DOI: 10.53469/jcmp.2024.06(11).51

To Investigate the Clinical Effect of Percutaneous Posterior Pedicle Screw System on Asymptomatic A3 Thoracolumbar Burst Fracture

Liang Jin[1], Xianteng Yang[2], Zhuojia Zhou[2], Jun Zhang[3], Jie Chen[3], Haifeng Huang[2,*]

[1,3]Guizhou University of Traditional Chinese Medicine, Guiyang 550025, China
[2]Guizhou Provincial People's Hospital Orthopedics Guiyang 550002, China
Correspondence Author, huanghaifeng@gz5055.com

Abstract: ***Objective:*** ***To evaluate the efficacy of percutaneous posterior pedicle screw system in asymptomatic single segment A3 thoracolumbar burst fractures.*** ***Methods:*** ***From January 2018 to May 2021, 25 patients with asymptomatic single-segment A3 thoracolumbar burst fractures without neurological symptoms were treated. All patients were treated with a simple percutaneous posterior pedicle screw system to perform a reduction of the fracture block by the same group of physicians. CT examinations were performed before and after surgery, and the fracture reduction and spinal canal diameter recovery were followed up, and the clinical data were retrospectively analyzed.*** ***Results:*** ***Postoperative CT scan was performed on 25 patients. The results showed that the posterior margin of the thoracolumbar spine was well restored, the height of the vertebral body and the diameter of the spinal canal were basically restored, and the space occupied by the spinal canal disappeared. On the third day after surgery, the patients had a postoperative cobb angle (6.16°±3.43°), anterior edge compression ratio of vertebral body (5.55%±2.61%), and vertebral body translation rate (6.81%±3.07%)Compared with the preoperative cobb angle (14.5°±5.91°), the anterior edge compression ratio of vertebral body (30.96% ±5.80%), the vertebral body translation rate (21.44% ±7.29%), the spinal canal mass (35.75% ±12.46%), and the VAS score (6.52±1.42) were significantly improved. The difference was statistically significant (P <0.05). All patients were followed up for 22 to 30 months, with an average of 26.44±2.02 months. The postoperative cobb angle, anterior margin compression ratio, vertebral body translation rate, and spinal canal occupancy rate were not significantly different after surgery. The difference was not statistically significant (P>0.05).*** ***Conclusion:*** ***Single segment A3 thoracolumbar burst fracture without neurological symptoms treated with percutaneous posterior pedicle screw system, no open surgery, has certain effectiveness and safety, This surgical method can be combined with clinical indications for scientific and rational application to reduce surgical trauma.***

Keywords: Lumbar vertebrae, Thoracic vertebrae, Fracture, Posterior percutaneous.

1. Introduction

High-energy trauma such as car accidents, falling and extrusion injuries of cadres are easy to cause thoracic and lumbar fractures. Thoracolumbar burst fractures are often concentrated in the chest 10- waist 2 segments, prone to chest 12, waist 1 and waist 2 vertebrae. Clinically, AO classification proposed by Magerl [1] and other scholars is often used to classify thoracolumbar fractures. At the same time, according to imaging manifestations and associated spinal soft tissue injuries, they are divided into three types: A, B and C, and each type is divided into three subtypes. Type A injury is the most common type of spinal fractures in the AO classification, where type A3 is a burst fracture due to axial compression. Type A3 thoracolumbar burst fractures are mainly fractures of the anterior middle column under the axial load of the spine. During injury, the axial load of the spine is increasing. When the axial load is greater than the anti-compression capacity of the vertebral body, it causes the vertebral body to burst, and causes the loss of the vertebral height and the increase of the anterior and posterior diameter. At this time, the spinal canal located at the rear of the vertebral body has relatively low pressure. After the destruction of the posterior wall of the vertebral body, the burst fracture block and soft tissue are easy to migrate back into the spinal canal, resulting in neurological symptoms. Type A3 thoracolumbar burst fracture treatment with posterior pedicle nail bar system instrumentation is considered to be a reliable and safe surgical modality. This method restored the vertebral body height to the original normal level, while relieving the nerve compression, the kyphosis deformity was corrected by [2], and reconstructed the stability of the spine. Studies have shown that patient-related quality of life is affected several years after posterior surgery of the thoracolumbar fractures without neurological deficit [3]. Iatrogenic muscle injury is associated with posterior stabilization of the spine, and open reduction and fixation is an important cause of postoperative pain, with persistent muscle defects [4] 1 year after open surgery for A3 fracture. Percutaneous short-circuit fixation plus kyphoplasty for thoracolumbar fracture can significantly reduce spinal deformity and postoperative pain [5]. This study is based on 25 patients with type A3 single-level thoracolumbar burst fracture without combined neurological symptoms admitted to Guizhou People's Hospital from January 2018 to May 2,2021, treated with percutaneous posterior pedicle nail rod system without open surgery, and postoperative follow-up period of 22-20 months, averaging 26.44 ± 2.02 months. Now, the report is as follows.

