Making short-segment posterior fixation more successful in treatment of unstable thoracolumbar fracture

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Background
Short-segment posterior fixation (SSPF) is liable to failure in unstable thoracolumbar fracture because of disruption of load-bearing anterior column. Intermediate screw and intracorporeal transpedicular grafting increase the stability of construct and enhance fracture healing, thereby avoiding long-segment posterior fixation and demanding anterior surgery in unstable thoracolumbar fracture.
Patients and methods
There were 20 patients with unstable thoracolumbar fractures treated with SSPF and TIG. These patients were followed for at least 14 months for to assess clinical improvement and the ability of the technique to reduce the fractures and maintain kyphosis correction with absence of implant failure.
Result
All patients were operated within the first week, with a mean time delay of 3.4 days. There were no cases with deep postoperative infection, iatrogenic dural tear, deterioration of neurologic deficit, or implant failure. The mean local kyphosis angle was 22.9° preoperatively, 9.7° postoperatively, and 11° at final examination. The mean anterior height collapse was 55.9% preoperatively, 87.5% postoperatively, and 79.8% at final examination.
Conclusion
SSPF with intermediate screw and TIG is an effective and safe technique in the treatment of unstable thoracolumbar fracture, with good clinical and radiological results.

Keywords:
intermediate screw, short-segment fixation, thoracolumbar fracture, transpedicular grafting

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Introduction

The optimal management of unstable thoracolumbar fractures continues to be a matter of controversy. Posterior pedicular fixation was the most common treatment method of thoracolumbar fractures [1].

When there is significant disruption of the anterior column, short-segment posterior fixation (SSPF level above and level below) does not ensure stability, resulting in poor reduction, kyphotic deformity, and occurrence of implant failure. This requires more extensive approach such as long-segment posterior fixation (LSPF), anterior reconstruction via anterior approach, or additional transpedicular procedures such as grafting or vertebroplasty to support anterior column. LSPF seems to be associated with less rate of failure, but the advantage of saving motion segment was diminished [2].

Biomechanically to decrease terminal bending, which subjects short-segment fixation to failure, intermediate fixation point is needed. So placement of screw at the fracture level and intracorporeal transpedicular grafting (ITG) of fractured vertebra significantly increase stability of construct and may avoid demanding anterior surgery and LSPF in unstable thoracolumbar fractures [3].

This study was conducted to evaluate the efficacy of SSPF with screw placement at fractured vertebra and ITG in correction of kyphotic deformity, maintenance of correction, and prevention of failure of fixation in unstable thoracolumbar fracture.

Patients and methods

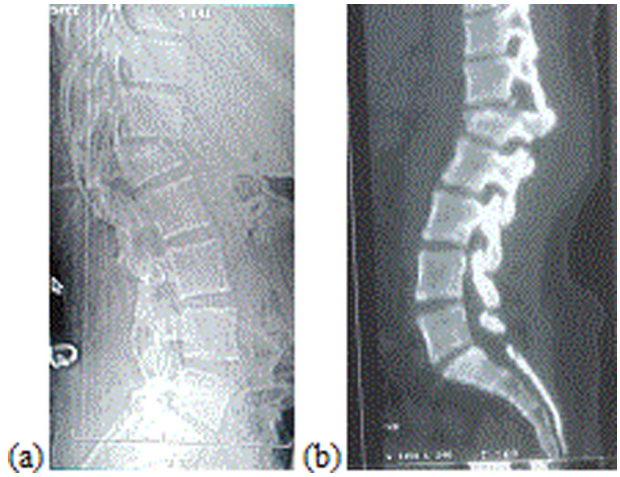
We operated on 20 patients with acute unstable thoracolumbar fractures (T11 to L1) using SSPF with insertion of screws at fractured vertebra and ITG at Zagazig University Hospital from April 2012 to June 2014. The study was approved by the

institutional ethics committee in the Orthopedic Department of Orthopaedic Surgery, Zagazig university, Egypt.

All patients were assessed with ABC (A, airway; B, breathing; C, circulation) of advanced trauma life support protocol with thorough neurological documentation using Frankle system. Patients with complete motor deficit (Frankle A and B) were excluded from the study.

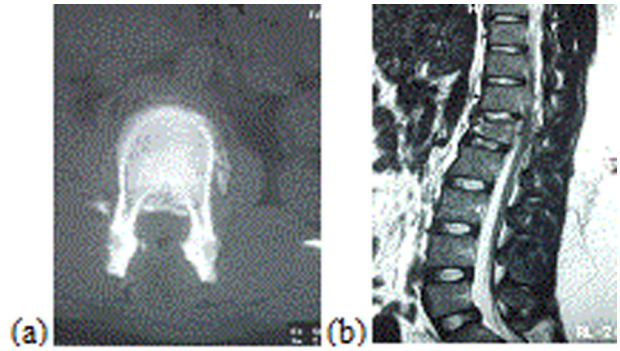
Plain radiography, computed tomography, and MRI (Figs. 1 and 2) were done for all patients to assess fracture pattern, integrity of the pedicles at fracture level, canal compromise, and neurological tissue. Patients with displaced pedicle fracture were excluded from the series. Mean local kyphosis and percentage of anterior vertebral body (VB) collapse were measured from plain lateral radiography preoperatively and at 6-month and 12-month postoperative follow-up visits to assess the ability of the technique to reduce fracture, to correct the deformity, to maintain correction, and to prevent occurrence of implant failure.

