ORIGINAL STUDY

Short-Segment Posterior Fixation With Index Level Screws Versus Long-Segment Posterior Fixation in Thoracolumbar Burst Fracture

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Abstract

Background data: Posterior instrumentation of thoracolumbar burst fracture is an excellent fixation method. Numerous methods depend on the number of fixed vertebrae. Both short-segment fixation, including the fractured vertebra (SSFIS), and long-segment fixation (LSF) have been widely used with no consensus on the better method.

Purpose: This study aims to compare the LSF and SSFIS in thoracolumbar spine fracture in terms of radiological and clinical outcomes.

Study design: This is a prospective comparative study.

Patients and methods: A total of 20 patients with thoracolumbar burst fractures were treated with posterior pedicle screw fixation and divided into two groups, with 10 patients each, based on the number of instrumented levels: LSF group and SSFIS group. The patients were evaluated for local kyphotic angle (LKA) correction, anterior vertebral body height loss (AVHL), visual analog scale for back pain, and Oswestry disability index (ODI) for functional outcome.

Results: No statistically significant differences were observed between the two groups regarding patient age, sex, reduction of visual analog scale for back pain, change in functional outcome assessed by ODI postoperatively, correction of LKA, and restoration of AVHL. However, there was a statistically significant difference favoring the SSFIS group regarding operative time, intraoperative amount of blood loss, incision length, and ODI at the 6-month follow-up.

Conclusion: This data suggest that SSFIS seems comparable to LSF in managing thoracolumbar fractures resulting in adequate correction of LKA, restoration of AVHL, and preserving more motion segments.

Keywords: Intermediate screw, Long-segment fixation, Pedicle screw fixation, Short-segment fixation, Thoracolumbar fracture

Introduction

The thoracolumbar spine region is more vulnerable to fractures as it is a biomechanical transition zone between the rigid thoracic spine and the more mobile lumbar spine [1,2]. Burst fractures constitute 10–20% of the thoracolumbar fractures and are associated with high-energy trauma, such as motor vehicle accidents and falls from height [3]. A retropulsion of the vertebral body's posterior cortex compromises the neural canal, resulting in neurological damage [4]. The ideal treatment for thoracolumbar burst fracture remains controversial. Decompression of the neural element, correction and prevention of posttraumatic kyphotic deformity, and restoration of vertebral body height are the goals of surgical treatment for these fractures [5]. Posterior instrumentation using transpedicular screws is an excellent method for managing these fractures, which provides spinal stability and good anatomical alignment and minimizes patient morbidity [6].
Short-segment posterior screw fixation (one level above and one level below the fractured vertebra) provides several benefits of shorter segment immobilization, less intraoperative blood loss, shorter operation duration, less muscle dissection area, and less complication. However, high failure rates have been reported attributing it to structural and mechanical deficiency of the anterior column. To prevent this failure, augmentation of the anterior column is done by inserting two screws in the fractured vertebra, which increases the stiffness of the construct and reduces the failure rate of the traditional short-segment fixation [7–10].

Stability would have been increased and kyphotic deformity reduced if long-segment posterior fixation (LSF) had been used, which would have lengthened the lever arm. However, it has a longer surgical duration, more blood loss and muscle injury, and more loss of mobility segments [7–10].

This research aims to evaluate the radiological and clinical results of LSF versus short-segment fixation with index level screw (SSFIS) in thoracolumbar spine fractures.

**Patients and methods**

This is a prospective comparative study comparing the outcome of surgical treatment of patients with thoracolumbar burst fractures. A total of 20 patients were enrolled in two groups, with ten patients each. The first group was treated by LSF, and the second by SSFIS.

Inclusion criteria were as follows: patients aged 20–60 years, those with thoracolumbar injury classification (TLICS) severity scores of more than 4 and with AO classification type A3 and A4, those neurologically intact (AISA E), and those with any degree of canal compression. Exclusion criteria were as follows: patients with comorbid conditions not permitting surgery and associated injuries like pelvic injury, head injury, pathological fracture, and multiple vertebral fractures.

