

Percutaneous pedicle fixation of dorsolumbar fractures without neurological deficits

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Abstract

Burst fractures are relatively common injuries in the thoracolumbar spine. However, treatment of AO type (A3) unstable thoracolumbar fractures is still controversial, especially for patients with no neurological deficits. To evaluate the efficacy and safety of percutaneous pedicle fixation using a minimally invasive technique for AO type (A.3) thoracolumbar fractures. This study was done on ten patients complaining of thoracolumbar spine fractures grade A3 at ages ranged from twenty to sixtyfive years old. Those patients were treated by percutaneous fixation. The results of the surgical procedure were collected immediately after surgery, and then during, and after the follow up period. All the results were statistically analyzed to get positive data and correlation between them, complications were discussed whether after surgery or at the follow up period. The percutaneous pedicle fixation technique presents radiological, clinical, and functional results that are significantly better than the published results with conservative treatment. This intervention, assisted by fluoroscopy, proved to be a technique with a high accuracy and reliability, with results similar to those reported in studies with the classical transpedicular fixation regarding the deformity correction, but superior with regard to blood loss, postoperative rehabilitation, and return to the activities of daily living. The results of this study show that this is a valid, safe, and effective treatment for (A3) thoracolumbar burst fractures without neurological deficits.

Keywords: Percutaneous pedicle fixation; dorsolumbar fractures; neurological deficits

1. Introduction

Burst fractures are relatively common injuries in the thoracolumbar spine. However, treatment of AO type (A3) unstable thoracolumbar fractures is still controversial, especially for patients with no neurological deficits. Although nonsurgical treatment has been described in several articles with good results, it is also well known that this type of treatment has several complications, including the worsening of kyphosis, consequences of prolonged bed rest, long period of recovery, and possible worsening/development of neurological deficits [1].

Surgical treatment has demonstrated better clinical and radiological results. It allows for immediate stabilization of the spine, restoration of sagittal alignment, and the possibility of spinal canal decompression [2].

However, the classical (open) surgical approach with pedicle fixation (short or long segment) involves extensive exposure and dissection, which is generally associated with a high rate of morbidity: high intraoperative blood loss, and significant infection and muscle injury rates. Minimally invasive surgery, in particular percutaneous pedicle fixation, has become increasingly popular in spinal surgery. The technique of placing pedicle screws percutaneously was initially introduced by Magerl in 1977. Kim et al proved that percutaneous pedicle fixation causes less muscle damage than open pedicle fixation techniques [3].

The aim of this study was to evaluate the efficacy and safety of percutaneous pedicle

fixation using a minimally invasive technique for AO type (A.3) thoracolumbar fractures

2. Patients and methods

The study took place between December 2016 and December 2018. In Benha University hospitals after approval of the study by ethical committee and patients consent.

Inclusion criteria were: AO type (A.3) thoracolumbar fracture; kyphosis $> 30^\circ$ and/or reduction of vertebral body height $> 50\%$ and/or compression of the spinal canal $> 50\%$.

Exclusion criteria were: age less than 18 years or over 70 years, impossibility of surgical treatment in the first ten days after the injury, and the presence of neurological deficits.

The mechanism of injury included: seven cases of falling from heights, two pedestrians being run over and one car crash. The pre- and postoperative evaluation during follow-up was performed using radiography and CAT of the thoracolumbar spine.

The radiological parameters evaluated were the Cobb angle, reduction of the height of the vertebral body, anterior wedging of the fractured vertebra, and compression of the spinal canal. The sagittal curvature was measured by the Cobb angle (defined as the angle between the upper surface of the vertebral body above the fracture and the bottom surface of the vertebral body at the level below the fracture). Patients were evaluated at one, three, six, and 12 months postoperatively, clinically, the Oswestry Disability Index was collected, and

radiographically and with CAT at three or six months.

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3. Results

Ten adult patients were included in this study, 7 were male and 3 female. The average age was 49.4 years (minimum of 24 and maximum of 68) As for the distribution of fractures by vertebral level, we obtained three cases affecting T10, one T11, one T12, , three L1, one L2, one L3.

All patients were treated with percutaneous pedicle fixation. The mean operative time was 81 minutes (minimum of 69, maximum of 95). The mean intraoperative blood loss was 85 ml (minimum of 75, maximum of 155 ml).

