Scholars Journal of Applied Medical Sciences
Abbreviated Key Title: Sch J App Med Sci
ISSN 2347-954X (Print) | ISSN 2320-6691 (Online)
Journal homepage: https://saspublishers.com

OPEN ACCESS

Orthopedic Surgery

Posterior Short Segment Fixation with Index Level Screw for the Unstable Thoracolumbar Burst Fracture

Mohammad Masud Rana[1*], Nokul Kumar Datta[2], Mohammad Ishaq Bhuiyan[3], Md. Asadullah Ripon[4], Dr. Sayed Didarul Islam[5]

[1]Assistant professor, Department of Orthopedic Surgery, Enam Medical College Hospital, Savar, Dhaka Bangladesh
[2]Professor, Department of Orthopedic Surgery, BSMMU, Dhaka Bangladesh
[3]Professor, Department of Orthopedic Surgery, Enam Medical College Hospital, Savar, Dhaka Bangladesh
[4]Associate Professor, Department of Orthopedic Surgery, Enam Medical College Hospital, Savar, Dhaka Bangladesh
[5]Consultant, Department of Orthopedic Surgery, Enam Medical College Hospital, Savar, Dhaka Bangladesh

DOI: 10.36347/sjams.2021.v09i06.023 | **Received:** 27.02.2021 | **Accepted:** 16.03.2021 | **Published:** 20.06.2021

***Corresponding author:** Mohammad Masud Rana

Abstract **Original Research Article**

Background: Thoracolumbar fracture is nearly 90% of all the spine injuries which treated by spine surgeons. The choice of the stabilization type is still the subject of controversy. In long segment fixation, the problem is that more motion segment loss is concerned. The number of motion segments involved in fusion of spine fracture is minimized by posterior short segment fixation with index level screw. ***Objective:*** The purpose of the study is to assess the ability of short segment fixation with index level screw at fracture level to correct deformity, maintain correction and prevent failure. ***Method:*** 15 patients who were operated between March 2018 and January 2021 were taken for the retrospective analysis. All patients were surgically treated with short segment fixation using a posterior surgical approach with transpedicular instrumentation. Pedicle screws were placed at one level above and below the fracture site. Additionally, pedicle screws were also inserted at the index level of the fracture. All the patients were followed up at 3 months, 6 months and 12 months postoperatively. ***Results:*** The Mean pre-operative kyphosis was 14° (range 6° to 24°). Average post-operative kyphosis was 0° (range 6° to −18°). Average follow-up kyphosis of all cases was 10° (range 0.85° to 35.00°). Excluding failures, average follow-up kyphosis was 8° (range 0.85° to 25.00°). The height of the vertebral body was maintained upto 95% in 6 patients, 80% in 6 patients, and 70% in 3 patients. At initial one-month follow-up, average Oswestry disability score was severe at 52.63% (range 16% to 84%). At most recent follow-up, average Oswestry disability score was minimal at 5.5% (range 0% to 16%). One patient was lost to long-term follow- up. Mean difference from one-month follow-up to most recent follow-up (excluding failures) was 47.27% ($P <$ 0.0001). ***Conclusion:*** The short same-segment fixation reduces the implantation failure rate and reoperation rate in our study. Long-term correction of kyphosis, however, has not been maintained. Clinical pain and disability improved at long-term follow-up, despite this loss of kyphosis correction.

Keywords: Same-segment fixation, Index level screw, Motion segment.

INTRODUCTION

In spite of improved knowledge of the morphometric, anatomic and biomechanical features of thoracolumbar vertebrae, management of unstable thoracolumbar fractures remains controversial [1,2,4,6-9,12,19,22]. The aims of treating vertebral fractures are early recovery of neurological deficit, anatomically overcoming damaged spinal segments and achieving firm and stable fixation for early rehabilitation [25,35]. Failed cases, however, are not uncommon due to insufficient spinal stability restoration provided by the short segment fixation technique by implanting two screws above and two screws below the fracture level in some cases of fracture [23, 32, 34]. Thus, some authors tried long segment fixation to increase stability and decrease the load share in each pedicle-screw [28,29]. However, long segment fixation. Therefore, another technique called 'short same segment fixation' has emerged, specifically referring to the implantation of one or two additional pedicle screws at the fracture level, 10 together with two upper and two lower pedicle

screws, and 5 or 6 screws altogether. The aim is to enhance fixation strength and minimize the possibility of failure with motion segment preservation. This modified technique, both through cadaveric experiment and clinical practice, verified its advantage in biomechanical stability [10, 13, 14, 18].

