Fusion-less short posterior segmental fixation in thoracolumbar fractures

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Background
The purpose of this study was to evaluate the effectiveness of short posterior fixation without fusion in treatment of thoracolumbar fractures.
Patients and methods
In a prospective study, 64 consecutive patients with types A3.2 and A3.3 thoracolumbar fractures were operated by pedicle screws fixation a level above and below the fracture without fusion followed by physiotherapy.
Results
The mean follow-up period was 18 months. The mean preoperative local kyphosis was 18.7°, and anterior vertebral height loss 51.63%. These significantly improved to 4.58° and 15.67% 1 month after fixation. Three months after implant removal, these radiologic parameters were 5.37° and 16.23%, whereas mean segmental motion was 9.58°. On Denis scale for back pain, 42 patients were P1, with no need for analgesics; 14 patients were P2 with minimal pain; and four were P3, needing occasional use of analgesics.
Conclusion
Satisfactory results can be achieved by posterior spinal fixation without fusion of thoracolumbar burst fractures (A3.2 and A3.3).

Keywords:
posterior spinal fixation, thoracolumbar fractures, without fusion

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Introduction

Fractures involving the spinal column are relatively common. For example, ~50 000 fractures are being reported in the USA annually. Surgery aims at providing stability, proper alignment, neurologic recovery, and early ambulation [1]. A consensus is yet to be reached regarding the optimum treatment of thoracolumbar burst fractures. Pedicle screw fixation combined with fusion is most commonly used. Fusion is believed to be necessary for long-term satisfactory results. According to load-sharing classification, anterior column reconstruction is required in cases with severe vertebral body comminution. In cases with retropulsed fragments and incomplete spinal cord injury, anterior direct decompression is also recommended [2–4].

Recently, a fusion-less technique where pedicle fixation is performed while preserving the facet joints has been proposed [5,6]. Such technique assumes to restore segmental range of motion after fracture healing and implant removal. This study aims to report on the radiologic and clinical outcomes of such technique, with stress on its advantages and disadvantages.

Patients and methods

A prospective study was conducted in Ain Shams University on 64 consecutive patients with types A3.2 and A3.3 thoracolumbar fractures (T10-L2). After adequate exposure, a short posterior segmental fixation was performed using pedicle screws inserted into the vertebra above and below the fractured one. No fusion was performed, and the facet capsules were preserved intact. No screws were inserted into the fractured vertebra. Rods were inserted straight or slightly lordotic, and distraction was applied. Patients with neurologic deficits requiring direct decompression, severe vertebral body comminution requiring either long posterior fusion or anterior reconstruction (score ≥7 in load sharing classification), disrupted posterior ligamentous complex as assessed by MRI, facet or pars fractures, associated limb fractures, or multiple vertebral fractures were excluded from the study. The implants were

removed 9 months after the initial procedure in an attempt to restore segmental motion after fracture union and to avoid implant failure. Two weeks after the initial and removal surgeries, rehabilitation was initiated and continued for 1 month using the same protocol for all patients, with emphasis on core muscle strengthening and back range of motion. Approval for the study was obtained from the ethics committee. All patients participating in the study signed a written consent.

The demographic data of the patients, mode of trauma, level of the fracture, mean operative time, and blood loss were recorded. The fractures were assessed radiologically using lateral view plain radiographs. Loss of vertebral body height expressed as percentage (100–anterior height of the fractured vertebra divided by the anterior height of the adjacent vertebra multiplied by 100) and local kyphosis angle (Cobb's angle between the superior endplate of the vertebra above and the inferior endplate of the vertebra below the fractured one) were measured preoperatively, at 1 month and 12 months (3 months after removal) postoperatively, and at the final follow-up. Dynamic lateral views were also used to measure motion around the fractured vertebra (change in Cobb's angle) 3 months after the removal. Back pain was assessed using Denis scale [7]. Any complication related to the procedures was also noted. The patients were followed up for at least 12 months (3 months after removal). Statistical analysis was done using paired *t*-test and repeated measures analysis of variance. *P* less than 0.05 was considered statistically significant and *P* less than 0.001 as highly significant.

