

Original Article

Polytrauma with Cervical Spine Injury: Clinical Features and Outcome Based on PROMIS Score

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Abstract

Background: Cervical spine injuries in the setting of polytrauma are potentially life-threatening and demand immediate multidisciplinary management. These injuries are often associated with high-energy trauma and carry a risk of long-term functional impairment. While traditional neurological assessments provide objective data, patient-reported outcomes offer deeper insight into recovery. This study evaluates the clinical profile, management approach, and recovery outcomes in such patients using the Patient-Reported Outcomes Measurement Information System (PROMIS).

Methods: A retrospective study was conducted on 68 patients with polytrauma and radiologically confirmed cervical spine injuries over a three-year period from 2020 to 2023 in a private academic setup. The study included 48 males and 20 females, aged 18 to 68 years, with 90% under the age of 45. All patients were managed according to Advanced Trauma Life Support (ATLS) principles. Neurological grading was done using the ASIA Impairment Scale. Surgical fixation was performed in 58 cases, while 10 patients were treated conservatively. PROMIS scores for physical function, pain interference, and depression were recorded at admission and at 12 weeks post-treatment.

Results: The most common mechanism of injury was road traffic accident (64.7%). Associated injuries included thoracic trauma (36.7%) and limb fractures (41.1%). At three months follow-up, significant improvement was noted in PROMIS physical function (from 36.4 ± 5.8 to 46.8 ± 6.4 , $p < 0.01$), pain interference (from 62.1 ± 6.0 to 51.3 ± 5.7 , $p < 0.01$), and depression (from 58.2 ± 6.3 to 47.9 ± 5.9 , $p < 0.01$). Patients with incomplete spinal cord injury and those who underwent early surgery had better functional outcomes.

Conclusion: Early diagnosis and structured intervention following ATLS guidelines contribute to improved functional recovery in patients with cervical spine injury and polytrauma. The PROMIS scoring system provides a valuable measure of patient-centered outcomes, supporting its routine use in trauma care and rehabilitation follow-up.

Keywords: Cervical spine trauma, polytrauma, ATLS, spinal cord injury, PROMIS score, functional outcome.

Table I: Patient Characteristics, Associated Injuries, and PROMIS Scores (n = 68)

Parameter	Value
Sex	
– Male	48 (70.6%)
– Female	20 (29.4%)
Age (years)	
– Age ≤ 45 years	61 (89.7%)
– Age > 45 years	7 (10.3%)
Mechanism of Injury	
– Road Traffic Accident	44 (64.7%)
– Fall from Height	17 (25.0%)
– Blunt Trauma	7 (10.3%)
Neurological Deficit (ASIA Grade)	
– ASIA A	10 (14.7%)
– ASIA B	8 (11.8%)
– ASIA C	14 (20.6%)
– ASIA D	22 (32.4%)
– ASIA E	14 (20.6%)
Associated Limb Fractures	
– Humerus fracture	5 (7.4%)
– Femur fracture	6 (8.8%)
– Tibia/fibula fracture	4 (5.9%)
– Pelvic fracture	4 (5.9%)
– Multiple limb fractures	5 (7.4%)
Management	
– Surgical fixation	58 (85.3%)
– Conservative (immobilization)	10 (14.7%)
PROMIS Scores (T-score)	
– Physical Function (mean ± SD)	36.4 ± 5.8
– Pain Interference (mean ± SD)	62.1 ± 6.0
– Depression (mean ± SD)	58.2 ± 6.3
– Patients with PROMIS PF T-score >45	12 (17.6%)
Preoperative	

