

Short Segment Pedicle Screw Instrumentation for Treatment of Type A Thoracolumbar Burst FracturesElmenawy M.¹, Farhood H.², El-Shoura S.¹ and Abdel Hady H.¹¹Orthopedic Surgery Department, Faculty of Medicine, Al-Azhar University (Damietta), Egypt²Orthopedic Surgery Department, Faculty of Medicine (Girls), Al-Azhar University, Cairo, Egypt
haytham.R@Yahoo.Com

Abstract: Background: the spinal column is part of the axial skeleton, and part of the posterior wall of the trunk. It is composed of bony vertebrae and intervertebral discs, supported by strong ligaments, and strong musculature. It is formed of 33 vertebrae; 7 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 4 coccygeal. The most common site of injury to the spine is the thoracolumbar junction, which is the mechanical transition between the rigid thoracic and the more flexible lumbar spine. **Objective:** to assess the results of short segment pedicle screw, which include placement of screw at fracture level in correction of deformity, maintenance of correction and preventing the failure of the fixation in type a thoracolumbar burst fractures. **Method:** 20 patients with thoracolumbar burst type a fractures from t12 to l4, who were treated with short segment posterior fixation, in the Department of Orthopaedics at new Dimettia Azahar University Hospital from January 2014 to May 2018. The 20 patients were classified according to the American Spinal Injury Association's. These patients had a score of 7 points or more according to load sharing classification (LSC) and therefore they were considered for sspf then the follow up period ranged from six to 18 months post-operative with an average of 10 months are occur to assessment of the outcome. **Results:** the 20 patients its mean age was 29.70 ± 9.21 with range from 18 to 50 years, as regard patients sex 14(70%) cases were male versus 6(30%) cases were female, the main mechanism of injury was had fallen from height (60%) then road traffic accidents (40%). The most frequently injured level was lv2 (35%). As regard to pain score and functional capacity was found that eight patients (40%) (score p1), eight patients (40%) (score p2), three patients (15%) (score p3), one patient (5%) (score p4) and no patients (0%) (score p5). In relation to neurological recovery there was no statistically significant difference between pre-operative scores and those of the last follow-up visit. ($p = 0.357$). In directional to the vertebral body compression percentage (vbcp). There was a significant statistical difference when comparing the pre-operative compression percentages with the post-operative and the follow-up **results** ($p1= 0.001, 0.001*$). **Conclusion:** hyperlordotic reduction and SSPI+IS was a safe and effective method of treating thoracolumbar burst fractures. this technique yields excellent radiological results with a very low rate of failure regardless of whether the fractures score high or low.

[Elmenawy M., Farhood H., El-Shoura S. and Abdel Hady H. **Short Segment Pedicle Screw Instrumentation for Treatment of Type A Thoracolumbar Burst Fractures.** *Nat Sci* 2018;16(12):158-161]. ISSN 1545-0740 (print); ISSN 2375-7167 (online). <http://www.sciencepub.net/nature>. 24. doi:[10.7537/marsnsj161218.24](https://doi.org/10.7537/marsnsj161218.24).

Keywords: Thoracolumbar Burst Type A Fractures, Short Segment Pedicle Screw

1. Introduction

The spinal column is part of the axial skeleton, and part of the posterior wall of the trunk. It is composed of bony vertebrae and intervertebral discs, supported by strong ligaments, and strong musculature. It is formed of 33 vertebrae; 7 cervical, 12 thoracic, 5 lumbar, 5 sacral, and 4 coccygeal. (1) The most common site of injury to the spine is the thoracolumbar junction, which is the mechanical transition between the rigid thoracic and the more flexible lumbar spine. (2) Absence of stabilizing articulations with the ribs, lordotic posture and more sagittally oriented facet joints are the most obvious explanations. Burst fractures represent about 10-20% of all thoracolumbar fractures spinal fractures have an annual incidence of 64 per 100,000 and neurological deficit is seen in 10-30%, resulting in an estimated 12,000 new spinal cord injuries in the United States every year. Only 54% of all patients with spinal

fractures return to their previous level of employment. (3) thoracolumbar fractures, usually caused by high energy axial loading and characterized by compression failure of the anterior and middle spinal columns, are most common among thoracolumbar fractures. (4) the aim of treating thoracolumbar fractures are healing of spine without progressive kyphosis, prevent neurological deterioration and to improve neurological function if present, prevention of instability and pain, to allow early mobilization and avoiding long bed rest complication and to minimize hospital stay. There are two ways to the a thoracolumbar burst fractures first one conservative treatment and the second operative treatment; the conservative treatment is indicated when neurologically intact patient, less than 25% loss of vertebral body height, less than 20° kyphosis, less than 10 % canal compromise and patients with 3 or less points of tlics are non-operative. (5) The conservative treatment is usefully in stable fractures

which including the postural reduction, bed rest, bracing and observation but there are many side effects in conservative treatment as prolonged immobilization carries risks of skin bedsores and deep vein thrombosis. (6)

