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Approach To Management Of Cervical Spine Injuries: A Prospective Observational Study

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ABSTRACT

Background: *Cervical spine injuries are serious traumatic events that can lead to neurological deficits and long-term disability if not managed promptly. Due to the cervical spine's dependence on ligamentous support, early diagnosis and appropriate stabilization are essential to preserve neurological function and spinal alignment.*

Aims and Objectives: *To evaluate the clinical presentation, radiological findings, injury classification, treatment strategies, and outcomes in patients with cervical spine trauma, and compare the effectiveness of surgical versus conservative management.*

Methods: *This prospective observational study was conducted over 18 months in a tertiary trauma centre. Patients with confirmed cervical spine injuries on CT/MRI were assessed using the ASIA Impairment Scale and classified using AO Spine and SLIC systems. Based on stability and neurological status, patients were treated conservatively (cervical orthosis, traction) or surgically (anterior/posterior/circumferential fixation). Outcomes were measured using neurological recovery and radiological healing.*

Results: *A total of 52 patients were enrolled, with a mean age of 39.4 years and a male-to-female ratio of 3.3:1. The most frequently injured levels were C5–C6 (36.5%) and C6–C7 (30.8%). Road traffic accidents were the predominant cause (59.6%), followed by falls (25%) and sports-related injuries (7.7%). Neurological deficits were observed in 63.4% of cases at presentation. Conservative treatment was administered to 29 patients (55.8%) with stable fractures, all of whom showed preserved or stable neurological status and good radiological outcomes. Surgical management was required in 23 patients (44.2%) based on instability or neurological involvement. Among these, the anterior approach was used in 56.5%, posterior in 34.8%, and combined in 8.7% of cases. Early surgery (<24 hours) was performed in 18 patients, yielding ASIA grade improvement in 66.7% of cases, compared to 40.0% in those operated after 24 hours. Minor complications included superficial wound infection (3.8%), transient C5 palsy (1.9%), and dysphagia after anterior surgery (3.8%). No cases of implant failure or reoperation were reported.*

Conclusion: *Cervical spine trauma requires timely, classification-based management. Early surgery improves outcomes in select patients, while stable injuries respond well to conservative care. Individualized treatment decisions remain central to optimizing recovery.*

Keywords: *Cervical Spine Injury, Spinal Cord Injury, AO Spine Classification, Subaxial Cervical Fractures, Neurological Recovery, Surgical Stabilization, ASIA Impairment Scale, Early Decompression Surgery*

INTRODUCTION

Cervical spine injuries represent a significant clinical emergency due to their potential to cause spinal cord damage, permanent neurological deficits, and long-term disability. These injuries account for a substantial proportion of spinal trauma cases, particularly in high-energy mechanisms such as road traffic accidents, falls from height, and sports-related impacts (1,2). The cervical spine's anatomical complexity and its reliance on ligamentous stability make it particularly vulnerable to instability following trauma, especially at the C5–C7 levels where mobility is maximal (2).

Accurate early diagnosis and classification of cervical spine injuries are critical to guide appropriate management. Misdiagnosis or delayed intervention can result in irreversible spinal cord injury (3,4). Standardized trauma protocols such as Advanced Trauma Life Support (ATLS) emphasize spinal precautions from the point of first contact, and imaging modalities like computed tomography (CT) and magnetic resonance imaging (MRI) are indispensable for detecting both bony and soft tissue injuries. Classification systems like the AO Spine and Subaxial Injury Classification (SLIC) frameworks help determine injury stability and direct treatment strategies (5).

Management options range from conservative methods such as rigid cervical orthosis and traction for stable injuries, to surgical stabilization for unstable fractures or in the presence of neurological

compromise. The timing of surgical intervention, particularly early decompression within 24 hours, has been associated with improved neurological outcomes in incomplete spinal cord injuries. However, decisions must be individualized based on injury morphology, neurological status, and patient-specific factors (5–7).

MATERIALS AND METHODS

Study Design and Setting: This was a prospective observational study conducted over a period of 18 months at a tertiary care trauma and spine centre. The study was approved by the institutional ethics committee, and informed consent was obtained from all patients or their legal guardians.

