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ORIGINAL ARTICLE

Long-Term Radiological Outcomes of Short-Segment Stabilization in Thoracic Burst Fracture

Salim Katar[1], Mehmet Onur Yuksel[2], Serdar Çevik[3], Pınar Aydın Öztürk[4], Oğuz Baran[5], Sevket Evran[5]

[1]Department of Neurosurgery, Balikesir University Faculty of Medicine, Balikesir, Turkey
[2]Department of Neurosurgery, Medipol University Faculty of Medicine, Istanbul, Turkey
[3]Department of Neurosurgery, Memorial Sisli Hospital, Istanbul, Turkey
[4]Department of Neurosurgery, Gazi Yasargil Research and Training Hospital, Diyarbakir, Turkey
[5]Department of Neurosurgery, Haseki Research and Training Hospital, Istanbul, Turkey

Abstract

Introduction: Short-segment (SS) transpedicular instrumentation and distraction have been used as a popular method recently due to the kyphotic angulation and adequate spinal canal decompression provided by the fusion of fewer mobile vertebra segments. This study aims to demonstrate that adequate decompression of spinal canal and kyphosis angulation can be improved by SS instrumentation and distraction in thoracic vertebrae burst fracture.

Methods: Patients who were admitted to our clinic for thoracic vertebra burst fractures between 2014 and 2017 and who underwent fusion with transpedicular screws were retrospectively analyzed.

Results: Both the sagittal index (SI) and canal occupation rates (COR) showed statistically significant changes between the pre-operative and early post-operative periods (pSI=0.001, pCOR=0.001). Evaluation results of the patients at 2-year follow-up; mean SI was 16.2°±1.25° and the mean COR was 6.25±2.4%. There was no statistically significant difference between both SI and CORs postoperatively and after 2 years of follow-up (pSI=0.916, pCOR=0.565).

Discussion and Conclusion: We believe that SS stabilization is sufficient especially in patients with COR <40%, SI <25°, American Spinal Injury Association score E, and preserved posterior elements of the vertebra.

Keywords: Burst fracture, Short segment, Thoracic vertebrae, Transpedicular instrumentation

Kyphosis angle increases in burst fractures of the thoracic region due to the collapse of the anterior part of the vertebral corpus. In addition, the extension of the bone fragment into the spinal canal, as well as ligament and cord damage associated with increased flexion and rotation forces occurring in the middle column are frequently observed[1,2]. The treatment in these patients is aimed to achieve stabilization, maintain the height of the vertebral body, and eliminate the spinal cord compression. At present, however, no precise algorithm exists for choosing the appropriate surgical intervention in these patients. However, per the literature, the prevention of sagittal angulation and instrumentation of a minimum number of vertebrae to achieve canal decompression is accepted as a common opinion[3,4].

Notably, anterior and posterior techniques are used for the

Correspondence (İletişim): Oğuz Baran, M.D. Haseki Egitim ve Arastirma Hastanesi, Norosirurji Klinigi, Istanbul, Turkey
Phone (Telefon): +90 212 453 20 00 **E-mail (E-posta):** oguzbaran@gmail.com
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stabilization of thoracic vertebral fractures. Although adequate spinal canal decompression is achieved with anterior intervention. Nonetheless, serious complications, such as increased bleeding, vascular injury, visceral organ injuries, and insufficient surgical experience, constitute a serious disadvantage compared with posterior intervention. Therefore, posterior intervention is considered safer and preferred more[5]. Posterior surgical techniques, especially the short-segment (SS) transpedicular instrumentation and distraction, have gained popularity recently owing to the kyphotic angulation and adequate spinal canal decompression provided by the fusion of fewer mobile vertebral segments[6,7].

In this study, we analyzed the pre-operative, post-operative, and long-term follow-up radiological data of 25 patients who underwent SS stabilization and distraction for thoracic vertebra burst fracture. This study aimed to demonstrate that SS instrumentation and distraction can provide adequate spinal canal decompression and kyphosis angulation.