Figure 1



Preoperative lateral radiograph and sagittal computed tomography images of a 32-year-old male with unstable L1 burst fracture.

Figure 2



Preoperative axial computed tomography (a) and sagittal MRI (b) images.

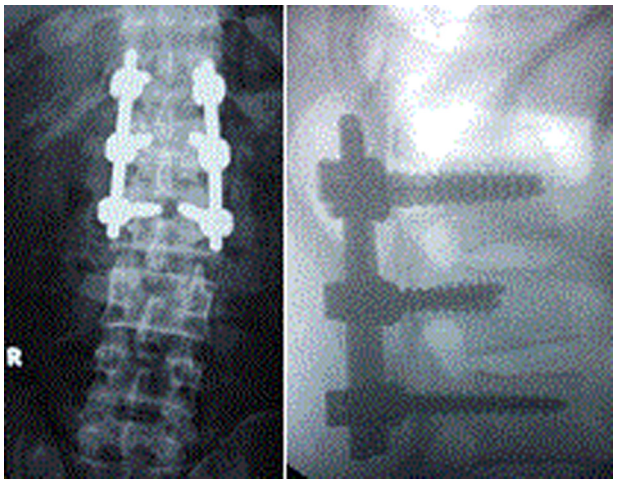
All operations were performed using the same instrumentation system. Pedicle screws were inserted first in adjacent vertebrae, and autologous iliac bone graft was taken in 12 cases, and in the remaining eight cases, we used the removed bone during decompression in grafting. ITG was performed before insertion of screw into the fractured vertebra. Small pieces of cancellous bone graft were introduced through the pedicle tract with the help of fine instrument as pedicle finder until the void in the VB is completely filled. The length of screw inserted into the fractured vertebrae was 25–30 mm, taking into consideration the possibility of the need for future anterior surgery for anterior column reconstruction. Intermediate screws of 4.5- or 5.5-mm diameter were used according to the diameter of pedicle of the fractured vertebra. The appropriate forces (compression or distraction) were applied over screwed level. Decompression was performed in nine cases with neurologic deficit and canal compromise. Transverse connector was used in eight cases to increase torsional rigidity of the construct in cases with marked instability.

Results

A total of 20 patients were included in the study. There were 12 male and eight female patients, with an average age of 33.6 years (range: 20–53 years). Overall, 12 cases had L1 fracture, seven cases had T12 fracture, and one cases had T11 fracture. Motor vehicle accident was the cause of fractures in most cases (13 cases) and fall from height was the cause in seven cases. Overall, 15 cases had isolated thoracolumbar fractures and five cases had associated injuries (head, pelviabdominal, and associated long bone fractures).

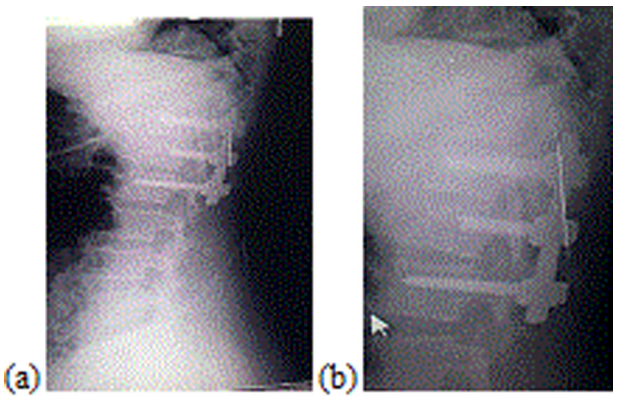
All patients were operated within the first week, with a mean time of 3.4 days (range: 1–6 days). The average operative time was 120 min (range: 100–140 min). The follow-up period ranged from 14 to 24 months, with a mean period of 18 months. There were no cases with deep postoperative infection, iatrogenic dural tear, deterioration of neurological deficit, or implant failure in this series. One case developed superficial wound infection, which improved with repeated dressing and antibiotics.

Figure 3



Immediate postoperative radiograph shows correction of kyphosis and vertebral body collapse.

Figure 4



Postoperative lateral radiographs at 6-month (a) and 12-month (b) visits show slight loss of kyphosis correction.

