

## OUTCOME OF FIXATEUR INTERNE IN THORACOLUMBAR TRAUMA

Lal Rehman, Azmatullah Khattak, Ismail Akbar\*, Mohammad Ilias, Amir Nasir,  
Mohammad Siddique, Mushtaq

Department of Neurosurgery, Hayatabad Medical Complex, Peshawar, \*Department of Surgery Ayub Medical College, Abbottabad, Pakistan

**Background:** Spinal cord injury (SCI) is a devastating condition often affecting young and healthy individuals around the world. This debilitating condition not only creates enormous physical and emotional cost to individuals but also is a significant financial burden to society at large. The **Objective** was to study the outcome of spinal fixation with fixateur interne in cases of thoracolumbar spinal injuries in terms of neurological recovery and complications. **Methods:** This Descriptive study was conducted at Department of Neurosurgery, Hayatabad Medical Complex and Postgraduate Medical Institute, Peshawar, from March, 2006 to December, 2007. Study included patients admitted in Neurosurgery Ward HMC, with acute traumatic spinal injuries during the above mentioned period who underwent thoracolumbar spinal fixation with fixateur interne. Name, age, sex, other relevant data, history, examination findings and investigation results were recorded. Postoperative outcome was evaluated taking neurological status, and complications like infection, implant failure and other complications into consideration. Follow-up of 6 months was carried out. **Results:** There were 31 patients, (18 male and 13 female). Fall from height (48%), road traffic accidents (26%) and crush injuries (26%) caused the trauma. Most common age group was from 21–30 years age. Fractured vertebrae included 2 D11 fractures, 12 D12 fractures, 13 L1 fractures, 3 L2 fractures and 1 L3 fracture. Mean operative time 80 minutes, mean blood loss 200 ml, mean hospital stay 6 days and mortality rate was 0%. Number of patients with Frankel grade A reduced from 27 to 19 and in Frankel grade E increased from 0 to 4 patients. Only one patient had infection and one patient had implant removal. **Conclusion:** Fixateur interne is a useful and low-cost implant for fixation of thoracolumbar junction injuries with very easy availability and easy operative insertion and little blood loss. It has excellent post-operative outcome in terms of neurological improvement and a very low complication rate. Mortality rate is minimal.

**Keywords:** Spinal Fixation, Fixateur Interne, Thoracolumbar Injuries

### INTRODUCTION

Spinal cord injury (SCI) is a devastating condition often affecting young and healthy individuals around the world. Traumatic spinal injury may lead to temporary or permanent neurological impairment with subsequent grave physical disabilities. Such neurological impairment may or may not improve with surgical treatment (fixation of vertebrae). This debilitating condition not only creates enormous physical and emotional cost to individuals but also is a significant financial burden to society at large.<sup>1</sup>

Cases of spinal injuries are managed surgically by spinal stabilization for which different surgical approaches are used. The goals of operative treatment are to decompress the spinal cord and to stabilize the disrupted vertebral column. Three basic approaches are used for surgical management of the thoracolumbar spine: (1) the posterior approach, (2) the posterolateral approach, and (3) the anterior approach.<sup>2</sup> The 4 basic types of stabilization procedures are (1) posterior lumbar interspinous fusion, (2) posterior rods, (3) cage, and (4) the Z-plate anterior thoracolumbar plating system. Each has different advantages and disadvantages.<sup>3</sup> One of the methods used for stabilization of spine is fixateur interne fixation. This method uses the posterior approach.

The purpose of this study is to evaluate the outcome of fixateur interne in cases of traumatic spinal injuries considering benefit to patients and complications of this procedure. Such data may help in evaluating the role of fixateur interne in terms of benefits and drawbacks of fixateur interne in spinal injury cases in our setting and provide data to those working in the field of spinal surgery and fixation for comparison with their own clinical experience.

### PATIENTS AND METHODS

The study was conducted in Neurosurgery Unit Hayatabad Medical Complex, Peshawar, from March 1, 2006 to December 31, 2007 over a period of 21 months. All the patients admitted with acute traumatic spinal injuries who underwent spinal fixation with fixateur interne were included in the study. Patients' age, sex and causes of injuries were recorded. Accurate history of their injuries was elucidated, complete physical examination performed and investigations (anteroposterior and lateral x-rays and CT scan of dorsolumbar spine were done in 27 patients while in 4 patients MRI was done to assess fracture type and location) carried out. All the patients were counselled about their conditions and prognosis. Informed consent was taken from all

patients for their management from history taking to surgical procedures.

