

MONOSEGMENTAL TRANSPEDICULAR FIXATION OF THORACOLUMBAR BURST FRACTURES

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Abstract:

Study design: Prospective clinical.

Objective: Evaluate efficacy of monosegmental transpedicular fixation for treatment of some thoracolumbar burst fractures.

Summary: Short segment posterior fixation become a popular technique to treat thoracolumbar burst fracture. It is saving more motion segments throughout reducing fusion segment numbers, Previous investigations which used monosegmental pedicle instrumentation with placement pedicle screws into fractured vertebral body for treating thoracolumbar fracture yielded good clinical results.

Method: 20 thoracolumbar burst fractures cases treated with monosegmental transpedicular fixation. All patients were followed-up radiologically and clinically. The preoperative, initial postoperative and the latest follow-up radiographs were evaluated for sagittal index, percentage of anterior body height compression and load sharing score. Clinically the latest follow-up functional outcomes were evaluated using Oswestery Disability Index and Low Back Outcome Score.

Results: 20 patients were followed-up successfully with the mean follow up period was 17 months. Sagittal index value of, anterior body height compression fractured vertebra% are 19.1+/-5.4 degrees and 37.03+/-10.87, respectively, improved (statistically significant) to 10.4+/- 4.16 degrees, and 19.3+/-9.6.

Conclusion: In conclusion, this study demonstrated that MSPI is effective and reliable operative technique for selected thoracolumbar burst fractures (type A3.1/A3.2).

INTRODUCTION

90% of spinal injuries involved thoracolumbar region; 10% - 20% of injuries were burst fractures (1). Thoracolumbar burst fractures results of vertical compression to flexed spine. Some extension force might be very necessary to cause characteristic burst fracture pattern (2).

Burst spinal fracture has anterior column, middle column fracture and bone fragments retropulsion to spinal canal. In many burst fractures, pedicles spread with associated fracture of posterior rim of involved lamina might occur (3). Combining of concomitant lamina fractures and burst fracture could be link with dural tear and entrapped nerves root (4).

Managing thoracolumbar burst fracture remains as challenges. Fundamental principling had not changing for long time for treatments. Ongoing controversy in determined treatment way til now. (5, 6, 7).

Saved motion segments through reducing fusion segments number is essential in spine fracture surgery (8). monosegmental pedicle instrumentation with pedicle screws placement to fractured vertebral body for thoracolumbar fractures save the spine motion through this principal(9,10).

Our target is evaluating monosegmental pedicle instrumentation efficacy in managing thoracolumbar burst fractures.

MATERIALS AND METHODS

Between 2013 and 2017, 20 , thoracolumbar burst fractures cases used in our investigation. Criteria used were: single level closed burst fracture (AO-ASIF type A3-1 and A3-2) without neurological impairment or with partial neurological deficit. All fractures met the following criteria: (a) Pedicles were intact without any defect on cortical walls; and (b) At least one of endplate intact or close to intact. Sagittal index exceeding 15 degrees or lost of anterior body height exceeding 50%. The exclusion criteria were: multilevel involvement, other spine fracture type, complete burst fracture (AO-ASIF type A3-3), patient with medical contraindications to surgery and burst fracture with complete neurological deficit.

The study included 6 females and 14 males with age ranged from 17 to 65 (mean 29.3 years).10 cases had fallen from a height and 10 cases had motor car accident. The time interval before intervention ranged from one to 7 days with mean 2 days. First lumbar vertebra was the most common fractured one, it represents 50% (10 cases) while L2 represents 25% (5 cases), T12 represents 15% (3 cases) and L3 represents 10% (2 cases). The majority of fractures was type A3.1, it represents 85% (15 cases) while type A3.2 represents 25% (5 cases). 6 patients had fractures around ankle, 2 patients had Pelvic fracture, 1patient had distal radius fracture and 1patient had humerus fracture. All patients were subjected to both clinical and radiological examination on admission to the hospital. The complete history of patients was taken including mechanism of injury and time of injury, Medication including type, dosage & duration, Past history of: previous back surgeries and medical diseases (e.g. DM, HTN, heart diseases, etc...). complete general physical examination and neurological examination was done. Neurological examination (motor, sensory, reflexes & digital rectal examination) was done as recommended by the American Spinal Injury Association.

Cases and relatives were informed about the options of the treatment. After the surgical decision was taken, investigated cases and consent was taken.