OBJECTIVE

The purpose of this study was to assess ability of short segment fixation with pedicle screw at the fractured level to correct deformity, maintain correction and prevent failure in comparison to the traditional long segment fixation.

METHODOLOGY

Type of study	Retrospective study
Place of study	Enam Medical College and other renowned private hospital
Study period	March 2018 to January 2021
Study population	15 patients were included in the study

Inclusion criteria

- Patients with thoracolumbar fractures confirmed by plain radiographs

Exclusion criteria

- Patients who were lost to follow up postoperatively

Study procedure

15 patients were included in the study. Mechanism of injury and treatment course were recorded. Each patient was treated with short same-segment fixation for thoracolumbar burst fractures between levels T11 and L4. Plain radiographs were evaluated preoperatively and postoperatively (3 months, 6 months and 12 months) for vertebral body height and kyphotic angulation using the traditional Cobb method [11]. Patients were also graded preoperatively and postoperatively based on the Frankel Scale. Clinical outcome was measured using the Oswestry Disability Index [14, 15].

Surgical technique

Through a posterior midline incision, Posterior spinal approach was made one level above and below the fracture. Bilateral pedicle screws were used above and below the fracture. All patients were surgically treated with short same segment fixation using a posterior surgical approach with transpedicular instrumentation. Pedicle screws were placed at one level above and below the fracture site. Additionally, pedicle screws were also inserted at the level of the fracture.

RESULTS

In our study, two types of injury were observed in the patients. Among all, 20% (3 patients) had road traffic accident and 80% (12 patients) had injury by falling from a height. See figure 1 below-

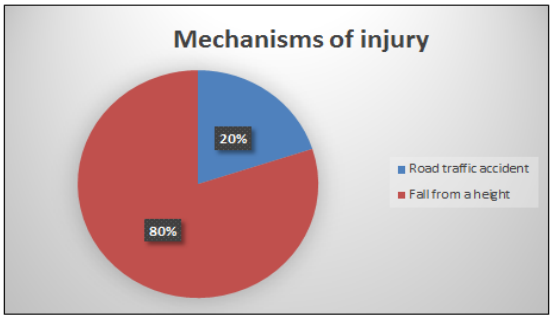

Fig-1: Mechanisms of injury in patients

In our study, preoperative Frankel Grades were measured. Preoperative Frankel Grade A was in 4 patients, Grade C was in 7 patients and Grade E was in 4 patients. See figure 2 below-

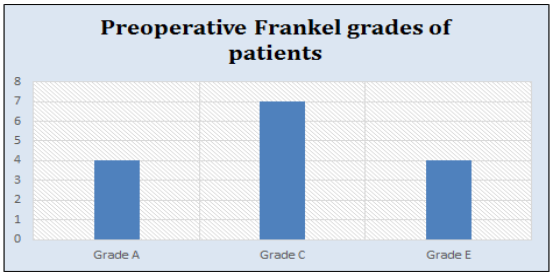

Fig-2: Preoperative Frankel Grade of patients.

Table 1 shows that the mean pre-operative kyphosis was 14° (range 6° to 24°), average post-operative kyphosis was 0° (range 6° to −18°), average follow-up kyphosis of all cases was 10° (range 0.85° to 35°) and excluding failures, average follow-up kyphosis was 8° (range 0.85° to 25.00°). A mean of 15° of kyphosis correction was attained from preoperation to post-operation ($P < 0.0001$). Average loss of kyphosis correction from immediate post-operation to most recent follow-up was 11°. See table 1-

Table-1: Kyphosis phase and kyphosis degree of the patients

Kyphosis phase	Kyphosis rate
Mean pre-operative kyphosis	14° (range 6° to 24°)
Average post-operative kyphosis	0° (range 6° to 18°)
Average follow-up kyphosis of all cases	10° (range 0.85° to 35°)
Excluding failures, average follow-up kyphosis	8° (range 0.85° to 25°).