2. Materials and Methods

2.1 Inclusion Criteria and Exclusion Criteria

Inclusion criteria: 1) confirmed as single level thoracolumbar burst fracture without any nerve compression symptoms; 2) thoracolumbar fractures were type A3; 3) without serious medical disease and intolerant to surgery; exclusion criteria: 1) pathological fracture or severe osteoporosis; 2) with infectious disease; 3) patients with poor compliance; 4) old fracture.

2.2 General Information

The cases in this group were from 25 patients with single segment A3 thoracolumbar burst fracture with no neurological symptoms admitted to Guizhou People's Hospital from January 2018 to May 2021, among which 17 cases were male and 8 women were 26-62 years old, and the average age was 47.84 ± 7.84 years old, among which 7 cases were injured by heavy objects, 7 cases were injured by traffic accidents, and 11 cases were injured from high fall. Fracture site: T11 4, T12 9,1 10 L, L2 2; all patients were diagnosed with burst fracture into the spinal canal, patients had AO type A3, without any neurological symptoms, and spinal cord injury was grade E according to the American Spinal Injury Association (ASIA) classification. All patients were treated with the percutaneous posterior pedicle screw distraction technique, and the patients were reviewed and followed up accordingly postoperatively. This study was approved by the hospital ethics committee, and all patients signed the informed consent form.

2.3 Method

All the cases used the internal fixation system. The specific operation steps were: under the general anesthesia of endotracheal intubation, the patient was in the prone position and marked the lateral edge of the spinal joint and the thickness of the pedicle root and the skin soft tissue to ensure a good Angle during the needle entry. The guide needle was treated through the skin opening, which reached the lateral edge of the pedicle in an oblique direction, and the puncture was performed inward in the direction of the pedicle. Under the fluoroscopy of the C arm, the inner core was removed and the K-wire was inserted. A hollow tissue separator is inserted along the K-wire for soft tissue protection until the bone surface. After tapping, pedicle screw (preoperative CT measurement). The connection rod was installed and the fracture was reduced. The height of the injured vertebra was recovered under C-arm fluoroscopy, and the kyphodeformity was corrected. The drain was placed for 24 hours to 48 hours, and antibiotics were routinely used to 24 hours to 48 hours.

2.4 Statistical Treatment

Data analysis using SPSS26.0 statistical software, and measurement data are expressed as mean ± standard deviation (x±s). Data were compared by paired samples t-test; P <0.05 was considered statistically significant.

3. Result

All patients received 22 to 30 months of follow-up, with a mean of 26.44 ± 2.02 months. Cobb angle, anterior edge compression rate, spinal canal occupancy, vertebral translation rate, and VAS scores, with statistical differences (P <0.05, Table 1). However, there was no significant statistical difference between Cobb angle, spinal canal proportion, vertebral translation rate and compression rate of vertebral front at the last follow-up (P> 0.05, Table 1). Figure 1 shows the typical case

