



Surgical Management of Traumatic Subaxial Cervical Spine Injuries: A Prospective Study

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Abstract

Background: The cervical spine is a complex anatomical region, prone to traumatic injuries necessitating careful assessment and management. This study focuses on the surgical management of traumatic subaxial cervical spine injuries, with a key emphasis on early detection, neural preservation, and accurate diagnostics.

Methods: A prospective study was conducted at Indira Gandhi Medical College, Shimla, involving 50 patients with traumatic subaxial cervical spine injuries. Patients were selected based on specific criteria, and clinical assessments, imaging, and laboratory investigations were performed. Surgical procedures involved anterior cervical discectomy and fusion.

Results: Preoperatively, 56% of patients exhibited no neurological deficits (ASIA grade E), underlining the importance of early intervention. Notably, none presented with ASIA grade A (complete neurological loss). The anterior approach was chosen in 96% of cases. Postoperatively, significant neurological improvement was observed, with no cases of neurological deterioration. Transient dysphagia was a common postoperative complication (100%), which resolved within weeks. Pain at the graft site was noted in 26% of patients, and only 2% experienced implant-related issues.

Discussion: The study's findings underscore the efficacy of early surgical intervention in maintaining and improving neurological function, with minimal postoperative complications. The preference for the anterior approach aligns with achieving neural decompression and axial load-bearing support. Positive shifts in neurological status, along with the absence of postoperative deterioration, reinforce the success of this approach.

Conclusion: This prospective study highlights the importance of comprehensive, timely surgical management for traumatic subaxial cervical spine injuries. It endorses the Subaxial Injury Classification (SLIC) system and its role in clinical decision-making. The study contributes to the existing literature on cervical spine injury management and supports current surgical practices.

Keywords: Cervical spine injuries, traumatic subaxial injuries, surgical management, anterior approach, ASIA chart grading, neurological outcomes, complications, SLIC grading system.

Introduction

An essential component of the spinal column, the cervical spine has complex anatomy and biomechanics. Due to this intricacy and the incidence of traumatic injuries, assessment and management must be done carefully. The key to giving the right therapy is early injury detection, stopping neurological degeneration, and accurate diagnostic assessments and interpretations.[1]

Following major trauma, 1.5 to 3.5 percent of people get traumatic fractures and dislocations of the cervical spine. 2.4% was the incidence, according to a research from the National Emergency X-Radiography Utilisation research (NEXUS). Notably, the subaxial area, which accounts for around 65% of all cervical spine injuries, is particularly traumatized, leading to the majority of cervical spinal cord injuries. Fractures in the lower cervical vertebrae, C6 and C7, account for a substantial portion, totaling 39.3% of cases. Of these injuries, C7 or C7-T1 dislocations comprise nearly 17%, underscoring the importance of assessing the cervico-thoracic junction in suspected cervical trauma cases.[2]

Low Glasgow Coma Scale scores, low systolic blood pressure, severe face fractures, risky injury mechanisms, male gender, and age over 35 are some risk variables that are linked to an increased incidence of cervical fracture among trauma victims. It's interesting to note that a head injury does not necessarily damage the cervical spine. Although very dynamic, the subaxial cervical spine protects vital organs and tissues such the spinal cord, nerve roots, and vertebral arteries. The anterior, middle, and posterior columns are three crucial columns that maintain its integrity. These columns are crucial for spinal stability because they cooperate to support weight and avoid abnormalities.[2]

Under physiological pressures, a motion segment that involves all anterior components and one posterior element, or the opposite, is stable. However, even in the absence of neurological impairments, lesions involving all three columns are regarded as unstable and call for surgical intervention. Decisions about how to manage cervical spine injuries are aided by classification systems.[4] Despite being widely utilized, the Allen and Ferguson approach lacks clear definitions and usefulness. As an alternative, the Subaxial Injury Classification (SLIC) grading system, which takes into account morphology,

integrity of the discoligamentous complex, and neurologic condition, aids in determining the necessity for surgical intervention. The AO Spine subaxial cervical injury classification classifies injuries into nine major classes based on morphology and other characteristics. This score method is consistent with that classification.[5]

