ORIGINAL RESEARCH

Analysis of post-surgical neurological outcomes of patients with traumatic dorsolumbar fractures with incomplete spinal cord injury

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ABSTRACT

Background: The treatment of individuals with spinal cord injuries is still debatable despite recent advancements in our knowledge of spinal mechanics, injury processes, better imaging methods, improved instruments, and enhanced rehabilitative care. In this work, we attempt to examine the neurological consequences of incomplete spinal cord injuries (SCI) to the dorsolumbar spine, which are managed at our center using posterior fixation and decompression.

Methods: Our study comprised 40 patients who underwent surgery in our center between October 2021 and November 2023 who had incomplete SCI as a result of dorsolumbar fractures. The American Spinal Injury Association (ASIA) Impairment Scale was used to evaluate the neurological status of these cases both before and after surgery, as well as at follow-ups after one, two, three, and six months.

Results: The patients in our study had a mean age of 33.7 years, with the majority falling into the young working age range of 26-40 years. There were 16 females and 24 males present. The most frequent cause of SCI was discovered to be falls from a height. In their Asia Impairment Scale, 24 instances out of 40 demonstrated improvement of one or more grades.

Conclusion: In situations of incomplete SCI, early mobilization and rehabilitation are achieved through the use of surgical fixation for dorsolumbar fractures. According to our research, these patients' neurological state gets better following surgical fixation.

Key words:ASIA impairment scale, pedicle screw fixation, dorsolumbar fractures, thoracolumbar fractures, vertebral fractures, and spinal cord injury

INTRODUCTION

Damage to the bone covering the spinal cord results in spinal cord injury. It typically happens in the context of high energy trauma, which causes vertebral fractures and dislocations [1]. A partial loss of sensory or motor ability in both lower limbs is known as paraparesis. Paraparesis is commonly caused by traumatic SCI of the dorsolumbar area [2]. An estimated 1.5 million people in India are thought to have SCI. Every year, over 20,000 new cases of SCI are added to this total[3].Paraparesis accounts for around 21% of instances with SCI, making it the second most frequent kind. The second most frequently afflicted region of the spine is the dorsolumbar region[4].The average lifetime cost of care for a person with SCI is approximately Rs. 1.6 crore, and an annual budget of Rs. 86 thousand crores (0.47% of GDP) is needed to meet the needs of all SCI patients in India [5]. These unmet needs have resulted in inadequate care for SCI patients, raising their morbidity, disability and death

rates.The American Spinal Injury Association (ASIA) Impairment Scale is used to determine the neurological condition of patients with SCI; grades B, C and D on the AIS indicate incomplete SCI [6]. Incomplete injuries have become more common in recent years [7].Many challenges arise during the course of treatment for patients with spinal cord injury. A multidisciplinary team consisting of orthopaedicians, nurses, physiotherapists, occupational therapists, psychologists and other professionals must provide them with thorough care. To resume their place in society, they require vocational rehabilitation [8]. Nowadays, a large number of people with SCI become unemployed and a burden to their families as well as society as a whole because there are insufficient rehabilitation programs.

Patients from low socioeconomic backgrounds are referred to our center occasionally from other hospitals. There is limited class 2 and sparse class 3 data to support the effectiveness of decompression in cases with incomplete SCI [9]. There is disagreement regarding the best time to perform surgery on SCI patients [10].

In this investigation, a number of cases with paraparesis brought on by traumatic incomplete dorsolumbar SCI that will be treated with posterior stabilization and decompression have been prospectively examined. We will use the ASIA Impairment Scale to analyze these patients' neurological recovery for a period of six months

MATERIAL AND METHODS

The study was approved by ethics committee of our institute. Patients admitted in our center between October 2021 and November 2023 fulfilling the following criteria were included in the study after getting an informed consent**.** Our center is a government setup with a dedicated spine department.

