

**OUTCOME OF LONG SEGMENT TRANSPEDICULAR STABILIZATION FOR THE
MANAGEMENT OF THORACOLUMBAR FRACTURE**

Yousuf Ali^{1*}, Chowdhury Iqbal Mahmud², Shahida Akter³, Khandaker Md. Nurul Arifeen⁴, Ali Faisal⁵, A. Z. M. Salimulla⁶, Samrat Parajuli⁷ and Sachindra Joshi⁸

¹Associate Professor, Spinal Surgery, Dept. of Orthopaedics, Bangabandhu Sheikh Mujib Medical University, Dhaka.

^{2,5,6}Associate Professor, Orthopaedic Surgery, Dept. of Orthopaedics, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh.

³Medical Officer, Dept. of Conservative Dentistry, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh.

⁴Professor, Orthopaedic Surgery, Dept. of Orthopaedics, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh.

^{7,8}Resident, Orthopaedic Surgery, Dept. of Orthopaedics, Bangabandhu Sheikh Mujib Medical University, Dhaka, Bangladesh.

***Corresponding Author: Dr. Yousuf Ali**

Associate Professor, Spinal Surgery, Dept. of Orthopaedics, Bangabandhu Sheikh Mujib Medical University, Dhaka.

Article Received on 15/07/2022

Article Revised on 05/08/2022

Article Accepted on 25/08/2022

ABSTRACT

Background: Thoracolumbar junction is the common area for spinal column fracture following a high energy trauma, of which most are burst fracture. Neurological deficit following the thoracolumbar fractures has resulted in increased morbidity in young patients. The posterior long segment transpedicular stabilization has gained popularity for its rigid fixation, improved radiological parameters and lesser failure rates; and has enhanced the patients' rehabilitation. **Aim:** This study was conducted to evaluate the outcome following long segment transpedicular stabilization for the management of thoracolumbar fracture. **Methods:** This multicentric prospective experimental observational study was carried out in Bangabandhu Sheikh Mujib Medical University (BSMMU) and different private clinics of Dhaka, Bangladesh from July 2006 to June 2020. Total no of patients was 205, only those patient treated with posterior decompression stabilization by posterior long Segment fixation and posterolateral fusion were included in this study. Multiple variables were studied, including demographic data, clinical variables, and radiological variables. Patients were followed up for at least one year. Outcomes were measured by VAS score, ASIA grading and radiological parameters. **Results:** In analyzing VAS scores of the participants in different stages of treatment, the score was improved from 6.90 ± 1.16 (Mean \pm SD) in pre-operative stage to 2.0 ± 0.8 (p value < 0.001) in final follow up. Based on ASIA Grading majority of the patients had 'B' to 'C' scores. At immediate postoperative period most of the patients had improved by one grade. But at the end of one year follow-up, majority of the patients (n=195) achieved 'E' score which was found in 95%. The mean preoperative angle of injured vertebra was 18.5° , the mean postoperative angle was 8.8° , the mean angle at 6 month's follow-up was 10.5° , the mean initial correction was 9.9° , and the mean loss of correction was 1.9° . So, the mean overall correction was found 8.0° . In analyzing the average percentages of the anterior body compression, it was 55.5% in preoperative stage and improved to 35% postoperatively, but slightly declined to 32.7% at the latest follow-up. **Conclusion:** The management of thoracolumbar fracture by long segment transpedicular stabilization provides an optimal clinical and neurological improvement with improved radiological parameters and lesser degree of complications in long term follow-up.

INTRODUCTION

Thoracolumbar junction is a region between T11 to L2 level of spine. It is the most common region for spinal fracture, accounting for nearly 90% of the cases and approximately 10-20% of the cases are burst fractures.^[1] This region is more susceptible to injury due to specific biomechanics of this segment where there is transition from rigid kyphotic thoracic spine to more flexible lordotic lumbar spine.^[2] In addition, the cases of

thoracolumbar fractures are increasing among the younger adults and almost always due to high energy trauma, like road traffic accident or fall from height. Around 27% of thoracolumbar fractures are associated with some degree of neurological deficits, which results in long term morbidity and loss of productive economic years, that imparts detrimental effects on the society.^[3] The thoracolumbar fracture is treated conservatively or operatively depending on the existence of the

neurological deficit and the stability of the spine. Current trend is towards rigid internal fixation of fractures, which allow early ambulation and rehabilitation; and decrease the complications related to prolonged immobilization during conservative treatment.^[1] The long segment transpedicular fixation, where two or more segments above and below the fractured vertebra are instrumented, provided good stabilization, halted the postoperative progression of kyphosis, and had lesser failure rate.^[4,5,6] This study was conducted to analyze the outcomes of long segment transpedicular stabilization for the management of thoracolumbar fracture.

