

Surgical Outcome in Thoracolumbar Fractures Managed by Short-segment Pedicle Instrumentation

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Abstract

Introduction: This study aims to evaluate the efficiency of short-segment instrumentation in treating thoracolumbar fractures in our institute. **Materials and Methods:** Twenty-two patients underwent posterior short-segment instrumentation for thoracolumbar fractures in our institute from 2007 to 2010 were included in this retrospective study. Radiological evaluations were carried out by measuring regional kyphosis angle (RA), anterior vertebral body compression percentage (AVC), and sagittal index (SI) during preoperative, postoperative and final follow-up, with the aim to investigate the rate of correction loss and implantation failure in relation to the Arbeitsgemeinschaft für Osteosynthese(AO) classification of fracture system and the Load Sharing score system. CT scans were also used to determine the preoperative to postoperative canal compromise ratio. During the final follow-up, clinical outcomes were analysed based on scores from the Denis' Pain's and Work scales and neurological function was scored according to the Frankel classification. **Results:** At the final follow-up (average duration of 15 months), 21 patients (95%) who partially or fully recovered from thoracolumbar fractures were able to resume daily activities with no complaints of pain, or only slight pain. No deterioration in neurological function were recorded. Upon evaluation at each point of time, (preoperative, postoperative and final follow-up), the average RA improved from 21° to 3.5° to 5.6°, average AVC improved from 40.8% to 90.2% to 88.2%, and average SI changed from 19.1° to 3.1° to 4.1°, respectively. Average canal compromise ratio decreased from 45% to 6.7% after surgery. No correlation was found between loss of correction and AO classification of fracture system, and loss of correction and Load Sharing system scores. Also, no correlation was found between clinical outcomes and the correction loss limited to 10°. **Conclusion:** Posterior short-segment fixation in thoracolumbar fractures showed a satisfactory outcome in 95% of the patients based on a 15-month follow-up in our institute, even among patients with comminuted fractures injuries.

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Key words: Short-segment fixation, Spine, Kyphosis angle

Introduction

Thoracolumbar junction vertebrae are particularly vulnerable in traumatic injuries and up to 90% of all spinal fractures occur in this area.¹ Treatment of thoracolumbar fractures has been a controversial subject for many years.²⁻⁴ Non-operative management recommended by some authors is effective when there is no evidence of neural compression or spinal instability. However, operative intervention should be seriously considered when a fracture is complicated by progressive neurological deficiency or in situations like neural element compression, fracture dislocation or progressive symptomatic kyphosis.^{5,6} The goals of surgical treatment of thoracolumbar fractures are to restore vertebral column stability, decompress the neural tissue, facilitate

neurological recovery, and prevent loss of correction with neurological impairment.^{4,6} Different surgical strategies and treatment methodologies were developed in past decades, but no one single method is clearly better than the rest, making it difficult to determine the optimal treatment strategy.⁷⁻⁹ Orthopaedic surgeons should consider the efficiency and advantages of different fracture segment fixation approaches (anterior, posterior), fixation ranges (short-, intermediate- or long-segment fixation), and whether or not bone grafting is necessary. An anterior approach can provide excellent visualisation for decompression of neural elements and easy access for reconstruction of the anterior column with a load-sharing construct. However, an anterior

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approach may be more technically demanding for obtaining a clear exposure, and thorough neural decompression, which can increase morbidity and potential vascular injuries.^{2,4} On the other hand, a posterior approach is technically less challenging. As a result, this approach is recommended by majority of the spinal surgeons as the choice of treatment for unstable thoracolumbar injuries.