Operative therapy attempts to straighten the spine, stop neurological damage from progressing, speed up recovery, regain biomechanical stability, and support functional rehabilitation. Depending on the type of damage, a surgeon will choose between anterior and posterior procedures based on a set of criteria. Neural decompression and axial load-bearing support by grafting and plating, particularly throughout one to two motion segments, are advantages of anterior surgery. However, it could be limited in how well it treats lordosis and might result in postoperative problems including dysphagia.[6]

The cervical spine is further stabilized via interbody fusion, which makes use of grafts or spacers. Although desirable for their osteogenic, osteoinductive, and osteoconductive qualities, autologous bone grafts need to be supplemented with anterior plates to avoid problems. Tricortical autografts are preferred for fusion because of their mechanical robustness, although their self-fixation characteristics may require extra support from anterior plates.[7] At the Indira Gandhi Medical College in Shimla, we frequently use anterior stabilizing procedures to treat subaxial cervical spine injuries, including open reduction, discectomy or corpectomy, and anterior plating with screws. Our prospective hospital-based study aims to examine the results of anterior stabilization in these instances using plating and bone grafting.[8]

Materials And Methods

Study Design and Setting: This prospective study enrolled 50 patients with traumatic subaxial cervical spine injuries who were admitted to and underwent surgical intervention at Indira Gandhi Medical College, Shimla, between October 2019 and October 2020.

Patient Selection Criteria: Inclusion Criteria:

1. Patients with cervical spine injuries exhibiting instability involving the C3 to C7 cervical levels.

2. Traumatic disc prolapse resulting in cord compression involving the C3 to C7 cervical levels.
3. All patients with cord damage, irrespective of whether they had complete or incomplete cord lesions.
4. Patients with a Subaxial Injury Classification (SLIC) score of four or higher.

Exclusion Criteria:

1. Patients with significant medical comorbidities such as malignancy, severe liver disease, or organic brain disease.
2. Patients with associated thoracolumbar spinal injuries.
3. Patients with cervical spine injuries involving the C1 and C2 cervical levels.

Clinical Assessment and Investigations: Upon admission, patients underwent a thorough clinical assessment, including neurological examinations based on a standardized performa (Annexure 1) and the American Spinal Injury Association (ASIA) chart (Annexure 4). Routine and specific blood tests, electrocardiograms, and radiological exams were performed to evaluate their condition.

Interventions: Patients with subluxation received skeletal traction with crutchfield tongs, gradually increased while monitoring neurological and radiological parameters. Attempts were made to reduce subluxations under general anesthesia if traction was unsuccessful. For patients with bilateral locked posterior facets, bilateral posterior facetectomy was performed. Surgery was conducted after a negative COVID-19 RTPCR report.

Patient Positioning: Patients were positioned supine on the operating table. In-line endotracheal intubation was performed, and crutchfield tongs were applied anterior to the ear to slightly extend the head. Sandbags were placed under the interscapular and left iliac regions, while both shoulders were directed toward the foot end of the table to facilitate hyperextension for improved cervical spine visualization.

Preparation of Surgical Site: The iliac crest and neck were aseptically prepared with sterilium and betadine scrub. Draping of the neck and iliac crest

was carried out, with an iodine-impregnated adhesive sheet used to stabilize the drapes and establish a sterile barrier.

Surgical Procedure: The surgical procedure involved anterior cervical discectomy and fusion. An oblique incision was made below the mandible, parallel to the sternocleidomastoid muscle. Key steps included exposing the anterior longitudinal ligament, performing discectomy, and graft placement. A cervical locking plate was secured in place, and the wound was closed in layers with the insertion of a negative suction drain.

Grading Used:

In the study, two grading systems are mentioned:

1. ASIA Chart Grading: ASIA stands for the American Spinal Injury Association. The ASIA Chart Grading is used to assess the neurological status of patients with spinal cord injuries. It categorizes patients into different grades from A to E based on their degree of neurological impairment. The grades are as follows:

- Grade A: Complete neurological impairment, indicating no sensory or motor function below the level of injury.
- Grade B: Incomplete neurological impairment, signifying sensory but not motor function below the level of injury.
- Grade C: Another level of incomplete neurological impairment, indicating both sensory and motor function below the level of injury but with muscle strength less than 3/5.
- Grade D: Incomplete neurological impairment, where both sensory and motor function are preserved below the level of injury, with muscle strength equal to or greater than 3/5.
- Grade E: Normal neurological status, showing that there is neither sensory nor motor impairment.

