile. The demographic trend of this study, which is mainly comprised of young adult males of rural origin and who are involved in manual jobs, is representative of the epidemiology of traumatic spinal injury reported in a similar study by Gnanenthiran et al. [12]. The most common mechanisms were road traffic accidents (45%), falls from height (40%), which is consistent with the results of Uddin et al. [13]. The large percentage of rural patients with late hospital presentations (20% arriving more than 72 hours) highlights the necessity of enhancing pre-hospital triage and referral systems for spinal trauma in Bangladesh [13]. The most fractured level was L1 (40%), which is consistent with its biomechanical role as the epicentre of thoracolumbar stress concentration under axial loading. Burst fractures were 60% of all fractures, and almost two-thirds of patients had canal compromise of  $\geq 25\%$ . These results are similar to those of Basaran et al. and Yang et al., which support the common epidemiology of shared trauma across South Asian contexts [14, 15]. The functional results after SSPF were very satisfactory. Mean VAS back pain declined from 7.6 to 2.1 at 6 months, and ODI improved from 61.8 to 23.4 ( $p < 0.001$  for both). The ODI improvement of 38.4 points was significantly greater than the minimum clinically important difference (MCID) of 12.8 points, which confirmed clinically meaningful recovery beyond statistical significance alone [16]. These improvements are in line with Jindal et al., who reported similar VAS and ODI improvements following SSPF of unstable thoracolumbar burst fractures [17]. Neurological recovery was observed in 35% of patients with preoperative deficits (improvement of  $\geq 1$  ASIA grade), with the proportion of neurologically intact (ASIA E) patients increasing to 65% at 6 months. None of the patients had a neurological worsening- a key safety indicator of any spinal fracture repair method. Yousefifard et al. support these results, showing that early surgical decompression and stabilization enhanced neurological outcomes in incomplete spinal cord injury following thoracolumbar trauma [18]. Selective decompression was done in 35% of patients with reported canal compromise and neurological deficits, which is consistent with Vercoulen et al. [19]. Radiological correction was strong. The kyphotic angle was reduced from  $19.6^\circ$  to  $8.4^\circ$  ( $p < 0.001$ ) and vertebral body height loss from 42.3% to 21.7% ( $p < 0.001$ ). The average kyphosis correction of about  $11^\circ$  is favorable compared to the values reported in prospective SSPF series, which generally range between  $8^\circ$  and  $15^\circ$  [20]. High technical accuracy of pedicle screw placement is confirmed by satisfactory implant positioning in 95% of patients. The residual deformity (mean 8.4) is within the clinically acceptable range and is unlikely to result in progressive functional impairment in the short to medium term [21]. The most common findings were superficial wound infection (7.5%), screw loosening (5%), and implant failure (5%). The rate of wound infection can be partially explained by the high incidence of nutritional deficiencies and delayed presentation in this trauma group. The safety of SSPF in a well-resourced tertiary care setting was further confirmed by the fact that only

one patient had to be reoperated, and there was no perioperative mortality, further supporting the safety of SSPF in a well-resourced tertiary care environment, as previously affirmed in meta-analyses comparing SSPF with alternative fixation strategies [22-24].

## LIMITATIONS

The small sample size ( $n = 40$ ) and single-center study limit the generalizability of the findings to larger populations. The 6-month follow-up is less likely to assess long-term outcomes like implant fatigue, adjacent segment disease, late hardware failure, and sustained neurological recovery.

## CONCLUSION

Unstable thoracolumbar spine fractures can be safely, effectively, and reproducibly treated with short-segment pedicle screw fixation. This study shows statistically and clinically significant changes in back pain and functional disability at 6 months postoperative, and significant neurological recovery in 35% of patients who presented with preoperative neurological deficits. Radiological results affirm consistent kyphotic deformity repair and restoration of vertebral body height, with stable implant positioning in 95% of patients. The rate of complications was low, and no neurological worsening or perioperative mortality was reported. These findings confirm the use of SSPF as the surgical modality of choice in the appropriate patients with thoracolumbar fractures in a tertiary care unit in Bangladesh and justify its continued use under the guidance of careful patient selection, experienced surgical technique, and timely operative intervention.

## RECOMMENDATIONS

Future multicenter prospective studies with larger sample sizes and a minimum follow-up of 2 years are recommended to comprehensively assess the long-term durability of SSPF outcomes in Bangladesh.

## FUNDING

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## CONFLICT OF INTEREST

None declared

## ETHICAL APPROVAL

The study was approved by the Institutional Ethics Committee

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