Pedicle screw devices allow immediate stable fixation since the screws traverse all the 3 columns. Advances in spinal instrumentation have led to the development of short-segment spinal instrumentation which provides sufficient fixation power without the need to fuse uninjured motion segments. Ever since Dick et al¹⁰ introduced this technique, short-segment pedicle instrumentation has become a popular method for treating thoracolumbar vertebral fractures.¹¹ As a result, fewer motion segments are incorporated, and postoperative morbidity is decreased. Like any other methods, this method has been associated with some complications such as early implant failure of fixation with progressive kyphosis. When treating unstable thoracolumbar fractures, different types of instrumentation for fixation have been described in practice such as “2 levels above and 1 level below pedicle screw fixation” and “1 level above and 1 level below including the fracture level pedicle screw fixation”.^{9,12-14}

To ensure proper use of short-segment spinal instrumentation and prevent any possible failure of fixation, McCormack et al¹⁵ who introduced a Load Sharing scoring system concluded that thoracolumbar fractures with a score of 7 points or more would ultimately result in a short-segment implant failure. Earlier studies reported the suboptimal outcomes with short-segment fixation based on this scoring system. Recent studies, however, demonstrated favourable clinical results compared to studies in the past.^{7,16-21} In our institute, short-segment fixation has been the choice of treatment for thoracolumbar fracture since 2007. Excellent spinal reduction, decompression of the neural elements, and spinal reconstruction were observed in all patients treated with this method, without any failed cases. This retrospective study evaluated the radiological and clinical outcomes from short-segment fixation in 22 patients. The Load Sharing scores alone might not be reliable in predicting posterior instrumentation failure as thoracolumbar fractures patients with high Load Sharing scores could still be successfully treated by short-segment fixation in our institute.

Materials and Methods

Study Patients

Posterior short-segment pedicle instrumentation was performed in 22 patients including 13 males and 9 females between 2007 and 2010. Patients' mean age was 38 ± 17

years. Causes of injury included motor vehicle accidents (8 patients), falling from a height (12 patients) and unspecified causes (2 patients). The average postoperative follow-up period lasted 15 ± 3 months.

Case Selection

Indication for the need for short-segment pedicle fixation included at least one of the following:^{4,7} posterior ligamentous complex failure, neurological injury, kyphosis of more than 20° as shown by radiographic imaging, loss of more than 50% vertebral body's height, compromised spinal canals, and spinal instability (based on the criteria of unstable thoracolumbar fractures by McAfee et al²²). Patients with osteoporosis or low bone mineral density (BMD) were at high risk of pedicle screw pullout.⁷ BMD was measured in all patients preoperatively, and patients aged over 55 years or had a BMD < -2.5 standard deviations (SD) below the young adult reference range were excluded for the short-segment intervention.

Radiographic Measurements

Plain radiographs were obtained at preoperative, immediate postoperative, and final follow-up (average duration of 15 months). Initial supine X-rays were taken because of the acuteness of the injury. Upright radiographs were obtained at the follow-up evaluations. For each lateral X-ray film, the following parameters were manually measured by 2 independent examiners according to the method described by Kim et al³ (Fig. 1). Regional kyphosis angle (RA) was defined as the angle between the superior endplate of the superior adjacent vertebra and the inferior endplate of the inferior adjacent vertebra.

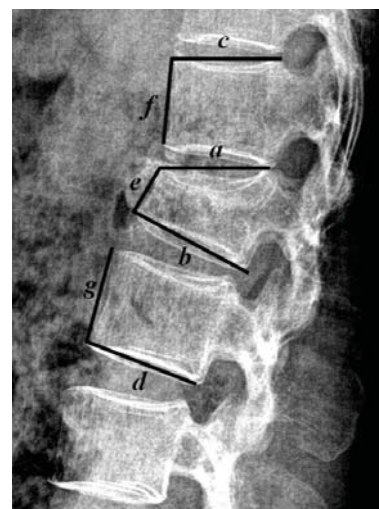


Fig.1 Schematic diagram of regional kyphosis (RA) and anterior body height compression (AVC) using the method of Kim et al.³
RA = angle between c and d; AVC = $2e/(f+g) \times 100$

