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## Post-operative neurological outcomes in patients of dorsolumbar fractures with incomplete spinal cord injury

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### Abstract

**Background:** Despite recent advances in understanding spinal mechanics, injury mechanisms, improved instrumentation, better imaging techniques and improved rehabilitative care, the management of spinal cord injury patients remain controversial. In this study we try to analyse neurological outcomes in cases of incomplete spinal cord injuries (SCI) of dorsolumbar spine treated by decompression and posterior fixation at our centre.

**Methods:** 36 patients with incomplete SCI due to dorsolumbar fractures which were operated in our centre between May 2017 and January 2019 were included in our study. The neurological status of these cases was assessed using American Spinal Injury Association (ASIA) Impairment Scale before and after surgery and at follow ups of 1 month, 2 month, 3 month and 6 months.

**Results:** The mean age of patients in our study was 33.7 years with most patients in 26-40 years that is the young working age group. There were 22 males and 14 females. Most common cause leading to SCI was found to be fall from height. 24 cases out of 36 showed improvement of 1 or more grades in their ASIA Impairment Scale.

**Conclusion:** Operative fixation of dorsolumbar fractures achieves early mobilisation and rehabilitation in cases of Incomplete SCI. Our study indicates that neurological status also improves in such patients after operative fixation.

**Keywords:** Spinal cord injury, dorsolumbar fractures, thoracolumbar fractures, vertebra fractures, pedicle screw fixation, asia impairment scale

### Introduction

Spinal cord injury occurs due to the damage to the bony protection around the spinal cord. It usually occurs in a setting of high energy trauma which leads to fractures and dislocations of the vertebra [1]. Paraparesis is partial loss of sensory or motor functions of both the lower limbs. Traumatic SCI of dorsolumbar region is one of the common causes of paraparesis [2]. People living with SCI in India are estimated to be 1.5 million. Around 20 thousand new cases of SCI are added to this figure annually [3]. Paraparesis is the second most common form of SCI and comprises about 21% of cases. Dorsolumbar region is the second most common affected region of the Spine [4]. Average lifetime cost of treatment of a person with SCI is around Rs. 1.6 crore and to cater the needs of all the persons with SCI in India an annual budget of Rs. 86 thousand crores is required (0.47% of GDP) [5]. These unfulfilled requirements have led to poor management of patients with SCI increasing their morbidity, disability and mortality.

Neurological status in SCI patients is given by the American Spinal Injury Association (ASIA) Impairment Scale where ASIA Impairment Scale (AIS) grades B, C, and D are Incomplete SCI [6]. Incidence of incomplete injuries have increased in recent years [7].

The patients with spinal cord injuries face a lot of problems in their treatment. They need comprehensive care from a team of Orthopaedicians, Nurses, Physiotherapists, Occupational Therapists, Psychologists and other disciplines. They need vocational rehabilitation so that they can return to their role in society [8]. Currently, due to lack of rehabilitation programmes a lot of persons with SCI end up being jobless and a burden for the society and their family.

The patients coming to our centre belong to low socioeconomic classes and are at times referred from other hospitals. There is no separate unit for SCI in our institute.

There is delay in obtaining fitness for surgery and lack of Operation Theatres. Facilities like X-rays, CT scan and MRI are also not freely available to all the patients. All these factors lead to neglect in care of poor patients.

The efficacy of decompression in cases with incomplete SCI is supported only by class 3 and sparse class 2 evidence [9]. The ideal time of surgical intervention in patients with SCI is also controversial [10].

In this study we have prospectively analysed a series of cases with paraparesis due to traumatic incomplete dorsolumbar SCI who will be treated by posterior stabilization and decompression. We will analyse neurological recovery in these patients using ASIA Impairment Scale. These cases will be followed up regularly for a duration of 6 months.

**Material and Methods**

The study was approved by ethics committee of our institute. Patients admitted in our centre between May 2017 and Jan 2019 fulfilling the following criteria were included in the study after getting an informed consent.

Inclusion Criteria:

1. Patients presenting with traumatic incomplete thoracolumbar spinal cord injury (AIS grades B, C and D).
2. Patients of greater than 18 years of age.
3. Patients consenting for the study and the surgery.
4. Patients completing regular follow up period of 6 months

**Exclusion Criteria**

1. Patients with complete spinal cord injury(AIS grade A)
2. Patients in which paraparesis is due to reasons other than trauma i.e. pathologies like tumour, tuberculosis etc.
3. Patients not consenting for study and surgical intervention.
4. Patients of less than 18 years of age.
5. Patients not completing regular follow up period of 6 months

Preoperative AIS grade was determined and AIS grade was reassessed regularly after Surgery, at follow up of 1 month, 2 months, 3 months and 6 months.