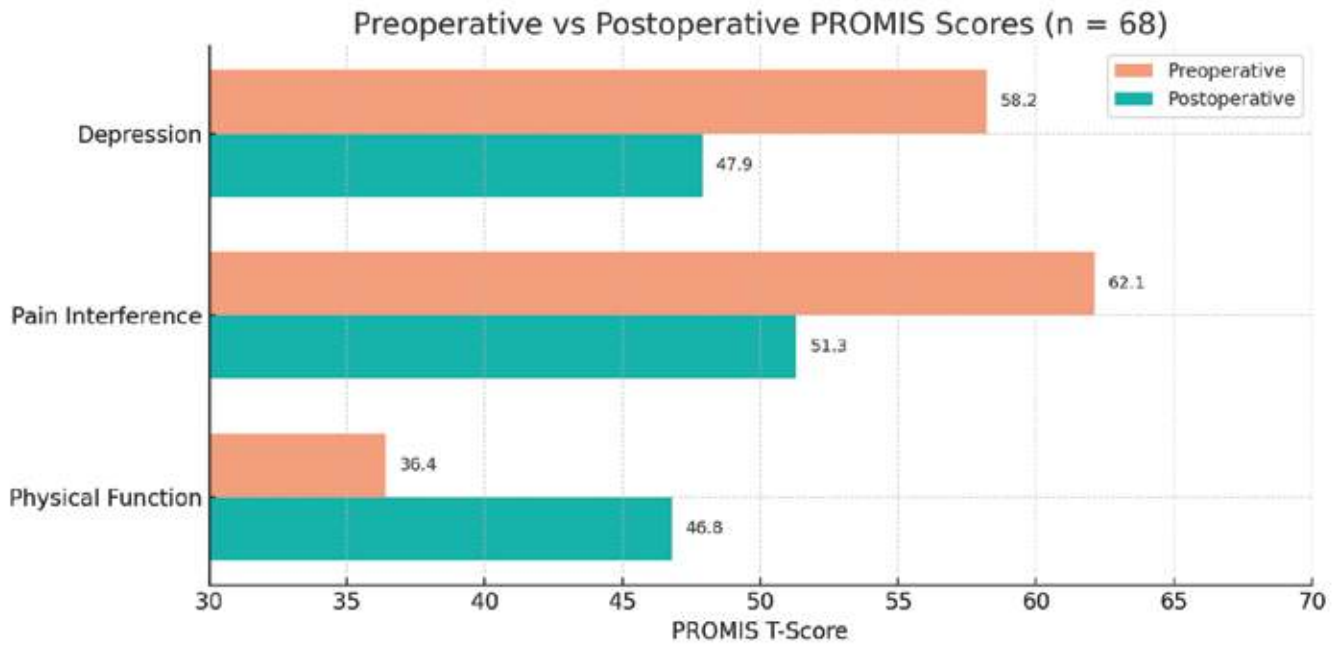


Figure 1: PROMIS Score preoperative vs. postoperative patients

Introduction

Polytrauma involving cervical spine injury remains a major challenge in emergency and trauma care. High-energy mechanisms such as road traffic accidents and falls are the primary causes of these injuries, particularly in young adults¹. Damage to the cervical spine can lead to spinal cord injury, with potential for lifelong neurological deficits. Early identification, rapid stabilization, and coordinated multidisciplinary care are essential to reduce mortality and optimize outcomes²⁻⁴.

Functional recovery after such injuries is often assessed using objective neurological grading; however, subjective functional status and quality of life are increasingly recognized as equally important⁵. The Patient-Reported Outcomes Measurement Information System (PROMIS) offers a validated approach to measure physical function, pain interference, and emotional well-being, providing a broader perspective on recovery. This study aims to evaluate the clinical profile, management, and functional outcomes of patients with polytrauma and cervical spine injuries using the PROMIS scoring system⁶⁻⁸.

Recent epidemiological reviews estimate that cervical spine trauma constitutes roughly 2–3 percent of all blunt trauma admissions worldwide, yet it accounts for a disproportionately high share of severe disability and long-term socioeconomic burden. In low- and middle-income countries—where rapid pre-hospital transport, advanced imaging, and specialized spinal units are often limited—the interval between injury and definitive management can be prolonged, compounding the risk of secondary neurological deterioration. Against this backdrop, incorporating standardized outcome metrics such as PROMIS is especially valuable: it facilitates cross-center comparisons, highlights disparities in access to timely care, and helps clinicians quantify the added benefit of early surgical stabilization, optimal hemodynamic control, and coordinated rehabilitation pathways⁹⁻¹¹.