Anterior vertebral body compression percentage (AVC) was calculated as the anterior height of the injured vertebra divided by average height of 2 adjacent anterior vertebrae. The sagittal index (SI) was the local kyphosis at a motion segment minus the baseline sagittal curve at the level of fracture according to the method of Farcy et al.²³ Possible vertebral body comminution and canal encroachment by bone fragments from the fractured vertebra were assessed by computed tomographic (CT) scan upon admission. The greatest narrowing of the spinal canal at the level of the fractured vertebra was measured, and compared with the average measurements of the vertebrae above and below. After the surgery, all patients received a CT scan to assess spinal canal restoration, and to determine the preoperative to postoperative canal compromise ratio. All fractures were classified using the AO classification of fractures system. The spinal injuries were also evaluated according to the Load Sharing spine fracture system scores outlined by McCormack et al.¹⁵

Surgical Techniques

Patients were carefully logrolled into a hyper extended, prone position with the abdomen hanging free for the purpose of minimising bleeding from the epidural venous plexus and achieving a significant initial reduction of the spinal fracture. All patients underwent short-segment posterior titanium alloy pedicle screw fixation, including 1 level above and 1 level below the fractured vertebra. For cases of highly comminuted fractures, screw fixation covered vertebrae “2 above and 1 below” the comminuted 1 (Fig. 2) or “inclusion of the fracture level” (Fig. 3). Pedicle screw constructs were used. The intermediate screws were used at the fracture level in all except 3 of the patients with comminuted fractures of the pedicle. The polyaxial screws were only placed at the fractured vertebra, with monoaxial screws placed at adjacent levels. After pedicle screw instrumentation, the 6 mm rods were contoured to reproduce the normal sagittal curvature of the thoracolumbar spine. The rods were then

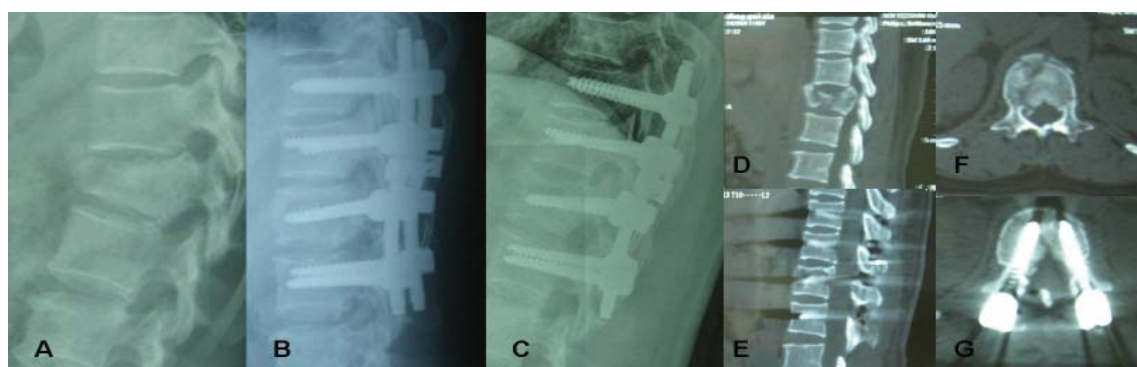


Fig. 2. Images of L1 unstable burst fracture in a 46-year-old female who fell from a height. (A) Preoperative lateral plain radiograph; (B) Lateral view of immediate postoperative result: two above-one below instrumentation with intermediate screws at the fracture level. (C) Radiograph at 15 months post-operation showed good maintenance of correction. (D, F) Preoperative CT scan images in axial and sagittal planes revealed a spinal canal compromise of about 45%; (E, G) Postoperative CT scan images in axial and sagittal planes revealing a reduction of spinal canal occupation and the intermediate screws at the level of the fracture.