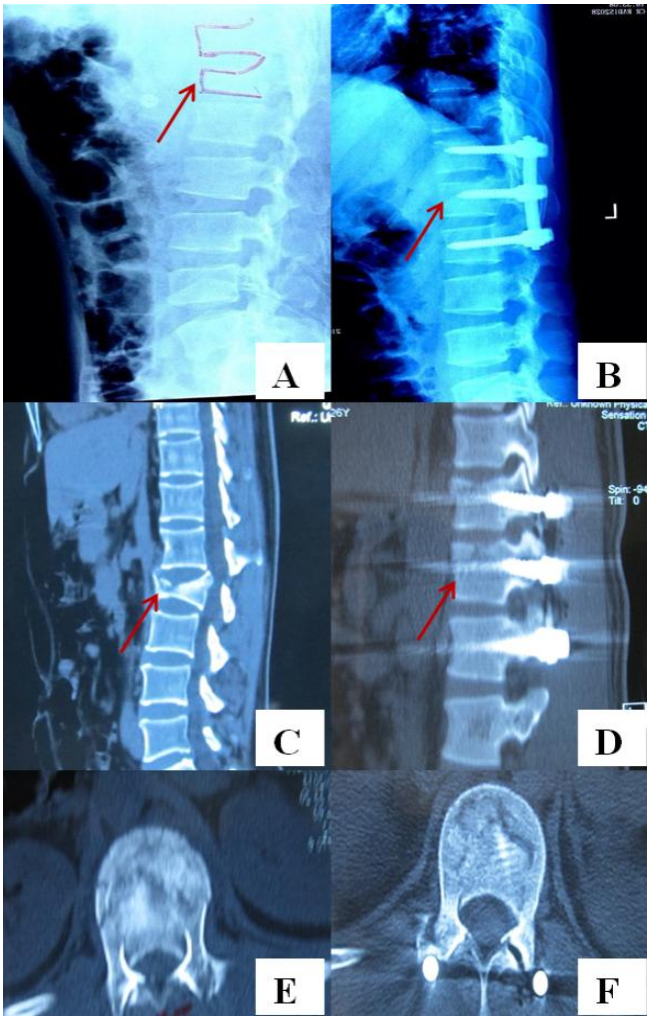

Figure 1: A typical male patient, a 26-year-old patient, was hospitalized with low back pain and limited mobility injury. A, C, E: DR and CT suggested burst fracture of thoracic 12 vertebra, forming space into the spinal burst. B, D and F: DR and CT plain scan indicated good reduction of intraspinal fracture block, basic recovery of thoracic 12 vertebral height and spinal aperture.

Table 1: Comparison of relevant parameters between preoperative, postoperative and follow-up of 25 patients (x±s)

	Cobb angle (°)	Vertebral translation rate (%)	Spinal canal occupancy rate (%)	Spinal canal occupancy rate (%)	Visual Analogue Scale score (score)
Preoperative	14.5±5.91 (scope7.68-26.48)	21.44±7.29 (scope10.18-37.28)	35.75±12.46 (scope15.03-60.09)	30.96±5.80 (scope15.63-40.08)	6.52±1.42 (scope3-8)
Postoperative	6.16±3.43* (scope2.36-13.50)	6.81±3.07* (scope2.43-15.48)	10.45±5.09* (scope4.13-23.16)	5.55±2.61* (scope1.33-11.22)	2.36±1.04* (scope1-4)
Follow-up	6.17±3.42# (scope2.31-13.45)	6.76±3.06# (scope2.40-15.10)	10.43±4.85# (scope4.15-21.80)	5.56±2.60# (scope1.35-11.38)	2.34±1.02# (scope1-3.9)

Note: * indicates P <0.05; # indicates P> 0.05 compared to the postoperative group

