

“A STUDY ON SHORT SEGMENT FIXATION FOR THORACOLUMBAR FRACTURES”

Background – Spine injury is being one of the commonest injuries which pose challenges to the patients and treating clinicians as well. Despite so much research and recent advances, there has not been unanimous consensus regarding the management of spinal injuries. However, the treatment aim of every injury to the spine is to restore of max possible function in patients. This study was conducted to assess the outcome of short segment fixation in fractures of the thoracolumbar spine.

Method & Material – This is a prospective cohort study done at our Tertiary Center during the period from April 2018 To September 2020. Patients with thoracolumbar spine injuries were, included in the study. Study on short-segment pedicle screw fixation and inter- transverse fusion for single-level acute thoracolumbar fracture.

Result – Mean age of the sample size was 40.58 years with male preponderance. The FRANKEL SCALE was used to grade the pre-op neurology; 17.2% were graded as E, 24.1% as D, 31 % as C, 13.8 % as B, and 13.8% A. ASIA motor and sensory score preoperative and postoperative at one year follow up was compared was found to be significant ($p < 0.05$). Preoperative VAS and Functional independent measures also showed significant improvement.

Conclusion – Surgical stabilization and decompression are essential strategies for further neuroprotection and recovery after a spine injury. Short segment fixation can be an option for thoracolumbar fracture. However, an unstable fracture may require extended fixation.

INTRODUCTION

The most commonly affected group by spinal cord injuries (SCI) are young males, having a M: F = 4:1, with an average age of 30 years.^{1,2} The commonest etiology of these injuries is motor-vehicular accidents, accounting for almost half of all injuries. Classifying site-wise, SCIs are most commonly encountered in the cervical spine followed by the thoracolumbar segment.

The treatment aim of every SCI is restoring of max possible function in patients, helping them lead a disability-free life. For these patients the treatment aims at the protection of healthy neural tissues, recovering of damaged cord and nerves, and providing optimum positioning for the muscle & bone to recover. Surgical stabilization of the spine prevents any more mechanical injury to the already injured cord. The surgical treatment gives the benefit of (a) immediate stabilization of the spine, (b) deformity correction, and (c) aid to the improvement of neurology by relieving any residual compression of the neural tissue.

This study aimed at obtaining clinical, functional, and radiological results of the short-segment fixation (SSF) for thoracolumbar (TL) fractures and to assess the advantages and complications of SSF with intertransverse fusion in TL fractures.

METHOD & MATERIALS –

This is a prospective cohort study done at our Tertiary Center during the period from April 2018 To September 2020. Patients with clinical and radiological diagnoses of traumatic thoracolumbar SCIs were, enrolled in the study. A detailed medical history was taken, Detail physical and neurological examination of the

patient was done as per the department protocol. The ASIA impairment scale³ and Frankel grading system⁴ were used for neurological charting. Radiological examination of the patient was done consisting of plain radiograph anteroposterior and lateral view. Fractures were classified using the Magrel classification system⁵. MRI was done to evaluate the injury to the neural structures and thecal sac compression due to hematoma or retropulsion bony fragments. Computed Tomography was used optionally to classify the fracture, calcified ligaments, which need to be decompressed surgically, and to evaluate bony compression or retropulsion fragment in the canal. For Dorsolumbar spine injuries- Posterior decompression and stabilization were done with Pedicle screw fixation and fused with intertransverse fusion. Post-operatively physical, neurological and occupational rehabilitation was provided to every patient and the recovery was assessed by Functional Independence Measure⁶.

OBSERVATION & RESULTS -

Total 40 patients with thoracolumbar spine fracture presented to our hospital during the study duration. Out of 40 cases, 5 had associated head injuries, 3 patients were denied for surgical intervention, 2 patients had associated fractures of other bones, were excluded. Rest 29 patients were included. One patient died on the 16th week of follow-up.

All the patients presented in the accident and emergency department were initially managed as per the ATLS protocol⁷. This study had an average age of 40.58 years with Male dominance.

The most common etiology was fall from height followed by motor-vehicular accidents.

Table 1 - Correlation of type of fracture with Frankel scale for neurologic assessment

Fracture Type	Frankel Scale					
	A	B	C	D	E	Total
Anterior wedge compression fracture	1	3	3	2	4	13
Burst fracture	3	1	6	5	0	15
Incomplete burst fracture	0	0	0	0	1	1
Total	4	4	9	7	5	29

There was no statistical evidence to conclude that the Frankel scale can be related to a particular type of fracture ($p > 0.05$) Similarly, there was no statistical evidence to conclude that the ASIA motor score can be related to a particular type of fracture. (p -value > 0.05)