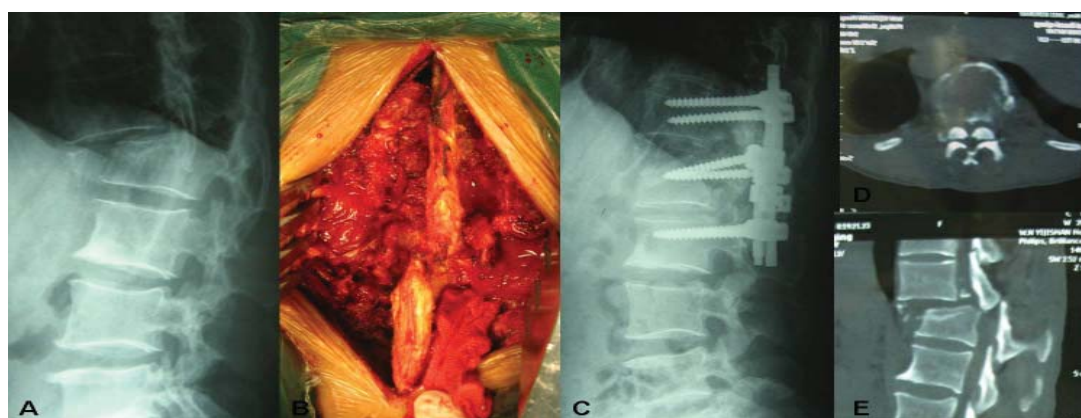


Fig. 3. Images of L1 unstable burst fracture in a 54-year-old male who fell from a height. (A) Preoperative lateral plain radiograph. (B) Intraoperative photo showing the posterior ligamentous disruption. (C) Postoperative lateral X-ray showed the optimal correction of kyphosis and realignment by the short-segment instrumentation with intermediate screws at the fracture level; (D, E) Preoperative CT scan images in axial and sagittal planes revealing severe spinal canal compromise and fracture-dislocation.

fixed within the heads of the pedicle screws, and torque was applied through the rod pusher to bring the vertebra back to the rod. Reduction of the fracture was accomplished by applying a gentle distraction force at the level of the fracture (ligamentotaxis).² Decompression, by total or partial posterior laminectomy, was performed only in cases where the spinal canal was narrowed by more than 50% by free bone fragments. This was followed by pushing back those bone fragments into their original positions (Fig. 4). A cross connector was used to link the rods. Either an interlaminar or an intertransverse process type of posterior fusion was performed by the authors. All patients were required to wear a rigid thoracolumbar orthosis (TLSO) for a minimum of 3 months postoperatively when they were able to stand upright. In this study, all implants were removed at an average time of 15 months after the surgery.

Clinical Assessments

Patients' preoperative neurological status and endpoint follow-up status after the surgery were recorded according to the modified Frankel's classification.²⁴ Denis' Pain and Work scales²⁵ were used to evaluate the clinical outcomes.

Statistical Analysis

Statistical analysis was carried out using SPSS13.0. Comparisons were performed using the Student's t-test for continuous data (changes in radiographic parameters over time), or for the average loss of correction in patients with Load Sharing score of ≤ 6 and ≥ 7 . The ANOVA test was carried out to compare the average loss of correction measured in AO type of A, B, and C. The probability level was set at $P < 0.05$.

Results

Radiographic Results

The average SI was 19.1° preoperatively, 3.1° immediate postoperatively, and 4.6° at the final follow-up with a correction loss of 1.5° . Each group's SI was significant different ($P = 0.02$). The mean AVC was 40.8% preoperatively, 90.2% immediate postoperatively, and 88.2% at the final follow-up with loss of body height of 2.0% in average. Each group's value was significantly different ($P = 0.01$). The average RA was 21° preoperatively, 3.5° postoperatively, and 5.6° at the final follow-up with a correction loss of 1.1° . This difference of value was also statistically significant ($P = 0.01$) (Table 1).