The clinical data of the patients fulfilling the inclusion criteria were as follows: history was taken from the patient, including the date of the injury and the details of the initial and subsequent treatment. Physical examination was documented, including a general, local, and neurological examination. Patients were submitted to the following radiological examinations: anteroposterior and lateral view radiography and computed tomography of the thoracolumbar spine.

Outcome parameters included the incision length, intraoperative blood loss, surgical time, clinical assessment, including visual analog scale (VAS) for back pain and Oswestry disability index (ODI), and radiological assessment, including Local kyphotic angle (LKA) and anterior vertebral body height loss (AVHL). The secondary objective is the assessment of complications in the two groups.

The LKA is the angle between a line drawn parallel to the superior endplate of one vertebra above the fracture and a line drawn parallel to the inferior endplate of the vertebra below the fracture. This was assessed on a standard lateral radiographic view (Fig. 1).

For AVHL, the anterior wall height of the fractured vertebra was measured; this value was divided by the anterior height average of the adjacent vertebrae at an upper and lower level. The obtained value was recorded in percentage using the following formula: \[ AVHL = 1 - \frac{V2}{(V1 + V3)/2} \times 100\% \], where V2 is the anterior wall height of the fractured vertebra, V1 is the anterior wall height of the vertebra above, and V3 is the anterior wall height of the vertebra below (Fig. 1).

**Surgical technique**

Hypotensive general anesthesia was used in all patients. Patients were placed in a prone position on a radiolucent frame that allowed the entire abdomen to hang free with hips and knees...
moderately flexed. Starting from the spinous process above the level of the fracture down to the spinous process below, we made a posterior midline incision. The incision was then widened by cutting into the subcutaneous fat and fascia.

To give access to pedicle screw insertion, the dissection of the paraspinal muscle was continued laterally after it had detached subperiosteally as one unit. In most cases, the partial reduction was accomplished when the patient was put in a prone position on a customized frame that restores the natural thoracicolumbar lordotic curves of the spine. Indirect decompression was done by countering the rod that corrects kyphosis and recreates normal lordosis; distraction and reduction maneuvers can be applied to aid in reducing compression via ligamentotaxis.

Pedicular screws were inserted with adequate width and length in the standard way and connected to a rod of suitable length. Fluoroscopy was used to confirm the position and depth of the screws intraoperatively. In the LSF, a long-segment construct was used, fixing two levels above and below the fractured vertebra without including the fractured vertebra by pedicle screws (Fig. 2). In the proximal levels, the rods were contoured in slight kyphosis and more lordosis in the distal levels. In the SSFIS, a short-segment construct was used, fixing one level above and below the fractured vertebra with a pedicle screw inserted in the fractured vertebra (Fig. 3). The rods were precontoured with slight lordosis to correct the kyphotic deformity. After copious irrigation and muscle debridement, a suction drain was placed deep in the wound, and the wound was closed in layers. No direct spinal canal decompression was done in both groups.

**Postoperative care**

Postoperative radiographs were performed, and all patients were instructed to wear a thoracolumbar brace at all ambulatory times for 2 weeks after surgery before gradually discontinuing use for the next 2 weeks. All patients had routine clinical and radiological checkups at 1, 3, and 6 months, where VAS of back pain and ODI were recorded and plain radiographs were taken.

**Statistical analysis**

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0 (IBM Corp., Armonk, New York, USA). Qualitative data were described using numbers and percentages. The Shapiro–Wilk test was used to verify the normality of distribution. Quantitative data were described using mean and SD. The significance of the obtained results was judged at the 5% level.

**Ethics committee approval and consent statement**

All patients were consented to the surgical operations along with a research consent to publish the data. The study was approved by the IRB.