Subaxial Injury Classification (SLIC) Score: The SLIC system is used to assess the severity and characteristics of subaxial cervical spine injuries. It considers various factors, including morphology, discoligamentous complex integrity, and neurological

condition, to assign a numerical score to the injury. The SLIC score helps clinicians determine the necessity of surgical intervention based on the

characteristics of the injury. A higher SLIC score indicates a more severe injury and may require surgical management.

Results

Table 1: Distribution of patients according to ASIA Chart grading preoperatively

ASIA chart grading	Frequency	Percentage
A-Complete	0	0
B-Incomplete	2	4
C-Incomplete	13	26
D-Incomplete	7	14
E-Normal	28	56
Total	50	100

In table 1 28(56%) patients were ASIA grade E that is no neurological deficit. 13(26%) of the patients were ASIA grade C and none of the patients had grade A.

Table 2: Distribution of patients according to approach used

Approach used	Frequency	Percentage
Posterior and Anterior	2	4
Anterior	48	96
Total	50	100

In table 2, 2(4%) patients had bilateral locked posterior facets and not able to do the close reduction, hence the vertebra remains displaced intraoperatively, bilateral posterior facetectomy done in these patients followed by anterior cervical discectomy and fusion. In 48(96%) patients anterior approach is used.

Table 3: Comparison according to ASIA Chart grading, preoperative and on last follow up.

ASIA chart grading	Preoperative		Post-operative		p value
	Frequency	Percentage	Frequency	Percentage	
A-Complete	0	0	0	0	0.00
B-Incomplete	2	4	0	0	
C-Incomplete	13	26	0	0	
D-Incomplete	7	14	8	16	
E-Normal	28	56	42	84	
Total	50	100	50	100	

In table 3, on preoperative assessment according to the ASIA chart grading, 28(56%) of the patients came under the category of ASIA grade E that is normal. About 13(26%) of the patients fall in the grade C that is incomplete neurological impairment. None of the patient had grade A. In the postoperative ASIA scoring, among 2 patients with ASIA grade B one recovered to ASIA grade E and another recovered to ASIA grade D respectively. Among 13 patients with ASIA grade C 7 patients recovered to ASIA grade D and 6 patients recovered to ASIA grade E. 7 patients with ASIA grade D recovered to ASIA grade E. Postoperatively 42(84%) patients fell under grade E and 8(16%) patients in Grade D. Postoperatively no patient deteriorated neurologically. This difference was statistically significant (p value 0.00).

Table 4: Distribution of patients according to postoperative complications

S.No.	Complications	Frequency (N=50)	Percentage
1	Transient dysphagia	50	100
2	Mandibular branch of facial nerve involvement	0	0
3	Superior laryngeal nerve involvement	0	0
4	Recurrent laryngeal nerve involvement	0	0
5	Wound infection	0	0
6	Implant related complication	1	2
7	Pain at graft site	13	26

In table 4, transient dysphagia was present in all 50(100%) of postoperative patients which subsided within few days to 1-2 weeks. Pain at graft site was present in 13(26%) patients. Only one (2%) patient had implant related complication.

Table 5: Functional Outcome - Distribution of Patients According to Neck Disability Score

Neck Disability Score	Frequency	Percentage
0-4 (No Disability)	39	78%
5-14 (Mild Disability)	9	18%
15-24 (Moderate Disability)	2	4%
25-34 (Severe Disability)	0	0%
35-50 (Complete Disability)	0	0%
Total	50	100%

This table illustrates the distribution of patients based on their Neck Disability Score. The majority of patients (78%) had either no disability or mild disability, while fewer patients had moderate or severe disability. No patients were in the complete disability category.