4. Discussion

Thoracolumbar burst fractures in spinal injuries are one of the common trauma [6]. At present, there is no unified standard for the treatment of A3 type thoracolumbar burst fracture without neurological symptoms at home and abroad, and the overall indications for non-surgical treatment of patients with traumatic thoracolumbar burst fracture are unclear [7]. The treatment of vertebral traumatic burst fractures without neurological disease is still controversial [8]. Thoracolumbar AO type A3 fracture is an axial unstable fracture, but thoracolumbar A3 fracture and other fractures at the thoracolumbar junction are all risk factors for compression of the dural sac and kyphosis [9]. Surgical treatment of patients can restore their active function early, while avoiding the further protrusion of the spinal canal to the back and causing neurological symptoms. For A3 thoracolumbar burst fracture with intraspinal bone protrusion, there may be different degrees of kyphosis deformity. Surgical treatment can restore the height of the vertebral body, reduce the intraspinal fracture block, and avoid the aggravation of long-term kyphosis deformity to the greatest extent [10]. The paper focuses on the efficacy of spinal bone reduction through the posterior percutaneous pedicle nail rod system, and [11] of pedicle internal fixation through the standard posterior stabilization technique in spinal surgery. The study results showed that the fracture blocks of the patient protruding into the spinal canal had achieved good reduction, and the proportion rate in the spinal canal after surgery was significantly reduced compared with the preoperative operation, and the statistical results were statistically significant. For burst fractures of single segment A3 thoracolumbar segment, the fixation time through the vertebral pedicle is short, which has more advantages for postoperative vertebral height maintenance and sagittal alignment than bone grafting [12]. In this study, the injured vertebra and its upper and lower vertebrae were nailed separately, and a relatively satisfactory recovery of the injured vertebra height was obtained after surgery. MRI revealed no significant lesions in the attached discs in thoracolumbar A3 fractures, and no major changes in [13] in signal strength and morphology. The reason may be that while the opening of the nail rod system restores the vertebral height, the collagen fibers in the disc converge into the center, thus producing the pulling force on the posterior edge of the fracture block, so that the posterior edge of the fracture block is well reduced [14].

Zou Wei and other scholars found that minimally invasive percutaneous pedicle grounding nail for the treatment of A3 type thoracolumbar burst fracture with neurological injury patients feedback good [15]. Posterior short segment pedicle nail combined with transpedicle root bone is an ideal method for the treatment of thoracolumbar burst fractures [16]. Traditionally, short-segment pedicle screw fixation combined with fracture block reduction through the paravertebral muscle approach is an effective surgical method for the treatment of thoracolumbar burst fractures [17]. Clinically, the treatment of single node type A3 thoracolumbar burst fracture depends on its clinical symptoms, neurological deficit and radiological features. Neurologically intact patients with mild malformations and biomechanical stability can be treated for [18] with conservative therapies. This study intraoperative not open surgery, simple percutaneous posterior pedicle nail rod system hold open treatment, reached the purpose of indirect spinal bone internal reduction, all patients with postoperative spinal fractures have achieved good reduction, the method effectively avoid the traditional surgical posterior laminectomy decompression effect on the spinal cord and cone, reduce the postoperative adhesion, reduce the harassment of local muscle. A3 thoracolumbar burst fracture, with single segment fixation of percutaneous pedicle screw, has safe and reliable postoperative efficacy, while reducing the surgical trauma and postoperative pain [19]. However, Aras EL et al proposed different views, suggesting that surgical treatment of patients with traumatic thoracolumbar burst fractures without neurological symptoms may not be a cost-effective strategy [20] compared with conservative treatment. But for unstable A3 thoracolumbar burst fractures, the surgeon aims to reduce compression from the nerve roots and spinal cord while providing stable internal [21] in the diseased spinal segment. Through this study, we show that patients with A3 thoracolumbar burst fracture combined with fracture block protrusion into the spinal canal without neurological symptoms, treated with percutaneous posterior pedicle nailing rod system, without laminectomy decompression, have certain effectiveness on thereduction of the bone block.

References

[1] Magerl F, Aebi M, Gertzbein SD, Harms J, Nazarian S. A comprehensive classification of thoracic and lumbar injuries. Eur Spine J. 1994;3(4):184-201.

[2] Zeng Zhongyou, Zhang Jianqiao, Jin Caiyi, etc. Follow-up results of thorac-of fixation fixation fixation fixation fixation fixation fixation fixation over 2 fixation [J]. Chinese Bone Injury, 2012,25 (2): 128-132.

[3] Moelmer M, Gehrchen M, Dahl B. Long-term functional results after short-segment pedicle fixation of thoracolumbar fractures[J]. Injury, 2013; 44(12): 1843-1846.

[4] Pishnamaz M, Schemmann U, Herren C, et al. Limitations in clinical outcome after posterior stabilization of thoracolumbar fractures do not correlate with dynamic trunk muscle dysfunction: an ultrasound controlled prospective cohort study[J]. Eur J Med Res,2018;23(1):26.

[5] Korovessis P, Mpountogianni E, Syrimpeis V. Percutaneous pedicle screw fixation plus kyphoplasty for thoracolumbar fractures A2, A3 and B2[J]. Eur Spine J,2017;26(5):1492-1498.