Table 2 shows that the height of the vertebral body was maintained upto 95% in 6 patients, 80% in 6 patients, and 70% in 3 patients. See table 2-

Table 2: The height of the vertebral body of patients

Height maintenance	Number of patients
95% height of the vertebral body	6
80% height of the vertebral body	6
70% height of the vertebral body	3

Figure 3 shows that, at initial one-month follow-up, average Oswestry disability score was severe at 52% (range 16% to 84%). At most recent follow-up, average Oswestry disability score was minimal at 5.5% (range 0% to 16%). Mean difference from one-month follow-up to most recent follow-up was 46.5% ($P < 0.0001$). See figure 3 below-

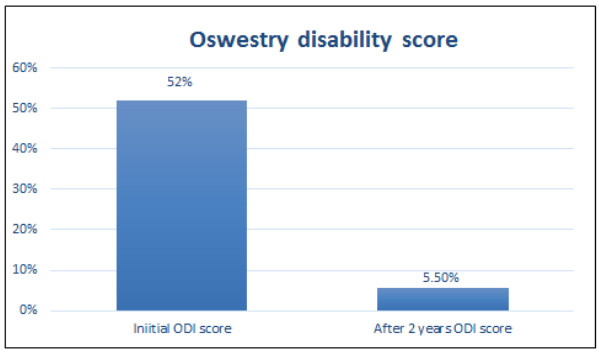

Fig-3: Oswestry disability score of the patients

Follow-up

All the patients were followed up clinically and radio logically. Average follow-up time was 24 months; range 3 to 42 months. Plain radiographs were evaluated preoperatively and postoperatively (3 months, 6 months and 12 months) for vertebral body height and kyphotic angulation.

DISCUSSION

For the treatment of thoracolumbar burst fractures, various surgical methods were used; long-segment posterior pedicle screw fixation was widely used among them. In unstable thoracolumbar junction fractures, Baaj et al. [2] conducted a biomechanical stability analysis of posterior fixation and stated that long-segment constructs were superior to short-segment constructs with fractured-level included and that short-segment constructs with fractured-level included were superior to those without fractured-level constructs. Though long-segment pedicle screw fixation offers stronger biomechanical power, short-segment (one level above and one level below the broken vertebral body) has also been commonly used, including fractured-level pedicle screw fixation. Short-segment constructs give the benefit of saving [21, 25, 26, 29, 31] motion segments, requiring a smaller incision and causing less damage to the spinal muscle during the process. Tezeren et al., [29] stated that while long-segment fixation had a better result from local kyphosis, sagittal index and anterior vertebral height compression measurements, short-segment fixation allows spinal stabilization while maintaining as many motion segments as possible at the same time, and there was no substantial difference between short-segment and long-segment clinical outcomes. In their analysis of predictive factors for kyphosis recurrence following short segment pedicle screw fixation, Kim et al., [16] stated that short-segment pedicle screw fixation including the broken vertebra is an effective surgical procedure for restoring and preserving vertebral column stability in thoracolumbar burst fractures. At the last follow-up, they registered a correction loss of 3.7±2.8 ° Cobb angle. Kana et al., [15] stated that with the use of short-segment pedicle screw fixation, including the broken vertebrae, reduction of unstable thoracolumbar injuries can be achieved and sustained, eliminating the need for anterior reconstruction. Despite the merits of short-segment fixation, many surgeons have indicated that the most significant drawbacks of this surgical procedure are early implant failure and loss of correction [13, 23, 27]. In the present study, with short segment fixation, a mean of 15° of kyphosis correction was attained from preoperation to post-operation ($P < 0.0001$). Average loss of kyphosis correction from immediate post-operation to most recent follow-up was 11°. Many surgeons conclude that poor clinical outcomes are precipitated by kyphotic deformity of the thoracolumbar spine, but the connection between these two factors is unclear. Some authors advocate that there is no established link between kyphosis and back pain or functional impairment [5, 24, 33]. The current study showed that failure of kyphosis correction was consistent with previous studies. In the management of selected young patients with unstable burst fracture, Kim et al., [17] indicated that short-segment pedicle screw fixation without bone fusion following postural reduction may be an efficient and secure surgical technique. A 10-year follow-up research by Toyone et al. [30] indicated that for burst fractures involving neurological deficit, the advantage of short-segment fixation without fusion is that it can maintain thoracolumbar motion without resulting in post-traumatic degeneration of the disc.