Despite only 20 to 30% of spine fractures require surgery, the remainder can be treated non-operatively with a brace, molded orthosis, or hyperextension cast and bed rest has also been effective, even in severe fractures but the ideal treatment for patients with fracture of the thoracolumbar spine remains surgical treatment. (7) Due to which indicating for surgery unstable fracture, rigid stability of the spine, direct or indirect decompression of spinal canal, restoration of coronal and sagittal height and finally healing of spine without deformity and is indicated when greater than 50% loss of body height, kyphosis greater than 20°, associated posterior element disruption, showing retropulsed canal fragment and canal compromised more than 30% and progressive neurological affection. (5)

The Surgical Management Aims To Realign The Spine, Maintain Its Stability And Optimise The Neurological Outcome. Various Methods Of Surgical Treatment Have Achieved These Objectives But Are Fraught With Complications. (8) anterior corpectomy and fixation has given good results the risk of morbidity and the technical expertise required precludes its routine use. Posterior fixation offers easy exposure and a less morbid approach, but with a high incidence of implant failure and recurrent kyphosis. (9) the advent of transpedicular screw fixation systems have made short-segment pedicle screw instrumentation (sspi) more reliable, traditional sspi involves placement of the pedicle screws only at the levels immediately adjacent to the fractured vertebral body (10). The causes of failure of posterior fixation appear to be the structural and mechanical deficiency of the anterior column, poor fixation in osteoporotic bone and insufficient points of fixation, to prevent this, various surgical techniques such as transpedicular bone grafting, cementing, anterior approach-instrumentation and strut grafting or long-segment fixation. (11) these techniques have the disadvantage of lengthening the operating time and exposing the patient to the risk of additional morbidity over that of short segment transpedicular fixation. In an attempt to achieve stiffer short-segment constructs, some surgeons add pedicle screws (termed intermediate or index-level screws at the level of the fractured vertebra. (11) Short-Segment pedicle screw fixation (1 level above and 1 level below the fracture level) is the most common treatment for thoracolumbar burst fracture. (12)

Aim of the Work

To assess the results of short segment pedicle screw, which include placement of screw at fracture level in correction of deformity, maintenance of correction and preventing the failure of the fixation in type a thoracolumbar burst fractures.

2. Patient and Methods

20 patients with thoracolumbar burst type a fractures from t12 to l4, who were treated with short segment posterior fixation, in the department of orthopaedics at new dimettia azahar university hospital from January 2014 to may 2018. The 20 patients were classified according to the american spinal injury association's. These patients had a score of 7 points or more according to load sharing classification (LSC) and therefore they were considered for SSPF then the follow up period ranged from six to 18 months post-operative with an average of 10 months are occur to assessment of the outcome including pain (was evaluated and recorded using the five-point pain-scale of denis. (13), neurological status (it was evaluated and recorded using asia impairment scale (14), functional capacity (it was evaluated and recorded using the five-point functional work-scale of denis (13). And radiological evaluation including the local kyphotic angle (LKA), the anterior vertebral body compression percentage (AVBCP) and the spinal canal compromise percentage. Then, these values were compared with the pre-operative and follow-up value.

3. Results

The 20 patients its mean age was 29.70 ± 9.21 with range from 18 to 50 years, as regard patients sex 14(70%) cases were male versus 6(30%) cases were female, the main mechanism of injury was had fallen from height (60%) then road traffic accidents (40%). The most frequently injured level was l2 (35%). As regard to pain score and functional capacity was found that eight patients (40%) (score p1), eight patients (40%) (score p2), three patients (15%) (score p3), one patient (5%) (score p4) and no patients (0%) (score p5). In relation to neurological recovery 17 patients (85%) scored e pre-operatively, increased to 19 patients (95%) at the last follow up visit, as two patients (10%) improved from score (c) to score (e). One patient (5%) who scored (b) pre-operatively, improved to score (d) at the last follow-up visit with there was no statistically significant difference between pre-operative scores and those of the last follow-up visit. ($p = 0.357$).