Table (1) Imaging evaluation results

	Kyphosis (cobb)	Reduction of vertebral body height(%)	Anterior compression(%)	Compression of the spinal canal(%)
Preoperative	16.9 (31.7-5.3)	(61.6-31.6)39.8	(57.2-27.8)37.4	28.5 (53.8-8.4)
postoperative	4.9	10.3	20.3	10.8
End of follow-up	8.7 (8.2)	(26.6)13.2	(13.3)24.1	13.9 (14.6)

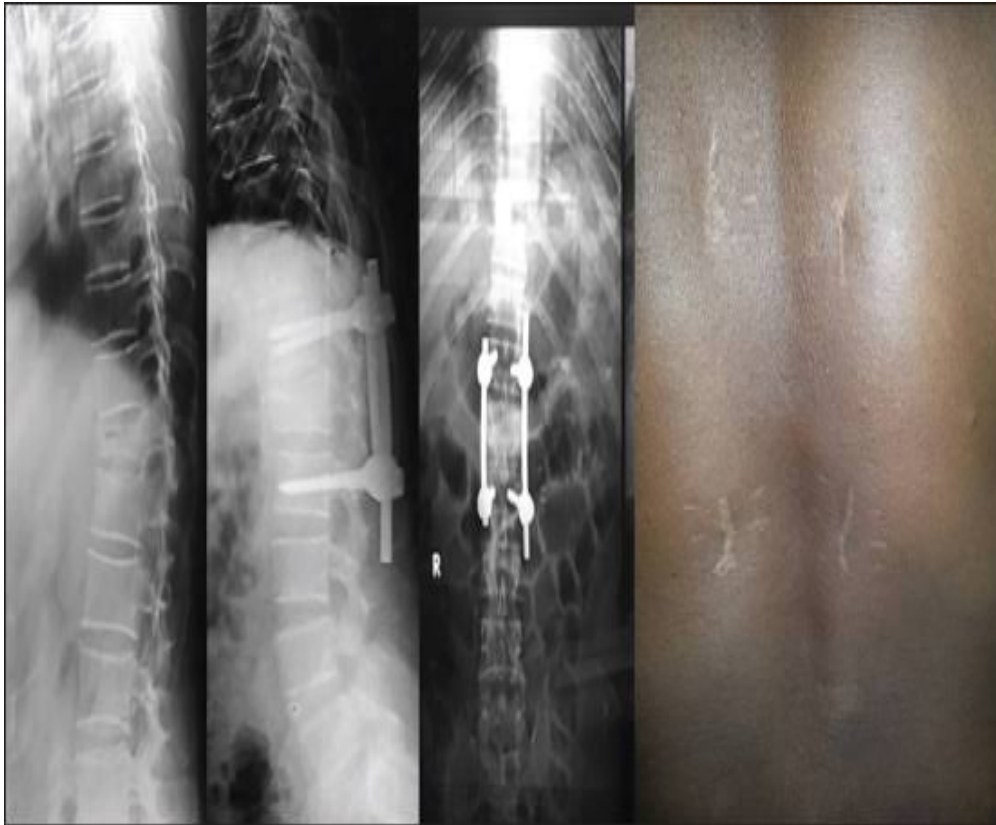
Hospitalization time was on average seven days (minimum of 5, maximum of 11 days). All patients were followed up as outpatients for an average period of seven months (minimum of three, maximum of 14 months).

The preoperative Cobb angle averaged 16.9° (5.3°-31.7°), postoperatively it was 4.9°, which represents an improvement of about 86%. At the end of follow-up it was 8.2°. The percentage of mean preoperative reduction of the vertebral body height was 39.8% (31.6% to 61.6%) and 10.3% postoperatively, representing an improvement of about 29.5%. At the final follow-up visit, it was 13.2%. The percentage of mean preoperative anterior wedging of the vertebral body was 37.4% (27.1% to 57.2%) and 20.3% postoperatively, representing an improvement of about 17 1%. At the final follow-up visit, it was 24.1%. The percentage of compression of the spinal canal was 28.5% (8.4 to 53.8). At the final follow-up visit, it was 13.9%.

The average clinical evaluation with the Oswestry disability index was 18% (excellent). Of the 10 patients treated, 10 showed no disabilities (0-20%),None showed a worsening of neurological status, infection, or fixation failure.

Case presentation, Fig 1 – 3

4. Case no 1



Fig(1). Male patient 34 years old with T11 burst fracture treated by percutaneous fixation.