Table 6: Radiological Outcome - Distribution of Patients According to Bridwell Fusion Grade

Bridwell Fusion Grade	Frequency	Percentage
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Grade 1	40	80%
Grade 2	10	20%
Grade 3	0	0%
Grade 4	0	0%
Total	50	100%

This table presents the distribution of patients concerning their Bridwell Fusion Grade, an indicator of radiological outcomes. The data shows that 80% of patients achieved Bridwell Fusion Grade 1, indicating successful fusion, while the remaining 20% achieved Grade 2, indicating partially successful fusion. No patients were in Grades 3 or 4.

Figure 1: Pre Operative And Post Operative Radiology



Figure 2: Post Operative Outcome



Discussion

The findings of this prospective study, focusing on the surgical management of traumatic subaxial cervical spine injuries, offer valuable insights into the outcomes of surgical interventions. The discussion will cover the key findings, their implications, and comparisons with relevant literature.[9]

Table 1 highlights the preoperative neurological status of patients, as measured by the ASIA chart grading. A significant portion of patients (56%) presented with no neurological deficits (ASIA grade E), emphasizing the importance of early surgical intervention to maintain neurological function. This is a critical finding, as it demonstrates that surgery can be successful in preserving neurological integrity.[10]

Table 2 reveals that the anterior approach was preferred in 96% of the cases.[11] This choice aligns with the goal of achieving neural decompression and axial load-bearing support, which are essential for managing cervical spine injuries effectively. The study's choice of the anterior approach for the majority of patients demonstrates a sound surgical strategy.[12]

Table 3 presents a positive shift in the ASIA chart grading from preoperative to postoperative

assessment. Among patients with initial ASIA grade B or C, several showed improvements, with some even progressing to ASIA grade D or E. [13] Notably, none of the patients experienced postoperative neurological deterioration. These findings suggest that anterior stabilization through cervical discectomy and fusion is effective in improving and maintaining neurological function. The statistically significant difference in ASIA chart grading (p-value 0.00) reinforces the success of the surgical intervention in terms of neurological outcomes.[14]

Table 4 outlines the postoperative complications experienced by the patients. Transient dysphagia was a universal complication, affecting all patients but resolving within a relatively short period. Pain at the graft site was observed in a substantial number of patients (26%), highlighting a common issue following such surgeries. Only one patient (2%) experienced implant-related complications, indicating a low incidence of hardware issues.[15] These complications are in line with what is commonly reported in literature and are manageable. The absence of complications related to neural structures, such as the facial nerve, superior laryngeal nerve, and recurrent laryngeal nerve, is a positive outcome that emphasizes the surgical team's proficiency.[16]

Table 5 highlights the functional outcome, providing details on the distribution of patients according to their Neck Disability Score. This reveals that the majority of patients had no or mild disability, underscoring the favorable functional outcomes following surgical interventions for subaxial cervical spine injuries.[17]

Table 6 addresses radiological outcomes, focusing on the Bridwell Fusion Grade. The data indicates that the surgical procedures were mostly successful, with 80% of patients achieving Bridwell Fusion Grade 1, indicating successful fusion. The absence of patients in Grades 3 or 4 indicates a high rate of successful fusion, further reinforcing the efficacy of the surgical approaches employed.[18]

The results of this study align with previous research on the surgical management of cervical spine injuries. The preference for the anterior approach, positive shifts in neurological status, and manageable postoperative complications are consistent with established practices and expectations. The study's endorsement of the Subaxial Injury Classification (SLIC) grading system and its utilization in decision-making supports the existing body of literature.[19] This system's consideration of morphology, discoligamentous complex integrity, and neurologic condition provides a valuable framework for assessing the necessity of surgical intervention.[20]

Conclusion

This prospective study, conducted at Indira Gandhi Medical College, Shimla, has provided important insights into the surgical management of traumatic subaxial cervical spine injuries. The results suggest that early surgical intervention is effective in preserving and improving neurological function, with minimal postoperative complications. The findings of this study contribute to the existing literature on cervical spine injury management and support the use of the SLIC grading system in clinical decision-making. Overall, the study underscores the importance of a comprehensive and timely surgical approach to maximize patient outcomes in cases of traumatic subaxial cervical spine injuries.

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