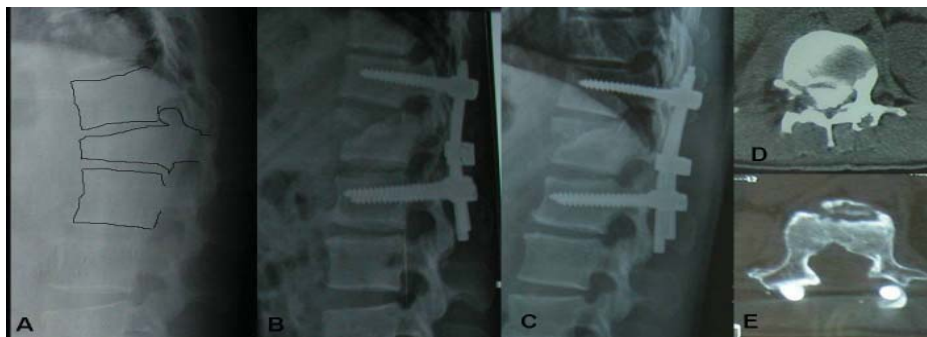


Fig. 4. Images of L1 unstable burst fracture in a 54-year-old male injured in a motorcycle accident. (A) Preoperative lateral plain radiograph. (B) Good correction achieved in the immediate postoperative lateral radiogram. (C) Good correction maintained at the final follow-up (15 months). (D) Preoperative CT scan in axial showed the spinal canal being completely narrowed by a retropulsed bony fragment. (E) Last follow-up axial CT image showed excellent remodeling in canal compromise.

Table 1. Changes in Radiographic Parameters over Time (Mean $\pm$ Standard Deviation)

Parameter	Preop	Postop	At final follow-up	Loss of correction	P values
RA ($^\circ$)	21 ± 5.2	3.5 ± 6.5	5.6 ± 5.9	1.1 ± 0.9	0.01
SI ($^\circ$)	19.1 ± 4.8	3.1 ± 5.4	4.1 ± 6.0	1.5 ± 2.1	0.02
AVC (%)	40.8 ± 12.5	90.2 ± 14.7	88.2 ± 13.8	2.0 ± 4.6	0.01

RA: Regional kyphosis angle; SI: Sagittal index; AVC: Anterior vertebral body compression percentage

According to AO classification of fractures system, these 22 cases were classified into 3 types: 13 cases were type A, 5 were type B and 4 cases were type C respectively. In type A fractures, the average RA values preoperatively, postoperatively, and at final follow-up were 19°, 3.0° and 4.1° respectively, with a loss of correction averaging 1.1°. In type B fractures, the respective values were 22°, 3.4° and 4.6°, with a loss of correction averaging 1.2°. In type C fractures, the respective values were 21°, 5.25° and 7°, with a loss of correction averaging 1.75°. There were no significant differences in RA values among the 3 groups according to AO classification (Table 2).

Sixteen patients had their Load Sharing scores ≤ 6 . The respective average RA preoperatively, postoperatively, and at final follow-up were 20.1°, 3.3° and 5.2° with a loss of correction averaging 1.9°. On the other hand, analysis of patients with Load Sharing scores ≥ 7 showed the respective

average RA values as 23.6°, 4.1° and 6.6° with a loss of correction averaging 2.5°. There were no significant differences in RA values between the 2 groups according to the Load Sharing scoring system (Table 3).

The cross-sectional area of the spinal canal was narrowed initially by an average of 45%. After the surgery, the narrowing was reduced to an average value of 6.7%. All the patients experienced significant improvement in spinal canal cross-section after the operative reduction by pushing back retropulsed bony fragments into their original positions.