Case no 2

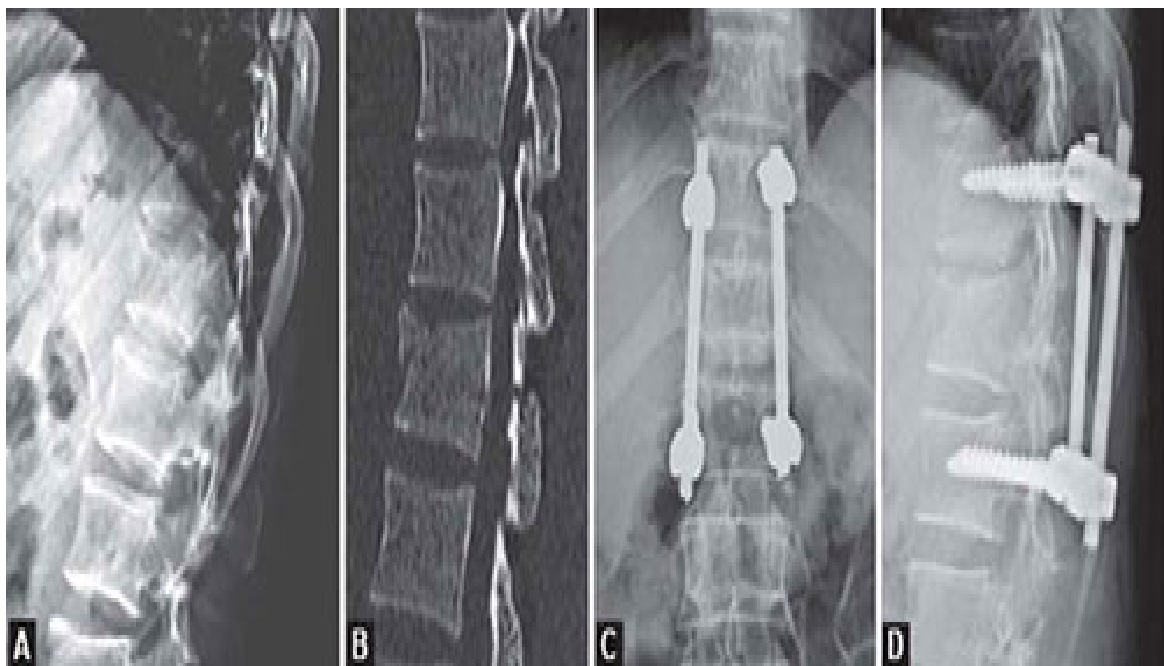


Fig 2 Burst fracture T12 treated with percutaneous fixation

Case no 3

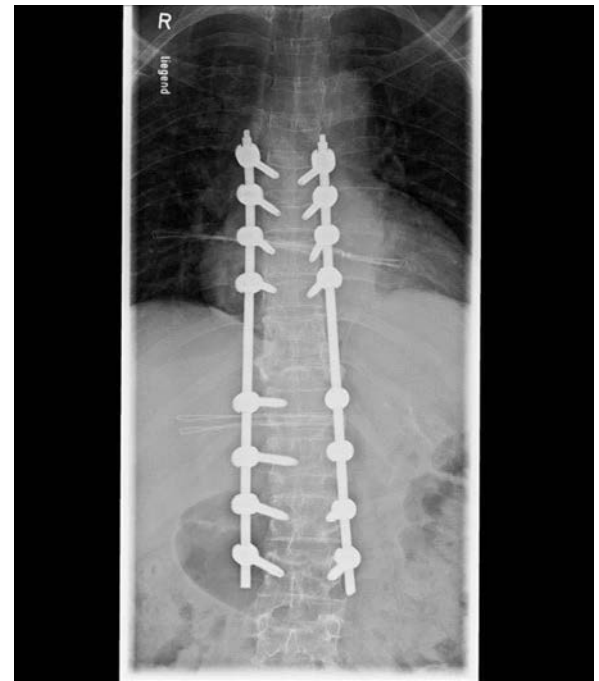
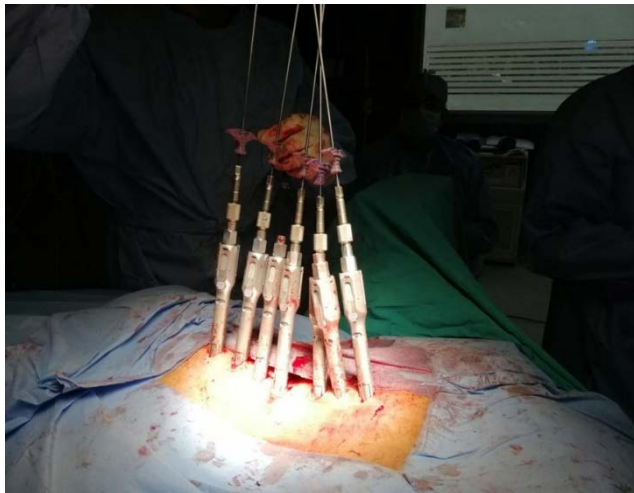


Fig (3)

5. Discussion

The choice of treatment of the thoracic and lumbar spine injuries is related to many factors such as the type of fracture, the presence of neurological damage, associated injuries, patient's age, and others more.