INCLUSION CRITERIA

1. Patients presenting with traumatic incomplete thoracolumbar spinal cord injury (AIS grades B, C and D).
2. Patients above 18 years of age.
3. Patients willing to give informed consent for surgery and study.
4. Patients completing regular follow up period of 6 months.

EXCLUSION CRITERIA

1. Patients with complete spinal cord injury (AIS grade A).
2. Patients with non-traumatic paraparesis i.e. pathologies like tumor/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.

Table 1: Grades of ASIA Impairment Scale (AIS)

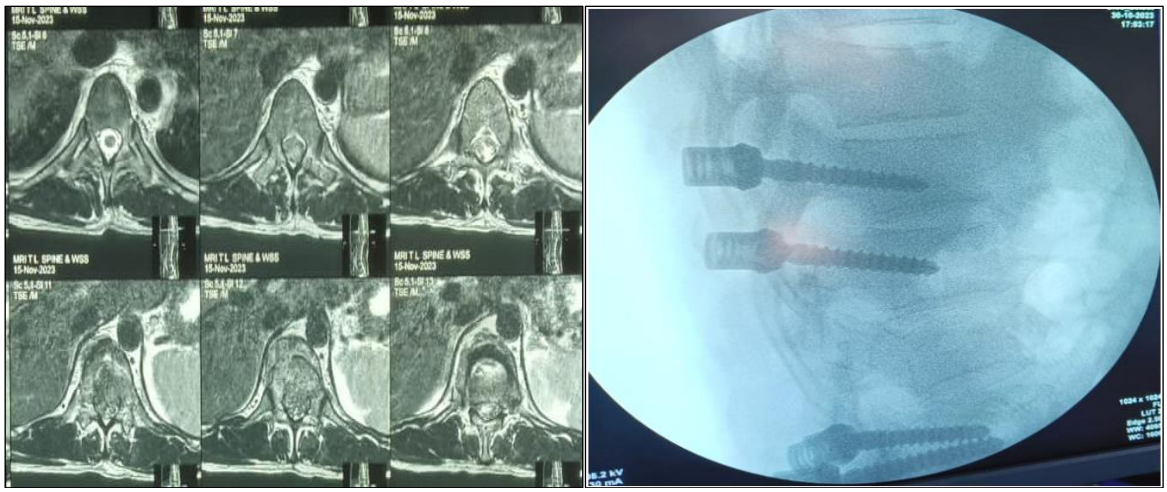
Grade	Type of Injury	Description of Injury
A	Complete	No sensory or motor function preserved in the segments S4-S5
B	Sensory Incomplete	Sensory but not motor function is preserved below the neurological level of injury (NLI) and includes the segments S4-S5
C	Motor Incomplete	Motor Function is preserved 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 ≥ 3
E	Normal	Sensation and motor function is normal in all segments

Under general anesthesia, the patients were operated on in a prone position over two bolsters, with the posterior midline approach to the spine. Following the insertion of Pedicle screws (fig.1), posterior decompression was accomplished by laminectomy; the deformity was then corrected by fixation and distraction using rods [11].

Unless there was a contraindication due to other injuries, rehabilitation began prior to surgery. In addition to receiving adequate nursing care, the patients also received respiratory physiotherapy, active and passive physiotherapy, DVT prevention massage, skin care, air/water mattresses (for patients who have lost sensory function), bowel care (using biological agents such as isabgol husk and, if necessary, laxatives), and psychological support. After a self-retaining catheter was inserted, bladder irrigations with a mild antiseptic solution were performed on a daily basis. After surgery, the self-retaining catheter was removed as soon as the patient felt comfortable, and all patients were taught how to self-intermittently catheterize.

Frequent follow-ups were conducted, and the AIS grade was evaluated and noted at each visit. Every patient who finished a minimum of 6 months of follow-up was included in the research.

Pre Op MRI



IntraopFluroscopy

Post Op X ray

RESULTS

24 male and 16 female patients with incomplete spinal cord injuries made up the total number of individuals involved in the study. 33.7 years was the mean age (range: 18 to 60 years).

