Trajectory of ASIA Grade Improvement in Incomplete Traumatic Spinal Cord Injury Following Surgical Decompression: A Quasi-experimental Study in Bangladesh

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ABSTRACT

Background

Traumatic spinal cord injury (TSCI) often leads to severe neurological impairment. Surgical decompression is a widely used intervention, but the extent and timeline of neurological recovery—particularly ASIA grade conversion—remain insufficiently documented in developing countries.

Objective

To evaluate ASIA grade improvement following surgical management in patients with incomplete TSCI.

Methods

This quasi-experimental study enrolled 38 patients with incomplete TSCI, who underwent surgical decompression across four tertiary hospitals in Dhaka, Bangladesh. ASIA impairment scale grades were recorded at admission and at 1, 3, and 6 months postoperatively. Statistical analysis included the Friedman test and chi-square tests to assess grade transitions. All statistical analysis were done by SPSS version 26.0

Results

The mean age was 37.5 years, with male predominance (86.8%). Fall from height (63.2%) was the most common mechanism of injury, and L1 was the most frequently affected level (63.3%). At admission, most patients were ASIA D (60.5%). At 6 months, 81.6% improved to ASIA E. Overall, 97.4% experienced at least one-grade improvement, with conversion rates of 83.3% for ASIA B, and 100% for ASIA C and D. The Friedman test indicated a statistically significant improvement across time points ($p = 0.001$).

Conclusion

Surgical decompression in patients with incomplete TSCI is associated with substantial neurological recovery. ASIA grade conversion can serve as a reliable marker for monitoring surgical outcomes in such patients.

Keywords

traumatic spinal cord injury; ASIA grade conversion; spinal decompression; quasi-experimental study; Bangladesh

INTRODUCTION

Traumatic spinal cord injury (TSCI) represents a life-altering neurological event with profound consequences on an individual's functional capacity, quality of life, and socioeconomic participation [1,2]. Over the past decade, age- and sex-standardized incidence rates of TSCI have

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remained relatively stable, with an estimated 26.5 cases per million population (95% CI: 25.0–27.9) [3]. The average age at injury is 59.2 years, and a significant male predominance has been consistently observed (across all World Health Organization (WHO) regions and World Bank income levels [4], accounting for approximately 68.3% of all cases [3]. Cervical spinal cord injuries are the most prevalent anatomical type [5], comprising 52.1% of all TSCIs [3]. The leading etiologies include traffic accidents, occupational accidents [3], fall from height and violence [5]. Primary spinal cord injury results from immediate trauma, such as vertebral fractures or disk herniation, damaging neural pathways and vasculature [6]. This is followed by secondary injury, causing progressive neuronal loss due to ischemia and inflammation [7].

Surgical intervention remains a cornerstone in the acute management of TSCI, with nearly half of all patients (48.8%) undergoing operative procedures to decompress and stabilize the spinal cord [4]. However, the extent to which surgical intervention contributes to neurological recovery remains an area of critical inquiry. The American Spinal Injury Association (ASIA) Impairment Scale (AIS) is the most widely used tool for assessing neurological damage and recovery in spinal cord injury (SCI), both pre- and postoperatively [8]. Beyond clinical application, it standardizes assessment, guides research, and helps predict neurological recovery and functional outcomes, including the potential to walk again [9].While early decompressive surgery has shown promise in experimental and clinical settings [10–12], real-world evidence on functional recovery trajectories, especially over a one-year horizon, remains limited and fragmented. To bridge this evidence gap, the present study aimed to observe the improvement of ASIA grade during first year following surgical intervention for traumatic incomplete spine injury.

MATERIALS AND METHODS

Study Design and Setting

This quasi-experimental study was conducted over a period of one year (January 14, 2023, to December 2023), at the Departments of Orthopaedics and Traumatology of four tertiary care centers in Dhaka, Bangladesh: Bangladesh Medical University (BMU), Dhaka Medical College Hospital (DMCH), Bangladesh Spine and Orthopaedic Hospital (BOSH), and Ibn Sina Medical College and Hospital (ISMCH).