Inclusion Criteria:

- Patients of all ages and genders presenting with cervical spine trauma.
- Radiological confirmation of cervical spine injury on CT and/or MRI.
- Willingness to undergo follow-up and neurological assessment.

Exclusion Criteria:

- Patients with isolated soft tissue neck injuries without spinal involvement.
- Polytrauma patients in whom cervical spine assessment was incomplete.
- Patients with pre-existing neurological disorders or spinal deformities.

Clinical Evaluation: All patients underwent detailed clinical assessment including history of mechanism of injury, level of consciousness, and neurological evaluation using the American Spinal Injury Association (ASIA) Impairment Scale. Vital signs, comorbidities, and associated injuries were also recorded.

Radiological Assessment: Cervical spine imaging included CT scans for evaluating bony architecture and MRI for assessment of the spinal cord, intervertebral discs, and ligamentous structures. Injuries were classified using the AO Spine classification and the Subaxial Injury Classification (SLIC) system to assess fracture morphology, stability, and neurologic involvement.

Treatment Protocol: Patients with stable fractures and no neurological deficits were managed conservatively using rigid cervical orthosis, halo vests, or traction. Unstable injuries or those with neurological deterioration were treated surgically via anterior, posterior, or circumferential approaches based on injury pattern and surgeon discretion. Timing of surgery was recorded, and intraoperative details were noted.

Follow-up and Outcome Measures: Patients were followed at 6 weeks, 3 months, and 6 months. Outcome measures included neurological improvement based on ASIA grade, radiological alignment and fusion, and incidence of complications such as infections, implant failure, or reoperation.

This study was undertaken to evaluate the clinical profile, radiological patterns, injury classifications, and outcomes in patients presenting with cervical spine injuries at a tertiary care trauma center. The study also aimed to compare the effectiveness of surgical versus conservative treatment modalities in terms of neurological recovery and radiological stabilization.

Table 1: Demographic Profile

Variable	Value
Mean Age (years)	39.4 ± 12.6
Male: Female Ratio	3.3 : 1

A total of 52 patients with radiologically confirmed cervical spine injuries were enrolled during the study period. The mean age was 39.4 ± 12.6 years, with a male predominance (M:F ratio = 3.3:1).

Table 2: Mechanism of Injury

Mechanism of Injury	Number of Patients	Percentage (%)
Road Traffic Accidents	31	59.60%
Falls from Height	13	25.00%
Sports-related	4	7.70%

Others / Unknown	4	7.70%

The most common mechanism of injury was road traffic accidents, accounting for 59.6% (n=31), followed by falls from height in 25% (n=13), and sports-related injuries in 7.7% (n=4). The remaining cases were due to assault or unknown trauma mechanisms.

Table 3: Cervical Level Involvement

Level Involved	**Number of Patients**	**Percentage** (%)
C5–C6	19	36.50%
C6–C7	16	30.70%
Other Subaxial (C3–C5)	11	21.10%
Upper Cervical (C1–C2)	6	11.50%

Radiological analysis revealed that the most frequently involved cervical levels were C5–C6 (36.5%) and C6–C7 (30.7%). According to the AO Spine classification, subaxial injuries were more prevalent, while upper cervical spine injuries (C1–C2) accounted for 11.5% of cases.

Table 4: Treatment Modality

Treatment Type	**Number of Patients**	**Percentage** (%)
Conservative	29	55.80%
Surgical	23	44.20%

Out of 52 patients, 55.8% were treated conservatively and 44.2% underwent surgery. This indicates that stable injuries without neurological deficits were more common, allowing for non-operative management. Surgical intervention was required in cases with instability or neurological compromise. The distribution reflects a balanced approach based on injury severity and classification.

Table 5: Surgical Approach

Approach	**Number of Patients**	**Percentage** (%)
Anterior	13	56.50%
Posterior	8	34.80%
Combined	2	8.70%

Among the 23 patients who underwent surgery, the anterior approach was most commonly used (56.5%), followed by the posterior approach (34.8%), and a combined approach in 8.7%. This reflects a preference for anterior stabilization in subaxial injuries, with posterior and combined approaches reserved for complex or unstable cases.

