

**ORIGINAL RESEARCH**

# A prospective study to assess the outcome of short segment added injury level pedicle screw fixation and conventional short segment pedicle screw fixation in thoracolumbar spine fractures

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## ABSTRACT

**Aim:** To compare the results of traditional short segment pedicle screw fixation with those of short segment additional injury level fixation in cases of thoraco-lumbar spine fractures.

**Methods:** One hundred patients with thoracolumbar fractures (most often wedge compression and burst fractures) who did not have any neurological abnormalities during a three-year period were included in the prospective research. Short segment injury level pedicle screw fixation (SSIPSF) and CPSF were used to handle 50 patients each, with each group being picked at random.

**Results:** There was minimal age and gender difference. Damage mechanism and skeletal level did not differ statistically. Each group included 15-60-year-olds. The second most common level involved in the SSIFL group was the L2 skeletal level, with 26 instances (52%). L1 was also linked in 29 CPSF instances (58% of the total). Initial postoperative kyphotic angle and beck index were statistically significant, however final radiography data for both groups was not ( $p > 0.05$ ).

**Conclusion:** Patients with wedge compression and spine burst fractures benefit from SSIPSF. Open SSIPSF with fracture level inclusion provided greater kyphosis correction, no instrument failures, and a more rigid design than CPSF.

**Key words:**Thoracolumbar fractures, Pedicle screw, Conventional pedicle screw fixation (CPSF), Short segment injury level pedicle screw fixation (SSIPSF)

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## INTRODUCTION

Thoracolumbar fractures are the most common spinal injuries.<sup>1</sup> Advancements in understanding the anatomical, morphometric, and biomechanical characteristics of thoracolumbar (TL) vertebrae have led to advancements in the treatment of unstable TL fractures, which have historically been a subject of debate and uncertainty.<sup>2</sup> Despite ongoing debate regarding its efficacy in certain types of fractures, posterior fixation is the prevailing surgical method employed to restore vertebral body height, rectify kyphotic deformity, reinstate spinal stability, and indirectly alleviate pressure on the spinal canal.<sup>3</sup>

There is ongoing debate over the optimal therapy for unstable TL burst fractures. Conservative therapy is often preferred when there is little kyphotic deformity, absence of neurological damage, or absence of an unstable fracture pattern. The treatment objectives of correcting kyphosis and decompressing the canal in the presence of a neurological deficit are well-established, and various surgical strategies have been suggested.<sup>4</sup> The objective of surgical intervention for spine fractures is to establish osseous fusion and restore the anatomical integrity of the spinal column. As required, it may be linked to decompression, reduction, and graft and/or internal fixation, using a

posterior, anterior, or combination method.<sup>5</sup> The traditional surgical method for posterior fixation involves using a short-segment construct with four screws, where pedicle screws are placed one level above and one level below the damaged vertebra.

Within the context of CPSF, a construct consisting of four screws connected by rods demonstrated a relatively elevated incidence of instrumentation failure (ranging from 9% to 54%) and a gradual decrease in the kyphotic angle. This is due to the fact that, during axial loading, the screws and rods of the CPSF are subjected to substantial cantilever bending loads, making them susceptible to potential failure of the implant.<sup>6</sup>

A typical objective of internal fixation is to reduce the number of vertebral levels involved in the fusion of a spine fracture. This is achievable by utilizing traditional short-segment posterior fixation; however, a 54% incidence of instrument failure or unfavourable clinical outcome was encountered with traditional short-segment posterior fixation.<sup>7</sup>

Short-segment posterior fixation with pedicle fixation at the level of the fracture (short same-segment fixation) suggests biomechanical advantages toward maintenance of kyphosis correction and reducing failure rates.<sup>8</sup> The trans-pedicular short same-segment construct represents an attempt to rebuild the anterior column without the need for anterior strut graft or plate fixation, hence, avoiding extensive arthrodesis of the motion segments and limited surgery-related injury.<sup>9</sup> Hence the current prospective study aimed to evaluate the short-term surgical and functional outcome of posterior short-segment fixation with implanting pedicle screw in the fractured level (short same-segment fixation) for treatment of recent single-level traumatic thoracolumbar fracture.

## **MATERIAL & METHODS**

In a prospective study one hundred patients with thoracolumbar fractures, mostly wedge compression and burst fractures, who did not have any neurological abnormalities were chosen for the study. The length of the study was between three years. There were fifty patients that were chosen at random from each group, and they were either treated with continuous pedicle screw fixation (CPSF) or short segment injury level pedicle screw fixation (SSIPSF).