Clinical Outcomes

At the final follow-up, back pain and movement disability were reduced significantly in 21 patients (95%), with the majority of patients reporting slight or no pain. These patients showed complete recovery and were able to resume their daily activities. (Table 4)

Table 2. Changes in Regional Kyphosis Angle According to AO classification (Mean $\pm$ Standard Deviation)

AO type	Preop (°)	Postop (°)	At final follow-up (°)	Loss of correction (°)
A (n = 13)	19 $\pm$ 4.7	3.0 $\pm$ 5.8	4.1 $\pm$ 5.1	1.1 $\pm$ 2.3
B (n = 5)	22 $\pm$ 5.3	3.4 $\pm$ 4.8	4.6 $\pm$ 4.3	1.2 $\pm$ 1.7
C (n = 4)	21 $\pm$ 4.2	5.25 $\pm$ 5.0	7.0 $\pm$ 5.8	1.75 $\pm$ 2.6
P value	0.37	0.13	0.08	0.61

Table 3. Changes in Regional Kyphosis Angle According to Load Sharing Score (Mean $\pm$ Standard Deviation)

Load Sharing score	Preop (°)	Postop (°)	At final follow-up (°)	Loss of correction (°)
≤ 6 (n = 16)	20.1	3.3	5.2	1.9
≥ 7 (n = 6)	23.6	4.1	6.6	2.5
P value	0.07	0.33	0.12	0.36

Table 4. Distribution of Patients Classified According to the Denis et al's Pain and Work Scale

Pain scale grade	No. of Patients	Work scale	No. of Patients
1. No pain	14	1. Heavy labor	15
2. Occasional, minimal pain	6	2. Sedentary job or lift restrictions	5
3. Moderate pain, no work interruption	1	3. Unable to return to previous work, but working full time	1
4. Moderate to severe pain, absence from work	1	4. Unable return to full time job	0
5. Constant severe pain, incapacitation	0	5. Unable to work	1

Table 5. Preoperative and Final Follow-up Neurological Status of 22 Patients

Preoperative neurological status	No. of Patients	Final follow-up neurological status				
		A	B	C	D	E
A	0	0	0	0	0	0
B	2	0	1	0	1	0
C	5	0	0	0	1	4
D	8	0	0	0	1	7
E	7	0	0	0	0	7

Neurological Recovery

There was no neurological deterioration as a result of the operative treatment. According to the Frankel grading system, 21 of 22 patients (95%) with incomplete injuries showed improvement by at least one grade (range, 1 to 2 grades). As an example, for immediate grade C postoperation, 4 cases improved to grade E at final check-up, and 1 case to grade D. There were 2 cases, 1 of grade B and 1 of grade D, where neither improvement nor deterioration were observed (Table 5).

Complications

There were no cases of implant failure due to pedicle screw breakage, loosening or disengagement. There were also no thrombophlebitis and superficial or deep wound infection. One patient with urinary tract infection was successfully treated with antibiotics.

Discussion

The concept of posterior transpedicular fixation of the spine was first introduced in the mid 1950s by Dr Roy-Camille²⁶ who used pedicle screw plates for the stabilisation of spinal injuries. Transpedicular screw fixation offers superior 3-column control and obviates the need for intracanal placement of hardware. Presently, the pedicle screw system represents a gold standard of spinal internal fixation.⁴ Short-segment posterior fixation is the most commonly used and has the advantage of incorporating fewer motion segments in the fusion, thus causing less morbidity than other methods. Although considered as a gold standard for treatment of thoracolumbar fractures, clinical outcomes reported about using short-segment pedicle is not consistent, which include a 5% to 94% failure rate of implants presumably due to several factors including implant failure, recurrent kyphosis and moderate-to-severe pain.^{3,27-29} Therefore, this method of fixation needs to be carefully re-evaluated. Our study provides an opportunity to re-examine the clinical outcomes when modern instrumentation and techniques are used during short-segment pedicle fixation.