Moreover, the multidimensional structure of PROMIS dovetails with emerging concepts in trauma-informed care, which emphasize not only motor recovery but also pain modulation, mental health, and social reintegration¹²⁻¹⁴. By tracking domains like Pain Interference and Depression alongside Physical Function, investigators can identify patient subgroups whose perceived well-being lags behind objective

neurological gains—a phenomenon often masked by traditional scoring systems¹⁵⁻¹⁸. Such granular insight paves the way for targeted interventions (e.g., cognitive-behavioral therapy, vocational counseling) that might otherwise be overlooked in the acute trauma setting. Consequently, this study stands to inform evidence-based protocols that are both neuroprotective and person-centered, ultimately advancing the standard of care for polytrauma patients with cervical spine injuries.

Methods

A retrospective study was carried out in private setup between January 2022 and December 2024. A total of 68 patients with confirmed cervical spine injuries associated with polytrauma were included. The inclusion criteria were age ≥ 18 years, radiologically confirmed cervical spine injury, and the presence of additional traumatic injuries (e.g., limb fractures, thoracic or abdominal trauma) [Table I]. Patients with

pre-existing spinal disorders or incomplete follow-up were excluded.

All patients were evaluated and managed according to the Advanced Trauma Life Support (ATLS) protocol. Cervical spine protection, airway management, and hemodynamic stabilization were prioritized. Neurological assessment was performed using the ASIA Impairment Scale. Imaging included CT and MRI of the cervical spine. Surgical intervention was offered based on instability, neurological deterioration, or compression, while conservative treatment involved immobilization with a cervical collar.

PROMIS scores (T-scores) were recorded at the time of admission (preoperative) and at 12 weeks post-treatment. Domains included physical function, pain interference, and depression. Data were analyzed using descriptive statistics and paired t-tests to compare pre- and postoperative scores. A p-value < 0.05 was considered statistically significant.

Results

Out of 68 patients, 48 were male (70.6%) and 20 were female (29.4%), with a mean age of 34.2 years (range 18–68). Most patients (90%) were younger than 45 years. The most common mechanism of injury was road traffic accidents (64.7%), followed by falls from height (25%) and blunt trauma (10.3%).

Neurological grading revealed ASIA E in 14 patients, ASIA D in 22, ASIA C in 14, ASIA B in 8, and ASIA A in 10 [Table III]. Associated injuries included thoracic trauma (36.7%), limb fractures (41.1%), and abdominal trauma (16.2%). Specific limb fractures included femur (6), humerus (5), tibia/fibula (4), and pelvic fractures (4).

Surgical intervention (anterior or posterior fixation) was performed in 58 patients (85.3%), while 10 patients (14.7%) were managed conservatively. Timing of surgery ranged from 6 to 72 hours post-injury.

Kaplan-Meier curve [Figure 2] in this study shows the proportion of patients not yet functionally recovered over time, stratified by ASIA grade:

- ASIA A and B show the slowest and least recovery over the 12-month period.
- ASIA C patients demonstrate moderate recovery rates.
- ASIA D shows early and steep recovery, with most patients regaining function within the first few months.
- ASIA E patients are considered functionally intact from the outset, hence a flat survival curve at zero (no delay to recovery).

At 3 months follow-up, PROMIS scores [Figure1] showed significant improvement in most domains:

Domain	Preoperative	Postoperative	p-value
Physical Function	36.4 ± 5.8	46.8 ± 6.4	< 0.01
Pain Interference	62.1 ± 6.0	51.3 ± 5.7	< 0.01
Depression	58.2 ± 6.3	47.9 ± 5.9	< 0.01

Improvement was more pronounced in patients with incomplete cord injury and those who underwent early surgical stabilization. Patients with ASIA A showed minimal functional recovery despite reduced pain interference.