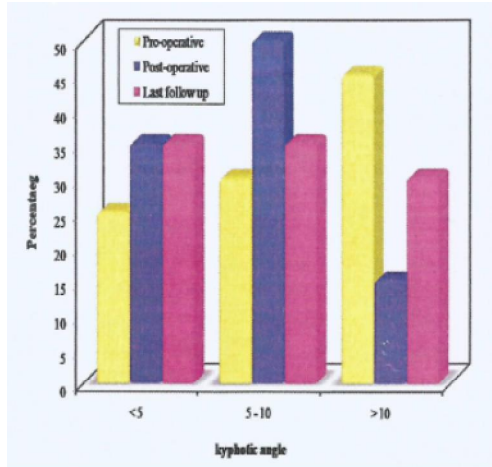


Figure (1): ASIA Classification Pre-Operative and At the Last Follow-Up.

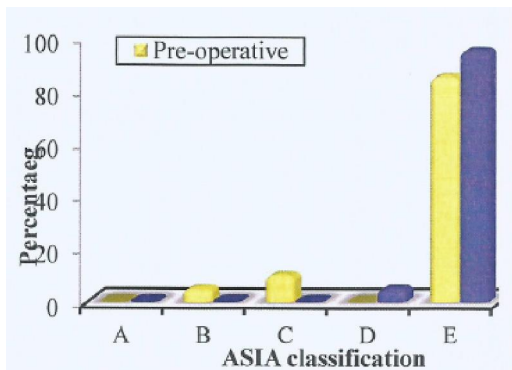


Figure (2): The Local Kyphotic Angle (LKA) Pre-Operative, Immediate Post-Operative and at the Last Follow Up.

As regard to radiological assessment was found that the mean pre-operative local kyphotic angle was 9.40 ± 5.30 , with a range between $2^\circ - 20^\circ$. post-operatively it improved to 5.85 ± 3.03 , and with a range between $1^\circ - 12^\circ$. At the last follow up, the mean has reached 6.50 ± 4.14 , with a range between 1– 14 with there was a statistically significant correction of the local kyphotic angle (lka) when compared to either the post-operative values, or the last follow-up values with the pre-operative ones ($p_1 = 0.017, 0.050$) respectively. While, when comparing the last follow-up values to the immediate post-operative ones, there was a statically insignificant loss of correction ($p_2 = 0.565$). In directional to the vertebral body compression percentage (vbcp). There was a significant statistical difference when comparing the pre-operative compression percentages with the post-operative and the follow-up results ($p_1 = 0.001, 0.001^*$). However, by comparing the post-operative compression percentages with the last follow-up values, there was no statistical difference ($p_2 = 0.525$).

As regard to the canal compromise percentage (ccp) was found that the pre-operative canal compromise percentages (ccp) in two patients (10 %) of $<30\%$, and one patient (5%) of $> 50\%$ pre-operatively were corrected post-operatively to a percentage of 0% and remained the same at the last follow-Up. There was no statistically significant difference when comparing both the post-operative and the last follow up with the pre-operative canal compromise percentage values ($p = 0.237$). finally; in relation to the correlation between the pre-operative load sharing scores (LSC) and the follow-up pain and functional capacity scores was found that there was a statistically significant positive correlation between the pre-operative load sharing score of our patients and both the pain score results and the work score results at the last follow-up. This indicates that lower pre-operative lsc scores resulted in better functional capacity and less pain.

4. Discussion

The treatment of thoracolumbar vertebral fractures is highly controversial. The vertebral stability after fracture constitutes an important part of the conflict. (15) short segment pedicle screw fixation has emerged as the treatment of choice for a patient with a burst fracture of the thoracolumbar spine. Pedicle screws have a high pull-out and cut-out strength and can withstand high stresses without failure. They can therefore achieve and maintain reduction of a short segment. Despite these advantages, they are unable to prevent anterior collapse, especially in a highly comminuted fracture. Late complications such as implant failure with recurrent kyphosis can be troublesome. (16) in a prospective clinical study, wang (et al 2012) compared the results of surgical treatment with and without fusion in thoracolumbar burst fractures. In that study, a total of 58 patients who were neurologically intact, with a kyphosis angle greater than 20° and a canal narrowing and collapse in vertebral height of greater than 50% were enrolled. As a result of that study, no marked difference was observed in kyphosis angles between the two groups. Radiographic parameters were found to be statistically better in the non-fusion group. Implant failure was screw breakage in eight patients (prevalance 13.7%), five of whom were in the fusion group whereas 3 were in the nonfusion group. The authors suggested that the short term outcomes of short segment pedicular fixation without fusion in the treatment of thoracolumbar fractures were satisfactory. Additionally, they suggested that the advantages of nonfusion surgery included the absence of donor site related problems, preservation of motion segments, decreased blood loss, and the shortened duration of the surgery. (17) liu (etal2009) published the results of a 5 years prospective randomized clinical study of 73

patients who underwent posterior short segment fixation with and without fusion for thoracolumbar burst fractures. Among radiological results, local kyphosis angle and loss of kyphosis angle correction were taken as the basis. As a result, no radiological or clinical differences were detected between the two groups. The duration of the operation and blood loss were found to be statistically significantly lower in the non-fusion group ($p < 0.05$). (18)