Results

Four patients were lost to follow-up and excluded from the study. The mean age of the patients was 27.6 years (18–48 years). There were 42 males and 18 females. Mode of trauma was motor vehicle accident in 30, fall from height in 27, and sports related in three. T10 was fractured in five, T12 in 16, L1 in 28, and L2 in 11. The mean operative time was 58 min, with mean blood loss of 220 ml. All patients agreed to and performed implant removal 9 months after the first surgery. The mean period of follow-up was 18 months (12–25 months).

The mean preoperative loss of vertebral height was 51.63%, whereas the mean local kyphosis angle was 18.7°. These improved to 15.67% and 4.58° 1 month after fixation, respectively ($P<0.001$); at three months after implant removal, the values were 16.23% and 5.37°, respectively, and at final follow-up, the values were 16.78% and 5.86°, respectively. On comparing the three postoperative values for each radiologic parameter, the loss of corrections was statistically insignificant. Regarding mean segmental motion in the fixed segments 3 months after screws removal, it was 9.58° (Tables 1, 2).

Table 1 Local kyphosis angle and loss of vertebral height

	Preoperative	Postoperative (1 month)	*P* value
Local Kyphosis angle	18.7°	4.58°	<0.001
Loss of vertebral height (%)	51.63	15.67	<0.001

Table 2 Loss of corrections after removal

	1 month after fixation	9 months (3 months after removal)	Final follow-up	*P* value
Local Kyphosis angle	4.58°	5.37°	5.86°	0.08
Loss of vertebral height (%)	15.67	16.23	16.78	0.146

Clinically, at final follow-up, patients were scaled according to Denis as having no pain (P1) in 42 patients, minimal pain with no need for analgesics (P2) in 14, and moderate pain with occasional need for analgesics (P3) in four. None of the patients were scaled as P4 or P5 requiring constant use of analgesics.

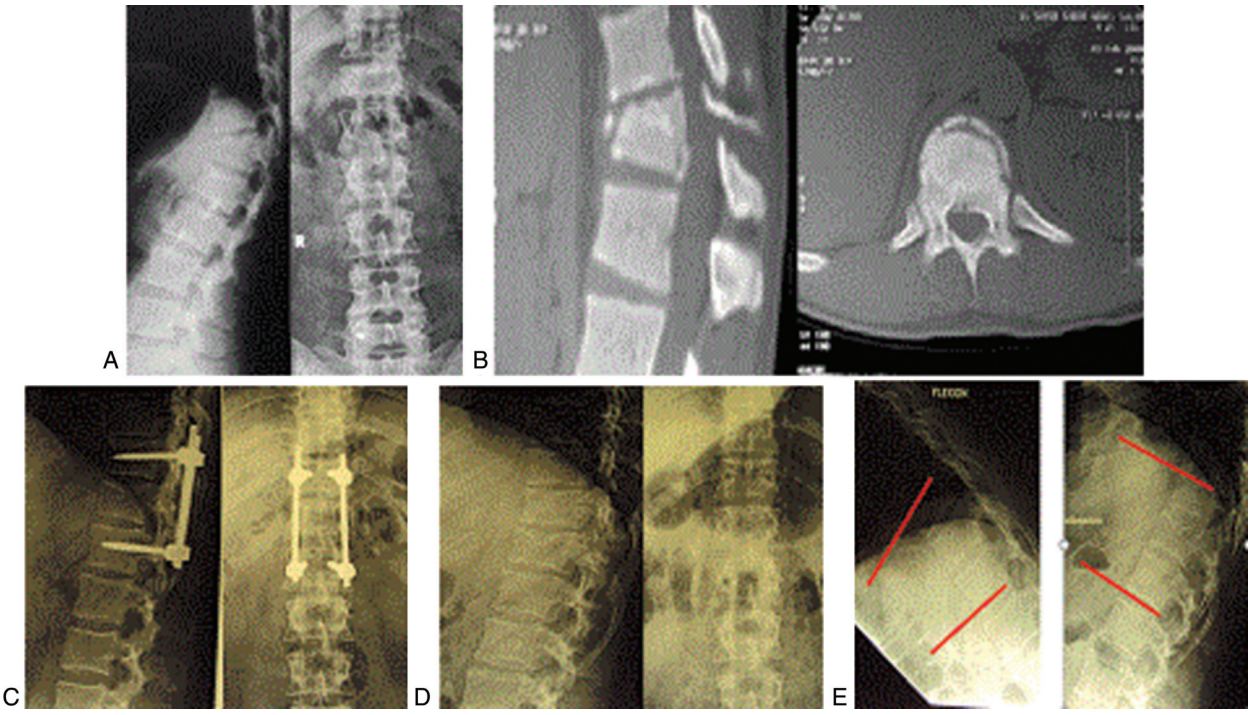
No implant failure was recorded in any of the patients before removal. Superficial wound infection occurred in three patients following fixation, which resolved with antibiotics (Fig. 1).