In all patients, midline posterior approach was used with verification of the level of fracture using fluoroscopy. The cases were instrumented by pedicle screws bilaterally into fractured level and one adjacent level, either superior or inferior depend on tge side of intact endplate. Indirect reduction of fracture was attained by rod contouring. Blood loss average is 158+49 mL (90-280 mL). The average operation time was 87+ 24 minutes (range, 70-113 minutes).After operation, cases managed with early mobilization and braces for 6 weeks. All patients were followed and the mean follow up was 17 months (range, 9-36 months). All patients were evaluated postoperatively, at 1 month, 3months, 6months, 9months, and 1 year. The preoperative, initial postoperative and follow-up radiographs were evaluated for sagittal index, percentage of anterior body height compression and load sharing score. Clinically the latest follow-up functional outcomes were evaluated using Oswestery Disability Index and Low Back Outcome Score.

RESULTS

Preoperative sagittal index ranged from 15 to 39 degrees with mean of $19.1 \pm 5.4^\circ$, while post operative sagittal index ranged from 3 to 19 degrees with mean of $10.4 \pm 4.16^\circ$, and the last follow up sagittal index ranged from 5 to 40 degrees with mean of $13.7 \pm 7.79^\circ$. The correction achieve from preoperative to postoperative stage. The preoperative anterior body height compression percentage ranged from 21 to 53 % with mean of $37.03 \pm 10.87\%$, while postoperative anterior body height compression percentage ranged from 9 to 35% with mean of $19.3 \pm 9.6\%$, and the last follow up anterior body height compression percentage ranged from 12 to 60% with mean of $28 \pm 13.29\%$. Table 1.

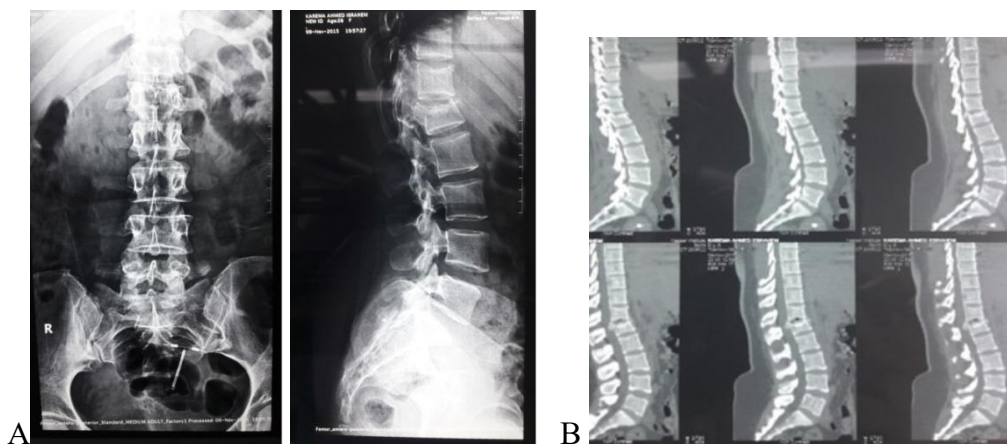
Table 1. Various radiological outcome measures.

	Initial	Postoperative	the last follow up
Sagittal index (°)	$19.1 \pm 5.4^\circ$	$10.4 \pm 4.16^\circ$	$13.7 \pm 7.79^\circ$
Compression percentage of vertebral height	$37.03 \pm 10.87\%$	$19.3 \pm 9.6\%$	$28 \pm 13.29\%$

In the clinical evaluation, the follow-up Oswestry Disability Index (ODI) % ranged from 16 to 36 with mean of 20 ± 4.94 while the last follow-up Low Back Outcome Score (LBOS) ranged from 54 to 71 with mean of 67 ± 3.94 . At the last follow-up evaluation, 100% of patients return to work; 90% have few or no restrictions in work abilities.

Two cases were complicated with correction loss including one broken screw. The first case was with preoperative SI 39 degrees, while postoperative SI was 19 degrees and last follow-up SI was 40 degrees and the second case which was complicated with broken screw had preoperative SI 23 degrees, while postoperative SI was 13 degrees and last follow-up SI was 24 degrees.

Figs. 1 and 2 were preoperative and postoperative X-rays and CT scan photographs of representative cases.