Table 2 - Paired t-test of a variable at admission and 1-year follow-up

Difference in scores: On admission – after 1 year	Mean difference	Standard Deviation	Standard Error Mean	p-value
ASIA MOTOR on admission - ASIA-MOTOR after 1 year	-11.71	12.77	2.41	.001
ASIA SENSORY- LIGHT TOUCH on admission - ASIA SENSORY - LIGHT TOUCH after 1 year	-8.57	12.71	2.40	.001
ASIA SENSORY - PINPRICK on admission - ASIA SENSORY- PIN PRICK after 1 year	-6.21	8.49	1.60	.001
VISUAL ANALOGUE SCALE on admission - VISUAL ANALOGUE SCORE after 1 year	8.14	1.53	0.28	.001
Functional Independence Measure (FIM) on admission - FIM after 1 year	-39.14	12.36	2.3	.001

ANGLE OF ANTERIOR WEDGE (in degree) on admission - after 1 year	8.46	6.49	1.22	.001
--	------	------	------	------

The ASIA motor score preoperative and post-operative at one-year follow-up were evaluated by paired t-test, and was calculated to be significant ($p < 0.05$). ASIA sensory light touch, ASIA sensory Pinprick, Visual analog scale, Functional Independence Measure, and Anterior wedge angle, assessed pre-op, post-op, and at one-year follow-up were evaluated & found to be significantly improved ($p < 0.05$).

The relation of the type of fracture with vertebra affected was evaluated statistically. The proportion of patients with hardware loosening did not correlate with the level of vertebra involved. ($p\text{-value} > 0.05$)

DISCUSSION

Management of the spinal injury is very challenging at the same time quite often frustrating. A definite protocol for the management of spine injuries is yet to be established. These patients require individualized care for their rehabilitation and can be achieved at a full-fledged spinal center.

This study had an average age of 40.58 years with male dominance, which is comparable to other studies. The explanation for this can be that the young- middle age group of the population often indulges in outdoor activities.^{1,2}

In our study, there is a male predominance of the patients, which is comparable to most of the studies. This is again in agreement with world literature and can be explained by the simple fact that the majority of the male is the breadwinner of the family, for which they have to travel, work in industries, etc and so they tend to get more injuries.^{1,2}

Most of the patients who had fallen were labor by occupation. This can be explained that the fall from height could be related to safety measures they had while working on site.

Our study maximum number of patients had fracture of thoracolumbar junction (T11- 10.3%, T12- 27.5%, L1- 31.3%, L2- 24.1%). Chung OM ⁸ reported that the most common site of involvement was L1 (35 cases) and L2 (31 cases), Dr.Nitin Kansal et al ⁹ and N Basheer et al ¹⁰ also found L1 vertebra to be commonly involved in thoracolumbar spine injuries. Roman Pfeifer et al ¹¹ noted that most patients had an isolated vertebral body fracture at the thoracolumbar junction (L1 and D12). Alvine et al ¹⁶ found that 70% of fractures were between the level of T11 – L2; Sasso et al ¹² and Razak et al ¹³ had similar findings with 80% and 92% fractures were between the level of T11 – L2, respectively.

The predilection of fracture for this area is due to 3 reasons.^{1, 2}

- (a) The curvature of the spine changes from kyphosis to lordosis and hence the concentration of forces occurs.
- (b) This is the junction of the fixed and mobile region with loss of stabilizing effect of rib cage obliterates
- (c) Increased sagittal plane mobility due to sagittal orientation of facet joints.

In our study, 44.82% of patients were having wedge compression fractures out of which 30.76% were having bowel and bladder involvement, and burst fracture was reported in 51.72% of patients with 40% of the patient having bowel and bladder involvement. However, there was no statistical correlation between the type of fracture and bowel and bladder involvement.

In our study there were 13.7 % of thoracic spine injuries, 27.5% of lumbar spine injuries, and 58.6% of thoracolumbar junction injury with burst fracture common at the lumbar spine and anterior wedge compression at the thoracolumbar junction. About the level of injury, M. Reinhold et al ¹⁴ found thoracic spine fractures in 19.8%, lumbar spine fractures in 13.2%, and thoracolumbar junction fractures in 67.0%. The fracture type varied with the spinal region involved, with the thoracic spine having more B and C type injuries (Magerl classification).

As per the Frankel scale for neurology, pre-operatively 13.8% were grade A, 13.8 % grade B, 31 % as grade C, 24.1% as grade D and 17.2% as grade E.

In this study, at 1 year follow up, 3.57% were grade A, 10.7% B, 7.14% C, 14.28% D, and 64.28% E.

Razak M et al ¹³, found that 64.4% of patients with incomplete lesions improved by at least 1 grade. Sasso et al ¹², noted that patients having incomplete neurology deterioration had improvement of at least 1 grade. Alvine et al.¹⁶, documented the neurology improvement being seen in half of the cases. Nasser R et al.¹⁵, found neurology loss patients exhibited minimum improvement of 1 grade on the last follow-up.