Objective

General objective

- To assess the effectiveness of long segment posterior pedicle screw fixation technic in treating thoracolumbar fractures.

Specific objective

- To determine the mode of injury and vertebrae involvement among participants.
- To assess the VAS scores and ASIA grading of the participants in several stages of treatment.
- To evaluate the changes of kyphotic angles of injured vertebra of patients in different stages.
- To assess the average percentages of the anterior body compression among patients in different stages.

METHODS AND MATERIALS

This prospective study was conducted from July 2006 to June 2020 in the Department of Orthopedic Surgery, BSMMU and in different private clinics of Dhaka. Total 205 patients (125 males and 80 females) with a mean age of 34.5 ± 6.45 Years, who underwent long segment transpedicular fixation for thoracolumbar fracture were included in this study. Preoperative evaluation of the patients were done clinically by history and examination, pain evaluation was done by Visual Analog Scale (VAS) Score and neurological evaluation was done by American spinal cord injury association (ASIA) impairment scale. Plain x-ray of thoracolumbar spine (AP and Lateral View) and CT scan with 3D reconstruction were obtained to evaluate the pattern of fracture, vertebral height, angle of kyphosis (Cobb's Method) and degree of canal compromise, whereas MRI was done to evaluate the insult to the spinal cord and nerve root along with the injury to posterior ligamentous complex (PLC). Fracture was classified according to the AO spine thoracolumbar injury classification system and Thoracolumbar Injury Classification and Severity score (TLICS) were assessed.

Surgery was indicated if there was an unstable fracture pattern, neurological deficit and TLICS score of ≥ 4 . Surgery was performed in multiple centers by the same spine surgeon. The standard posterior midline longitudinal approach was used for the exposure of posterior elements. When indicated decompression was

performed. At least 2 normal adjacent segments above and below the fractured vertebra were instrumented with appropriate size pedicle screws and stabilized by rods (long segment transpedicular stabilization). The fixation was done in extension and distraction. The duration of surgery, approximate blood loss and perioperative complications were noted.

All patients were followed up for at least 12 months, during the follow up they were assessed by VAS score and ASIA impairment scale; and additionally, plain x-ray was also obtained. Any complications were noted, and relevant investigations were performed.

Data analysis

Qualitative data were expressed as frequency & percentage and analyzed by chi-square test. Quantitative data were expressed as mean & standard deviation and analyzed by independent t-test. Data were processed and analyzed using software 'Statistical Package for Social Science' (SPSS) version 26. For all analyses, p-value < 0.05 was considered significant.

RESULTS

In this study, the mean (\pm SD) age of the participants was 34.5 ± 6.45 years. A total of 205 participants were included in this study, out of which 125(60.97%) were male and 80 (39.03%) were female. In the majority of cases (70%), RTA (Road traffic accident) was associated as the mode of injury. In the rest 30% cases, 'fall from height' was the mode of injury. On the other hand, L1 and L2 vertebra was the most common vertebra to get fractured and the ratio was 33% and 39% respectively. In analyzing VAS scores of the participants in different stages of treatment, the score was improved from 6.90 ± 1.16 (Mean \pm SD) in pre-operative stage to 2.0 ± 0.8 (p value < 0.001) in final follow up. Based on ASIA Grading majority of the patients had 'B' to 'C' scores. At immediate postoperative period most of the patients had improved by one grade. But at the end of one year follow-up, majority of the patients (n=195) achieved 'E' score which was found in 95%. The mean preoperative angle of injured vertebra was 18.5° , the mean postoperative angle was 8.8° , the mean angle at 6 month's follow-up was 10.5° , the mean initial correction was 9.9° , and the mean loss of correction was 1.9° . So, the mean overall correction was found 8.0° . In analyzing the average percentages of the anterior body compression, it was 55.5% in preoperative stage and improved to 35% postoperatively, but slightly declined to 32.7% at the latest follow-up.

Table 1: Mode of Injury and Vertebrae involvement among participants (N=205).