To better predict the high failure rate of this method, McCormack et al¹⁵ advanced a classification system based on the Load sharing score. Three main factors are considered in this scoring system: the extent of the entire vertebral body comminution, the quantification of displacement for bony fracture fragments, and the amount of kyphosis correction necessary to restore the physiologically normal sagittal plane alignment at the level of the injury. Using this scoring system, Parker et al¹⁹ reported that short-segment instrumentation successfully treated thoracolumbar fractures when the load sharing score was 6 points or less, while those patients with scores over 7 points were treated with alternative surgery by anterior short-segment fixation to support the anterior column. As mentioned above, the risk of an anterior approach was higher than posterior approaches, and single anterior fusion might fail in cases with disrupted posterior stabilising elements. Meanwhile, long-segment fixation (bridging 2 to 3 levels above and 2 levels below the fractured vertebra) to lengthen the level arm of the construct were reported^{30,31} to enhance spinal stability and allow effective reduction of kyphotic deformity. However, long segment fixation could also result in stiffness and discomfort, and, it could not preserve the motion segments. Therefore, it was not suitable for treating young patients.^{3,9}

Differ from the literature, Gelb et al¹⁶ recently conducted a retrospective study of 27 patients with thoracolumbar fractures operated upon with short-segment fixation regardless of fracture pattern, injury level, associated injuries, or load sharing classification. The average length of follow-up was 14.4 months. They found no correlation between (i) loss of correction and load sharing classification, (ii) loss of correction and AO classification, (iii) or loss of correction and level of injury. None of the 27 patients experienced implant failure in terms of pedicle screw breakage, bending, loosening or pull-out. This study concludes that short-segment fixation without postoperative bracing could be successful in the treatment of thoracolumbar fractures. Short-segment fixation has been the choice of treatment for thoracolumbar fractures in our institute since 2007, and similar favourable clinical

outcomes were obtained as in Gelb et al.¹⁶ We believe that our success in using short-segment instrumentation is attributed to the following:

1. Strict exclusion criteria were set. To avoid implant failure, patients aged 55 years and above or with a BMD <2.5 SD below the young adult reference range were not treated with short-segment instrumentation. As a result, no cases of pedicle screws pull-out and loss of correction due to osteoporosis were found in this study. Although the pedicle screws could provide 3-column fixation, screw loosening has often been reported in elderly patients, probably due to poor bone quality which decreased the strength of pedicle screw fixation.^{7,9,18,20,32}
2. In studies by Lee²⁰ and Kim²¹, there were 3 failure cases due to osteoporosis. Thus, we would always consider alternative techniques such as long-segment fixation when treating the patients. In general, methods that avoid ending instrumentation within the kyphotic segment should be considered^{21,32} instead of short-segment instrumentation for fractures complicated by osteoporosis. We chose not to remove any comminuted bony fragments. Instead, they were pushed back into their original positions, hence restoring the anterior and mid-column stability to prevent future increases in kyphotic deformity after obtaining an initial correction. The posterior approach is a method familiar to most of the spinal surgeons. During the surgery, a small impactor was used to push the comminuted bony fragments into their original position in patients undergoing total or partial laminectomy by the posterior approach. As a result of this action, we had adequate spinal canal decompression with an average canal narrowing reduction from 45% to 6.7% and satisfactory neurological recovery in 21 cases. In the recent study by Jun et al,¹⁷ the surgeons did not perform impaction of large bony fragments, but opted to remove them to achieve adequate decompression for fear that the impacted bony fragments might displace and compress the nerves in some of the patients. However, we believe that the removal of the bony fragments is not suitable for the patients with thoracolumbar fractures. First, without the support of the anterior and mid-column, recurrent kyphosis and instrumentation failure had been observed frequently after posterior short-segment pedicle fixation for a thoracolumbar fracture.^{1,4,33} In this study, we impacted the displaced bony fragments into the original positions to reconstruct the anterior and mid-column, and used this bony fragment as a strut graft to restore the anterior and mid-column stability, and to prevent

future increased kyphotic deformity after obtaining an initial correction. Second, some authors^{8,34} have described spontaneous remodelling of the spinal canal during the follow-up period. We found no cases with impacted bony fragment displacement and nerve recompression in this study. Although the relation between the canal diameter and its association with neurological sequelae after trauma remains unclear, this study shows that the neurological improvement is associated with a remarkable clearance of the spinal canal.

