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Posterior short segment spinal fixation in unstable fractures of the thoraco lumbar spine: radiological and neurological outcome assessment

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ABSTRACT

Background: A major dilemma still exists regarding management of unstable fractures of thoraco lumbar region. A posterior short segment spinal fixation without bone grafting improves spinal alignment, early ambulation and subsequent decrease in complications arising out of prolonged bedrest.

Methods: A total of 30 patients presenting at the Accident and Emergency Department meeting the inclusion criteria were recruited for the study. A complete neurological and radiological assessment was done preoperatively, immediate post operatively and after 6 months using Frenkels grade system and Denis pain scale and Denis work scale respectively.

Results: A statistically significant difference was observed between the initial kyphosis of the injured vertebra as compared to immediate postoperative period (p<0.0001), Improvement in neurological status was statistically significant at 6 month follow up (Z=4.355, p=0.00). Functional assessment revealed that 47% of the subjects experienced a minimal pain with a mean pain score of 1.9 with a mean functional score of 3.83 at the final follow up. **Conclusions:** Our study shows that short segment spinal fixation in unstable fractures of the thoraco lumbar spine provides a comparable neurological and functional outcome and is a reliable management option.

Keywords: Posterior short segment, Thoraco-lumbar, Unstable fracture, Fixation

INTRODUCTION

The thoracic and lumbar spine is divided anatomically and functionally into Thoracic (T1-T10), thoraco lumbar junction (T10-L2) and lumbar spine (L3-L5). The unique positioning of the thoracolumbar junction between the rigid, less mobile thoracic spine to the more dynamic and flexible lumbar spine, makes it vulnerable to fractures due to which fractures are the most common pathological event at this junction. Despite being one of the most common injuries of the vertebral column, 50% are unstable fractures leading to significant levels of

disability, deformity and neurological deficit.³ If the treatment modality is taken into consideration, controversies exists there too as to whether to opt for a non-operative treatment or a surgical management, the timing of surgery, approach, and type of surgery, requirement of a bone graft, decision to go for a fusion even though several studies have been conducted in this area.⁴⁻⁶ A posterior surgery avoids the morbidity of anterior exposure in patients with concomitant pulmonary or abdominal injuries. Performing this surgery with a short segment fixation further prevents stiffness among spinal motion segments. Forces applied to the spine in

short segment fixation are not strong and fatigue failure is uncommon.⁷ Moreover it is not necessary to remove the construct, although this is often required with long rods.

Surgical treatment improves spinal alignment, decreases deformity, the patient can be mobilized earlier, eventually decreasing the complication arising out of prolonged bed rest. Hence the objective of our study is to evaluate the radiological and neurological outcome of patients with thoracolumbar fractures treated by posterior short segment fixation without bone grafting.

METHODS

A prospective study was conducted at Government Medical College, Kottayam from March 2008 to February 2010 on 30 patients who presented to the Accident and Emergency Department of the tertiary care centre. The study was approved at the Institutional Review Board and the Institutional Ethics Committee. A written informed consent was obtained from all patients who were selected for the study.

Patient selection

The patients recruited were patients with unstable thoracolumbar fractures as diagnosed on radiological evaluation, age above ≥ 18 years and ≤ 60 years, having single vertebral injury with neurological involvement and with neurologically stable patients with instability criteria (kyphotic deformity $>20^{\circ}$ and vertebral height loss >50%). Patients with skeletal or non-skeletal malignancies, osteoporotic fractures or multiple level fractures were not included in the study.

Patients on reporting to the accident and emergency department were assessed for the vital signs (pulse, blood pressure, respiratory rate), followed by general physical examination and examination of the whole body under good light for other associated injuries, if present. A detailed history regarding date and time of injury, time elapsed since injury, mode of injury, involuntary passage of urine or faeces, type of first aid/treatment received, mode of transport used after injury, was recorded.

A complete neurological examination of the patient (sensory as well as motor) was done. Neurological assessment was done using Frankel's grade system. In the case of patients having associated injuries, the consultant's recommendations were accepted and executed.

Patients fulfilling the inclusion criteria were enrolled for study after getting informed written consent. Demographic profile of the patient, and coexisting complications were recorded.

After the patient's condition was stable and initial clinical assessment was done, the patient was sent for radiological investigation. Roentgenograms of the

dorsolumbar spine - anteroposterior and lateral views were taken. Radiological assessment of the injury to the spine was done. McAfee's system was used to classify the fractures. Specialized investigations like CT and MRI scan were also done as and when required. The patients and the attendants were informed about the type of injury, and the possible options.

Surgical technique

Written informed consent was taken from all the patients after explaining the procedure to them. Pedicle screw and rod system was used for stabilisation of the spine, with a pair of screws above and below the injured vertebra.

After administration of general anaesthesia, patient was positioned prone on radiolucent table. The thoracolumbar area to be instrumented was prepared and draped. An incision was made from one spinous process above the area to be instrumented to spinous process below the area to be instrumented. The subcutaneous tissue and muscle was infiltrated with epinephrine 1: 500,000. The dissection was continued with electrocautery through the fascia. Perispinal muscles were dissected from the processes with Cobb spinous elevators electrocautery. Dissection was continued to the tips of the transverse processes in the thoracic and lumbar spine.