**Results**

**Epidemiological data**

The mean age in group A (LSF) was 44.30 ± 6.77 years (range: 34.0–54.0 years) and in group B (SSFIS) was 44.10 ± 7.84 years (range: 30.0–56.0 years). The number of male patients was slightly

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Fig. 2. A case of long-segment posterior fixation. (A) Preoperative lateral radiography showing D12 burst fracture. (B) Preoperative sagittal computed tomography shows a D12 fracture. (C) Preoperative axial computed tomography of D12 burst fracture. (D) Six-month postoperative radiography lateral view of healed D12 burst fracture with correction of local kyphotic angle and restoration of anterior vertebral body height loss.
larger than the number of female patients, and the male patients represented 60% and 50% in group A (LSF) and group B (SSFIS), respectively. The Arbeitsgemeinschaft für Osteosynthesefragen (AO) type 4 represented 70 and 60%, and TLICS score 5 represented 50 and 60% in groups A (LSF) and B (SSFIS), respectively. There was an insignificant difference between the two groups regarding demographic data (Table 1).

Operative data

The operative time was significantly shorter in the SSFIS group than that in the LSF group (88.40 ± 6.19 versus 109.40 ± 14.28 min, respectively; \( P < 0.001 \)). The total amount of operative blood loss was significantly lower in the SSFIS group than that in the LSF group (322.9 ± 34.86 vs. 403.2 ± 30.58 ml; \( P < 0.001 \)). The incision length was significantly shorter in the SSFIS group than that in the LSF group (8.40 ± 1.17 vs. 11.23 ± 0.64 cm, respectively; \( P < 0.001 \)) (Table 2).

There were statistically significant differences between the LSF group versus the SSFIS group regarding incision length, intraoperative blood loss, and surgical time that favored SSFIS.

Oswestry disability index functional outcome

During the follow-up of the LSF group, the ODI was 37.40 ± 4.33 at 3 months postoperatively, which improved to 17.80 ± 1.93 at 6 months postoperatively.

Table 1. Summary of demographic data in both patients’ groups.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>LSF (n = 10) [n (%)]</th>
<th>SSFIS (n = 10) [n (%)]</th>
<th>Test of significance</th>
<th>( P )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>44.30 ± 6.77 (43.0–47.0)</td>
<td>44.10 ± 7.84 (43.0–47.0)</td>
<td>( t = 0.061 )</td>
<td>0.952</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td>( \chi^2 = 0.202 )</td>
<td>( \text{FE} P = 1.000 )</td>
</tr>
<tr>
<td>Male</td>
<td>6 (60)</td>
<td>5 (50)</td>
<td>( \chi^2 = 0.219 )</td>
<td>( \text{FE} P = 1.000 )</td>
</tr>
<tr>
<td>Female</td>
<td>4 (40)</td>
<td>5 (50)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AO type</td>
<td></td>
<td></td>
<td>( \chi^2 = 0.4242 )</td>
<td>( \text{MC} P = 1.000 )</td>
</tr>
<tr>
<td>Type 3</td>
<td>3 (30)</td>
<td>4 (40)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type 4</td>
<td>7 (70)</td>
<td>6 (60)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TLICS score</td>
<td></td>
<td></td>
<td>( \chi^2 = 0.4242 )</td>
<td>( \text{MC} P = 1.000 )</td>
</tr>
<tr>
<td>TLICS 4</td>
<td>3 (30)</td>
<td>3 (30)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TLICS 5</td>
<td>5 (50)</td>
<td>6 (60)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TLICS 6</td>
<td>2 (20)</td>
<td>1 (10)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fracture level</td>
<td></td>
<td></td>
<td>( \chi^2 = 0.4242 )</td>
<td>( \text{MC} P = 1.000 )</td>
</tr>
<tr>
<td>D11</td>
<td>1 (10)</td>
<td>1 (10)</td>
<td>( t = 0.9402 )</td>
<td>0.370</td>
</tr>
<tr>
<td>D12</td>
<td>2 (20)</td>
<td>3 (30)</td>
<td>( \chi^2 = 0.219 )</td>
<td>( \text{FE} P = 1.000 )</td>
</tr>
<tr>
<td>L1</td>
<td>4 (40)</td>
<td>4 (40)</td>
<td>( \chi^2 = 0.4242 )</td>
<td>( \text{MC} P = 1.000 )</td>
</tr>
<tr>
<td>L2</td>
<td>3 (30)</td>
<td>2 (20)</td>
<td>( \chi^2 = 0.4242 )</td>
<td>( \text{MC} P = 1.000 )</td>
</tr>
</tbody>
</table>