CONCLUSION

Posterior short segment fixation with index level screw including the fractured vertebral body is as effective as long-segment pedicle screw fixation for the treatment of unstable thoracolumbar burst fracture. The stabilization of the short segment has faster pain relief and less tissue destruction than the long segment with the same biomechanical stability. The short segment fixation in our study reduces the implantation failure rate and the rate of reoperation. Clinical pain and disability improved in long-term follow-up despite the loss of kyphosis correction. To explore the contrasting findings of recent studies, more clinical studies on the efficacy of short segment fixation are needed.

REFERENCES

1. Abraham DJ, Herkowitz HN, Katz JN: Indications for thoracic and lumbar spine fusion and trends in use. Orthop Clin North Am.1998; 29:803-11.
2. Baaj AA, Reyes PM, Yaqoobi AS, Uribe JS, Vale FL, Theodore N, Sonntag VK. Biomechanical advantage of the index-level pedicle screw in unstable thoracolumbar junction fractures. J Neurosurg Spine.2011; 14:192-197.
3. Benzel EC, Baldwin NG: Crossed-screw fixation of the unstable thoracic and lumbar spine. J Neurosurg.1995; 82:11-6.
4. Bohlman HH: Treatment of fractures and dislocations of the thoracic and lumbar spine. J Bone Joint Surg Am.1985; 67:165-9.
5. Cantor JB, Lebwohl NH, Garvey T, Eismont FJ. Non operative management of stable thoracolumbar burst fractures with early ambulation and bracing. Spine.1993; 18: 971-976.
6. Capen DA, Gordon ML, Zigler JE, Garland DE, Nelson RW, Nagelberg S: Non operative management of upper thoracic spine fractures. Orthop Rev.1994; 10:818-21.
7. Cinotti G, Gumina S, Ripani M, Postacchini F: Pedicle instrumentation in the thoracic spine: a morphometric and cadaveric study for placement of screws. Spine. 1999; 24:114-9.
8. DiMar JR 2d, Wildle PH, Glassman SD, Puno RM, Johson JR: Thoracolumbar burst fractures treated without combined anterior and posterior surgery. Am J Orthop.1996; 25:159-65.
9. Ebrahiem NA, Jabaly G, Xu R, Yeasting RA: Anatomic relations of the thoracic pedicle to the adjacent neural structures. Spine. 1997; 22:1553-6.
10. Eno JJ, Chen JL, Mitsunaga MM: Short same-segment fixation of thoracolumbar burst fractures. Hawaii J Med Public Health. 2012; 71:19-22.
11. Esses SI, Botsford DJ, Wright T, Bednar D, Bailey S: Operative treatment of spinal fractures with the AO internal fixator. Spine. 1991; 16:S146-150.
12. Grigoriou E, Dormans JP: "Pediatric Spine Trauma."The Growing Spine. Springer Berlin Heidelberg. 2016; 359-381.
13. Gurwitz GS, Dawson JM, McNamara MJ, Federspiel CF, Spengler DM: Biomechanical analysis of three surgical approaches for lumbar burst fractures using short-segment instrumentation. Spine.1993; 18:977-982.
14. Guven O, Kocaoglu B, Bezer M, Aydin N, Nalbantoglu U: The use of screw at the fracture level in the treatment of thoracolumbar burst fractures. Journal of Spinal Disorders and Techniques.2009; 22:417-421.
15. Kanna RM, Shetty AP, Rajasekaran S: Posterior fixation including the fractured vertebra for severe unstable thoracolumbar fractures. Spine.2015; J 15(2):256-64.
16. Kim GW, Jang JW, Hur H, Lee JK, Kim JH, Kim SH: Predictive factors for a kyphosis recurrence following short-segment pedicle screw fixation including fractured vertebral body in unstable thoracolumbar burst fractures. J Korean Neurosurg Soc.2014; 56: 230-236.
17. Kim HY, Kim HS, Kim SW, Ju CI, Lee SM, Park HJ. Short segment screw fixation without fusion for unstable thoracolumbar and lumbar burst Fracture: a prospective study on selective consecutive patients. J Korean Neurosurg Soc.2012; 51:203-207.
18. Kramer DL, Rodgers WB, Mansfield FL. Transpedicular instrumentation and short-segment fusion of thoracolumbar fractures: A prospective study using a single instrumentation system. J Orthopaedic Trauma.1995; 9:499-506.
19. Koca K, Verim S. The Radiographic Evaluation of the Musculoskeletal System and Spine. In: Korkusuz F. (eds) Musculoskeletal Research and Basic Science. Springer, Cham; 2016.
20. Lee YS, Sung JK: Long-term follow-up results of short-segment fixation for unstable thoracolumbar junction fracture. J Korean Neurosurg Soc.2005; 37:416-21.
21. Mahar A, Kim C, Wedemeyer M, Mitsunaga L, Odell T, Johnson B. Short-segment fixation of lumbar burst fractures using pedicle fixation at the level of the fracture. Spine. 2007; 32: 1503-1507.
22. McCullen G, Vaccaro AR Garvin SR. Thoracic and lumbar trauma. Orthop Clin North Am.1998; 29:813-28.
23. McLain RF, Sparling E, Benson DR: Early failure of short segment pedicle instrumentation for thoracolumbar fractures. A preliminary report. Journal of Bone and Joint Surgery American.1993; 75:162-167.
24. Mumford J, Weinstein JN, Spratt KF, Goel VK: Thoracolumbar burst fractures. The clinical efficacy and outcome of non-operative management. Spine.1993; 18: 955-970.
25. Parker JW, Lane JR, Karaikovic EE, Gaines RW. Successful short-segment instrumentation and fusion for thoracolumbar spine fractures: A consecutive 41/2-year series. Spine. 2000; 25: 1157-1170.
26. Sanderson PL, Fraser RD, Hall DJ, Cain CM, Osti OL, Potter GR. Short segment fixation of thoracolumbar burst fractures without fusion. Eur Spine J.1999; 8: 495-500.
27. Sasso RC, Cotler HB. Posterior instrumentation and fusion for unstable fractures and fracture-dislocations of the thoracic and lumbar spine. A comparative study of three fixation devices in 70 patients. Spine.1993; 18:45-460.
28. Tezeren G, Bulut O, Tukenmez M, Ozturk H, Oztemur Z, Ozturk A: Long segment instrumentation of thoracolumbar burst fracture: fusion versus non fusion. J Back & Musculoskeletal Rehabilitation.2009; 22:107-112.
29. Tezeren G, Kuru I. Posterior fixation of thoracolumbar burst fracture: Shortsegment pedicle fixation versus long segment instrumentation. J