Image intensification was used to identify the upper level to be instrumented. The thoracic pedicle on one side was identified with image intensification. Beam is adjusted until the pedicle is visualised on end. Bone over the lateral pedicle is decorticated. A blunt awl was inserted into the pedicle was advanced through the pedicle. The path of the awl was monitored with C arm images. The awl was removed after the vertebral body was entered. The continuity of the pedicle wall in all four quadrants was confirmed with a small ball tipped probe. The pedicle and vertebral body were tapped to at least one half of the depth of the vertebral body. Then the pedicle screw of desired length was inserted. Screw was placed on the contralateral thoracic pedicle in the same fashion. The pedicles in the lumbar spine are at the point where the midline of the transverse process and the longitudinal axis of the superior facet meet. Screws were placed in similar way in lumbar pedicles. Rods of adequate length were placed on screw slots. Nuts were placed and tightened on one end. Distraction applied at fracture site and final tightening was done. Fracture reduction was confirmed under C arm.

In some of the cases where cord was compressed by the posterior elements of the vertebrae, decompression was achieved by doing laminectomy. The retropulsed bony fragments were scooped out to ensure that nothing compressed the cord anteriorly and the remaining bony fragments were pushed anteriorly with the help of dissector. Adequacy of the decompression was checked by looking for the pulsations in the dural sac as well as by gently passing a blunt probe in the spinal canal of the

superior and the inferior vertebrae. The status of the cord was noted whether contused, lacerated or completely transected.

After treatment

Ambulation was delayed till 10th postoperative day. After that they were encouraged to sit and to use a thoraco lumbar sacral orthosis for 3 months.

The parameters used for assessment are as follows: Kyphotic angle was measured using Cobb's method (angle between the superior end plate of upper and inferior end plate of lower non injured vertebrae) pre operatively, immediate post-operative period and at 12 months post operatively. Frankel's grade system was used for assessment of neurological status pre operatively and on follow up at 1st month, 6th month and 12th months post operatively. Functional outcome was assessed using Denis pain and work scale at 12 months post operatively.

Statistical analysis

Data was entered on a predesigned proforma for each individual patient. The data was then entered into an Excel work sheet and analysis was done using SPSS version 16 (Trial version). Quantitative data was represented with mean and standard deviation whereas qualitative data was represented as percentages and proportions. Fixing the level of significance at 0.05 and level of high significance at 0.01, statistical tests like Wilcoxin Sign Rank test and Chi square test were used to assess statistical significance for continuous variables not normally distributed and categorical data respectively.

RESULTS

A total of 30 patients were taken for the study. The age distribution of the study sample ranged from 18 yrs to 60 yrs, with a mean age of 38.33 yrs. The major part of the study sample comprised of the persons within the age group of 30 and 50 years. 97% Of the study sample were males. The major occupation of the patients was coconut tree climbing and being a male dominated field, the number of women involved in the current study was limited. 73% of the patients sustained injury following fall from height especially from top of coconut trees. The rest of the patients sustained injuries following road traffic accidents. The most frequently injured level was the thoracolumbar junction (70%) followed by L2 (13.3%) and T11 (13.3%). 83.3% patients presented with unstable burst fractures as assessed by McAfee classification, making it the most common fracture type encountered during the study (Figure 1).

The average time from injury to operation was 4.87 days (± 4.8 days, range 0-14 days). The following line graph depicts the number of patients and their injury surgery interval (IS interval). 26.7% of the surgeries conducted

were within the first 2 days in the current study (Figure 2).

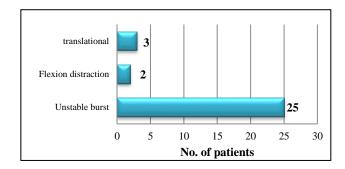


Figure 1: Type of fracture sustained.

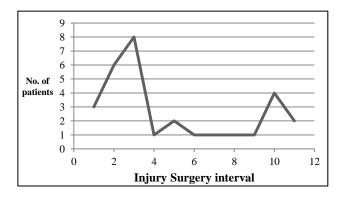


Figure 2: Injury-surgery interval of the patients.

Radiological assessment

The patients were evaluated radiologically by measuring the kyphotic angle using Cobb's method pre and postoperatively.

The mean preoperative Kyphotic angle was found to be 27.07° and the mean postoperative Kyphotic angle was 15.67° . The average correction 11.4° was achieved and there was an average loss of correction of 1.96° in the 12 month follow up period. There was a statistically significant improvement between the initial kyphosis of the injured vertebral segment and that in the immediate post-operative period (t=10.502, p<0.001, paired t test)

Neurological status assessment shows more improvement in the Frankel grade in patients with partial neurological loss (Table 1). The improvement in neurological status was statistically significant during the first follow up (Z=4.355, p=0.00, Wilcoxon sign rank test).