Thin patients, patients under 15 years of age, patients with bed sores and patients with open wounds were not considered for fixateur interne. Peroperative image intensifier and postoperative check x-rays were used to assess fracture reduction. Clinical neurological examination especially Frankel grade were used to assess pre-operative and post-operative neurological status. Relevant examination and investigation for other possible complications were carried out. Re-assessment of neurological status and other outcome was continued in the post-operative period and this study includes the observations made till 6 month post-operative period.

The analysis was performed using SPSS 10. Frequency and pattern of different injuries, their mechanism, age and gender of the patients and level and extent of neurological injuries were considered.

## RESULTS

During the above mentioned period, 31 patients of traumatic spinal injuries underwent fixateur interne fixation. Out of 31, there were 18 (58%) male patients and 13 (42%) female patients. Male to female ratio was nearly 1.4:1. Mode of trauma included fall from height being most common with 15 cases (48%), crush injuries causing trauma in 8 patients (26%) and road traffic accidents causing injury in 8 patients (26%) as shown in Figure-1. Age distribution included 1 patient below 20 years, 12 patients of 21–30 years age group, 10 patients of 31–40 years age range and 8 patients of 41–50 years age group as shown in Table-1.

Positive outcome was evaluated considering the neurological improvement (somatic system and bladder and bowel control) while negative outcome was observed taking into consideration the infection rate, neurological deterioration, bed sores development, failure of procedure or implant, mortality rate and other complications like deep vein thrombosis, urinary tract infection and renal failure etc.

Vertebral fractures included 2 D11 fractures, 12 D12 fractures, 13 L1 fractures, 3 L2 fractures and 1 L3 fracture (Table-2). Satisfactory reduction was achieved in all operated patients, which was assessed on peroperative fluoroscopic imaging and post-operative check x-rays. Neurological recovery was observed using Frankel grade as criteria. Pre-operatively Frankel grade A was observed in 27 patients, Frankel grade B and D was observed in just 1 patient each and Frankel grade C was observed in 2 patients. Postoperatively Frankel grade A was observed in 19 patients, Frankel grade B was observed in 4 patients, Frankel grade C was observed

in 2 patients, Frankel grade D in 2 patient and Grade E was observed in 4 patients (Table-3).

Infection occurred in surgical site in 2 out of 31 patients which makes up 6.5% of the total number of patients. In just one patient implant failure occurred due to infection which, therefore, had to be removed. While the other patient recovered with debridement and wound wash.

Neurological deterioration, Development of bed sores, and other complications like deep vein thrombosis, urinary tract infections, renal failure etc were not observed in any patient. Mortality rate was 0% as no patient died. Mean amount of blood loss during these surgeries was 200 ml. Average operating time was 80 minutes. Mean duration of hospitalization in postoperative period was 6 days.

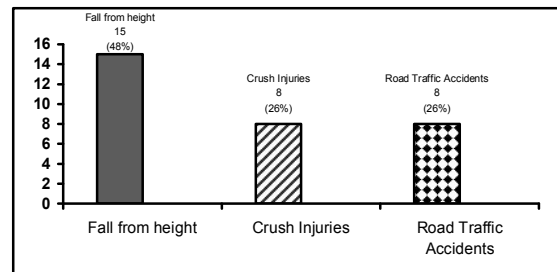


Figure-1: Mode of Trauma

Table-1: distribution of patients according age

Age Years	Number	Percentage
≤20	1	3.22
21–30	12	38.71
31–40	10	32.26
41–50	8	25.81

Table-2: Level of Fracture

Level	Number	Percentage
D 11	2	6.45
D 12	12	38.71
L 1	13	41.94
L 2	3	9.68
L 3	1	3.23

Table-3: Pre-operative and post-operative Frankel grades (Neurological Outcome)

Frankel grades	Pre operative		Post-Operative	
	Number	%	Number	%
A	27	87.10	19	61.29
B	1	3.23	4	12.90
C	2	6.45	2	6.45
D	1	3.23	2	6.45
E	0	0.00	4	12.90

Table-4: Percentage of complications of Fixateur Interne (n=31)

Complications	Number	%
Infection	2	6.4
Implant Removal	1	3.2
Neurological deterioration	0	0
Bed sores, DVT, UTI	0	0
Mortality	0	0

## DISCUSSION

The epidemiology of spinal trauma observed in the present study was very similar to other studies. As injuries are more common in male gender<sup>4-11</sup>, greater number of male patients underwent fixateur interne fixation in this study. Out of 31, there were 18 (58%) male patients and 13 (42%) female patients with male to female ratio of 1.4:1. According to Liu CL<sup>12</sup> the male to female ratio was 1.6 to 1. Another study shows 9 males out of 10 patients<sup>13</sup> while Benson DR<sup>14</sup> showed a 5:1 M:F ratio in a study carried out on outcome of fixateur interne in dorsolumbar spinal injuries. These figures show that male gender make up the majority of patients undergoing spinal fixation. Since male gender has more physical responsibilities in life, the importance of neurological recovery in spinal injury patients has special meaning in the context of spinal fixation.