### **INCLUSION CRITERIA**

All closed Thoracolumbar vertebral (D11-L4) fracture with intact both of Pedicle of fractured vertebrae, age > 18 years, Duration of injures 1 to 7 days, AO spine TLICS classification Type A1, A2, A3, A4, B1, as ASIA grade D and E only, General condition of patient normal, No/minor Associated injuries.

### **EXCLUSION CRITERIA**

Multilevel spinal injuries, Poor anesthetic or general risk patient, Thoracolumbar vertebral fracture with

fracture pedicles, AO spine TLICS classification Type B2, B3, C, Neurological injury ASIA grade A, B, C.

## **METHODOLOGY**

SSFIFL (group I) constructions encompassing two vertebrae to the injury, one upper and one lower, were used to treat 50 patients (38 males and 12 females). There were another 50 individuals in group II who were treated with Conventional pedicle screw fixation (CPSF) constructs (42 males and 5 females). Four vertebrae were treated with instrumentation, two on either side of the fracture, with no screws placed in the fractures.

To repair the kyphotic deformity and drive the injured vertebra ventrally, along with a short-segment transpedicular fixation (SSFIFL) at one level above and one level below the injured segment, an additional lordotic screw was inserted at the fracture level on each side after standard posterior midline approach. The procedure was conducted under fluoroscopic supervision, and, if required, the pedicle screw design was adjusted to treat the spinal deformity. Sides with damaged index vertebra pedicles were excluded for screw placement. Two lordotic rods connected all screws. Before securing the set screws and utilising cross-link, a distraction force was applied based on the wounded endplate. The screws were 40 or 45 mm length depending on the vertebra's position and diameter. 5.5-mm screws were utilised cephalad to the T11. Youth needed smaller screws in diameter and length. Decompression was done by laminectomies in all instances to remove the disc remains or the retropulsion pieces which remained in the spinal canal or to drive them back into the vertebral body. No bone transplants were used for fusion. Mean blood loss, operation time, and implant cost were reported.

Postoperatively, all patients were immobilized in a thoraco-lumbosacral orthosis for six weeks. At one, three, six-, and 12-months following surgery, as well as annually thereafter, all patients were examined.

A third party observed radiological parameters and functional results at each visit. Radiographic measures, ASIA grading, ODI, and VAS were taken pre-, post-, and at every follow-up. The Beck index, kyphotic angle, and deformation were utilized to evaluate radiography results. Kyphotic angle was calculated using the complete upper and lower vertebral endplates. Kyphotic deformation was calculated using the broken vertebrae's inferior-superior endplate angle. The Beck index is the anterior-posterior vertebral height difference.<sup>10</sup> Pain was measured using a 100-point VAS. Functional outcomes were assessed using the ODI. ASIA grading assessed neurological recovery.

### **STATISTICAL ANALYSIS**

SPSS 25.0 (IBM Corp., Armonk, NY, USA) was used for statistical analysis. A Kolmogorov-Smirnov test found the normal variable distribution. The independent-sample t-test compared mean data.

Radiographic parameter time measurements were compared using an ANOVA methodology for each group. Analysis of heterogeneous variables uses non-parametric approaches. Non-parametric variables

were analysed using Mann-Whitney U. The chi-square test compared groups' category variables. The significance threshold was 0.05.

## RESULTS

**Table 1: Patient demographic data**

	SSFIFL	CPSF	P-value
Number of patients	50	50	
Age in years	34.36 ± 12.88	32.18 ± 11.33	0.525
Sex (Male/Female)	38/12	42/8	0.316
Mode of injury (Fall)	43 (86%)	40 (80%)	0.183
Skeletal level of injury (L1)26 (52%)	26 (52%)	29 (58%)	0.052

Age and gender were similar across groups. Mode of injury and skeletal degree of damage did not vary statistically. Members in both groups were 15-60. L1

was the most usually affected skeletal level in SSFIFL, followed by L2 with 26 (52%). With 29 cases (58%), L1 was the most prevalent CPSF level.