3. With advance medical instrumentation and good surgical techniques, posterior short-segment fixation provides satisfactory clinical outcomes. The currently used posterior pedicle system allows a link between a pedicle screw and a rod of optimal diameter. The link is constructed by a connecting element that can change the inclination between the screw and the rod axes in vertical and horizontal planes. The system is completed by a threaded locking mechanism that firmly locks the connecting element rotation, and subsequently allows the surgeon to fix the rod inclination in the most suitable position. Therefore, this special screw-to-rod locking mechanism undoubtedly has contributed to the reduction of instrumentation failure.¹⁶ At the same time, several authors demonstrated that intraoperative rod contouring and corrective procedures using reduction devices were generally thought to be risk factors for the failure of spinal constructs, particularly with pure titanium or titanium alloy implants due to their notch sensitivity.³⁵⁻³⁷ We precontoured the rod and used a cantilever-type method to introduce the rod into the screws without performing any in situ bending of the rod. We thought the precontoured rod would likely provide a 3-point bending force as the apex of the rod would engage the intermediate injured vertebra. The technique of including pedicle fixation at the fracture level into a posterior construct has offered a better kyphosis correction and a stronger 3-point posterior support to reduce instrument failures. In a cadaveric biomechanical study by Mahar et al,¹⁴ it was demonstrated that insertion of the pedicle screws at the fracture level could strengthen the construct biomechanically. As seen in the results of this study, there was a variable amount of postoperative loss of correction at the last follow-up while there were no patients with more than 10° correction loss in the sagittal plane, and correction of the kyphotic deformity was well-maintained. We attributed the correction loss primarily to disc space collapse, and it seemed that the final clinical outcomes (pain and

work scale) had no relation with the correction loss, which was limited to 10°.

Finally, some studies have suggested that the Load sharing scoring system was a reliable and easy-to-use classification scheme for choosing the treatment method for thoracolumbar fractures.^{19,38} By using this scoring system, Parker et al¹⁹ predicted that fractures with a score 6 or less could be safely treated with short-segment posterior fixation with low risk of implant failure or progressive deformity. However, an anterior strut graft with longer instrumentation should be used to treat the fractures with a score of 7 or more.

In our institute, all the patients who met inclusion criteria, whether the Load Sharing score point ≤ 6 or ≥ 7 , were operated upon with posterior short-segment fixation. There were no cases of implant failure in terms of pedicle screws breakage, loosening or disengagement. Therefore, we found that it was not necessary to emphasise that the fractures with a Load Sharing score ≥ 7 needed an anterior-only approach, or a staged anterior reconstruction or augmentation following a posterior approach.

In a similar study, Farrokhi et al,¹³ concluded that fracture level pedicle screw combination could achieve and maintain kyphosis correction, and there were no evidence to emphasise that fractures with Load Sharing scores of 7 or more should be treated by an anterior approach. Nevertheless, there are some differences in the results based on Load Sharing scores, although they do not affect the overall clinical outcome. We found that patients with a Load Sharing score ≥ 7 had an average of 2.5° loss of correction, compared with a 1.9° loss of correction in patients with a point ≤ 6 at the final follow-up ($P > 0.05$).

Limitations

This study has several limitations. First, it was a retrospective design with a small number of patients and short-term follow-up. Second, it was not a randomised control study as there were no controls to compare the outcomes. Thus, it was not a comparative study between the posterior long-segment fixation and anterior approach fixation. Finally, we could not evaluate the effects of bone fusion on the final outcome in all the patients because not all subjects underwent CT scan at the final follow-up. We hope to conduct a larger scale prospective randomised study to confirm our findings and address the above issues in the near future.

Conclusion

With advanced medical instrumentation and good surgical techniques, the results from this study favour a posterior approach with short-segment fixation for thoracolumbar fracture patients younger than 55 years old and are free

of osteoporosis, even though the fracture is classified as highly comminuted fracture.

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