The proportion of patients with more than 1 grade improvement in the Frankel grading is apparently higher (88.2%) in the group that underwent surgery within 48 hrs of getting injured when compared to only 61.5% showing a similar improvement with a delay of more than 48 hrs but this difference is not statistically significant (Table 2).

Table 1: Neurological status (according to Frankel grade) at the end of 12 months.8

Due anaustiva naunalagical status	No. of patients	Improvement in Frankel grade		
Pre operative neurological status		≥1 grade	≥2 grade	
Complete paraplegia	13	6	3	
Incomplete paraplegia	17	17	11	
Total	30	23	14	

Table 2: Association between injury surgery interval and neurological improvement of at least 1 grade in final follow up.

Injury surgery interval (hrs)	Neurological status improvement		Total
	No improvement in grade >1 grade improvement		
	N (%)	N (%)	N (%)
≤48	2 (11.8)	15 (88.2)	17 (100)
>48	5 (38.5)	8 (61.5)	13 (100)
Total	7 (23.3)	23 (76.7)	30 (100)

 $\chi^2 = 2.935$; p=0.08.

Functional assessment

Functional assessment using the Denis pain scale revealed a mean pain score of 1.9 at the final follow up. Majority (47%) experienced occasional minimal pain (P2). The denis work scale showed a mean functional score of 3.83. One fifth (23%) were able to return back to sedentary work/ heavy work with restrains. But 40% of them were bedridden/ completely disabled at the final follow up.

DISCUSSION

Despite the various controversies associated with management of unstable fractures of the thoracolumbar region, whether to use posterior or anterior approach; posterior approach is one of the common approaches to the fracture management. There are apprehensions regarding the high rate of hardware failure due to lack of anterior support and progressive kyphosis. Inspite of the mentioned complications, the clinical prognosis is satisfactory. Our study focused on 30 patients who based on the indication, underwent posterior short segment fixation and were followed up at intervals of 6 months.

The general profile of the patients revealed that majority of the cases were aged between 30-50yrs of age with a mean age of 38.33 yrs, which is in contrast to that quoted by other studies, where the average age was between 28-33 yrs. ¹⁶⁻¹⁸

The most common mode of injury was fall from height (73%) mainly fall from coconut trees, being one of the commonest semi-skilled works adopted by people of Kerala. Hence 97% of the patients were males in the present study. This finding is similar to a study conducted by Khare et al where 60% of the injury sustained was due to fall from height, mainly from construction sites. ¹⁶ The other common following cause observed from the current study was road traffic accidents which interestingly has been quoted as the most common cause of injury in western literature. ¹⁷

The most frequent injured level was the thoracolumbar junction (70%) followed by L2 (13%) and T11 (13%), which was comparable to studies conducted by Mohammed F Butt et al and Weyns et al showing 58% and 60% affliction respectively to fractures to the thoraco lumbar junction. The increased affliction to this region is due to its mobility and due to the fact that this area represents the transition from normal thoracic kyphosis to the lumbar lordosis.

In the present study, the implant (pedicle screw system) was found to satisfactorily correct the deformity and maintain the achieved correction with an average correction of 11.4° and average loss of correction of 1.96° in the 12 month follow up period. The finding can be compared with other studies as shown in Table 3.

Table 3: Comparison of study findings with literature.

Study	Kyphotic angle		Maan aannaatian	Loss of Kyphotic angle on
	Preoperative	Postoperative	Mean correction	final follow up
Mohammad et al. ¹⁹	21.48°	12.86°	8.62°	3.46°
Lee et al. ²²	17.33°	12.26°	5.07°	1.8°
Current study	27.07°	15.67°	11.4°	1.96°

Despite substantial initial correction, a gradual increase in Cobb's angle was noted which is largely due to loss of disc height. This was comparable to other studies where bone grafting was done along with posterior short segment fixation. The critical period for follow up which is sufficient to rule out any further collapse is 6 months as suggested by Parker et al, and in the current study, the cases have been followed up till 12 months post operatively. In the contract of the contract o

The neurological status as assessed by the Frenkel's grading system showed 53.3% of the cases having complete neurological deficit pre operatively. A favourable grade improvement in the neurological status was observed (88.2%) in the group that underwent surgery within 48 hrs of sustaining injury. The average time from injury to surgery being 4.87 days in our study must have contributed to the grade improvement. This is in contrast to Butt et al which could be due to longer injury to surgery interval observed in the latter's study. In the current study 17 patients with partial neurologic deficits showed 2 grades of improvement in 64% cases. The results were similar to a study by Altay et al. 22

The mean pain score of 1.9 as per denis pain scale was obtained in the final follow up. Butt et al and Lee et al and got a mean pain score of 2.07 and 1.6. The functional score for the current study was 3.83 in contrast to studies conducted by Butt et al and Lee et al, where the mean work scores were 2.8 and 2.07 respectively which may be due to the longer follow up period compared to the current study. 19,23

CONCLUSION

It can be hence concluded that posterior short segment fixation using pedicle screw system provides a reasonably favourable neurological and functional outcome that helps in immediate rehabilitation of patients suffering from traumatic unstable thoracolumbar spine.

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Ethical approval: The study was approved by the

institutional ethics committee

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