FE, Fisher’s exact test; MC, Monte–Carlo test; LSF, long-segment fixation; \( P \), \( P \) value for comparing between the studied groups; SSFIS, short-segment fixation with index level screw; TLICS, thoracolumbar injury classification severity score.
Table 2. Summary of operative data in both groups.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>LSF (n = 10)</th>
<th>SSFIS (n = 10)</th>
<th>Test</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incision length (cm)</td>
<td>11.23 ± 0.64 (10.50–12.50)</td>
<td>8.40 ± 1.17 (7.0–11.0)</td>
<td>6.699*</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Blood loss (ml)</td>
<td>403.2 ± 30.58 (349.0–456.0)</td>
<td>322.9 ± 34.86 (289.0–399.0)</td>
<td>5.475*</td>
<td>&lt;0.001*</td>
</tr>
<tr>
<td>Surgical time (min)</td>
<td>109.40 ± 14.28 (90.0–132.0)</td>
<td>88.40 ± 6.19 (78.0–99.0)</td>
<td>4.266*</td>
<td>0.001*</td>
</tr>
</tbody>
</table>

P < 0.001. Meanwhile, the ODI in the SSFIS group was 37.10 ± 4.51 at 3 months postoperatively and improved to 15.0 ± 1.15 at 6 months postoperatively (P < 0.001). Comparing ODI between the two groups, there was a statistically insignificant difference, whereas at 6 months postoperatively, there was a statistically significant difference in favor of SSFIS (Table 3).

Visual analog scale for back pain

During the follow-up of the LSF group, the VAS of back pain improved from 8.40 ± 0.916 preoperatively to 5.50 ± 0.85 at 1 month postoperatively and to 1.90 ± 0.74 at 6 months postoperatively, which was statistically significant (P < 0.001). Meanwhile, in the SSFIS group, the VAS of back pain improved from 8±1.033 preoperatively to 5.70 ± 1.06 at 1 month postoperatively and to 1.60 ± 0.70 at 6 months postoperatively, which was statistically significant (P < 0.001). Comparison of the postoperative VAS between the two groups showed statistically insignificant differences between both groups during both follow-up periods (Table 4).

Local kyphotic angle

In the LSF group, the preoperative LKA was 14.54 ± 2.05 and improved to 2.24 ± 0.30 at 6 months postoperatively, which was statistically significant (P < 0.001). Meanwhile, in the SSFIS group, the preoperative LKA was 14.75 ± 1.97 and improved to 2.16 ± 0.25 at 6 months postoperatively, which was statistically significant (P < 0.001). Although the LKA showed a significant decrease after treatment in both groups, there were insignificant differences between the two groups (Table 5).

Anterior vertebral height loss

In LSF group, the preoperative AVHL was 34.90 ± 2.92 and improved to 11.20 ± 1.99 at 6 months postoperatively, which was statistically significant (P < 0.001). In the SSFIS group, the preoperative AVHL was 35.30 ± 3.33 and improved to 11.60 ± 1.78 at 6 months postoperatively, which was statistically significant (P < 0.001). Although the AVHL significantly decreased in both groups after treatment, there were insignificant differences between the two groups (Table 6).

Postoperative complications

In the LSF group, two patients (20%) developed wound infections. One had a superficial infection, which was treated by antibiotics and repeated dressing, whereas the other patient had a deep infection treated with debridement. In the SSFIS group, one patient (10%) developed a wound infection treated with antibiotics and repeated dressing. No screw

Table 3. Oswestry disability index (ODI) in both groups.

