

Efficacy of Short and Mono segment Spinal Fixations in Traumatic Incomplete Thoracolumbar Burst Fractures

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ABSTRACT

Background: Controversies still mount over the long segment, short segment and mono segment screw fixation for traumatic thoracolumbar spine burst fractures. This article aims to provide our initial experience of the effectiveness of these management modalities with additive focus on their potential benefits upon preventing the loss of correction over time. **Methods:** We included all operated cases of thoracolumbar fractures presenting with the ASIA grade of above 'C' between December 2014 to December 2017 in a retrospective manner in terms of operative time, estimated intra-operative blood loss, any post-operative surgical wound complications, implant cost, average time lapse for the patients to return to physiotherapy and the follow up radiological imaging at 6 months. **Results:** Long segment fixation is comparatively more time consuming with considerable blood loss and high incidence of postoperative wound complications. We observed that both short as well as mono segment screw fixations had similar incidences with regards to the common complications pertaining to the spinal implant placement procedures. **Conclusions:** Both short and mono-segment fixation procedures resulted in comparable short and long term results. Though long segment fixation is comparatively more stable, it is, however, expensive with a higher incidence of other postoperative complications.

Keywords: long segment fixation, mono segment fixation; short segment fixation; thoracolumbar burst fractures.

INTRODUCTION

Thoracolumbar spine fractures account for the most common location implicated during spinal injuries.¹ Transitional zone of the region predisposes for vertebral body collapse and kyphotic encroachment upon the spinal canal thereby harbinger for neurological deficits.² Despite its high incidence, there has not been a specific consensus with regards to the ideal approaches during its surgical management. The anterior approach offers direct neural decompression with provision for inserting high load-bearing implants thereby minimizing the risk of implant failures.³ This modality in a study provided high fusion rate and improvement in neurological status by at least one Frankel grading in almost 95% of cases.⁴ It also demonstrated more effective correction for kyphotic deformity.⁵

The posterior approach is a comparatively more familiar surgical corridor to most operating surgeons and provides indirect decompression through postural reduction and longitudinal distracting force from the intact longitudinal ligament.⁶ Herein we try to study the outcome differences between short segment fixations (excluding the involved segment) with mono-segment fixation (inclusion of the involved segment) in traumatic thoracolumbar burst fractures.

METHODS

This is a cross-sectional study conducted in College of Medical Sciences-teaching hospital where 32 operated cases of thoraco-lumbar fractures between December 2014 to December 2017 was included in a retrospective manner in terms of operative time, estimated intra-operative blood loss, any post-operative surgical wound complications, implant cost, average time lapse for the patients to return to physiotherapy and the follow up radiological imaging at 12 months. Ethical approval was taken from Institutional Review Committee of

Inclusion criteria

- All thoracolumbar traumatic fractures presenting with ASIA grade equal or above Type 'C'.
- Age > 18 years.
- Sagittal index >15 degree.
- Loss of anterior body height > 30%.
- Refractory pain at fracture site.
- Intact Pedicles of affected vertebra for mono-segment fixation

Exclusion criteria

- Presenting neurological status below ASIA Type 'C'.
- Damage to pedicles (monosegment fixation).
- Significant polytrauma with hemodynamic instability.

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- Concomitant other spinal level injuries.
- Severe osteoporosis.
- Failure to provide consent for participation in the study.
- Lost to follow up within the study period.

The patients were managed with either a short segment (SSF) or a monosegment (MSF) posterior pedicle screw fixation. The location and projection of pedicle screws were confirmed by the use of intra-operative C-arm images and post-operative CT images. To reduce the confounding biases, the same operating team performed the surgical procedures in all the cases. Though efforts were made in utilizing Medtronic implants in all the patients, due to financial restraint, we had to resort for low cost alloy implants in few patients. Radiological evaluation was assessed by CT spine in the first post operative day followed by plain X-ray at 1, 3,6 and 12 months respectively for ruling out any implant failure and sequential assessment of bony fusion. Fusion was conferred with presence of at least one inter-transverse continuous bony ridge. All the patients were instructed for early assisted mobilization under thoracolumbar brace application and structured physiotherapy following the surgery. Written consent was obtained from all the patients who were included in this study. Ethical clearance was obtained from the Institutional Review and Academic Committee of the College of Medical Sciences, Chitwan, Nepal.

RESULTS

Short segment fixation (SSF) was carried out in 16 patients whereas mono-segment fixation (SSF+MSF) was performed in another 16 patients.

Intraoperative parameters

Short segment fixation was less time consuming as a segment of fixation as well as the hardware used were comparatively less (Table 1). Blood loss was similar for SSF and SSF+IS as the surgical exposure was similar (Table 1).