Discussion

Surgery in the treatment of burst fractures of the spine aims to restore stable pain-free spine while protecting or facilitating recovery of the neural elements. Pedicle screw fixation is widely used, generally combined with fusion of the affected segments [4,8,9]. However, few studies have reported on the success of posterior fixation without fusion in treating thoracolumbar fractures [5,6,10].

There are several proposed advantages to avoiding fusion. Operative time is shorter as no time is needed to prepare fusion bed or harvest bone grafts. Less bleeding is also expected. Donor site morbidity

Figure 1



A 34-year-old female experienced T12 burst fracture following fall from height. (a) Preoperative plain radiographs. (b) Preoperative computed tomography. Preoperative loss of vertebral height and local kyphosis angle were 57.2% and 37°, respectively. Fixation without fusion was performed. (c) Postoperative plain radiographs (1 month). Loss of vertebral height and local kyphosis angle improved to 18.7% and 6°, respectively. Implants were removed after 9 months. (d) Plain radiographs 3 month after removal. The radiologic parameters were 19.6% and 7.4°, respectively. (e) Dynamic views showed motion of 7.8°.

occasionally encountered following iliac bone grafting can be avoided. Better function is assumed by preservation of motion following screws removal while avoiding subsequent adjacent fusion disease. The disadvantages include possibility of implants failure and the need for second operation for their removal with potential loss of correction in the nonfused segments or appearance of back pain thereafter [5,6,10].

In a comparative study, Dai *et al.* [10] reported shorter operative time of 102 min in the nonfusion as opposed to 152 min in the fusion group. They also reported less blood loss of 310 ml as opposed to 423 ml. Similarly, Wang *et al.* [5] reported shorter operative time and blood loss of 162 min and 442 ml, respectively, in nonfusion group, whereas they were 224 min and 572 ml, respectively, in the fusion group. In our study, we could achieve even shorter operative time and less bleeding with meticulous hemostasis than their studies (58 min and 220 ml, respectively).

Regarding donor site morbidity following posterior iliac crest bone grafting, Robertson and Wray stated that pain scores following spinal fusion tended to be high at 6 months and decreased at 12 months [11]. However, Dai *et al.* [10] in their study did not report any significant problem at the donor site.

Implant failure and screw breakage obviously appear to be more common with nonfusion. Early removal of implants before their failure was performed in our study. Screw breakage has been reported in both fusion and nonfusion groups, mostly denoting pseudarthrosis in the fusion group [5].

In our study, even after removal of the screws, no patient complained of severe pain at final follow-up. Only four patients occasionally required analgesics, whereas the rest did not need them at all. The loss of corrections was statistically insignificant. The minor increase in the Cobb's angle is attributable mainly to the collapse of the injured disc adjoining the fracture rather than collapse of the vertebral body.

Following implant removal, segmental motion was restored in the previously fixed segments (9.58°). In comparative studies, significantly greater motion was observed in the nonfusion than fusion group. Saving motion segments in the lumbar region is important, especially in active young patients, and prevents adjacent segment degeneration [4]. There is a doubt as

to the possibility to fix without fusion in children as spontaneous fusion can occur without attempting [12,13].

Conclusion

Satisfactory results can be achieved by posterior spinal fixation without fusion of thoracolumbar burst fractures (A3.2 and A3.3). It provides adequate radiologic correction as well as clinical relief while preserving motion with effective rehabilitation. Long-term follow-up is needed to see if this technique can truly prevent occurrence of adjacent segment disease.

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Conflicts of interest

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