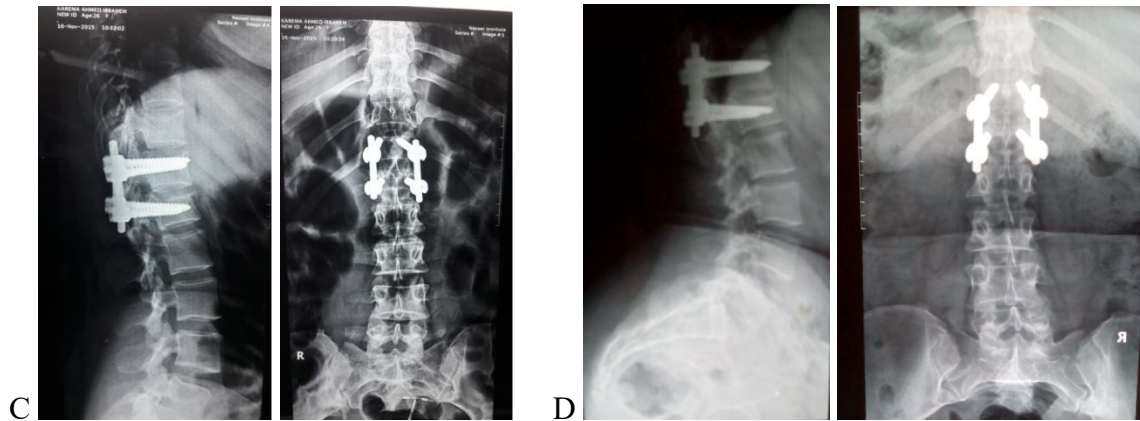


Fig. 1 L1 burst fracture classified as A3.2 in Female patient, 27 years old, house wife as a result of Falling from height. **(A)** Preoperative anteroposterior and lateral radiograph. **(B)** Preoperative thoracolumbar spine computed tomography sagittal images. **(C)** images initial Postoperative anteroposterior and lateral radiographs. **(D)** One year follow-up anteroposterior and lateral radiograph.

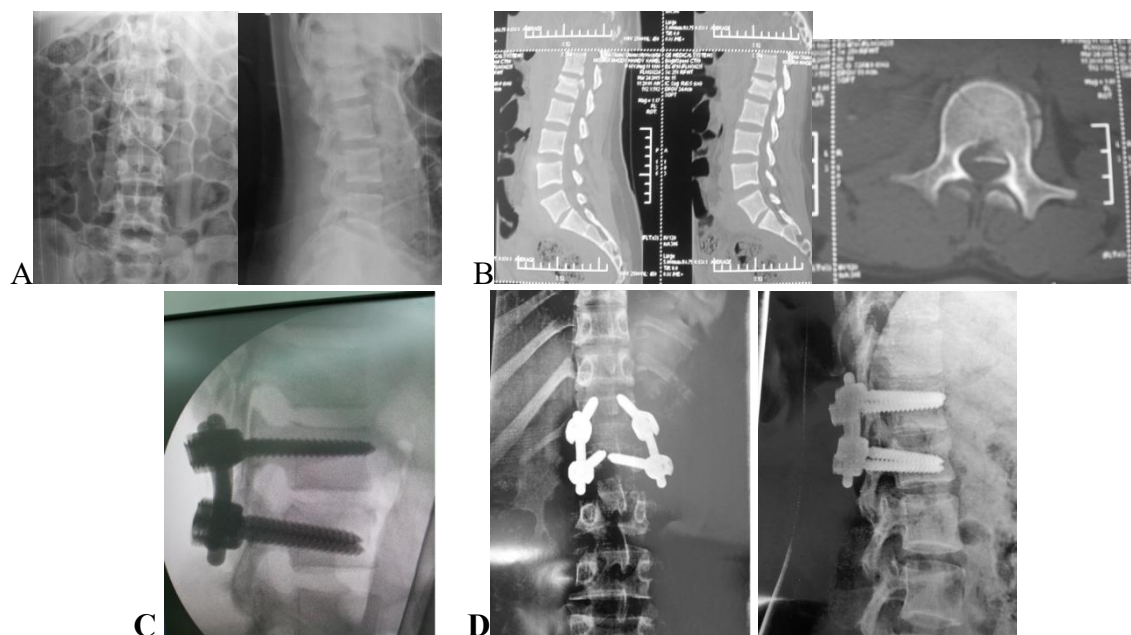


Fig. 2 L1 burst fracture classified as A3.1 in Female patient, 17 years old, house wife as a result of Falling from height. **(A)** Preoperative anteroposterior and lateral radiograph. **(B)** Preoperative thoracolumbar spine computed tomography sagittal and axial images. **(C)** images initial Postoperative lateral radiograph. **(D)** One year follow-up anteroposterior and lateral radiograph.