Spinal Disorders & Techniques.2005; 18:485-488, 2005.

30. Toyone T, Ozawa T, Inada K Shirahata T, Shiboi R, Watanabe A. Short-segment fixation without fusion for thoracolumbar burst fractures with neurological deficit can preserve thoracolumbar motion without resulting in post-traumatic disc degeneration: a 10-year follow-up study. Spine.2013; 38:1482-1490.
31. Wang ST, Ma HL, Liu CL. Is fusion necessary for surgically treated burst fractures of the thoracolumbar and lumbar spine? A prospective, randomized study. Spine.2006; 31:2646-2652; discussion 2653.
32. Wang XY, Dai LY, Xu HZ, Chi YL. Kyphosis recurrence after posterior short-segment fixation in thoracolumbar burst fractures. Journal of neurosurgery Spine. 2008; 8:246-254.
33. Weinstein JN, Collalto P, Lehmann TR. Thoracolumbar "burst" fractures treated conservatively: a long-term follow-up. Spine.1988; 13:33-38.
34. Xu BS, Tang TS, Yang HL. Long-term results of thoracolumbar and lumbar burst fractures after short-segment pedicle instrumentation, with special reference to implant failure and correction loss. Orthopaedic Surgery.2009; 1:85-93.
35. Yue JJ, Sossan A, Selgrath C, Deutsch LS, Wilkens K, Testaiuti M. The treatment of unstable thoracic spine fractures with trans pedicular screw instrumentation: A 3-year consecutive series. Spine.2002; 27:2782- 2787.