Original Article

Long-segment fixation versus short-segment fixation with instrumentation of index vertebra for thoracolumbar fractures

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ABSTRACT

Background: We assessed and analyzed the clinical, perioperative, functional, and radiological outcomes of long- versus short-segment (SS) fixation of thoracolumbar spine fractures that included the index vertebra.

Methods: We retrospectively evaluated 119 patients with thoracolumbar spine fractures (i.e., using AO classification system). The patient was followed up for a minimum of 1 year at which time the angles of correction were measured on lateral X-rays (i.e., using Cobb’s method). Neurological grading employed the Frankel’s grading system. Operative time, perioperative blood loss, and time to mobilization were also analyzed.

Results: After 1 year, the loss of kyphosis was not significantly different between the two groups. Although there were no statistical differences in terms, regarding neurological outcomes, time to mobilization, or duration of hospitalization, the operative times and perioperative blood loss were significantly reduced in patients undergoing SS fixation.

Conclusion: We determined the efficacy of SS fixation for thoracolumbar fractures including the index vertebra.

Keywords: Fixation, Pedicle screws, Spine trauma, Thoracolumbar fracture, Treatment

INTRODUCTION

The goals for treating thoracolumbar fractures include; the restoration of vertebral column stability, obtaining adequate decompression of the spinal canal, and early mobilization of the patient. The classical “long-segment” constructs include instrumenting two or three levels above and below the injured level,[7,8] while short-segment (SS) fusions (i.e., one level above/1 below) preserve more motion segments and may potentially reduce morbidity.[3] Here, we retrospectively compared the outcomes of long versus SS fixation in 119 thoracolumbar fractures.

MATERIALS AND METHODS

We evaluated 119 adults who sustained single level posttraumatic thoracolumbar fracture/fatigue dislocation. The CT scans had to document that at least one side of the fractured
vertebra/pedicle was intact. Where feasible, patients also underwent MRI scans to evaluate spinal cord compression, the status of the anterior/posterior longitudinal ligaments, and the intervertebral disk.

**Clinical data**

Multiple baseline parameters were also recorded [Table 1]. Mechanisms of spinal injury included; motor vehicle accidents (68 patients), falls from a height (49 patients), and falls from bicycles (two patients). Preoperative Frankel grades included 24 Grade A through 23 Grade E patients. Of the 24 Grade A patients, 10 underwent SS fixation versus 14 who had long-segment fusions. Neurological grading used the Frankel system and patients were evaluated at 6 weeks, 3 months, 6 months, and 1 year interval following surgery. L1 was most commonly fractured followed by T12 in both groups.

**Fracture patterns using AO spine injury classification systems**

We used the AO spine injury classification systems for evaluating fractures. Patients underwent either SS fixation or long-segment fixation at the discretion of the surgeon (i.e., not randomized). A plain radiographs were evaluated preoperatively and postoperatively for kyphotic angulation using the Cobb method.[2]

**Short- and long-segment fixation**

SS fixations included pedicle screws placed one level above and one level below the fracture site, pedicle screws inserted into the index vertebra, followed by rod application (i.e., contoured rods using ligamentotaxis to correct kyphosis and perform lordotic distraction) [Figures 1 and 2]. Long-segment fusions included pedicle screws placed in vertebrae 2 above and 2 below the index fracture level, with added screws placed in the fractured vertebral body [Figures 3 and 4].

**RESULTS**

Improvement was based on achieving a postoperative Frankel Grade C or above, and comparable neurological recoveries were noted in both groups. Although there were no statistical difference between the two groups in terms of duration from injury to surgery, time to mobilization, and duration of hospitalization, operative time and perioperative blood loss were significantly reduced for SS fusions (P < 0.0001) [Table 2]. The mean preoperative kyphosis for both short- and long-segment fixation, mean postoperative kyphosis, and 1-year follow-up kyphosis were comparable for both groups. No statistical differences were found between two groups.

**Postoperative complications**

Complications were encountered in 20 patients. Eight dural tears were managed with Prolene 5-0 sutures reinforced with

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**Table 1: Baseline parameters.**

| Parameter                          | Short segment | Long segment |
|-----------------------------------|---------------|--------------|
| Number of patients                | 54            | 65           |
| Age (years)                       | 31.72±11.17   | 32.01±11.15  |
| Gender                            |               |              |
| Male                              | 43            | 56           |
| Female                            | 11            | 9            |
| Level of fracture                 |               |              |
| T11                               | 5             | 9            |
| T12                               | 16            | 22           |
| L1                                | 26            | 26           |
| L2                                | 7             | 8            |
| Neurological deficit complete/incomplete |          |              |
| A                                 | 10            | 14           |
| B                                 | 12            | 10           |
| C                                 | 19            | 17           |
| D                                 | 5             | 9            |
| E                                 | 8             | 15           |