To assess the efficacy of this technique in correction of kyphosis and maintenance of correction, simple radiographic parameters such as mean VB height collapse percentage and local kyphosis were used for easier measurement and to minimize interobserver bias (Figs. 3 and 4).

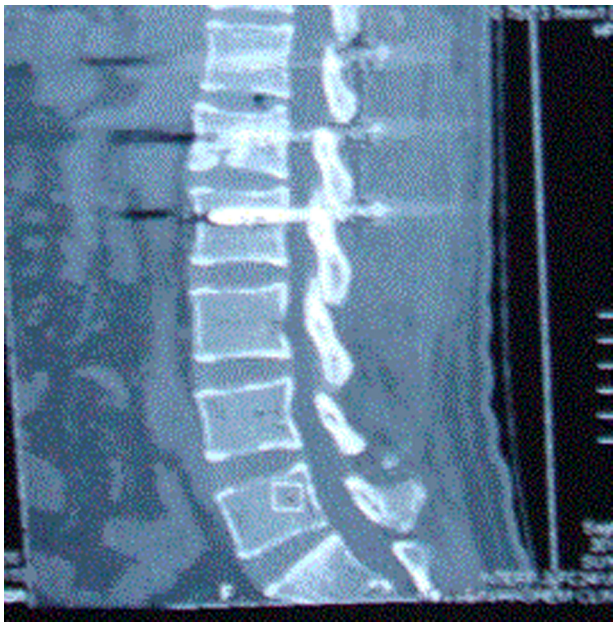
The mean local kyphosis angles were 22.9° preoperatively, 9.7° postoperatively, and 11° at the final examination (Table 1). The amount of correction between preoperative and postoperative was 13.2° and between preoperative and the final follow up was 11.9°. These figures were considered statistically significant ($P<0.005$). The slight loss of correction between postoperative and final follow up was 1.3, and it was considered statistically insignificant ($P>0.005$).

The percentages of mean anterior VB height collapse were 55.9% preoperatively, 87.5% postoperatively, and 79.8% at the final examination (Fig. 5). The amount of correction between preoperative and postoperative was 31.6%, with a statistically significant result ($P<0.005$). The mean loss of between postoperative and final follow up was 7.7% (Table 1), and the difference was considered statistically insignificant ($P>0.005$).

Table 1 Comparison between preoperative and postoperative radiological data

	Preoperative	Postoperative	At 6 months of follow-up	At 12 months of follow-up
Vertebral body height collapse (%)	55.9	87.5	81.1	79.8
Local kyphosis (deg.)	22.9	9.7	10.2	11

Figure 5



Sagittal computed tomography 6 months postoperatively shows maintenance of vertebral body height and graft incorporation.

Discussion

Selection of the surgical method in the treatment of thoracolumbar burst fractures remains a matter of discussion. Multiple parameters have to be considered, such as the type and stability of the fracture, degree of CC, and neurological status. SSPF offers advantages such as incorporating fewer motion segments in the fusion, shorter operative time, and fewer blood transfusions, but without body reconstruction, SSPF has an incidence of implant failure and rekyphosis [4]. To prevent this, several

techniques have been developed to augment the anterior column in burst fractures, such as anterior instrumentation and strut grafting or vertebroplasty [5].

In this study, we combined the use of intermediate screw and ITG for the treatment of unstable thoracolumbar fractures based on biomechanical advantage that intermediate screw aids in reduction, supports end plate, increases fixation point, provides mass effect, fills defect created after reduction, and results in restoration of height together with ITG, which aids in height restoration maintenance and enhances VB healing with rapid restoration of mechanical integrity of anterior column, thereby decreasing incidence of loss reduction, rekyphosis, and implant failure.

The study by Guven and colleagues compared SSPF with inclusion level and LSPF. They observed that fracture level fixation achieved lower rate of correction failure, which was most significant on short-segment construct [6].

Benefits of placement of screw in fractured vertebra in SSPF were proved in the studies by Gelb and colleagues, Farrokhi and colleagues, and Baaj and colleagues, as well as in Mahar and colleagues' cadaveric biomechanical study [1,2,7,8]. Transpedicular grafting of injured VB in addition to short-segment fixation has been offered as a possible solution by Knop *et al*. [9] and Alanoy *et al*. [10]; however, cementing of injured vertebra beside SSPF is other option, which was previously mentioned by Cho *et al*. [11], but this technique may lead to cement extrusion into spinal canal, particularly if posterior longitudinal ligament is torn.

The novelty of this study is that it combines the use of inclusion screw and grafting in the same procedure when most papers either use inclusion screw or grafting with SSPF.

Conclusion

The fracture level into the construct and ITG have offered a better kyphosis correction, in addition to fewer instrument failures, without additional complications, and with a comparable if not better clinical and functional outcome. We recommend insertion of screws into pedicles of the fractured thoracolumbar vertebra with transpedicular intracorporeal bone grafting when considering a SSPF.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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