

Comparison of Short Segment Pedicle Screw Fixation Including the Fractured Vertebra Versus Long Segment Fixation in Thoracolumbar Fractures

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ABSTRACT

Objective: To compare the radiologic outcomes of short-segment fixation (SSF-P) with screw insertion into the fractured vertebra versus long-segment fixation (LSF), without fractured-level screw for the treatment of unstable thoracolumbar fractures.

Methods: Radiological parameters of 17 patients who had SSF-P or LSF for the treatment of unstable thoracolumbar fractures and had at least one-year follow-up duration were retrospectively evaluated. Local kyphosis (LK) angle and anterior vertebral height (AVH) value were measured from the preoperative, early postoperative and follow-up radiographs; intergroup comparisons were performed.

Results: The mean age of the patients (male: 12, female: 5) was 50.1 ± 12.8 years and the mean follow-up duration was 15.7 ± 6.4 months. Fracture levels were L1 (n=8), L2 (n=5), T12 (n=2), L3 (n=1) and L4 (n=1). SSF-P was performed for 9 patients and LSF for 8 patients. The mean preoperative LK angles were $17.4 \pm 10.6^\circ$ in the SSF-P group and $16.5 \pm 5.8^\circ$ in the LSF group ($p=0.83$). In early postoperative measurements, the mean LK angles were $6.9 \pm 5.6^\circ$ in the SSF-P group and $10.3 \pm 7.3^\circ$ in the LSF group ($p=0.14$). In the follow-up evaluation, they were $8.8 \pm 5.8^\circ$ and $12.0 \pm 7.2^\circ$, respectively ($p=0.36$). Preoperative mean AVH values were $72.4 \pm 14.5\%$ in the SSF-P group and $56.4 \pm 14.8\%$ in the LSF group ($p=0.05$). In early postoperative measurements, AVH values were $88.5 \pm 9.5\%$ in the SSF-P group and $75.6 \pm 18.5\%$ in the LSF group ($p=0.13$). In the follow-up evaluation, they were $86.6 \pm 11.3\%$ and $69.1 \pm 19.5\%$, respectively ($p=0.06$).

Conclusion: Radiological outcomes of SSF-P were similar to LSF in the treatment of unstable thoracolumbar burst fractures. We recommend the SSF-P method, which provides a stable fixation without sacrificing mobile segments, in the treatment of unstable burst fractures.

Keywords: Thoracolumbar fracture, instrumentation, pedicle screw, trauma

INTRODUCTION

Posterior instrumentation with pedicle screws is the most commonly used method in the treatment of unstable thoracolumbar fractures. It is possible to detect all three columns of the spine and correct the deformity caused by the fracture without experiencing potential complications of anterior surgery (1). With the short segment posterior pedicle screw fixation short-segment fixation (SSF), it is aimed to protect the movable

segments by placing screws on the upper and lower level of the fracture line. However, with this method, high rates of failure and related progressive kyphosis have been reported in many studies (2,3). While it is possible to provide a more stable fixation with long segment posterior pedicle screw fixation (LSF), movable segments are sacrificed (3).

In order to increase the stability of SSF, placing screws on pedicles in the broken spine is a method recommended in biomechanical

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studies (4,5). However, although successful results are generally reported in clinical studies, their effects on radiological and clinical results in the long term are not clear (6-8). The aim of this study is to compare the radiological results of SSF (SSF-P) applied by placing a pedicle screw on the broken spine with LSF.

METHODS

This study was conducted in accordance with the principles of the World Medical Association Declaration of Helsinki "Ethical Principles for Medical Research Involving Human Subjects" (amended in October 2013). Ethics committee approval was received for this study from the Ethics Committee of the Clinical Researches of University of Health Sciences, Taksim Training and Research Hospital (approval number: 121, date: 16.01.2019).

The records of patients who had posterior instrumentation due to unstable fractures of the thoracolumbar region in 2 different centers were reviewed retrospectively. Seventeen patients with no neurological deficit, fracture type A4 or B2 according to the AOSpine thoracolumbar fracture classification and at least 1-year follow-up were included in the study. Patients with multiple levels of fractures, neurological deficits and undergoing decompression were excluded from the study.