In the present study, the average regional angle during the preoperative stage was 14.344° and 2.068° post-op and 5.75° on the last follow-up. Here are the kyphotic angle readings for other similar studies:

	Kyphotic angle (in degree)		
Study	Pre-op	Post-op	At 1 year
Current Study	14.344	2.068	5.75

Nasser MG et al ¹⁷	23.6	7	11.5
Alvine et al. ¹⁶	12	1	6
Razak M. et al. ¹³	20	7	9

In this present study, the mean VAS score pre-op was 9.0, 7.48 post-op, and 0.857 at a 1-year follow-up. Adalberto Bortoletto et al ¹⁸ found the mean VAS was 7 pre-op, 6 at 1-month post-op and, 4 at 6months post-op.

In our study, the mean FIM on admission was 66.57 and at one year of follow-up was 105.714 with a mean improvement of 93.14. Significant improvement was noted in all the patients. However, the functional betterment was more in patients with time between injury and surgery was less. Gelson Aguiar da Silv et al ¹⁹ found that more severe injuries gained functionality more comparatively ($p<0.05$). The mean FIM gain seen in various levels, from lowest to highest, was: thoracic, thoracolumbar junction, and lumbar.

Conclusion

It can be concluded that SSF can be a good choice for fixation of thoracolumbar fracture fixation, especially for stable type. However, loss of kyphosis corrections is commonly seen with unstable thoracolumbar fracture fixation.

Reference –

1. Parsons KC. The impact of spinal cord injury on long-term survival. J Insur Med 1991;23(4):227
2. Parsons KC, Lammertse DP. Rehabilitation in spinal cord disorders. 1. Epidemiology, prevention, and system of care of spinal cord disorders. Arch Phys Med Rehabil 2005;72(4-S):S293–S294
3. Roberts TT, Leonard GR, Cepela DJ. Classifications in brief: American spinal injury association (ASIA) impairment scale. Clinical orthopaedics and related research. 2017 May;475(5):1499.
4. Frankel HL, Hancock DO, Hyslop G, Melzak J, Michaelis LS, Ungar GH, Vernon JD, Walsh JJ. The value of postural reduction in the initial management of closed injuries of the spine with paraplegia and tetraplegia. Spinal Cord. 1969 Nov;7(3):179-92.
5. Magerl F, Aebi M, Gertzbein SD, Harms J, Nazarian S. A comprehensive classification of thoracic and lumbar injuries. European Spine Journal. 1994 Aug;3(4):184-201.
6. Kortbeek JB, Al Turki SA, Ali J, Antoine JA, Bouillon B, Brasel K, Brenneman F, Brink PR, Brohi K, Burris D, Burton RA. Advanced trauma life support, the

evidence for change. *Journal of Trauma and Acute Care Surgery*. 2008 Jun 1;64(6):1638-50.

7. Hall KM, Cohen ME, Wright J, Call M, Werner P. Characteristics of the Functional Independence Measure in traumatic spinal cord injury. *Archives of physical medicine and rehabilitation*. 1999 Nov 1;80(11):1471-6
8. Chung OM. Epidemiology of acute thoracolumbar fractures of young adults in Hong Kong. *Hong Kong Journal of Orthopaedic Surgery* 2001;5(1):40-46
9. Dr.NitinKansal, Dr.Atul Agrawal. Management of unstable Dorsolumbar spine injuries with transpedicular rod and screw fixation. *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)* e-ISSN: 2279-0853, p-ISSN: 2279-0861. Volume 4, Issue 3 (Jan.- Feb. 2013), PP 77-81
10. N Basheer MS, Deepak Gupta M Ch, GD Sathyarthi M Ch, Deepak Aggarwal MCh, S.Sinha M Ch, BS Sharma M Ch, AK Mahapatra M Ch. Unstable Dorsolumbar fractures: A prospective series of 94 cases. *Indian Journal of Neurotrauma (IJNT)* 2010,VOL 7,No.1,pp55-60.
11. Roman Pfeifer, Miguel Pishnamaz, Derek Dombroski, Nicole Heussen, Hans-ChristophPape and Bernhard Schmidt-Rohlfing. Outcome after thoracoscopic ventral stabilisation of thoracic and lumbar spine ractures. *Journal of Trauma Management & Outcomes* 2012, 6:10
12. Sasso RC, Cotler HB, Reuben JD: Posterior Fixation of Thoracic and Lumbar Spine Fractures using DC Plates and Pedicle Screws. *Spine* 16:S134-S139, 1991
13. Razak M, Mahmud MM, S.A. Hyzan MY, Omar A, Short segment posterior instrumentation, reduction and fusion of unstable thoracolumbar burst fractures – a review of 26 cases, *Med J Malaysia*, 2000, Sep, 55 Suppl, C: 9 – 13.
14. M. Reinhold • C. Knop • R. Beisse • L. Audige' • F. Kandziora • A. Pizanis • R. Pranzl • E. Gercek • M. Schultheiss • A. Weckbach • V. Bu"hren • M. Blauth.