Discussion

Cervical spine injury in the setting of polytrauma is a critical condition with high morbidity if not promptly recognized and managed. In our cohort, the predominance of younger males reflects the common demographics of trauma victims. The high incidence of road traffic accidents underscores the need for improved road safety and public awareness¹⁹⁻²⁴.

Timely application of ATLS protocols allowed for rapid stabilization and imaging, facilitating early surgical intervention in the majority of cases. Surgical fixation contributed significantly to functional recovery, particularly in patients with incomplete spinal cord injuries. The use of PROMIS scores provided valuable insights beyond neurological recovery, capturing changes in mobility, pain perception, and emotional health²⁵.

Previous studies have largely focused on neurological grading systems, but our findings support the incorporation of patient-reported outcomes in clinical follow-up. The statistically significant improvement in PROMIS domains emphasizes the benefits of early surgical stabilization and structured rehabilitation²⁶.

However, patients with complete spinal cord injury (ASIA A) demonstrated limited gains in physical function, highlighting the irreversible nature of severe spinal cord damage and the need for long-term supportive care in such cases²⁷.

Patients with polytrauma who sustain cervical spine injuries experience notably higher rates of complications and mortality compared to those without spinal involvement. Injuries at the cervical level, especially in the upper segments, often lead to respiratory insufficiency, cardiovascular instability, and extended stays in intensive care setting²⁸. The combination of cervical spinal trauma with other major injuries, such as head or chest trauma, significantly worsens prognosis. Mortality rates in such cases can be substantial, particularly when there is a delay in diagnosis or definitive management²⁹. Additionally, long-term functional outcomes tend to be poor, with many patients requiring prolonged rehabilitation or permanent supportive care. These observations highlight the importance of prompt identification and comprehensive treatment strategies tailored to this high-risk group³⁰.

Conclusion

Polytrauma with cervical spine injury remains a major clinical challenge, particularly in young, active individuals. Early recognition and adherence to ATLS principles, combined with timely surgical intervention, result in favorable outcomes in patients with incomplete neurological deficits. PROMIS scoring serves as a valuable tool to assess patient-centered outcomes, offering a more comprehensive understanding of recovery. Integrating functional and emotional health assessments into post-trauma care can better inform rehabilitation strategies and long-term planning.

Table II: Patients characteristics, injury patterns, fractures and premorbid conditions

Parameter	Number (%)
Total Patients	68
Sex (Male)	48 (70.6%)
Sex (Female)	20 (29.4%)
Age Range (years)	18-68 (Mean: 34.2)
Age ≤ 45 years	61 (89.7%)
Age > 45 years	7 (10.3%)
Mechanism of Injury	
- Road Traffic Accident	44 (64.7%)
- Fall from Height	17 (25.0%)
- Blunt Trauma	7 (10.3%)
Associated Limb Fractures	
- Femur Fracture	6 (8.8%)
- Humerus Fracture	5 (7.4%)
- Tibia/Fibula Fracture	4 (5.9%)
- Pelvic Fracture	4 (5.9%)
- Multiple Limb Fractures	5 (7.4%)
Other Associated Injuries	
- Thoracic Injury	25 (36.7%)
- Abdominal Injury	11 (16.2%)
- Head Injury	9 (13.2%)
Premorbid Conditions	
- Hypertension	12 (17.6%)
- Diabetes Mellitus	9 (13.2%)
- Smoking History	15 (22.1%)

Table III: ASIA Classification and Functional Outcome in Polytrauma Cervical Spine Injury Patients (n = 68)

ASIA Grade	No. of Patients	Percentage (%)	Typical Functional Outcome	Notes
ASIA A	10	14.7%	Poor functional recovery; complete motor and sensory loss	Highest risk of permanent disability; low PROMIS physical function scores expected
ASIA B	8	11.8%	Limited recovery; some sensory sparing	Often associated with pain interference and emotional burden on PROMIS
ASIA C	14	20.6%	Moderate recovery possible with rehabilitation	Partial motor function preserved; PROMIS may show improvement over time
ASIA D	22	32.4%	Good functional recovery expected	Ambulatory patients; may still have pain interference or mood disturbances
ASIA E	14	20.6%	Normal neurological	Best outcomes; PROMIS scores