**Table 2: Comparison of surgical parameters and radiological outcome.**

| Parameter                              | Short         | Long          | P value |
|----------------------------------------|---------------|---------------|---------|
| Duration from injury to surgery (days) | 3.8±1.3 (2–7) | 3.8±1.5 (2–7) | >0.05   |
| Operative time (minutes)               | 156±27 (98–216) | 193±32 (119–282) | 0.0001  |
| Perioperative blood loss (mL)          | 436±106 (220–700) | 513±127 (240–780) | 0.0001  |
| Time to mobilization (days)            | 3.54±0.2 (3–4) | 3.56±0.3 (3–4) | >0.05   |
| Duration of hospitalization (days)     | 14.4±3.6 (11–15) | 14.6±4.5 (11–16) | >0.05   |
| Preoperative kyphosis, Degrees         | 18.74±10.5   | 18.74±10.5   | 0.47    |
| Postoperative kyphosis, degrees        | 3.08±10.77   | 3.66±10.59   | 0.3859  |
| Follow-up kyphosis, degrees            | 2.94±10.63   | 3.45±10.17   | 0.3974  |
| Neurological recovery                  | 20/54        | 17/65        | 0.201   |
fat; all dural leak repairs proved successful.\(^4\) Nine patients had suture site complications which were managed conservatively. Three patients developed deep vein thrombosis treated with compression stockings and pharmacological agents. There were postoperative infections – superficial or deep.

**DISCUSSION**

Although many studies have documented the efficacy of long-segment fixation for the treatment of thoracolumbar fractures, SS fusions have increasingly proved as effective

| Author Reference | Patients | Average age Level of fractures | MR findings CT findings | Surgical procedures | Outcomes/ conclusion |
|------------------|----------|--------------------------------|-------------------------|--------------------|---------------------|
| Sanderson et al. | 24       | 33.1 years (±14.2, range 18–62) | Kyphotic deformity >20° | Short-segment fixation without fusion | Cobb angle Injury – 20.75±9.4 Follow-up – 13.9±7.6 Anterior body height loss (%) Injury – 38±14.2 Follow-up – 21.4±8.7 20 patients had satisfactory results for low back outcome scale Routine fusion with SS fixation of TL fracture is not necessary |
| Wang et al. | 58       | 39.8±11.6 years T12: 9, L1: 21, L2: 24, L3: 3, L4: 1 | Kyphotic deformity >20° | Short-segment transpedicular fixation with “lordorizing screw” in fractured vertebra to correct kyphotic deformity with or without posterolateral fusion | Correction of kyphosis on follow-up – 10.7±7.4° Correction of vertebral body height on follow-up (%) – 33.0±11.0 No significant difference between Greenough low back outcome scale Short-segment fixation of TL burst fractures without fusion was satisfactory |
| Chokshi and Shah | 50       | 33.4 years (range, 18–68) years T11-L2: 41, nine cases in remaining TL region | Fracture dislocation of TL spine McCormack load-sharing score ≤6 | Short-segment fixation with fusion using autologous bone graft and decompression | Kyphosis angle Preoperative – 26.80°±14.50° Follow-up – 5.50°±110° VAS score Preoperative – 8.6 Follow-up – 2.4 Including the fracture level in short-segment fixation for TL fracture dislocation (with a McCormack load-sharing score ≤6) achieves good kyphosis correction and correction maintenance |
| Li-Yang et al. | 73       | 34.6 years (range, 24–57) years T11: 5, T12: 11, L1: 41, L2: 16 | Single level Denis Type B burst fracture McCormack load-sharing score ≤6 | Short-segment pedicle screw fixation with or without posterolateral fusion | Local kyphosis angle (degree) No significant difference between fusion and nonfusion group at any interval No significant difference in neurological recovery, VAS score, and SF-36 physical and mental component scores between groups |
Agrawal, et al.: Long versus short fixation of thoracolumbar fractures

Surgical Neurology International • 2022 • 13(233) | 4

[Table 3]. Sanderson et al.[6] determined that routine fusion in SS fixation of thoracolumbar burst fractures (i.e., posterior or posterolateral fusion) was unnecessary. Wang et al.[9] similarly found that short-term results of SS fixations without fusion were satisfactory. Chokshi and Shah[1] successfully treated 50 patients with thoracolumbar fractures with SS constructs and index screws. Li-Yang et al.[5] also demonstrated satisfactory outcome of 73 patients treated by SS fixation without fusion. Here, we have also documented the relative efficacy of short- versus long-segment fusion for treating thoracolumbar fractures.

**CONCLUSION**

We concluded that SS fixation was as effective as long-segment fusion for treating thoracolumbar fractures.

**Declaration of patient consent**

Patient's consent not required as patient's identity is not disclosed or compromised.

**Financial support and sponsorship**

Publication of this article was made possible by the James I. and Carolyn R. Ausman Educational Foundation.

**Conflicts of interest**

There are no conflicts of interest.

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