The demographic characteristics (age, gender, type of trauma) and clinical data (pre-and postoperative neurological conditions, complications) of the patients were recorded. Fracture morphology of patients who underwent direct radiographic imaging, computed tomography and magnetic resonance imaging before surgery were evaluated according to the AOSpine thoracolumbar fracture classification and load sharing classification (9,10).

Local kyphosis (LK) angle (wedge angle) and anterior vertebral height (AVH) values were measured by two independent surgeons on preoperative, early postoperative and final follow-up radiographs. LK angle is the Cobb angle value between the upper and lower surfaces of the broken vertebra in lateral X-ray. For the AVH, the anterior wall height of the broken vertebra was measured; this value was divided by the anterior height average of the adjacent vertebrae at an upper and lower level (6). The obtained value was recorded in percentage (Figure 1). Screw breakage, loosening and rod breakage were evaluated as implant failure.

Surgical technique: All patients in the study were applied posterior midline approach in prone position under general anesthesia. After checking the level of fracture under scopy, monoaxial and/or polyaxial pedicle screws were placed bilaterally. Fracture reduction was achieved with compression and distraction forces and using appropriate contoured rods. Local bone material was used for fusion.

Statistical Analysis

Microsoft Excel for Mac 2011 program was used for statistical evaluations. Preoperative, postoperative and follow-up values obtained by radiological measurements were given as mean \pm

standard deviation. The Student's t-test was used for statistical analysis. The degree of significance was determined as $p < 0.05$.

RESULTS

Of the 17 patients, 12 were male and 5 were female. Their mean age was 50.1 ± 12.8 years and mean follow-up time was 15.7 ± 6.4 months. Nine patients had concomitant extremity, pelvis, and/or rib fractures. The fracture level was L1 in 8 patients, L2 in 5 patients, T12 in 2 patients, and L3 in one patient, and L4 in one patient. According to the AOSpine thoracolumbar fracture classification, 9 cases were evaluated as type A4, 8 cases were evaluated as type B2. According to the load sharing classification, while the mean score of all patients was 6.2 ± 1.0 , it was 5.5 ± 0.5 in the SSF-P group and 6.0 ± 1 in the LSF group ($p = 0.11$). SSF-P was applied to 9 patients and LSF was applied to 8 patients (Table 1) (Figure 2, 3).

While the mean LK angle value before surgery was 17.4 ± 10.6 degrees in the SSF-P group, it was 16.5 ± 5.8 degrees in the LSF group ($p = 0.83$). AVH value was measured as $72.4 \pm 14.5\%$ in the SSF-P group and $56.4 \pm 14.8\%$ in the LSF group ($p = 0.05$). In the early postoperative period, the mean LK angle value was 6.9 ± 5.6 degrees in the SSF-P group and 10.3 ± 7.3 degrees in the LSF group. Decreased LK angle values observed in the postoperative period were statistically significant for both groups ($p = 0.003$ and $p = 0.001$). Significant improvements in AVH values were also observed. The mean value was $88.5 \pm 9.5\%$ in the SSF-P group and $75.6 \pm 18.5\%$ in the LSF group ($p = 0.01$ and $p = 0.03$). When the LK angle and AVH values between the SSF-P and LSF groups were compared in the early postoperative period, the differences were

Table 1. Details of patients' demographic and fracture features

	Age	Gender	Fracture level	AOSpine	Load sharing	Type of fixation
1	56	M	L3	A4	5	SSF-P
2	37	M	L2	B2	7	SSF-P
3	61	F	L2	A4	6	SSF-P
4	50	M	L1	A4	6	SSF-P
5	29	M	L4	A4	6	SSF-P
6	51	M	L2	B2	4	SSF-P
7	34	M	L1	B2	5	SSF-P
8	23	M	L1	A4	7	SSF-P
9	59	M	L1	A4	6	SSF-P
10	38	M	L2	B2	7	LSF
11	67	F	L1	B2	7	LSF
12	61	M	L2	A4	7	LSF
13	61	F	L1	B2	7	LSF
14	58	F	L1	A4	7	LSF
15	51	M	T12	B2	8	LSF
16	50	F	T12	B2	5	LSF
17	65	M	L1	A4	5	LSF