<table>
<thead>
<tr>
<th>ODI</th>
<th>LSF (n = 10)</th>
<th>SSFIS (n = 10)</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 month postoperative</td>
<td>37.40 ± 4.33(32.0–45.0)</td>
<td>37.10 ± 4.51(32.0–45.0)</td>
<td>0.152</td>
<td>0.881</td>
</tr>
<tr>
<td>6 months postoperative</td>
<td>17.80 ± 1.93 (15.0–21.0)</td>
<td>15.0 ± 1.15(13.0–17.0)</td>
<td>3.934*</td>
<td>0.001*</td>
</tr>
<tr>
<td>t(10)</td>
<td>14.161* (&lt;0.001*)</td>
<td>14.506* (&lt;0.001*)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LSF, long-segment fixation; P, P value for comparing between the studied groups; P1, P value for comparing between pre and postoperative; SSFIS, short-segment fixation with index level screw; t, Student’s t-test; t1, paired t-test.

* Statistically significant at P ≤ 0.05.

Table 4. Visual analog scale (VAS) in both groups.

<table>
<thead>
<tr>
<th>VAS</th>
<th>LSF (n = 10)</th>
<th>SSFIS (n = 10)</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative</td>
<td>8.40 ± 0.916 (7.0–10)</td>
<td>8.20 ± 1.033 (7.0–10)</td>
<td>0.458</td>
<td>0.653</td>
</tr>
<tr>
<td>1 month postoperative</td>
<td>5.50 ± 0.85 (4.0–7.0)</td>
<td>5.70 ± 1.06 (4.0–7.0)</td>
<td>0.466</td>
<td>0.647</td>
</tr>
<tr>
<td>6 months postoperative</td>
<td>1.90 ± 0.74 (1.0–3.0)</td>
<td>1.60 ± 0.70 (1.0–3.0)</td>
<td>0.933</td>
<td>0.363</td>
</tr>
<tr>
<td>t(10)</td>
<td>13.500* (&lt;0.001*)</td>
<td>11.781* (&lt;0.001*)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

LSF, long-segment fixation; P, P value for comparing between the studied groups; P1, P value for comparing between pre and postoperative; SSFIS, short-segment fixation with index level screw; t, Student’s t-test; t1, paired t-test.

* Statistically significant at P ≤ 0.05.
Discussion

This study reported 20 patients with thoracolumbar trauma without neurological deficits. The mean age was 44.20 years, and 60% were males. They were two groups, with 10 patients each: group A had LSF, and group B had SSFIS. There was no statistically significant difference between the two groups regarding patient age, sex, reduction of VAS for back pain, change in functional outcome assessed by ODI postoperatively, correction of LKA, and restoration of AVHL. However, there was a statistically significant difference favoring the SSFIS group regarding operative time, intraoperative amount of blood loss, incision length, and ODI at 6-month follow-up.

Epidemiologic findings

The total number of patients reported in this study is 20 patients. This sample size is less than that in other studies, including those by Sallam et al. [11] (91 patients), Guven et al. [12] (72 patients), and Ye et al. [10] (44 patients); however, it was more than those reported by others such as Çetin et al. [13] (17 patients). The mean age in group A (LSF) was 44.30 ± 6.77 years (range: 34.0–54.0 years) and in group B (SSFIS) was 44.10 ± 7.84 years (range: 30.0–56.0 years). The number of male patients was slightly larger than that of female patients; male patients represented 60 and 50% in groups A (LSF) and B (SSFIS), respectively. The AO type 4 represented 70 and 60% and TLICS score 5 represented 50 and 60% in groups A (LSF) and B (SSFIS), respectively. There were insignificant differences between the two groups in terms of demographic data.

Operative findings

In theory, reducing the number of fixed levels (one level above and below the fracture) will result in a shorter surgical incision, less blood loss, and a shorter surgical procedure. This was the case in this study when SSFIS was compared with LSF. Furthermore, it was found that adding more screws to a fractured vertebra did not increase the operational time or blood loss [14].