Conservative treatment of stable vertebral fractures is proposed with success by many authors with different techniques: bed rest followed by external orthoses, extension gymnastics, plaster jacket in bed, or stand reduction [4]. Regardless of the methodology adopted, the treatment should be continued for a period of at least 3-4 months during which the patient care and cooperation is mandatory.

The problems related to bed rest, particularly in the elderly, are countless, although difficult to calculate. Deep vein thrombosis may affect up to 30% of patients. Obesity, chronic obstructive pulmonary disease, venous incompetence, and psychiatric disorders are almost absolute contraindications to conservative treatment.

In addition, today more and more patients need to return to their social and working life in a short time; therefore, surgery becomes the simplest way to shortcut recovery.

The rationale for applying MIS in the management of the spine fractures is to reduce the approach-related morbidity associated with

the conventional technique: iatrogenic muscle denervation, increased intramuscular pressures, ischemia, pain, and functional impairment.

Because of the impossibility to perform a fusion, the minimally invasive percutaneous stabilization has been limited to relatively stable vertebral fractures, involving mainly bone component with a consistent possibility of spontaneous healing after immobilization; the screws and rods implanted acted as an internal fixator, leading to the biological healing of all fractures. Wang et al. comparing two groups of patients with thoracolumbar burst fractures, one treated by instrumented fusion, while the other just fixed without fusion, showed that there were no statistically significant differences in the long term between the two groups with a slight advantage, both for clinical than for radiographic parameters, for the group treated only with fixation without fusion [5]. This study further justifies the minimally invasive approach we have taken.

PMMA injection through fenestrated cannulated screws provided additional stability in fixation procedures carried out on osteoporotic vertebral columns without affecting fracture healing.

Implant removal remains a controversial key point against this technique as it requires a second surgery and a general anesthesia, adding risks for the patient and costs for the hospital. Nevertheless, the real need for implant removal is probably much lower than that showed in our study as most of the patients who had the implant removed showed no clinical or radiological complications at the time of second surgery.

Further studies are required to determinate the real need for hardware removal. monoaxial screws should be considered for this kind of surgery, when it is possible [6].

The complications in our series are comparable to those reported in the literature for conservative treatment, and much less than with open fusion.

6. Conclusion

The percutaneous pedicle fixation technique presents radiological, clinical, and functional results that are significantly better than the published results with conservative treatment. This intervention, assisted by fluoroscopy, proved to be a technique with a high accuracy and reliability, with results similar to those reported in studies with the

classical transpedicular fixation regarding the deformity correction, but superior with regard to blood loss, postoperative rehabilitation, and return to the activities of daily living. The results of this study show that this is a valid, safe, and effective treatment for (A3) thoracolumbar burst fractures without neurological deficits.

7. References

- [1] M. Domenicucci, R. Preite, A. Ramieri, P. Ciappetta, R. Delfini, and L. Romanini, "Thoracolumbar fractures without neurosurgical involvement: surgical or conservative treatment?," *J. Neurosurg. Sci.*, vol. 40, no. 1, pp. 1-10, 1996.
- [2] R. F. McLain, "The biomechanics of long versus short fixation for thoracolumbar spine fractures," *Spine (Phila. Pa. 1976)*, vol. 31, no. 11S, pp. S70-S79, 2006.
- [3] D.-Y. Kim, S.-H. Lee, S. K. Chung, and H.-Y. Lee, "Comparison of multifidus muscle atrophy and trunk extension muscle strength: percutaneous versus open pedicle screw fixation," *Spine (Phila. Pa. 1976)*, vol. 30, no. 1, pp. 123-129, 2005.
- [4] H. D. Been, R. W. Poolman, and L. H. Ubags, "Clinical outcome and radiographic results after surgical treatment of post-traumatic thoracolumbar kyphosis following simple type A fractures," *Eur. Spine J.*, vol. 13, no. 2, pp. 101-107, 2004.
- [5] S.-T. Wang, H.-L. Ma, C.-L. Liu, W.-K. Yu, M.-C. Chang, and T.-H. Chen, "Is fusion necessary for surgically treated burst fractures of the thoracolumbar and lumbar spine?: a prospective, randomized study," *Spine (Phila. Pa. 1976)*, vol. 31, no. 23, pp. 2646-2652, 2006.
- [6] A. Sebaaly, M. Rizkallah, F. Bachour, F. Atallah, P. E. Moreau, and G. Maalouf, "Percutaneous cement augmentation for osteoporotic vertebral fractures," *EFORT open Rev.*, vol. 2, no. 6, pp. 293-299, 2017.