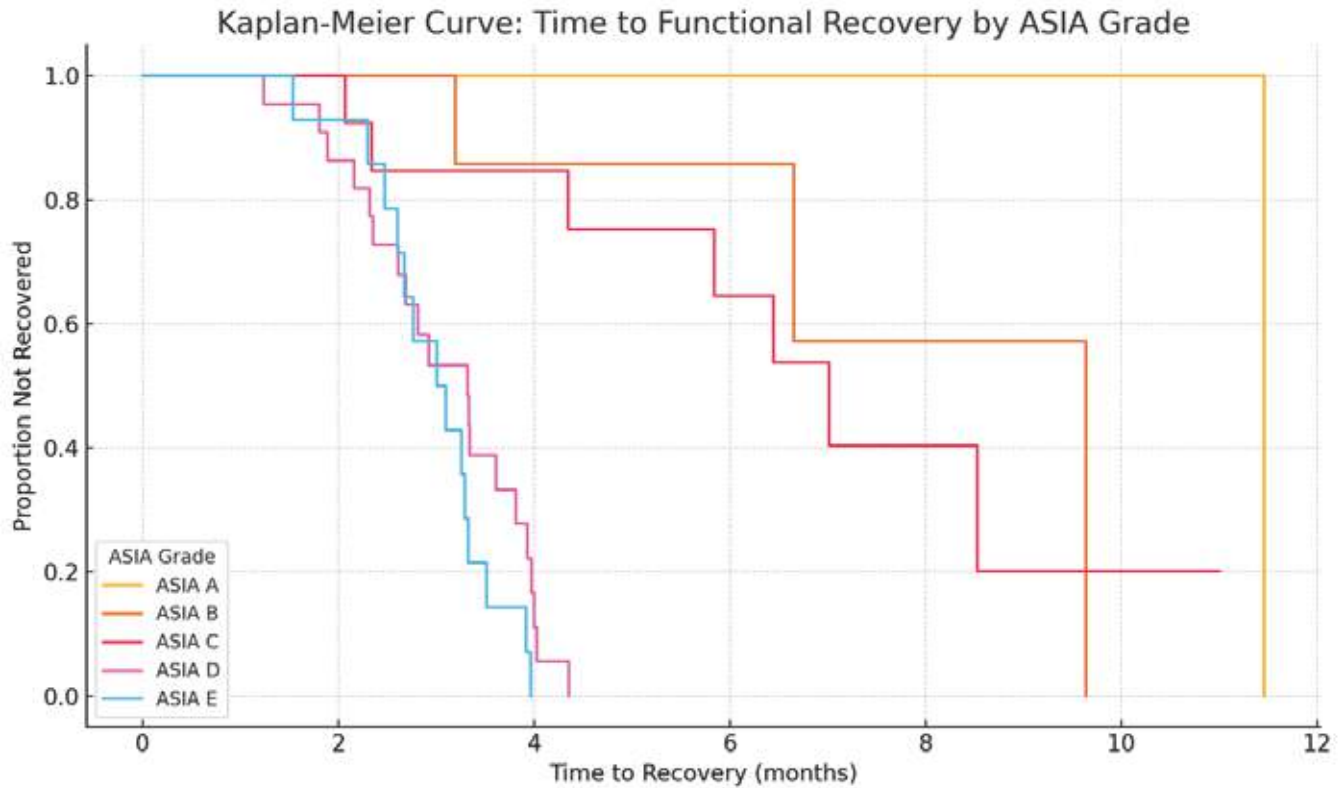


Figure 2: Kaplan-Meier Curve: Time to Recovery by ASIA Grade

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