**Table 2: Radiological parameters and their significance**

Index	SSFIFL	LSPF	P-value
Preoperative kyphotic angle	22.75 ± 4.53	21.63 ± 8.31	0.312
Postoperative kyphotic angle	3.98 ± 1.44	5.58 ± 2.07	0.000
Final kyphotic angle	9.13 ± 3.04	10.18 ± 3.35	0.132
Preoperative kyphotic deformation	22.75 ± 4.69	21.48 ± 5.89	0.314
Postoperative kyphotic deformation	9.00 ± 2.90	8.48 ± 2.35	0.565
Final kyphotic deformation	10.53 ± 3.11	9.88 ± 2.22	0.380
Preoperative Beck index	0.56 ± 0.12	0.59 ± 0.146	0.384
Postoperative Beck index	0.80 ± 0.08	0.85 ± 0.087	0.001
Final Beck index	0.769 ± 0.08	0.77 ± 0.095	0.743

Final radiographic data for both groups showed no statistical significance ( $p > 0.05$ ), although the initial postoperative kyphotic angle and beck index was statistically significant.

## DISCUSSION

The discussion on the management of thoracolumbar fractures has been continuing for a long time.<sup>11-13</sup> Despite this, the majority of writers consider that surgery should be undertaken for unstable burst fractures. However, the methodologies remain disputed.<sup>13-15</sup>

Surgical therapy is often suggested for individuals with neurologic impairments or in those with significant instability. Currently, posterior short segment pedicle screw internal fixation is one of the most used operational techniques to treat unstable thoracolumbar/lumbar burst fracture.<sup>16</sup> Although the clinical outcomes of this operation are typically good, increasing kyphosis and a high likelihood of device failure remain a worry. Lack of the anterior column supporting is the major cause of hardware failure.<sup>17,18</sup> Burst fractures of thoracolumbar/lumbar spine may produce neurologic problems and kyphotic deformity,<sup>19-21</sup> which may have a considerable influence on the patients' life quality. Disputes about the best treatment for spine fracture among doctors as there are, it has come to a consensus among most scholars that operation is needed to treat unstable

thoracolumbar/lumbar burst fractures and fractures with existing or potential nerve handicap. Biomechanical and clinical studies have shown that when there is loss of more than 50% of the vertebral body height or more than 25° angulation deformity of the injured segment, acute spinal instability results, and the spinal segment will eventually fail with weight-bearing.<sup>22</sup>

No optimum surgical method exists at present. By anterior approach we can decompress nerves adequately and give solid anterior column support. However, this strategy demands lengthier operation time and the incidence of approach associated complication and the fatality rate is much greater than posterior approach. Although the combination of anterior and posterior technique may produce the most stable biomechanical repair, the operation duration, complication and morbidity rate can be substantially greater than that of the single method. Traditionally the freestanding posterior approach is comparatively an uncomplicated treatment but can only indirectly diminish a damaged vertebral body, and the methods of augmenting the anterior column are restricted.<sup>23,24</sup>

Regarding age and gender, there was no significant variance between the two groups. In addition, no significant statistical difference was identified across mechanism of injury, and skeletal degree of damage. The age range in both groups was 15-60 years. L1 was by far the most usually implicated bone level,

followed by L2 with 26 (52%) occurrences in the SSFIFL group, respectively. L1 was likewise the most prevalent level implicated in the CPSF group with 29 instances (58%). The final radiography data for both groups did not exhibit any statistically significant differences ( $p > 0.05$ ). However, the first postoperative kyphotic angle and Beck index exhibited statistically significant variations. Several studies have proposed using a combination of SSPF (single-stage posterior fixation) and phased anterior column reconstruction to fully restore the weight-bearing column and correct kyphosis.<sup>24</sup> Nevertheless, it required two surgical procedures, resulting in increased costs and heightened perioperative morbidity and suffering. Therefore, they are not frequently embraced by patients who have normal neurological function.<sup>25</sup> The study also determined that the combined approach is necessary when the posterior approach alone is insufficient to withstand a biological axial force. Therefore, it is essential to effectively restore the anterior weight-bearing block in order to prevent a secondary decrease in correction and implant failure. Short-segment fixation has the benefit of preserving motion segments in comparison to longer instrumentations. Conversely, researchers in recent investigations have identified quicker implant failure and corrective loss as the primary drawbacks of this approach.<sup>26,27</sup> There is ongoing debate on the appropriateness of using short-segment pedicle screw instrumentation for treating unstable thoracolumbar/lumbar burst fractures.

## CONCLUSION

The SSIPSF technique is an effective method for treating wedge compression and burst fractures of the spine in patients. The incorporation of the fracture level into the build in Open SSIPSF provides superior kyphosis correction, as well as a more robust and stiff construct compared to CPSF, without any instrument failures or extra problems.

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