**Table 1:** Grades of ASIA Impairment Scale (AIS)

Grade	Type of Injury	Description of Injury
A	Complete	No sensory or motor function preserved in the segments S4-S5
B	Sensory Incomplete	Sensory but not motor function is preserved below the neurological level of injury (NLI) and includes the segments S4-S5
C	Motor Incomplete	Motor Function is preserved below the NLI More than half of key muscle functions below the NLI have a muscle grade less than 3
D	Motor Incomplete	Motor function is preserved below the NLI At least half of key muscles below the NLI have a muscle grade $\geq 3$
E	Normal	Sensation and motor function is normal in all segments

Patients were operated under General Anaesthesia in prone position over 2 bolsters, using posterior midline approach to spine. After insertion of Pedicle screws (fig. 1) posterior decompression was performed using laminectomy and finally fixation and distraction with rods was done to achieve correction of deformity [11].

Rehabilitation was started pre-operatively unless contraindicated by other injuries. Patients were given adequate nursing care, active and passive physiotherapy, DVT prevention massage, skin care, air/water mattresses (in patients with sensory loss), bowel care (using biological agents like ispaghula husk and if required laxatives were also given), respirometer physiotherapy and psychological support. Bladder irrigation with mild antiseptic solution was done at regular intervals when self-retaining catheter was placed. Self-retaining catheter was removed as soon as patient is comfortable post operatively and self-intermittent catheterization was taught to all patients.

Regular follow ups were done and at each follow up AIS grade was analysed and recorded. All patients completing follow up of minimum 6 months were included in the study.

**Results**

A total 36 patients with incomplete spinal cord injury were included in study out of which 22 were males and 14 were females. The mean age was 33.7 years (range 18 to 60 year). 92 % of our cases were less than 50 years and 67 % were less

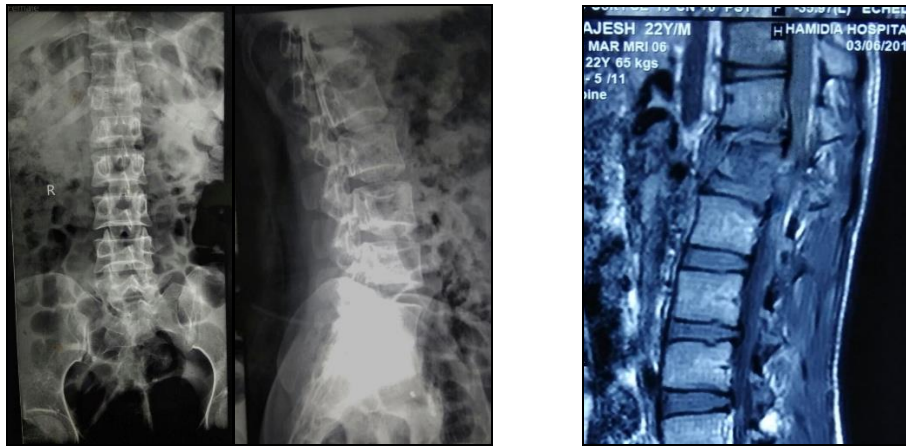
than even 40 years. The most common mode of injury was fall from height found in 58% cases followed by motor vehicle accidents found in 36% cases. The mean injury to surgery interval was 14 days (range 5 to 40 days).

Most patients presented with initial neurology corresponding to AIS D (50%). 8 cases (22%) had AIS B and 10 cases (28%) had AIS C. After a follow up of 6 months the neurological status of 24 cases (67%) improved by more than 1 AIS grade in which 3 cases had improvement of 2 AIS grades.

**Table 2:** Neurological Improvement in the studied group as per Frankel’s grid method [12] (modified for AIS grade)

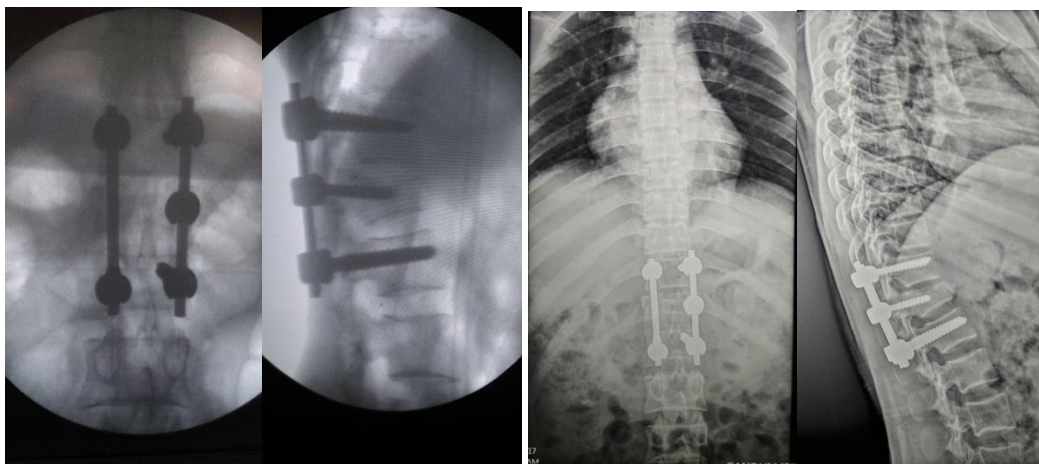
		Post-OP AIS					Total
		A	B	C	D	E	
Pre-OP AIS	A						
	B		3	4	1		8
	C			4	4	2	10
	D				5	13	18
	Total		3	8	10	15	36

Complications were found in 9 patients (25%). Complications included bed sore (14%), urinary tract infection (5%), deep infection (3%), chronic backache (3%) and sexual dysfunction (3%).