Variables	N	%
Mode of injury		
RTA	145	70.74
Fall from height	60	29.26
Vertebra involved		
T11	16	7.80
T12	26	12.68
L1	83	40.48
L2	69	33.65
L3	11	5.36

Table 2: VAS scores and ASIA grading of the participants in several stages of treatment

Score	Preoperative (Mean \pm SD)	Final follow-up (Mean \pm SD)	P value
VAS	6.90 \pm 1.16	2.0 \pm 0.8	<0.001

Asia grade	Preoperative	Postoperative	1 yr. Follow-up
A	30	10	5
B	75	20	1
C	90	25	2
D	10	65	2
E	0	85	195

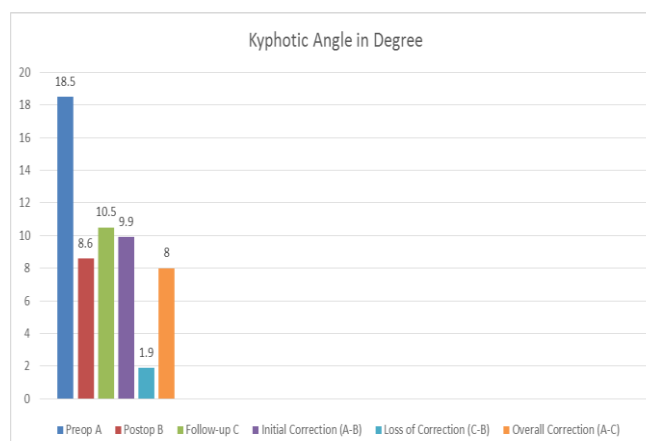
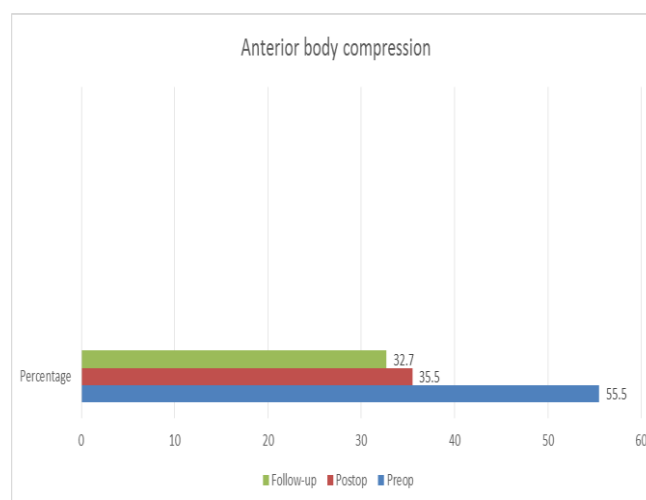
**Figure 1: Mean changes of kyphotic angles of injured vertebra in different stages (N=205).****Figure 2: Average percentages of the anterior body compression in different stages (N=205).**



Image 1: Pre-operative X-ray, MRI.

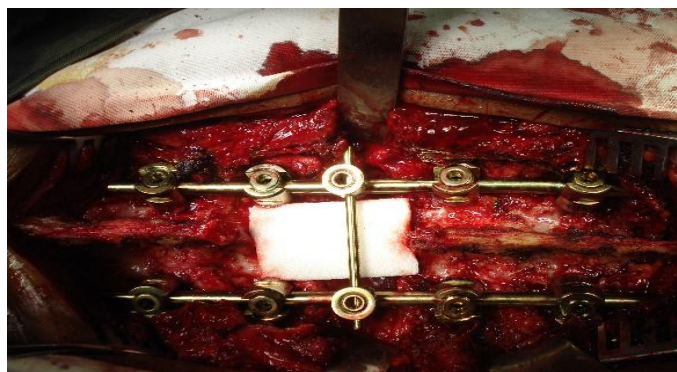


Image 2: Per operative image.

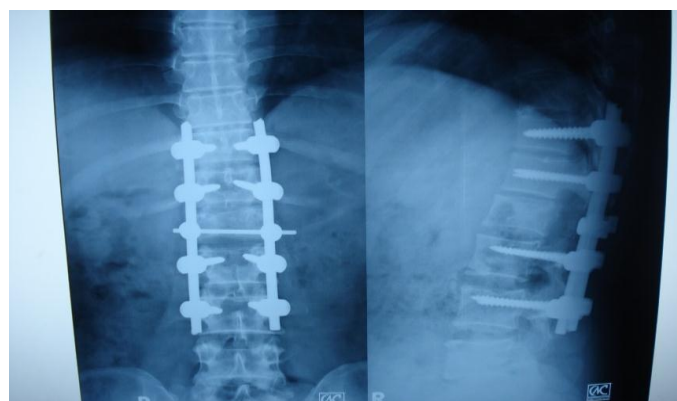


Image 2: Postoperative image (Immediate).