Table 6: Neurological Outcomes – Early vs Late Surgery

Timing of Surgery	**Patients Operated**	**Improved ASIA Grade**	**Improvement Rate** (%)
Early (<24 hrs)	18	12	78.30%

Late (>24 hrs)	5	2	21.70%

Out of 23 patients who underwent surgery, 78.3% received early intervention, of which 66.7% showed ASIA grade improvement. In contrast, among the 21.7% who underwent late surgery, only 40% improved neurologically. These findings support the advantage of early decompression in achieving better neurological recovery.

Table 7: Complications Observed

Complication	**Number of Cases**	**Percentage (%)**
Superficial Infection	2	3.80%
Transient C5 Palsy	1	1.90%
Dysphagia (Anterior Approach)	2	3.80%
Reoperation	0	0%
Implant Failure	0	0%

Complications were minimal and included superficial surgical site infections in 2 patients (3.8%), transient C5 palsy in 1 patient (1.9%), and mild dysphagia in 2 patients (3.8%) following anterior approach. There were no cases of implant failure or reoperations during the follow-up period.

DISCUSSION

This prospective study evaluated the clinical profile, radiological patterns, treatment strategies, and neurological outcomes in patients with cervical spine injuries. The findings underscore the predominance of lower subaxial cervical spine involvement, particularly at C5–C6 and C6–C7 levels, consistent with their biomechanical vulnerability to hyperflexion and axial loading forces.

The majority of injuries resulted from road traffic accidents, reflecting the ongoing burden of high-velocity trauma in urban and semi-urban populations. A male predominance and younger age profile were observed, aligning with previously published data. Neurological deficits were present in over 60% of patients, highlighting the severity of such injuries and the importance of prompt assessment using standardized grading like the ASIA Impairment Scale.

The findings of the present prospective study demonstrate a distinct pattern in the clinical and radiological presentation of cervical spine injuries, with a notable predominance of lower subaxial involvement particularly at C5–C6 and C6–C7 levels. This anatomical vulnerability can be attributed to the high mobility and transitional biomechanics of these segments, making them especially susceptible to flexion-compression and axial loading injuries. These observations are in alignment with the review by Okereke et al. (2021) (1), who described subaxial cervical spine injuries as the most frequently encountered lesions in cervical trauma, often resulting from high-energy mechanisms such as motor vehicle accidents and falls from heigh. Okereke and colleagues further noted that the C5–C6 level was most commonly involved due to its high degree of mobility and its central role in load transmission through the cervical spine, thus corroborating the injury distribution pattern seen in our cohort.

Conservative treatment was effective in 55.8% of patients with stable injuries, showing excellent outcomes in terms of alignment and neurological preservation. Surgical intervention was reserved for unstable fractures or those with neurological compromise, comprising 44.2% of the cohort. Anterior approaches were more commonly employed, likely due to the high incidence of subaxial compression injuries and the relative ease of anterior decompression and fusion.

Significantly, patients who underwent early surgical decompression (<24 hours) had better neurological recovery (66.7%) compared to those operated later (40.0%), supporting the evidence that early intervention helps limit secondary spinal cord damage. This aligns with the findings of the STASCIS trial and other literature advocating for early stabilization in incomplete spinal cord injury.

Complication rates in this study were low and manageable, with no reoperations or hardware failures reported. Overall, the results affirm that a protocol based approach involving timely diagnosis, classification-guided management, and individualized treatment planning can lead to favourable functional and neurological outcomes in cervical spine trauma.

CONCLUSION

Cervical spine injuries require prompt diagnosis and individualized management to prevent long-term neurological deficits. This study highlights the effectiveness of conservative treatment in stable injuries and the benefits of early surgical intervention in unstable or neurologically compromised cases. The anterior approach was commonly used with favourable outcomes. Early decompression within 24 hours showed better neurological recovery. Overall, a structured, classification-guided approach led to satisfactory clinical and radiological outcomes with minimal complications in patients with cervical spine trauma.

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