The operative time was significantly shorter in the SSFIS group than that in the LSF group (88.40 ± 6.19 min vs. 109.40 ± 14.28 min, respectively; P < 0.001), and the total amount of perioperative blood loss was significantly lower in SSFIS group than that in the LSF group (322.9 ± 34.86 ml vs. 403.2 ± 30.58 ml, respectively; P < 0.001).

These results agree with those by Tezeren et al. [14], who reported operative time and blood loss of 152 ± 27 and 411 ± 111 ml, respectively, in short-segment posterior fixation and 188 ± 32 min and 550 ± 145 ml, respectively, in LSF. Nagaty et al. [15], in 2021, reported in their retrospective study that SSFIS had less operative time (137.73 ± 16.96) than that of LSF (153.57 ± 19.525); in addition, SSFIS had less blood loss compared with LSF in treating thoracolumbar fractures.

Clinical and functional outcomes

In this article, the clinical parameters in both groups showed significant improvement in terms of VAS and ODI postoperatively. The preoperative VAS of back pain significantly improved from 8.20 ± 1.033 to 1.90 ± 0.74 and from 8.40 ± 0.916 to 1.60 ± 0.70 at 6 months in the SSFIS and LSF groups, respectively (P < 0.001). These results agreed with Sallam et al. [11].

Table 5. Local kyphosis angle (LKA) in both groups.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>LSF (n = 10)</th>
<th>SSFIS (n = 10)</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative</td>
<td>17.95 ± 10.1 (3.00–30.00)</td>
<td>24.30 ± 15.0 (13.00–23.00)</td>
<td>2.46*</td>
<td>0.021</td>
</tr>
<tr>
<td>6 months postoperative</td>
<td>19.10 ± 10.0 (13.00–23.00)</td>
<td>24.30 ± 15.0 (13.00–23.00)</td>
<td>2.46*</td>
<td>0.021</td>
</tr>
</tbody>
</table>

LSF, long-segment fixation; P, P value for comparing between the studied groups; t, Student's t-test; t1, paired t-test.

Table 6. Anterior vertebral height loss (AVHL) in both groups.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>LSF (n = 10)</th>
<th>SSFIS (n = 10)</th>
<th>t</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative</td>
<td>34.90 ± 2.92 (30.0–39.0)</td>
<td>35.30 ± 3.33 (30.0–40.0)</td>
<td>0.285</td>
<td>0.779</td>
</tr>
<tr>
<td>6 months postoperative</td>
<td>11.20 ± 1.59 (8.0–15.0)</td>
<td>11.60 ± 1.78 (9.0–15.0)</td>
<td>0.474</td>
<td>0.641</td>
</tr>
</tbody>
</table>

LSF, long-segment fixation; P, P value for comparing between the studied groups; t, Student's t-test; t1, paired t-test.
The preoperative LKA was 17.4°, the radiological outcomes between SSFIS and LSF.

The ODI significantly improved from 37.40 ± 4.33 at 3 months postoperatively to 17.80 ± 1.93 at 6 months postoperatively in the LSF group and from 37.10 ± 4.51 at 3 months postoperatively to 15.0 ± 1.15 at 6 months postoperatively in the SSFIS group (P < 0.001). These results agree with those of Canbek et al. [16], who reported the ODI in the short-segment fixation group at the final follow-up was 14.1 ± 3, whereas in the LSF group, the ODI at the final follow-up was 29.2 ± 4.