Materials and Methods

This study retrospectively analyzed patients who were admitted to our clinic for thoracic vertebra burst fractures between 2014 and 2017 and who underwent fusion with transpedicular screws. This study included patients who were graded E per the American Spinal Injury Association (ASIA) classification had magnetic resonance imaging or computed tomography images revealing canal occupation rate (COR) <40% and sagittal index (SI) <25°, had no posterior column fractures, underwent transpedicular screw fusion to the lower and upper segments of the fractured vertebral corpus (SS), and were followed for at least 2 years.

The same surgical team performed the surgical procedures. The pre-operative neurological status of the patients was evaluated according to the ASIA classification[8]. The SI was determined by measuring the angle between the lines drawn from the upper and lower endplates of the fractured vertebra, known as the vertebral wedge angle, as described by Farcy[9]. The COR was determined as the ratio of the mean of midsagittal canal diameter of the upper and lower vertebrae adjacent to the fractured vertebra to the midsagittal canal diameter at the level of the fractured vertebrae, according to Willian method[10].

Statistical analysis

Statistical analysis was performed using the MedCalc Statistical Software version 12.7.7 (MedCalc Software bvba, Ostend, Belgium; http://www.medcalc.org; 2013). Descriptive statistics were presented using the mean and standard deviation for normally distributed variables. Independent samples t-test was used to compare the pre-operative, post-operative, and 2-year follow-up data concerning SI and COR between the two groups. Statistical data were accepted as significant when a two-sided p-value was lower than 0.05.

Results

This study evaluated overall 25 patients – 9 women (36%) and 16 men (64%) – who underwent SS fusion for thoracic burst fracture. The mean age at the time of surgery was 36.6 years (±6.4, range 23–48 years). No statistically significant differences were noted regarding age distribution between women (36.1±4.4 years) and men (36.8±7.4 years) (p=0.842).

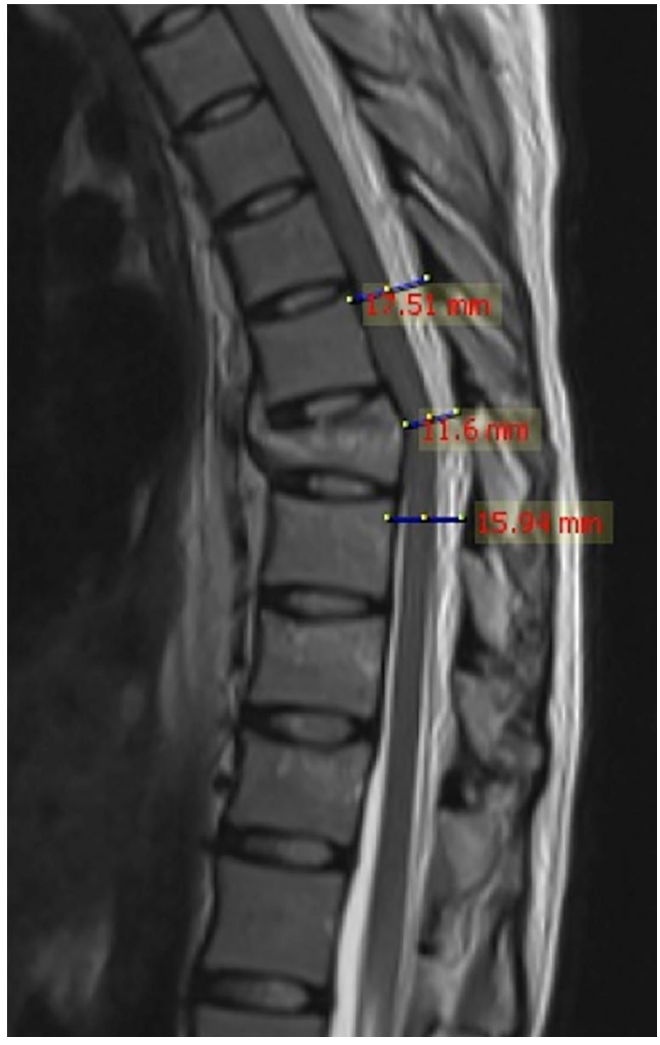

Figure 1. Intra-canal occupation rate due to thoracic vertebra fracture was 30%.