M: Male, F: female, SSF: short-segment fixation, LSF: fractured-level screw

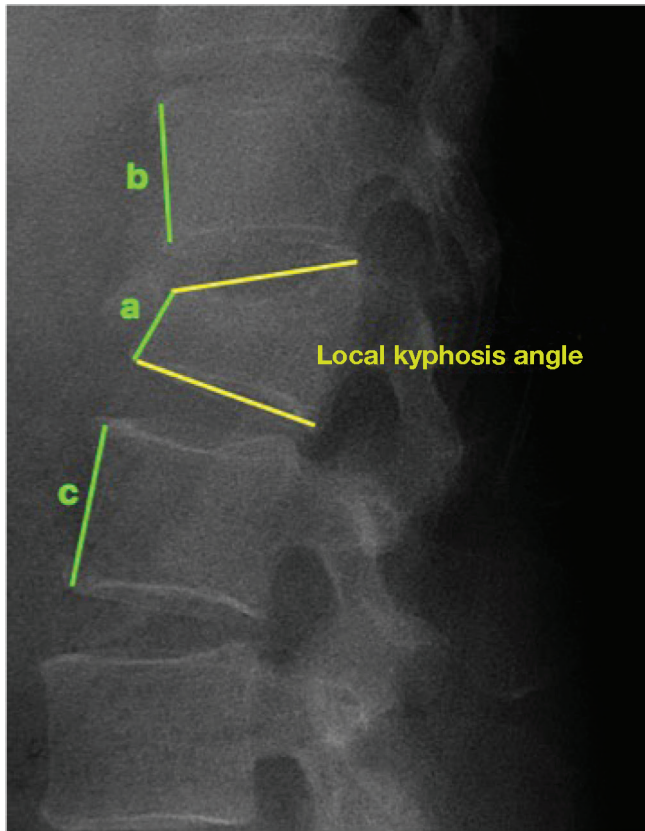


Figure 1. Values measured on the lateral graph a: Local kyphosis angle: Cobb angle between the upper and lower surfaces of the broken vertebra b: Anterior vertebral height (%): $a/[(b+c)/2] \times 100$

not statistically significant ($p=0.14$ and $p=0.13$) (Table 2).

The LK angle values measured in the last follow-up graphs of the patients were 8.8 ± 5.8 degrees in the SSF-P group and 12.0 ± 7.2 degrees in the LSF group. These increases observed according to the early postoperative values were found statistically significant ($p=0.006$ and $p=0.001$). In follow-up radiographs, AVH value was measured as $86.6 \pm 11.3\%$ in the SSF-P group and $69.1 \pm 19.5\%$ in the LSF group. Changes in these values were not significant for both groups compared to the early postoperative period ($p=0.05$ and $p=0.09$). When the LK angle and AVH values measured in the last follow-up graphs in the SSF-P and LSF groups were compared, the differences were not statistically significant ($p=0.36$ and $p=0.06$) (Table 2).

Neurological complications and implant failure did not develop in any patient in the postoperative period. One patient had superficial infection, which was treated with local wound care and antibiotics, and one patient had a resistant infection that required removal of the implants in the late period.

DISCUSSION

Our study reveals that in unstable thoracolumbar burst fractures, the radiological results of SSF and LSF applied with the insertion of screws to the pedicles at the broken level are not different in the early postoperative and mid-term follow-up.

Table 2. Comparison of radiological data between groups

	SSF-P	LSF	p
Local kyphosis angle (°)			
Preop	17.4 ± 10.6	16.5 ± 5.8	0.83
Postop	6.9 ± 5.6	10.3 ± 7.3	0.14
Follow-up	8.8 ± 5.8	12.0 ± 7.2	0.36
Anterior vertebra height (%)			
Preop	72.4 ± 14.5	56.4 ± 14.8	0.05
Postop	88.5 ± 9.5	75.6 ± 18.5	0.13
Follow-up	86.6 ± 11.3	69.1 ± 19.5	0.06