Radiological outcomes

The common radiological parameters used to study the effectiveness of treatment are the LKA and the AVHL% correction. In this article, the radiological parameters showed significant differences after treatment in both groups (P < 0.001), with no significant differences between the two groups at 6 months postoperatively. These results are in agreement with those of Çetin et al. [13], who evaluated the radiological outcomes between SSFIS and LSF. The preoperative LKA was 17.4 ± 10.6° and 16.5 ± 5.8° (P = 0.83), was 6. ± 5.6° and 10.3 ± 7.3° (P = 0.14) early postoperatively, whereas it was 8.8 ± 5.8° and 12.0 ± 7.2° at the last follow-up (P = 0.36) in SSFIS and LSF, respectively. Preoperative AVH was 72.4 ± 14.5% and 56.4 ± 14.8% (P = 0.05), early postoperative was 88.5 ± 9.5% and 75.6 ± 18.5% (P = 0.13), whereas it was 86.6 ± 11.3% and 69.1 ± 19.5% (P = 0.06) at the last follow-up in SSFIS and LSF, respectively. They concluded that there was no significant difference between the two groups in correcting and maintaining LKA and increasing and maintaining AVH in patients with thoracolumbar burst fractures.

Aldarzi et al. [17] found a significant difference in the AVHL between the preoperative and postoperative values (48.4% preoperatively, 10.65% postoperatively, and 12.85% at final follow-up; P < 0.05). They concluded that AVH restoration is attributed to many reasons. The lordotically contoured rods and pedicle screw fixation at the fractured vertebra can produce a forward driving force to enhance the reduction and reshaping. Moreover, the screw inserted into the fractured vertebra can be used to directly raise the end plate to assist in the restoration of the compressed vertebral height. Second, short-segment fixation with intermediate screws can improve the stress distribution of the internal fixation system and protect the uninjured vertebra and intervertebral disc. Finally, there may be a vertebral body filling effect because vertebral compression results in trabecular bone destruction; a cavity is produced within the vertebral body after reduction. This may induce vertebral recollapse postoperatively. A pedicle screw inserted into the fractured vertebra can fill this cavity, resulting in a better reduction of the fractured vertebra. El-Shehaby and colleagues, in their study of 46 patients with thoracolumbar fractures who underwent SSFIS and LSF in 2013, reported that SSFIS has a profound and comparable correction of LKA compared to LSF. However, they advised the SSFIS should be preserved for cases with mild to moderate posttraumatic kyphosis [18]. Nagaty et al. [15], in 2021, reported no significant difference in Cobb’s angle measurement after 12 months between SSFIS and LSF.

Morbidity

In the LSF group, two patients (20%) developed wound infection. One had a superficial infection and was treated with antibiotics and repeated dressing, whereas the other patient had a deep infection treated with debridement. In the SSFIS group, one patient (10%) developed wound infection and was treated with antibiotics and repeated dressing.

Posterior instrumentation using transpedicular screws is an excellent method for treating thoracolumbar burst fractures and provides spinal stability, good anatomical alignment, and little patient morbidity [8]. Several biomechanical studies [10,19] were done to evaluate the index level fixation stability. These studies confirmed the superiority of short-segment fixation with intermediate screws constructs over the conventional short-segment constructs.

Ye et al. [10] stated that the use of intermediate screws for fractured vertebrae improves clinical outcomes, corrects deformity, and maintains correction in unstable thoracolumbar fractures. Kapoen et al. [19] observed that a short-segment posterior fixation with two extra screws at the fracture level (a six-screw construct) considerably increases spinal stability, provides stronger fixation, and decreases stress in the pedicle screws in the nonfractured vertebra.

In the current study, the intermediate screws were applied in the fractured level in the SSFIS to help in anterior column support using long fixed-angled screws. According to our results, the intermediate screw supports the comminuted body and shows comparable radiological results to LSF regarding correction and maintenance of the kyphotic.
deformity. Farrokhi et al. [20] and Guven et al. [12] conducted randomized controlled trials to compare the results of conventional short-segment stabilization with the index level fixation, and they concluded that inclusion of the fracture level into the construct had offered better kyphosis correction and fewer instrument failures.

This study had some limitations, including the small number of our patients, nonrandomization of the patients, and the short period of radiological follow-up. All these might be points of criticism that should be resolved in future studies. Finally, a prospective multicenter randomized controlled trial is warranted to determine more definitive guidelines for the treatment of these fractures.