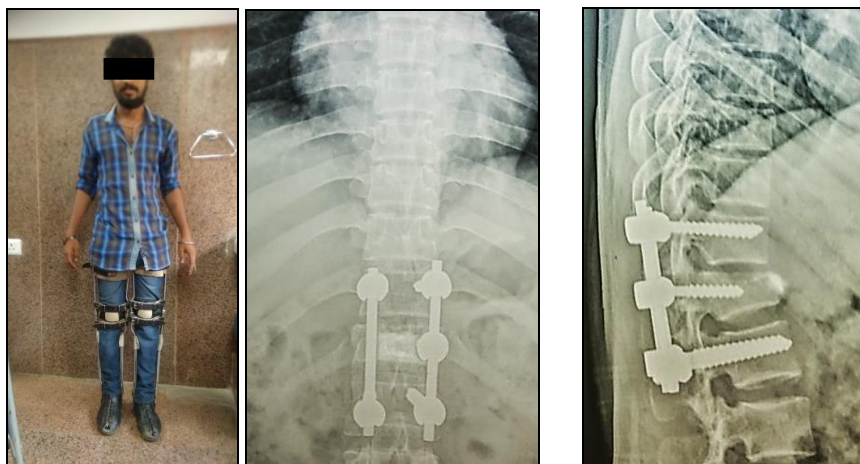
Pre-Op X-rays

Pre-Op MRI



Intra-Op Fluoroscopy

Post-Op X-rays



Patient using KAFO at 2 months follow up

6 months follow up X-rays

**Fig 1:** 22yr/M Compression Fracture D12, AIS grade D improved to AIS grade E till 6 months follow up.



**Fig 2:** Bed sore in a patient presented after 14 days of injury. It healed with skin care and using dry antibiotic powder.

## Discussion

Although the present study is only an experience on thirty six patients as compared to large studies in literature, thus it may have projected erroneous incidence or frequency of the various components of the study because of small number of patients. However it still provides an insight into the prevailing situation of the disease process and its recovery pattern in general government hospital with average facilities. Overall 66.7% neurological improvement of at least 1 AIS grade was seen among all patients with incomplete neurological deficit. 3 cases (8.3%) had improvement of 2 AIS grades. Neurological recovery that occurred in our sample was statistically significant ( $p = 0.001$ ).

Transfeldt *et al.* (1990) <sup>[5]</sup> studied the effect of delayed anterior decompression in patients with spinal cord and cauda equina injuries of the thoraco lumbar spine. 46.5 percentage of cases with incomplete spinal cord injury had neurological improvement in his study. Anderson *et al.* (1993) <sup>[6]</sup> performed early surgery in 14 cases of incomplete paraplegia due to thoracic level spinal injury and compared neurologic recovery to historical controls treated by postural reduction or late surgical intervention. They have reported improvement in neurological status in 92% of their patients.

Jun *et al.* (2011) <sup>[12]</sup> in a retrospective study of 13 patients having lower thoracic and lumbar fractures were treated using posterior decompression and fusion. Their study showed 92% improvement of at least 1 Frankel grade with an average of 1.7 grade improvement. Lee *et al.* (2018) <sup>[13]</sup> in a study of 56 patients have reported improvement in 53.6% of cases. It can be seen that historically different studies have observed variable percentage of improvement in cases of spinal cord injury. This can be attributed to the small sample sizes as small change in number of cases pose as a big change in percentage of cases. The results obtained in our study are similar to those observed previously.

Spieß *et al.* (2009) <sup>[14]</sup> provide the latest data on natural course of neurological recovery without surgical intervention. They have reported 43.5% spontaneous improvement of more than one AIS grade in cases with incomplete spinal cord injury over a follow up period of one year. Thus the result observed in our study after operative treatment is better than conservative treatment observed in his study.

We have observed a mean injury to surgery time of 14 days (range 5-40 days). This can be attributed to a number of factors like many of our patients were from rural background and had poor socioeconomic status. This along with poor referral machinery have resulted in delayed presentation of such patients in our institute. At the institute level there was delay in obtaining fitness from physician and anaesthesiologist along with late availability of implants. Moreover studies like that of Anderson *et al.* (1993) <sup>[6]</sup> and Lee *et al.* (2018) <sup>[17]</sup> have taken patients operated within 24 hours and within 8 hours as early group respectively. They have considered patients operated after 24 hours as late group. It was not feasible for us to operate patients in such short duration due to various restrictions as mentioned above.

## Conclusion

Early decompression and stabilization of spinal column fractures have several potential advantages: they allow early mobilization to prevent systemic complications of prolonged immobilization such as pulmonary infections, decubitus ulcers, thrombophlebitis etc.; reduce the length of hospital stay; and improve rehabilitation.

Our study indicates that operative intervention done in cases

of incomplete spinal cord injury has better chances of neurological recovery as compared to historical cases treated conservatively. However, the definite answer regarding the timing of surgery in such patients remain uncertain because of the lack of large well-designed randomized, controlled trials.

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