SSF: Short-segment fixation, LSF: fractured-level screw

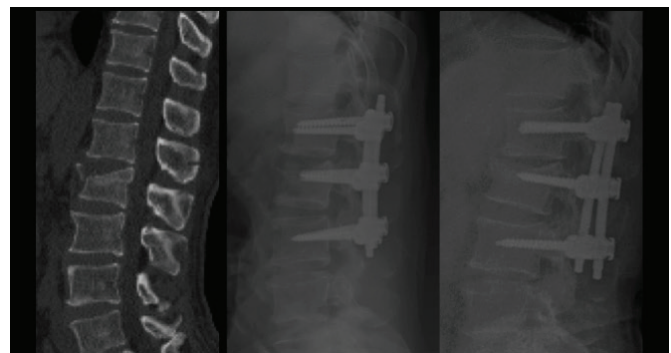


Figure 2. Preop, early postoperative and 12th month follow-up images of a 51-year-old male patient with an L2 burst fracture (AOSpine type B2, load sharing score 4)

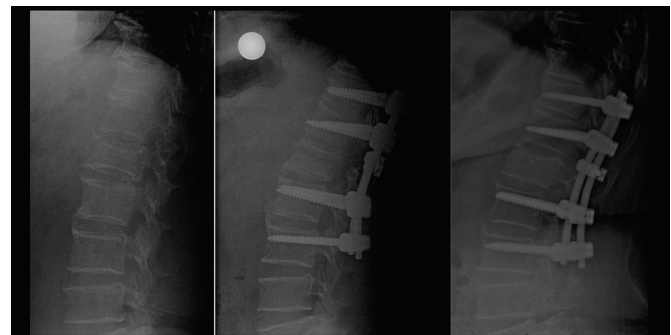


Figure 3. Preop, early postoperative and 18th month follow-up images of a 58-year-old woman with L1 burst fracture (AOSpine type A4, load sharing score 7)

Our results are compatible with similar studies in the literature. In the study of Pellisé et al. (6), evaluating the radiological results of 72 patients, they reported that 6-screw fixation was sufficient for the treatment of burst fractures of the thoracolumbar region. In patients with load bearing scores ≥ 7 , they detected an increase in LK angle less than 5° in the first 6 months. In our study, LK angle values in both the SSF-P and LSF groups increased by 1.9 and 1.7 degrees, respectively, compared to the early postoperative period in the last follow-up graphs. This increase was found statistically significant. Changes in AVH values were not found significant. However, there was no significant difference in the follow-up LK angle values of both groups with similar load bearing scores.

Kanna et al. (7) reported that even reductions of unstable fractures with load sharing scores ≥ 7 could be successfully achieved and maintained by SSF-P. In the recent follow-up graphs, they detected an increase of approximately 1.2° in the LK angle.

Farrokhi et al. (11) compared SSF-P and SSF results, and they reported that instrument insufficiency was more frequent with SSF, kyphosis could be corrected better with SSF-P, and clinical results were similar.

Güven et al. (12) reported in the series of 72 cases that, in the treatment of thoracolumbar burst fractures, kyphosis could be better corrected and protected by short or long segment screw fixation placed at the level of the fracture. They emphasized that this effect was more pronounced with SSF-P. Dobran et al. (13) compared SSF-P with LSF in thoracolumbar transition region fractures, and they reported that LK could be corrected with SSF-P similar to LSF and sagittal alignment could be maintained. In our study, no implant failure was observed in the SSF-P and LSF groups. Improvements in LK angle and AVH values were found significant in both groups. When the postoperative values were compared between the groups, improvements in LK angle and AVH value were obtained in the SSF-P group, similar to the LSF group. No significant difference was found between the radiological values measured in the follow-up radiographs.

The fact that our study is based on radiological parameters and does not include clinical results of patients can be considered as its weakness. The retrospective character of the study did not make this evaluation possible. Another weakness is that the number of patients is relatively low. The fact that it included only certain types of burst fractures and relatively rare fixation types was considered as the reason for this situation.

CONCLUSION

In unstable thoracolumbar burst fractures, radiological results similar to long segment pedicle screw fixation were obtained with short segment posterior pedicle screw fixation applied by placing a pedicle screw on the broken spine. We think that this method, which makes it possible to obtain a stable fixation without sacrificing the mobile segments, should be preferred in the treatment of unstable thoracolumbar burst fractures.

Ethics Committee Approval: Ethics committee approval was received for this study from the Ethics Committee of the Clinical Researches of University of Health Sciences Turkey, Gaziosmanpaşa Training and Research Hospital (approval number: 121, date: 16.01.2019).

Informed Consent: This is a retrospective study.

Peer-review: Externally peer-reviewed.

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Conflict of Interest: The authors have no conflict of interest to declare.

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