**Conclusion**

Our data suggest that SSFIS seems comparable to LSF in managing thoracolumbar fractures resulting in adequate correction of LKA, restoration of AVHL, and preserving more motion segments. Conducting a randomized controlled study with long-term follow-up and a large patient sample size is recommended.

**Conflict of Interest**

There are no conflicts of interest.

**Abbreviations**

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>VAS</td>
<td>Visual Analogue Scale</td>
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<td>ODI</td>
<td>Oswestry Disability Index</td>
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<td>LKA</td>
<td>Local kyphosis angle</td>
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<tr>
<td>LSF</td>
<td>long-segment fixation</td>
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<tr>
<td>AVH</td>
<td>anterior vertebral height</td>
</tr>
<tr>
<td>AVHC</td>
<td>anterior vertebral height compression</td>
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<td>SSFI</td>
<td>short-segment fixation with intermediate screw</td>
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</tbody>
</table>

**References**

الملخص العربي

مقارنة تأثير التثبيت الخلفي القصير مع تثبيت الفقرة المكسورة والتثبيت الخلفي الطويل في حالات الكسور الاجتاجية لل الفقرات الصدرية الفقطية

البيانات الخلفية

يعد التثبيت الخلفي للكسور الاجتاجية لل الفقرات الصدرية الفقطية طريقة منخفضة تكلفة لعلاج تثبيت الفقرات. وهناك العديد من الطرق التي تستخدم على عدد الفقرات التي تمت تثبيتها.

تم استخدام كلاً من التثبيت الخلفي القصير بما في ذلك الفقرة المكسورة والتثبيت الخلفي الطويل على نطاق واسع دون إجماع على الطريقة الأفضل.

الغرض

الهدف من هذه الدراسة هومقارنة بين التثبيت الخلفي الطويل مقابل التثبيت الخلفي القصير مع مساحير على مستوى الفقرة المكسورة في الكسور الاجتاجية لل الفقرات الصدرية الفقطية من حيث النتائج الإشعاعية والسريرية.

تصميم الدراسة

دراسة مقارنة مستقبالية

الموضوع والطرق

تم تضمين عشرة مرضى في الدراسة. تم تقسيمهم إلى مجموعتين (أ) بالثني القطني الطويل (أي مستويين أعلى وأسفل الفقرة المكسورة) ، و (ب) بالثني القطني للجزء الأقصى من الفقرة المكسورة (أي مستوي واحد أعلى وأسفل الفقرة المكسورة مع تثبيت VAS (، AVHL (، و فحص الارتفاع السكلي الأصلي (LKA) ) ، و فحص ارتفاع الجسم الرئيسي للجهاز الحركي).، والقياس النظري المرن (؛) للناتج الوظيفي.

النتائج

يوجد هناك فروق ذات دلالة إحصائية بين المجموعتين فيما يتعلق بعرق المريض والجنس، والآخر بزيادة فاز (VAS)، والتغيير في النتائج الوظيفية التي تم تقديمها بواسطة مؤشر الإعاقة (ODI) بعد الجراحة، وتحسين زاوية الجرح واستعادة الفقرة المكسورة للإعاقة. ومع ذلك، كانت هناك دلالة إحصائية نجاة مجموعة التثبيت الخلفي القصير مع تثبيت الفقرة المكسورة فيما يتعلق بوقت العملية، وكمية فقدان الدم أثناء العملية، وطول الجرح، والتغير في النتيجة الوظيفية.

الخلاصة

ثبت أن التثبيت الخلفي القصير مع تثبيت الفقرة المكسورة هو نوع مشابه من التثبيت الخلفي مع التثبيت القطني الخلفي الطويل في الكسور الاجتاجية لل الفقرات الصدرية الفقطية من خلال إعطاء نتائج جيدة فيما يتعلق بصحة زاوية الجرح، واستعادة الفقرة المكسورة للإعاقة، والحفاظ على المزيد من شرائح حركة أكثر من التثبيت الخلفي الطويل.