Study Population

A total of 38 patients with traumatic spinal injury (TSI) with incomplete neurological deficits; who were eligible for surgical management were enrolled in this study. Patients were included if they had a single-level traumatic spinal cord injury with radiologically confirmed compression and clinical neurological involvement, were between 15 and 60 years of age, and presented within three weeks of injury. If patients had associated head injuries, polytrauma involving the torso, a history of pre-existing neurological disorders, previous spinal surgery, or penetrating spinal injuries; then they were excluded.

Data Collection Procedure

After obtaining approval from the Institutional Review Boards (IRBs) of the participating centers, patients meeting the eligibility criteria were identified and informed written consent was obtained. Data were collected using a structured questionnaire. Sociodemographic details (age, sex, occupation) and clinical variables including level of spinal injury, timing of surgery after injury, bowel and bladder status, and ASIA grade at admission were recorded prior to surgery. Postoperative variables such as ASIA grade at follow-up, length of hospital stay, and postoperative complications were assessed after scheduled operational intervention, at the outpatient visits up to one year after surgery. Follow up was conducted at 1st, 3rd & 6th months of operation.

All collected data were initially checked for completeness and accuracy, then entered into Microsoft Excel (version 2010) and analyzed using IBM SPSS Statistics for Windows, version 26.0. Continuous variables were summarized as means and standard deviations or medians and interquartile ranges depending on distribution, while categorical variables were expressed as frequencies and percentages. Independent t-tests or ANOVA were applied for comparing numerical variables, and Pearson's chi-square or Fisher's exact tests were used for categorical comparisons. A p-value < 0.05 was considered statistically significant. The study adhered to the ethical principles of the Declaration of Helsinki, IRB clearance (IBN SINA: ISMC/EC/2022/03,DMC: ERC-DMC/ECC/2023/15, BMU: 4283) and all patient informed written consents and information were filled in by patients themselves.

RESULT

This Quasi-experimental study comprised of a total of 38 patients having traumatic incomplete spine injury who fulfilled the inclusion criteria for this study were selected during the study period. All the patients managed surgically and were followed up at 1st, 3rd & 6th months after operation. The primary outcome of the study was to evaluate the conversion of ASIA grade during first year following operative management for traumatic incomplete spine injury.

Table I: Distribution of the study participants according to sociodemographic characteristics (n=38)

Variables	Number (n)	Percentage
Age in years		
15-24	8	20.5
25-34	9	23.1
35-44	11	28.2
≥45	11	28.2
Mean ±SD	37.53 ± 13.04	
Sex: Male	33	86.8

Data expressed as frequency, percentage and mean± SD

Most of the patients were male (86.8%) with a mean age of 37.53 years with highest prevalence in patients more than 35 years of age.

Table II: Distribution of the participants according to cause, type and level of injury (n=38)

Cause of injury	Number (n)	Percentage
Fall from height	24	63.2
RTA	13	34.2
Fall of heavy object	1	2.6
Type of injury		
Burst fracture	24	63.2
Traumatic subluxation	5	13.2
Flexion compression	4	10.5
Fracture dislocation	3	7.9
Chance fracture	2	5.3
Level of injury		
L1	24	63.3
D12	5	13.2
C 5/6	4	10.5
D 11/12	2	5.2
C 6/7	1	2.6
D11	1	2.6
D 9/10	1	2.6

Fall from height was the most prevalent cause (63.2%) with burst fracture being the most common type of injury (63.2%). L1 being the most frequent (63.3%), followed by D 12 (13.2%), C 5/6 (10.5%), D 11/12 (5.2%), C 6/7, D11 (2.6%), and D 9/10 (2.6%).