DISCUSSION

Selecting thoracolumbar burst fractures ideal treatment is of remain discussion matter. Pervious studies had not the ability to prove substantial differences in functional outcomes between operative and non-operative treatments, regardless the neurological injury (11, 12).

Reviewed 24 neurologically healthy patients (34months) with unstable thoracolumbar burst fractures were managed by either casting or bracing and early ambulation. Clinical follow-up examinations were performed throughout using questionnaire in where cases asked to pain feeling rates, overall satisfactions with treatments. Kyphotic deformity might be corrected with hyperextension casting but tend to recur through mobilization and healing courses. No correlations reported among kyphosis and clinical outcome and non-operative management of thoracolumbar burst fractures with hyperextension casting or bracing was more safe and effective treatment (13).

In contrary, other clinical trials proved that operative management had many advantages in treating acute burst fracture regarding neurologic deterioration prevention (14).

Surgical method was better than temporizing ones in treating fractures, restoring neurological function, moving early, and decrease complications (15).

Surgical approach with various methods were applied as anterior, posterior, and combined anteroposterior instrumentations which were very effective (16, 17). Anterior approaches could achieve more correction in local post-traumatic kyphosis and require more invasive technique (18).

Short segment fixation remains a common surgical treatment in thoracolumbar burst fracture (19) and this procedure present multiple advantages as: easy reduction of fracture, small number of fixed vertebrae and avoid segmental mechanic alterations of longer spinal segment fixation of unaffected level and thereby diminishing subsequent degeneration and junctional pain.

Mainly the disadvantage for SSF was related to long-term and low stability in anterior damaged spine (20).

However, it has been demonstrated SS fixations are in relations to unacceptable implant failure rates, instability and postoperative loss of kyphosis correction. Alternative method was using longer segmental instrumentations for reducing load on each screw(21, 22).

With minimal invasive surgery advent , reported novel monosegmental fixation techniques with placing pedicle screws into fractured vertebral body for treating thoracolumbar burst fractures (9, 23). Cases mobilized within 10 days of surgery. Follow up for 6 months, no cases experienced neurologic deficit or developed delayed kyphotic deformity (9).

In this study the effectiveness of monosegmental pedicle instrumentation in managing of thoracolumbar burst fractures investigated prospectively. Deformity and fracture severities determined by measuring preoperative sagittal index, %ABC, and LSC. In addition, besides the age and distribution of the fractures, neurological examination was done as recommended by the American Spinal Injury Association (ASIA). Follow up was done by radiological assessment of sagittal index, %ABC and by clinical assessment using LBOS and Oswestery Disability Index.

In this study there was significant differences between preoperative and follow-up sagittal index [mean preoperative SI (19.1 ± 5.4 degrees), mean postoperative SI (10.4 ± 4.16 degrees), mean follow-up SI (13.7 ± 7.79 degrees)] and %ABC [mean preoperative %ABC (37.03 ± 10.87), mean postoperative %ABC (19.3 ± 9.6), mean follow-up %ABC (28 ± 13.29)] meaning that significant improvement in fracture deformity. The median of loss of kyphotic correction at last follow-up was 28% from initial postoperative kyphotic correction. According to our results it was found that, long-term angular correction loss which had close attention. All incidence of kyphotic correction loss post MSPI combined with load-sharing score of 8 points.

By clinical evaluation of the patients, no correlation found between different degree of kyphosis and function. the average follow-up Oswestery Diability Index % (ODI) was 20 ± 4.94 (minimal disability) and the average follow-up Low Back Outcome Score (LBOS)

was 67 ± 3.94 which means excellent status. At final follow-up evaluation, 100% return to their works; 90% have few or no restrictions in ability to jobs. Most of cases were without procedure complications, while three cases were complicated with correction loss including one broken screw with a 15% failure rate.