67% of our cases were younger than 40 years old, and 92% of our cases were younger than 50 years old. Falling from a height was the most frequent cause of injury, occurring in 58% of cases, while motor vehicle accidents followed in 36% of instances. The range of the injury to operation interval was 5 to 40 days, with a mean of 14 days.

50% of individuals had initial neurology that matched AIS D when they first appeared. 28% had AIS C and 22% had AIS B. The neurological state of 24 subjects was assessed after a 6-month follow-up.

Following a six-month follow-up, 24 individuals (67%) showed improvement in their neurological state of more than one AIS grade, with 3 instances showing improvement of two AIS grades.

Of the patients, 10 (25%), had complications. Bed sores accounted for 7.5% of complications, followed by urinary tract infection (5%), deep infection (2.5%), chronic backache (5%), and sexual dysfunction (5%).

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

	A	B	C	D	E	Total
A						
B		3	4	1		8
C			4	4	4	12
D				5	15	20
Total		3	8	10	19	

X axis-Post op AIS; Y axis-Pre op AIS

DISCUSSION

The current study only includes 40 patients, compared to larger studies in the literature; hence, due to the small sample size, it may have projected incorrect incidence or frequency of the various study components. In general, nonetheless, it still offers information into the state of the illness process and its healing pattern in a government hospital with mediocre amenities.

All patients with incomplete neurological deficiency showed an overall neurological improvement of 66.7% of at least one AIS grade.Improvement by two AIS grades was seen in 4 patients (10%). There was a statistically significant neurological recovery in our group ($p = 0.001$).

The effects of delayed anterior decompression on patients with spinal cord and cauda equina lesions of the thoracolumbar spine were investigated by Transfeldt*et al.* (1990) [5]. In his study, neurological improvement occurred in 46.5% of individuals with incomplete spinal cord injury. In 14 cases of incomplete paraplegia resulting from thoracic level spinal injury, Anderson *et al*. (1993) [6] performed early surgery and compared the neurologic recovery to historical controls who underwent postural reduction or late surgical intervention. 92% of their patients have shown improvement in their neurological state, according to their reports.

Jun *et al*. (2011) [12] treated 13 patients with posterior decompression and fusion for lower thoracic and lumbar fractures in a retrospective review. 92% of the participants in their study improved by at least one Frankel grade, with an average increase of 1.7 grades. 53.6% of the 56 patients in the study by Lee *et al*. (2018) [13] showed improvement. It is evident that various studies conducted in the past have noted varying percentages of improvement in spinal cord injury cases. Small sample sizes may be to blame for this, as a slight change in the number of cases can result in a significant change in the proportion of cases. Our study's findings are consistent with earlier observations.

The most recent information on the natural course of neurological healing without surgical intervention is provided by Spiess*et al.* (2009) [14].

Over the course of a year-long follow-up, they have documented 43.5% of cases with incomplete spinal cord injuries showing spontaneous improvement of more than one AIS grade. Therefore, the outcome of surgical treatment in our study is superior to that of conservative treatment in his study.

A mean injury to surgery time of 14 days has been observed, with a range of 5-40 days. There are several reasons for this, including the fact that a large portion of our patients came from low-income rural backgrounds. These patients presented late to our institute as a result of this as well as subpar referral mechanisms.

Furthermore, patient groups in trials such as Anderson *et al.* (1993) [6] and Lee *et al*. (2018) [17] were operated on within 24 hours and 8 hours, respectively.

CONCLUSION

Besides reducing the length of hospital stay and improving rehabilitation, early decompression and stabilization of spinal column fractures allows for early mobilization to prevent systemic complications of prolonged immobilization, suchas pulmonary infections, decubitus ulcers, and thrombophlebitis.

Based on our research, patients with incomplete spinal cord injuries who receive surgical intervention have a higher likelihood of neurological recovery than those who receive conservative care in the past. However, the dearth of significant, well-designed randomized,

controlled trials makes it difficult to determine with certainty when surgery should be performed in these patients.

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