Among the 25 patients, the site of thoracic burst fractures was as follows: The eighth vertebra in ten patients, the ninth vertebra in six patients, the sixth vertebra in four patients, and the seventh vertebra in fine patients. The mean pre-operative SI of patients was 21.7°±1.3° (range, 20–25°), and the mean COR was 35.3%±5.3% (range, 25–40%). In the early post-operative period, the mean SI measurement was 16.25°±1.4° (range, 15–20°), and the mean COR was 6.9%±2.5% (range, 5–10%). Both the SI and COR showed statistically significant changes between the pre-operative and post-operative periods (pSI=0.001, pCOR=0.001). Radiographic evaluation results of patients at a 2-year follow-up were as follows: Mean SI was 16.2°±1.25° (range, 15–19°) and the mean COR was 6.25%±2.4% (range, 5–10%). No statistically significant differences were noted between both SI and COR postoperatively, and after 2 years of follow-up (pSI=0.916, pCOR=0.565). After 2 years of follow-up, a minimal change was observed regarding the SI (1°) in four patients, and a minimal regression in the COR was noted in two patients.

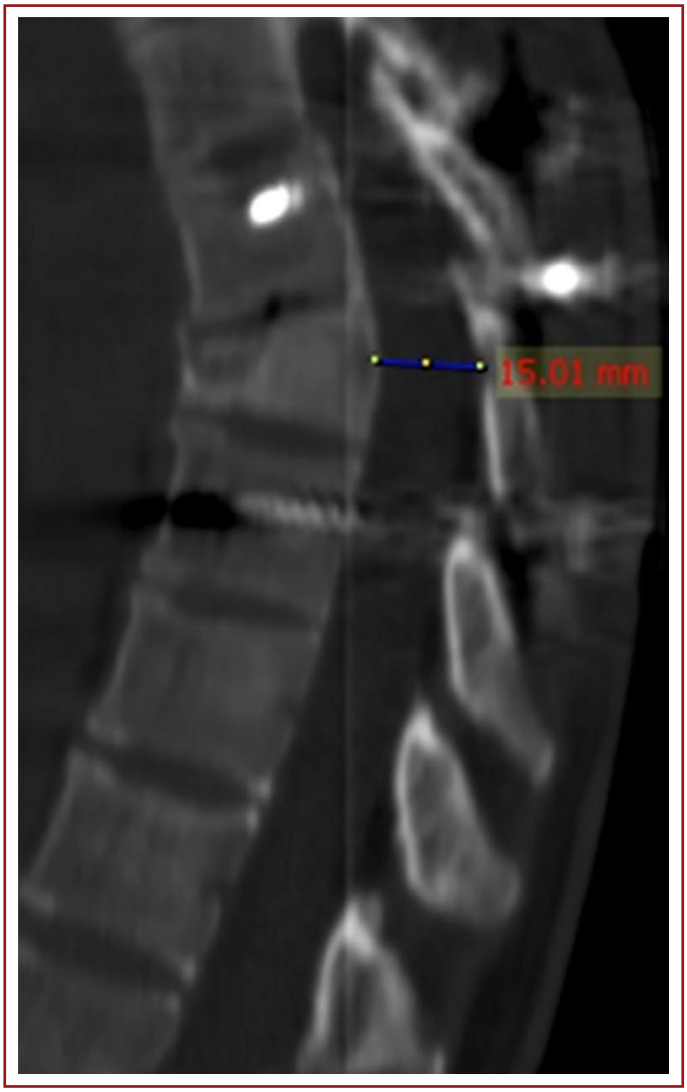

Figure 2. Improvement of the rate of intravascular occupation after short segment stabilization and distraction in the same patient.