[6] Wang J, Zhou Y, Zhang ZF, et al. Radiological study on disc degeneration of thoracolumbar burst fractures treated by percutaneous pedicle screw fixation[J]. Eur Spine J,2013;22(3):489-494.

[7] Bakhsheshian J, Dahdaleh NS, Fakurnejad S, et al. Evidence-based management of traumatic thoracolumbar burst fractures: a systematic review of nonoperative management [J]. Neurosurg Focus, 2014; 37(1):E1.

[8] Oberkircher L, Schmuck M, Bergmann M, et al. Creating reproducible thoracolumbar burst fractures in human specimens: an in vitro experiment[J]. J Neurosurg Spine,2016;24(4):580-585.

[9] Guzey FK, Eren B, Tufan A, et al. Risk Factors and Compression and Kyphosis Rates after 1 Year in

Patients with AO type A Thoracic, Thoracolumbar, and Lumbar Fractures Treated Conservatively [J]. Turk Neurosurg, 2018;28(2):282-287.
[10] Mattei TA, Hanovnikian J, H Dinh D. Progressive kyphotic deformity in comminuted burst fractures treated non-operatively: the Achilles tendon of the Thoracolumbar Injury Classification and Severity Score (TLICS)[J]. Eur Spine J, 2014, 23(11):2255-2262.
[11] Hahn P, Oezdemir S, Komp M, et al. Navigation of pedicle screws in the thoracic spine with a new electromagnetic navigation system: a human cadaver study[J]. Biomed Res Int, 2015,2015:183586
[12] Jiang Weiyu, Zhao Liujun, Ma Weihu, et al. Transtraumatic vertebral fixation and transinjured vertebral bone grafting in the treatment of thoracolumbar rupture A case-control study of fractures[J]. Chinese Journal of Bone Injury, 2013, 26 (11): 923-926.
[13] Jiang Weiyu, Zhao Lijun, Ma Wuhu, et al. Transvertebral fixation and transvertebral graft in the treatment of thoracolumbar burst A case-control study of bone fractures [J]. Chinese Bone Injury, 2013,26 (11): 923-926.
[14] Loriaut P, Mercy G, Moreau PE, et al. Initial disc structural preservation in type A1 and A3 thoracolumbar fractures[J]. Orthop Traumatol Surg Res, 2015; 101(7): 833-837.
[15] Huang Yusheng, Zhang Ning, Xiao Yayun, et al. Anatomical analysis of reduction of thoracolumbar burst fracture type A3 [J]. Journal of Changzhi Medical College, 2015,29 (3): 174-175.
[16] Zou Wei, Xiao Jie, Zhang Yang, et al. Minimally invasive percutaneous pedicle root nails and sub-incision channel decompression in the treatment of A3 thoracic and lumbar fractures[J]. Chinese Journal of Reconstructive and Reconstructive Surgery, 2017, 31(7):830-836.
[17] Li Gaoming, Tang Dezhi. Posterior short segment pedicle nail combined with transpedicle bone graft for thoracolumbar burst fracture[J]. Chinese Journal of Bone Injury, 2015, 28(1):8-11.
[18] Dong Yilong, Peng Maoxiu, Huang Yijian, et al. Treatment of thoracic and lumbar fracture by short segment combined with traumatic fixation of the paravertebral intermuscular space[J]. Chinese Journal of Bone Injury, 2012, 25(10): 834-837.
[19] Shamji MF, Roffey DM, Young DK, et al. A pilot evaluation of the role of bracing in stable thoracolumbar burst fractures without neurological deficit[J]. J Spinal Disord Tech,2014;27(7):370-375.
[20] Ma Yiqun, Li Xilei, Domg Jian et al. Percutaneous and open pedicle screw fixation for incomplete thoracic and lumbar burst fractures[J]. Chinese Medical Journal, 2012, 92(13): 904-908.
[21] Aras EL, Bunger C, Hansen ES, et al. Cost-Effectiveness of Surgical Versus Conservative Treatment for Thoracolumbar Burst Fractures[J]. Spine (Phila Pa 1976), 2016;41(4):337-343.
[22] Zdeblick TA, Sasso RC, Vaccaro AR, et al. Surgical treatment of thoracolumbar fractures[J]. Instr Course Lect, 2009, 58: 639-644.