Operative treatment of 733 patients with acute thoracolumbar spinal injuries: comprehensive results from the second, prospective, internet-based multicenter study of the Spine Study Group of the German Association of Trauma Surgery. *Eur Spine J* (2010) 19:1657–1676 DOI 10.1007/s00586-010-1451-5

15. Nasser R, Yadla S, Maltenfort MG, Harrop JS, Anderson DG, Vaccaro AR, Sharan AD, Ratliff JK. *J Neurosurg Spine*. 2010 Aug; 13(2):144-57. Review.
16. Alvine GF, Swain JM, Asher MA, Burton DC. Treatment of thoracolumbar burst fractures with variable screw placement or Isola instrumentation and arthrodesis: case series and literature review. *J Spinal Disord Tech*. 2004; 17(4):251-264.
17. Nasser R, Yadla S, Maltenfort MG, Harrop JS, Anderson DG, Vaccaro AR, Sharan AD, Ratliff JK. *J Neurosurg Spine*. 2010 Aug; 13(2):144-57. Review.
18. Adalberto Bortoletto¹, LuizCláudioLacerda Rodrigues², Marcelo Hide Matsumoto³. Evaluation of Surgical Treatment of Fractures of Thoracolumbar Spine with Third-Generation Material for Internal fixation. *Rev Bras Ortop*. 2011;46(3):299-304
19. Gelson Aguiar da Silva², Soraia Dornelles Schoeller³, Francine Lima Gelbcke⁴, Zuíla Maria Figueiredo de Carvalho⁵, Evelise Maria de Jesus Paula da Silva⁶. FUNCTIONAL ASSESSMENT OF PEOPLE WITH SPINAL CORD INJURY: USE OF THE FUNCTIONAL INDEPENDENCE MEASURE – FIM¹. *Text Context Nursing*, Florianópolis, 2012 Oct-Dec; 21(4): 929-36.

Figure Legends



Figure 1 – Pre – operative X – ray of Spine Suggestive of Fracture

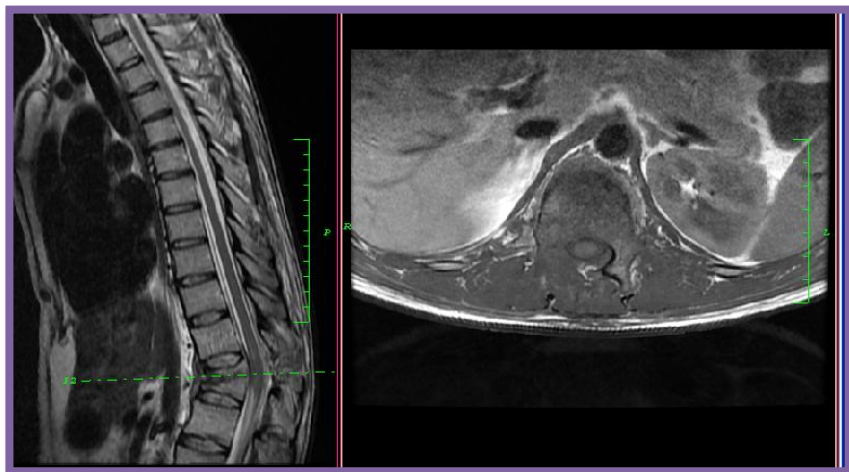


Figure 2 – Pre – operative Magnetic Resonance of Spine

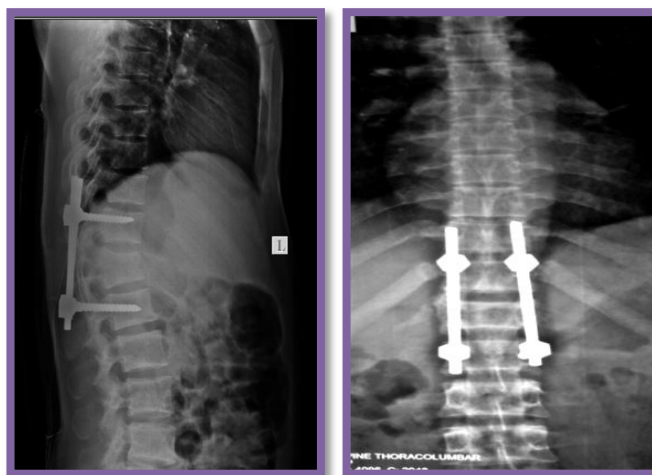


Figure 3 – Immediate Post – operative X – ray of Spine