Preoperative and postoperative images of a case with short segment stabilization are shown in Figures 1 and 2.

Discussion

The necessity of surgical treatment in burst fractures of the vertebra is a well-known fact[3,11-14]. Regardless of the method chosen, the main goal of treatment is to ensure early mobilization of the patient by stabilizing the vertebral column and eliminating the compression of bone fragments extending into the canal. Therefore, to achieve stabilization surgically, it is necessary to limit the number of immobile segments through as little instrumentation of the vertebra as possible[15]. However, the treatment of burst fractures is controversial[16,17]. In the presence of unstable fractures of the thoracic vertebra, stabilization can be achieved by the anterior or posterior intervention. However, studies have shown that both surgical methods have no clear superiority over the other[18]. Although adequate spinal canal decompression is provided by anterior intervention, posterior intervention is safer and more preferred because of the serious complications caused by the anterior approach, such as increased bleeding, vascular injury, visceral organ injuries, and difficulty in instrumentation[5]. The posterior SS transpedicular instrumentation method has recently garnered popularity due to the fusion of fewer mobile sites[6,7]. Moreover, SS stabilization is considered to reduce complications due to shorter operating time and lesser surgical fixation materials[19].

Verlaan et al.,[20] in a review of studies evaluating the results of posterior surgical techniques used in the treatment of thoracic and thoracolumbar fractures, noted no differences between patients who underwent long-segment (LS) stabilization and those who underwent SS instrumentation. Besides, they reported low complication rates and shorter return-to-work time in SS patients. However, in an experimental study, they reported that the SS stabilization procedure based on the three-column concept of burst fracture was inadequate concerning flexion, extension, and axial rotation tests, and a sturdier construct was needed to control the fracture[21]. Tezeren et al.[22] reported that the SI and local kyphosis angle were better in the LS instrumentation group than the SS instrumentation group. However, a recent study determined that the results of kyphosis correction and continuity of

sagittal balance after SS fixation for thoracolumbar burst fracture were similar to the results of LS instrumentation. Therefore, we believe that SS stabilization can be an excellent option in appropriate cases.

This study aimed to evaluate the 2-year follow-up results of patients who underwent SS fixation for thoracic vertebral fracture. The SI and COR were compared using statistical analysis to evaluate the pre-operative, early post-operative, and 2-year follow-up results. Based on our experience, the ASIA score was found to be A, B, C, and D in patients who had surgery for thoracic vertebral fracture and had more than 40% COR. Hence, we think that SS fixation and distraction procedure are not suitable in patients with more than 40% COR, and ideally, posterior decompression should be performed in them. Notably, the patient group in our study comprised patients with an ASIA score of E wherein the SI was <25°, the COR was <40%, and no neurological motor or sensory deficits were present.

Nevertheless, two main conclusions can be drawn from this study. First, according to the statistical analysis, it was observed that both the SI and COR decreased significantly in the pre-operative period in patients with thoracic burst fractures treated with SS stabilization (pSI=0.001, pCOR=0.001). Second, no statistical difference was observed between the results obtained postoperatively and at a 2-year follow-up (pSI=0.916, pCOR=0.565). These findings reveal that SS stabilization is sufficient to reduce the SI and COR, as well as to maintain the radiological parameters during long-term follow-up.

Conclusion

No increase in the SI because of kyphosis was observed during the mean 2-year follow-up of 25 patients who underwent surgery for thoracic vertebra burst fracture. Therefore, we believe that SS stabilization is effective, especially in patients with the COR <40%, SI <25°, ASIA score of E, and preserved posterior elements of the vertebra.

Ethics Committee Approval: Ethics committee approval was not obtained according to retrospective nature of the study.

Peer-review: Externally peer-reviewed.

Conflict of Interest: None declared.

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