Our results were in line with those in the trial performed by Wei et al (24) for management of 47 thoracolumbar burst fractures by posterior monosegmental stabilization, Significant differences among preoperative and follow-up sagittal index [mean preoperative SI (13.1 ± 5.4 degrees), mean postoperative SI (4.5 ± 2.7 degrees), mean follow-up SI (7.1 ± 4.2 degrees)] and %ABC [mean preoperative %ABC (43 ± 11.5), mean postoperative %ABC (20.1 ± 15.7), mean follow-up %ABC (26.8 ± 8.9)]. Averages follow-up Oswestry Disability Index % and Low Back Outcome Score (LBOS) were (ODI) 34 ± 9.7 and 74 ± 8.7 , respectively. The average of loss of kyphotic correction at last follow-up was 30.2%. Three cases were complicated with correction loss with a 6.38% failure rate.

Liu et al (25) have reported that monosegmental pedicle instrumentation resulted in satisfactory radiographic evaluation in patients with type A3.1/A3.2 thoracolumbar burst fractures of Load Sharing Score of 7 [mean preoperative SI (15.3 ± 6 degrees), mean postoperative SI (6.3 ± 4.1 degrees), mean follow-up SI (8.2 ± 4.2 degrees)] and %ABC [mean preoperative %ABC (33.9 ± 11.2), mean postoperative %ABC (8.1 ± 6), mean follow-up %ABC (9.7 ± 6.2)]. The average of loss of kyphotic correction at last follow-up was 21.1%. Liu et al have reported that there were no cases complicated with correction loss or fixation failure .

In comparing the results in this study with the results of the trial performed by Wei et al (24) for management of 38 thoracolumbar burst fractures by posterior short segmental stabilization, there was no significant difference between them. Wei et al reported that [mean preoperative SI (11.5 ± 6.5 degrees), mean postoperative SI (2.3 ± 1.6 degrees), mean follow-up SI (4.8 ± 2.9 degrees)] and %ABC [mean preoperative %ABC (39.4 ± 13), mean postoperative %ABC (21.7 ± 11.5), mean follow-up %ABC (24.5 ± 12.4)]. Also the average follow-up Oswestry Disability Index % (ODI) was 37.6 ± 11.5 and the average follow-up Low Back Outcome Score (LBOS) was 60.2 ± 9.6 . Two cases were complicated with correction loss with a 5.26% failure rate.

In the trial performed by Liu et al (25) for management of 33 thoracolumbar burst fractures by posterior short segment pedicle screw fixation, Significant differences among preoperative and follow-up sagittal index [mean preoperative SI (18.7 ± 8.4 degrees), mean postoperative SI (6.7 ± 5 degrees), mean follow-up SI (7.6 ± 4.5 degrees)] and %ABC [mean preoperative %ABC (37.8 ± 14.9), mean postoperative %ABC (2.5 ± 4.2), mean follow-up %ABC (7 ± 5.5)]. Liu et al have reported that there was no cases complicated with correction loss or fixation failure.

The results in this study were near to the results of the trial performed by Kim et al (26) for management of 32 thoracolumbar burst fractures by posterior long segment pedicle screw fixation. Kim et al reported that mean preoperative kyphotic angle was (19.4 ± 7.7 degrees), mean postoperative kyphotic angle was (9.1 ± 7.2 degrees), mean follow-up kyphotic angle was (10.8 ± 8 degrees) and mean preoperative ABC% (39.5 ± 15.4), mean postoperative ABC% (19.4 ± 13.1), mean follow-up ABC% (22.1 ± 11.6)]. Three cases were complicated with implant failure with failure rate of 9.375 %.

In the trial performed by Sapkas et al (22) for management of 30 thoracolumbar burst fractures by posterior long segment pedicle screw fixation, mean preoperative Cobb angle was (17.5 ± 6.8 degrees), mean postoperative Cobb angle was (3 ± 2 degrees), mean follow-up Cobb angle was (6 ± 4 degrees) and mean preoperative %ABC (40 ± 10), mean postoperative %ABC (6 ± 10), mean follow-up %ABC (8 ± 10)]. George et al have reported that there was no cases complicated with implant failure

In conclusion, this study demonstrated that MSPI is effective and reliable operative technique for selected thoracolumbar burst fractures (type A3.1/A3.2) with load-sharing score < 7 points. MSPI shorten operative times and decrease blood loss amounts and give better clinical outcome.

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