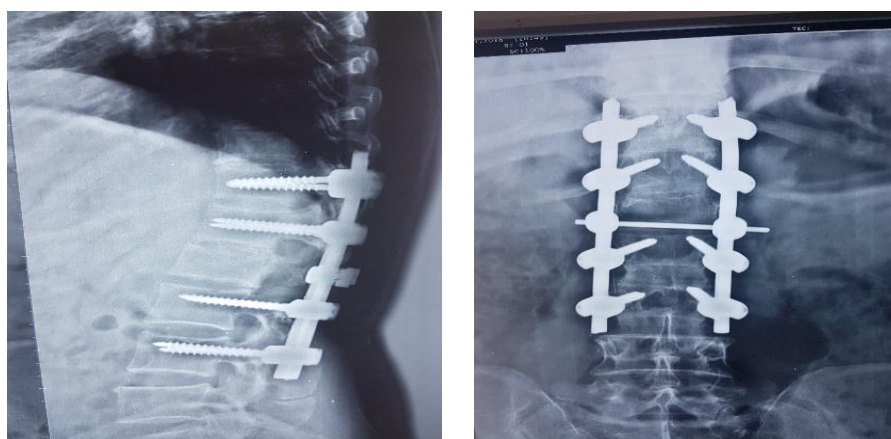


Image 3: Image of follow-up (After 6 year).

DISCUSSION

The spinal cord injury (SCI) following thoracolumbar fractures accounts for 4.2% of the cases.^[7] The TLICS score, which has incorporated neurological status of patient along with the injury morphology and posterior ligamentous complex (PLC) integrity, has improved the decision-making ability for the management of the thoracolumbar fractures, i.e., greater than 90% agreement across number of providers.^[8] TLICS score of > 4 warrants for operative treatment. The main goals of surgical treatment in thoracolumbar fractures are to mitigate pain, facilitate neurologic recovery by decompression of the spinal canal along with its nerve roots, restore and maintain vertebral body height and alignment, and obtain rigid fixation to halt the progression of kyphosis. Although, the anterior and posterior approaches are options provided to the surgeons; debate still persists over definite approach to be used.^[9] Thoracolumbar fracture are caused by flexion-axial loading forces, thus is best treated posteriorly with reduction and fixation by extension and distraction.^[1] Since the establishment of posterior transpedicular screw by Boucher in 1959, many modern instrumentation techniques has been developed.^[10] Also, some authors has shown excellent results in regards to spinal stability and alignment, postoperative neurological improvement and low morbidity following posterior instrumentation.^[11,12]

Thoracolumbar burst fracture results from axial loading that compresses the vertebral body, which is often a high energy trauma. A meta-analysis done by Katsuura et al on epidemiology of thoracolumbar fracture showed that the motor vehicle accidents and fall from height accounted for 36.7% and 31.7% of fractures, respectively.^[3] Whereas a cohort by Marré et al. demonstrated 48% and 43.2% of thoracic fractures resulted from motor vehicle accidents and fall from height, respectively.^[13]

Many authors have shown that L1 vertebra was more frequently injured followed by T12; at thoracolumbar junction.^[3, 5,6,14-16]

Dobran et al. showed 72.4% of the patients improved to at least one ASIA grade following surgery.^[17] A cohort study done by Marré et al. showed improvement in 83.3% of the patients with incomplete cord injury (ASIA B, C, D) whereas no improvement were reported in complete injury (ASIA A).^[13]

Different authors have shown significant improvement in VAS score for back pain following surgical intervention.^[18, 19]

A Meta-analysis by Li and Liu, found out better radiological indexes, in regards to Anterior body height, cobb angle, restoration of canal compromise and implant failure; in long segment fixation than in short segment fixation.⁴ Also other studies have demonstrated that the

radiographic parameters were more desirable following long segment fixation than short segment fixation.^{6, 14} Another meta-analysis also demonstrated better kyphosis correction and decreased in loss of correction in long term follow-up of patients in long segment fixation.^[19]

CONCLUSION

The management of thoracolumbar fracture by long segment transpedicular stabilization provides an optimal clinical and neurological improvement with improved radiological parameters and lesser degree of complications in long term follow-up.