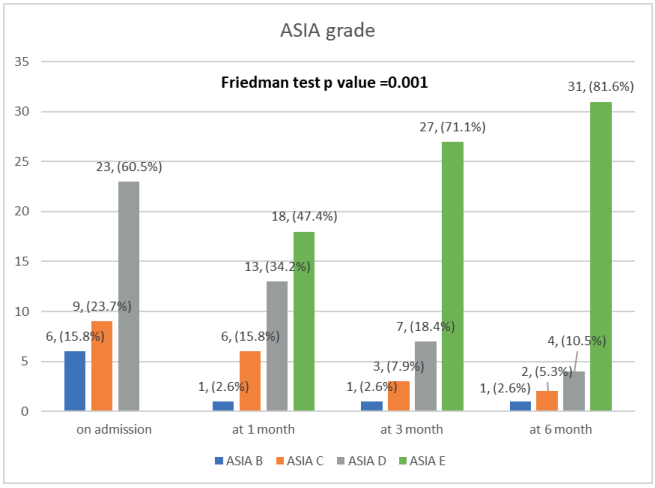

Figure 1: Distribution of the participants according to ASIA grade (on admission and at each follow up)

Figure 1 illustrated the distribution of ASIA grades at baseline, and at 1, 3, and 6 months following surgical intervention. A progressive improvement in neurological function was evident over time. At admission, the majority of patients were graded ASIA D (60.5%) or C (23.7%), with only 15.8% graded ASIA B. By 6 months, 81.6% of patients had improved to ASIA E, indicating complete recovery, while the proportion of patients in lower ASIA grades significantly declined. The Friedman test revealed a statistically significant change in ASIA grade distribution across the timepoints (p=0.001), confirming consistent neurological improvement following surgery.

Table III: Rate of ASIA grade conversion on final post-operative follow-up

ASIA grade improvement from admission	6th month
Unchanged	1 (2.6%)
One grade shift	28 (73.7%)
2 grade shifts	7 (18.4%)
3 grade shifts	2 (5.3%)
Conversion rate	
Grade B	83.3%
Grade C	100%
Grade D	100%
Overall conversion rate	97.4%

At the end of 6th months follow up, one grade improvement was observed in 73.7% patients, 2 grade improvement was observed in 18.4% patients, 3 grade shift was observed in 5.3% patients and one patient's condition remained.

DISCUSSION

This study studied 38 participants with traumatic incomplete spine injury who underwent operative management during the specified study period. The primary objective was to assess the conversion of the ASIA grade during the first year following operative management.

The participants' demographic profile revealed, middle-aged people, with a mean age of 37.53 years, were the prevalent group. Patients with traumatic incomplete spine injury showed an age range spanning between 41-47 years) [13–15]. The present study had male-female ratio was 6.5:1. Male predominance in patients of traumatic spinal injury was found to be universal [14,16,17].

Fall from height (63.2%) was the prevalent causative factors, followed by RTA (34.2%). Although motor vehicle accident was found to be the common cause of such injury [18,19], evidence towards fall being the prevalent also exist [16,17,20].

The participants exhibited diverse injury types, with burst fracture being the most prevalent (63.2%). The distribution of injury levels showed L1 was the most common (63.3%) site for this study and by a couple of articles [21,22].

In this study, preoperative neurological status revealed, more than half of the patients were in ASIA D (60.5%) grade. Follow-up at six-months, remarkable 81.57% improved to ASIA grade E. So, after 6 months of postoperative follow up neurological status improved in 37 patients (97.4%); either 1, 2 or 3 grade conversion and 1 patient (2.6%) remained unchanged. Lee et al. achieved 86% improvement neurologically using the ASIA impairment scale [23]. Fawcett *et al.*, also observed that vast majority of recovery occurs in the first 3 months which were comparable [25].

In the present study, the prevalence at least one-grade shifts was 71%. Fehlings et al., showed in their study that 36.6% had I grade improvement, 16.8% had 2 grade improvement, 3.1% had 3 grade improvement and 1 (0.8%) had I grade worsening [26].

From the observation of the current study, 100% conversion rate was seen in ASIA grade C and D whereas Grade B had 83.3% conversion rate. Comparable conversion rate was found in a few studies within 1 year follow up (ASIA D: 90%)[27], (ASIA C:81.8%) [17,18]

CONCLUSION

Surgical decompression in incomplete traumatic spinal cord injury leads to significant neurological improvement, with most patients achieving higher ASIA grades within six months. ASIA grade conversion serves as a reliable indicator of functional recovery following operative intervention.

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Conflict of interest: None

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