The most common age group who underwent fixation with fixateur interne in the present study was 20-30 years age group. Mean age of patients in the study done by Liu CL<sup>12</sup> was 42 years, Koo DW<sup>13</sup> observed mean age of 31 years in patients included in his study, Benson DR<sup>14</sup> described 31 years to be the mean age of patients in his study. All these studies show that it the age of early adulthood in which patients mostly undergo spinal fixation with fixateur interne. This shows the significance of this treatment modality as early adulthood is the most physically active part of life during which individual endeavours to build up his life for himself and his/her family by using physical and mental resources.

The commonest modes of trauma observed in this study was fall from height which constituted 48% of injuries with crush injuries (consisting of 26%) and road traffic accidents (consisting of 26%) following next in frequency. According to Nadeem M<sup>11</sup> fall was the commonest mode of trauma which constituted 74.6% of all injuries.

Average operating time was calculated to be 80 minutes for these cases while mean blood loss was 200 mL. Blood loss was found to 250 mL in another study<sup>11</sup>. Mean duration of hospitalization was 6 days. It was found to be 7.9 days in one other study.<sup>11</sup>

Most commonly involved level of fracture was L1 with 13 cases and D12 with 12 cases. In the study done by Liu CL<sup>12</sup> one fracture occurred on T11, seven on T12, 16 on L1, 11 on L2, one on L3, four on L4 and two on L5. According to Benson DR<sup>14</sup>, in his study twenty-one fractures occurred at the thoracolumbar junction (T10-L2) and 4 in the lumbar spine (L3-5). Therefore T12 and L1 fractures were found most commonly in all studies which was consistent with the present study.

Neurological improvement was observed in this study which was assessed using Frankel grade as criteria in pre-operative and post-operative period. In this study there was no patient in Frankel grade E before surgery but there were 4 patients who gained Frankel grade E in post-operative period in up to 6 month follow-up. Similarly number of patients in Frankel grade A was reduced from 27 to 19 in up to 6 month follow-up. Neurological recovery of 1 or more Frankel grades was observed in 14 out of 31 patients in this study. In one other study by Nadeem M<sup>11</sup> there were 19 patients in grade E before surgery and on 1 year follow-up there were 27 patients in grade E which shows significant improvement. Benson DR<sup>14</sup> observed an improvement of at least 1 Frankel grade in 11 out of 25 patients which makes up 44% % of cases. All these studies show that spinal fixation with fixateur interne does help in neurological recovery in many patients. Follow-up of patients for neurological recovery, however, takes long time as neurological recovery in spinal trauma is a slow process. The follow-up period in the present study was relatively short (i.e. 6 months) as this was an initial study for a procedure recently introduced in present setting. Some of the studies have shown longer follow-up duration with good results. Nadeem M<sup>11</sup> arranged a 12 months follow-up, while Liu CL<sup>12</sup> carried out follow-up for 66 months. Bensone DR<sup>14</sup> did a 12 months follow-up, Lindsey RW<sup>15</sup> and Sim E<sup>16</sup> carried out 24 and 25 months follow-up respectively. On the other hand no neurological deterioration was observed in the present study in the post-operative period while same observation was done by Nadeem M<sup>11</sup>. Other studies done by Bensone DR<sup>14</sup> and Lindsey<sup>15</sup> also give same results with no patient having neurological deterioration in the postoperative period. This observation shows that fixateur interne is quite a safe method of spinal fixation with minimal fear of neurological complication.

Complications observed in the present study were infection in 2 patients and implant removal in 1 patient. A low complication rate has been reported by other authors too.<sup>17</sup> Nadeem<sup>11</sup> has reported a complication rate of 2.5%, Liu CL<sup>12</sup> has reported 16% complication rate, Noack W<sup>18</sup> has reported no complications and Briem D<sup>19</sup> has reported minor complication rate of 37% at local operative site. This low complication rate in the present and other studies again indicates the safety of the procedure.