REFERENCES

1. Dai LY, Jiang SD, Wang XY, Jiang LS. A review of the management of thoracolumbar burst fractures. *Surgical neurology*, 2007; 1, 67(3): 221-31.
2. Denis F. The three column spine and its significance in the classification of acute thoracolumbar spinal injuries. *Spine*, 1983; 1, 8(8): 817-31.
3. Katsuura Y, Osborn JM, Cason GW. The epidemiology of thoracolumbar trauma: a meta-analysis. *Journal of orthopaedics*, 2016; 1, 13(4): 383-8.
4. Li J, Liu L. Comparison of short-segment versus long-segment fixation for the treatment of thoracolumbar burst fracture: a meta-analysis. *Int J Clin Exp Med*, 2017; 1, 10(10): 1750-62.
5. Dobran M, Nasi D, Brunozi D, Di Somma L, Gladi M, Iacoangeli M, Scerrati M. Treatment of unstable thoracolumbar junction fractures: short-segment pedicle fixation with inclusion of the fracture level versus long-segment instrumentation. *Acta neurochirurgica*, 2016; 158(10): 1883-9.
6. Sapkas G, Kateros K, Papadakis SA, Brilakis E, Macheras G, Katonis P. Treatment of unstable thoracolumbar burst fractures by indirect reduction and posterior stabilization: short-segment versus long-segment stabilization. *The open orthopaedics journal*, 2010; 4: 7.
7. Zilbermint V, Hershkovitz Y, Peleg K, Dubose JJ, Givon A, Aranovich D, Dudkiewicz M, Group IT, Kessel B. Spinal cord injury in the setting of traumatic thoracolumbar fracture is not reliably associated with increased risk of associated intra-abdominal injury following blunt trauma: An analysis of a National Trauma Registry database. *Chinese Journal of Traumatology*, 2021; 1, 24(3): 132-5.
8. Patel AA, Vaccaro AR, Albert TJ, Hilibrand AS, Harrop JS, Anderson DG, Sharan A, Whang PG, Poelstra KA, Arnold P, Dimar J. The adoption of a new classification system: time-dependent variation in interobserver reliability of the thoracolumbar injury severity score classification system. *Spine*, 2007; 1, 32(3): E105-10.
9. Xu GJ, Li ZJ, Ma JX, Zhang T, Fu X, Ma XL. Anterior versus posterior approach for treatment of thoracolumbar burst fractures: a meta-analysis. *European Spine Journal*, 2013; 22(10): 2176-83.

10. Aly TA. Short segment versus long segment pedicle screws fixation in management of thoracolumbar burst fractures: meta-analysis. *Asian spine journal*, 2017; 11(1): 150.
11. Cresswell TR, Marshall PD, Smith RB. Mechanical stability of the AO internal spinal fixation system compared with that of the Hartshill rectangle and sublaminar wiring in the management of unstable burst fractures of the thoracic and lumbar spine. *Spine*, 1998; 1, 23(1): 111-5.
12. Sjöström L, Karlström G, Pech P, Rauschnig W. Indirect spinal canal decompression in burst fractures treated with pedicle screw instrumentation. *Spine*, 1996; 1, 21(1): 113-23.
13. Marré B, Ballesteros V, Martínez C, Zamorano JJ, Ilabaca F, Munjin M, Yurac R, Urzúa A, Lecaros M, Fleiderman J. Thoracic spine fractures: injury profile and outcomes of a surgically treated cohort. *European Spine Journal*, 2011; 20(9): 1427-33.
14. Tezeren G, Bulut O, Tukenmez M, Ozturk H, Oztemur Z, Ozturk A. Long segment instrumentation of thoracolumbar burst fracture: fusion versus nonfusion. *Journal of back and musculoskeletal rehabilitation*, 2009; 1, 22(2): 107-12.
15. Tabak AY, Günay MC, Altay M, Türker HB. Effects of short-and long-segment posterior instrumentation on spinal canal remodeling in thoracolumbar vertebra burst fractures. *Turkish Journal of Trauma and Emergency Surgery*, 2011; 1, 17(2): 141-8.
16. Lee SH, Pandher DS, Yoon KS, Lee ST, Oh KJ. The effect of postoperative immobilization on short-segment fixation without bone grafting for unstable fractures of thoracolumbar spine. *Indian journal of orthopaedics*, 2009; 43(2): 197.
17. Dobran M, Iacoangeli M, Di Somma LG, Di Rienzo A, Colasanti R, Nocchi N, Alvaro L, Moriconi E, Nasi D, Scerrati M. Neurological outcome in a series of 58 patients operated for traumatic thoracolumbar spinal cord injuries. *Surgical neurology international*, 2014; 5(7): S329.
18. Chokshi JJ, Shah M. Outcomes of including fracture level in short-segment fixation for thoracolumbar fracture dislocation. *Asian spine journal*, 2019; 13(1): 56.
19. Assunção CA, Simões FC, Prado GO. Thoracolumbar burst fractures, short X long fixation: a meta-analysis. *Coluna/Columna*, 2016; 15: 78-84.