Type	Operative time (min)	Blood loss (ml)
SSF	100±30	120±50
SSF+MSF	120±15	120±50

Postoperative parameters

It was easier for cases with SSF and SSF + MSF for early postoperative mobilization due to smaller surgical trauma and comparatively minimal tissue retraction during the procedure (Table 2).

Hardware failure

One hardware failure was encountered in one patient as he did not comply with the instruction of

Type	Wound infection	Return to ambulation (days)
SSF	2	4±2
SSF+MSF	2	4±2

wearing the thoracolumbar belt during mobilization. He was in drug withdrawal syndrome being managed in a rehabilitation facility wherein he was flexing and extending his spine without any external support.

Post-operative kyphosis

None of the cases showed postoperative increased kyphosis during their one year follow up visits.

DISCUSSION

Short segment fixation amounts to shorter operative time, minimal blood loss and incorporation of lesser motion segments during fixation thereby minimizing adjacent segment degeneration. This approach also facilitates quicker mobilization, minimal opiate use and improved cost savings to the patients.^{7,8} With the provision of small incisions and thereby minimized trauma to posterior musculo-ligament complex allowing for a more rapid rehabilitation.⁹ It also benefits in minimizing infection rates.¹⁰ The screw on the affected vertebrae during mono-segment fixation adds up to the constructed support thereby reducing implant failures.¹¹ There is also no provision for added bone graft fusion following short segment pedicle screw fixation.¹² This eliminates bone graft donor site morbidities as well as reduces overall operative time.^{13,14}

There are studies implicating spontaneous canal remodeling thereby obviating the need for canal decompression that can further hinder the spinal stability by hampering the posterior column.^{15,16} Others have advocated for direct decompression by tapping method to the retropulsed fragments to enhance the chances of neurological improvement.¹⁷ Some authors also advocated injecting calcium cement for restoring body height and thereby combating risk of kyphotic deformity.^{18,19} Wang et al., even implicated the aspects of percutaneous pedicle screw fixation only without decompression for patients with minimal deficits, within ASIA grade D or E and less than 1/3 of canal encroachment achieving similar clinical results in terms compared to the conventional surgery.²⁰ MSF may be unsuitable in cases with significant damage to inferior endplates.²¹ Disc degeneration is common adjacent to the fractured endplates. Though implants further accelerated this process, they had significant impact upon the clinical outcome.²² Oner et al., accounted

such changes to the index trauma to endplates following confirmation of preserved signal intensity within discs.²³ Yang et al., also concluded that consequences of disc degeneration would not be a concern in cases with intact longitudinal ligaments. Discs degenerations following implant removal also did not impact much upon clinical results owing to their intact range of motion integrity.^{24,25} Some studies have shown poor results with SSPF.²⁶ The loss of integrity of the anterior column with subsequent kyphosis in conjunction to osteoporosis as well as compromised fixation points amounted to implant failure.²⁷⁻³⁴ Guven et al., concluded least correction of kyphotic deformity as well restoration of anterior vertebral height in SSPF.³⁵

Long-segment posterior pedicle screw fixation (LSPF) governs greater stability but at the expense of sacrificing motion segments. They increase intradiscal pressure and thereby accelerate adjacent segment degeneration.^{36,37} A cadaveric study has shown mono-segment fixation providing more biomechanical stability as well as maintenance of kyphotic correction than traditional SSPF.^{38,39} The kyphotic change is subsequent to damage to the adjacent endplates at the time of fracture.⁴⁰ Implant failure also depends on the material used such as Titanium to confer better strength to sustain them throughout the process of fracture healing.⁴¹ There has been reports suggesting the utilization of screw size of around 60-80% of outer pedicle cortical diameter to facilitate the pedicle expansion thereby

increasing the implant stability.^{42,43} Another important aspect governing better outcome of this technique is linked to integrity of the posterior element. The posterior complex provides support and prevent instrument failure and furthermore its removal has not been efficacious in improving neurological outcome.⁴⁴⁻⁴⁶ Because preservation of the posterior column leads to the reduction of stress in the injured anterior and middle columns, it may prevent early instrumentation failure.⁴⁶ Current literature recommends short and monosegment fixation techniques to be limited to flexion-distraction or Chance-type vertebral injuries only.

CONCLUSIONS

Both short and monosegment fixations fared similar results comparable to the long segment fixation methods in traumatic thoracolumbar fractures. However, the results should be validated through high volume and multicentric randomized control studies.

Limitation of the study

There are certain limitations to our studies. Foremost being low inclusions of cohort groups in the study. Secondly, a long term follow up analysis is justified in terms of neurological outcome in the patients as well as the status of the fusion and stability of the involved segments.

Conflict of Interest: None

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