Mortality rate was 0% in the present study and similar results were observed in other studies too. Nadeem M<sup>11</sup> observed a mortality rate of 0% and Lindsey<sup>15</sup> described it to be nearly 1%. This again highlights the safety with which the procedure can be carried out with minimal risk.

## CONCLUSION

Fixateur interne is a useful and low-cost implant for fixation of thoracolumbar junction injuries with very easy availability and easy operative insertion with little blood loss. It has excellent post-operative outcome in terms of fracture reduction and neurological improvement and a very low complication rate. Mortality rate is minimal.

## REFERENCES

1. Ackery A, Tator C, Krassioukov A. A global perspective on spinal cord injury epidemiology. *J Neurotrauma* 2004;21:1355-70.
2. Benz RJ, Garfin SR: Current techniques of decompression of the lumbar spine. *Clin Orthop Relat Res* 2001;(384):75-81.
3. Collins WF: Surgery in the acute treatment of spinal cord injury: a review of the past forty years. *J Spinal Cord Med* 1995;18(1):3-8.
4. Kuptniratsaikul V. Epidemiology of spinal cord injuries: a study in the Spinal Unit, Siriraj Hospital, Thailand, 1997-2000. *J Med Assoc Thai* 2003;86:1116-21.
5. Dryden DM, Saunders LD, Rowe BH, May LA, Yiannakoulis N, Svenson LW, *et al.* The epidemiology of traumatic spinal cord injury in Alberta, Canada. *Can J Neurol Sci* 2003;30(2):113-21.
6. Martins F, Freitas F, Martins L, Dartigues JF, Barat M. Spinal cord injuries--epidemiology in Portugal's central region. *Spinal Cord*. 1998; 36:574-8.
7. Brandenburg MA, Archer P, Mallonee S. All-terrain vehicle-related central nervous system injuries in Oklahoma. *J Okla State Med Assoc* 2005;98(5):194-9.
8. Dubuisson AS, Kline DG. Brachial plexus injury: a survey of 100 consecutive cases from a single service. *Neurosurgery* 2002;51:673-82. discussion 682-3.
9. Butt MF, Farooq M, Mir B, Dhar AS, Hussain A, Mumtaz M. Management of unstable thoracolumbar spinal injuries by posterior short segment spinal fixation. *Int Orthop*. 2007;31:259-64.
10. Junge A, Gotzen L, von Garrel T, Ziring E, Giannadakis K. Monosegmental internal fixator instrumentation and fusion in treatment of fractures of the thoracolumbar spine. Indications, technique and results. *Unfallchirurg* 1997;100:880-7.
11. Nadeem M, Ghani E, Zaidi GI, Rehman L, Noman MA, Zaman K. Role of Fixateur Interne in Thoracolumbar Junction injuries. *J Coll Physicians Surg Pak* 2003;13:584-7.
12. Liu CL, Wang ST, Lin HJ, Kao HC, Yu WK, Lo WH. AO fixateur interne in treating burst fractures of the thoracolumbar spine. *Zhonghua Yi Xue Za Zhi (Taipei)* 1999;62:619-25.
13. Koo DW; Fish WW. Spinal cord injury and snowboarding--the British Columbia experience. *J Spinal Cord Med* 1999;22:246-51.
14. Benson DR, Burkus JK, Montesano PX, Sutherland TB, McLain RF. Unstable thoracolumbar and lumbar burst fractures treated with the AO fixateur interne. *J Spinal Disord* 1992;5:335-43.
15. Lindsey RW, Dick W. The fixateur interne in the reduction and stabilization of thoracolumbar spine fractures in patients with neurologic deficit. *Spine* 1991;16(3 Suppl):S140-5.
16. Sim E, Stergar PM. The fixateur interne for stabilising fractures of the thoracolumbar and lumbar spine. *Int Orthop* 1992;16:322-9.
17. Sandvoss G, Feldmann H. Kluger's "fixateur interne" for spinal instability. *Neurosurv Rev* 1991;14(2):119-25.
18. Noack W, Raetzl G. Treatment of spondylolisthesis in adults using the dorsal approach with the fixateur interne and a special repositioning device. *Z Orthop Ihre Grenzgeb* 1988;126:205-10.
19. Briem D, Rueger JM, Linhart W. Osseous integration of autogenous bone grafts following combined dorso-ventral instrumentation of unstable thoracolumbar spine fractures. *Unfallchirurg* 2003;106:195-203.

## Address for Correspondence:

**Dr. Lal Rehman**, Department of Neurosurgery, Jinnah Postgraduate Medical Institute, Karachi. **Cell:** +92-300-5108616  
**Email:** drlalrehman@yahoo.com