Conclusion

Hyperlordotic reduction and SSPI+IS was a safe and effective method of treating thoracolumbar burst fractures. This technique yields excellent radiological results with a very low rate of failure regardless of whether the fractures score high or low.

References

1. Gray H. Gray's Anatomy: The Anatomical Basis of Clinical Practice. 40th ed. Edinburgh: C. Livingstone; 2008: 287-91.
2. Anoushka S, Lindsay T, Suhkvinder K, Aria N, Michael G. Global Prevalence And Incidence Of Traumatic Spinal Cord Injury. *Clin Epidemiol*. 2014; 6: 309–31.
3. Mclain, Robert F. Functional Outcomes After Surgery For Spinal Fractures: Return To Work And Activity. *Spine* 2004; 29: 470-7.
4. Tezer M, Erturer RE, Ozturk C, Et Al. Conservative Treatment Of Fractures Of The Thoracolumbar Spine. *Int Orthop* 2005; 29:78–82.
5. Mariotti AJ, Diawan AD: Current Concepts In Anterior Surgery For Thoracolumbar Trauma. *Orthop Clin North Am* 33: 403, 2002.
6. Serdar T, David J, Steven J. Deep Vein Thrombosis Prophylaxis In Trauma Patients. *Thrombosis*.2011; 1-11.
7. Sasso RC, Renkens K, Hanson D, Et Al. Unstable Thoracolumbar Burst Fractures Anterior-Only Versus Short-Segment Posterior Fixation. *J Spinal Disord Tech* 2006; 19:242–48.
8. Samir A, Mostafa A. Elsameab. Inclusion Of The Fracture Level In Short-Segment Fixation Of Unstable Traumatic Thoracolumbar Spine Fractures. *Al-Azhar Assiut Medical Journal*. 2016; 14 (4):153-8.
9. Ling W, Jianjun L, Hong W, Qun Y, Decheng L, Weiguo Z, Et Al. Posterior Short Segment Pedicle Screw Fixation And TLIF For The Treatment Of Unstable Thoracolumbar/Lumbar Fracture. *BMC Musculoskelet Disord*. 2014; 15: 40.
10. Korovessis P, Baikousis A, Zacharatos S, Et Al. Combined Anterior Plus Posterior Stabilization Versus Posterior Short Segment Instrumentation And Fusion For Mid-Lumbar (L2-L4) Burst Fractures. *Spine* 2006; 31:859–68.
11. Tezeren G, Kuru I. Posterior Fixation Of Thoracolumbar Burst Fracture: Short-Segment Pedicle Fixation Versus Long-Segment Instrumentation. *J Spinal Disord Tech*. 2005; 18:485–88.
12. Sandra E, Remko S, Jan HB, Harriët W, Rob KW. Construct Validity Of Functional Capacity Tests In Healthy Workers. *BMC Musculoskeletal Disorders*.2013; 14:180.
13. Williams M. American Spinal Injury Association (ASIA). Standard Neurological Classification Of Spinal Cord Injury.2006.
14. Chang H, Seung H, Yongjung J, Kim H, Hyeong C. Technical Report Of Free Hand Pedicle Screw Placement Using The Entry Points With Junction Of Proximal Edge Of Transverse Process An Lamina In Lumbar Spine: Analysis Of 2601 Consecutive Screws. *Korean J Spine*. 2013; 10(1):7-13.
15. Yung AW, Thng PL. Radiological Outcome Of Short Segment Posterior Stabilization And Fusion In Thoracolumbar Acute Fractures. *Ann Acad Med Singapore*, 2011 40:140-44.
16. Wang H, Li C, Liu T, Zhao WD, Zhou Y. Biomechanical Efficacy Of Monoaxial Or Polyaxial Pedicle Screw And Additional Screw Insertion At The Level Of The Fracture, In Lumbar Burst Fracture. An Experimental Study. *Indian J Orthop* 2012, 46:395- 401.
17. Liu S, Li H, Liang C. Monosegmental Transpedicular Fixation For Selected Patients With Thoracolumbar Burst Fractures. *J Spinal Disord Tech* 2009, 22:38-44.

11/3/2018