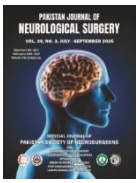

PAKISTAN JOURNAL OF NEUROLOGICAL SURGERY (QUARTERLY) – OFFICIAL JOURNAL OF PAKISTAN SOCIETY OF NEUROSURGEONS

Original Research

Correlation Between Neuro-Ortho Clinical Findings and Radiological Patterns in Cervical Spine Trauma

Hafiz Abdul Basir[1], Muhammad Younas Khan[2], Uroosa Naz Hussain[3], Duaa Zainab[3] Saneela Mumtaz[4], Absaar Alam[5]

[1]Department of Radiology, Scout Medical Complex, Minawar Garrison, Gilgit
[2]Department of Orthopedics, Saidu group of teaching hospital, Swat
[3]Department of Radiology, Shaheed Mohtarma Benazir Bhutto Institute of Trauma, Karachi
[4]Department of Radiology, Shaukat Khanum Memorial Hospital, Lahore
[5]Department of Neurosurgery, Lady Reading Hospital, Peshawar, Pakistan

ABSTRACT

Objective: To evaluate the correlation between neuro-orthopedic clinical findings and radiological imaging patterns in patients presenting with cervical spine trauma at a tertiary care hospital.

Materials and Methods: A prospective observational study was conducted at the Department of Radiology and Orthopedics, Lady Reading Hospital, Peshawar. A total of 354 patients aged 14 years and above with suspected or confirmed cervical spine trauma were enrolled. Detailed clinical neuro-orthopedic examinations were performed using the American Spinal Injury Association (ASIA) scale. All patients underwent CT and MRI cervical spine imaging. Clinical findings were correlated with radiological injury patterns.

Results: The mean age of patients was 37.2 ± 10.8 years, with a male predominance (65.5%). Road traffic accidents were the leading cause of injury (59.3%). The most frequent radiological findings were compression fractures (39.5%) and spinal cord signal changes (14.7%). ASIA grades C and D were most common. A statistically significant moderate positive correlation was observed between spinal cord signal changes on MRI and severity of neurological deficit ($r = 0.61$, $p < 0.001$).

Conclusion: There is a strong association between clinical neurological impairment and radiological abnormalities in cervical spine trauma. Incorporating MRI with clinical evaluation improves diagnostic accuracy and assists in prognostication. Multidisciplinary neuro-ortho-radiological assessment is crucial for optimal management of cervical spine injuries.

Keywords: Cervical spine trauma, ASIA scale, MRI, neurological deficit, radiological correlation, neuro-orthopedic evaluation.

Corresponding Author: Muhammad Younas Khan
Email: dryounaskhan90@gmail.com
Department of Orthopedics, Saidu group of teaching hospital, Swat – Pakistan

Date of Submission: 11-06-2025
Date of Revision: 11-09-2025
Date of Acceptance: 12-09-2025
Date of Online Publishing: 13-9-2025
Date of Print: 30-9-2025

DOI: 10.36552/pjns.v29i3.1147

INTRODUCTION

Cervical spine trauma is a critical emergency that threatens both bony stability and neurological function.[1] Harm affecting the upper spine has been shown to compromise the structure of the bone system while also placing the fragile nervous components located inside the vertebral passage at serious risk. Because of the difficult bodily arrangement and closeness to the brainstem, harm within this area has been noted to produce considerable medical harm, and during extreme instances, fatal consequences have been caused. A correct and fast identification has been regarded as crucial for avoiding lasting disability, worsening nerve condition, or deadly results.[2] A collective method using nervous bone and imaging disciplines has been deemed necessary to fully examine such damage and enable swift therapeutic action.[3]

Seven individual spine bones forming the cervical area have been described to hold key responsibilities in head balance, enablement of broad movement capacity, and safeguarding of neural tissue and spinal nerves.[4] External force directed to this area has been linked to numerous injury variations encompassing soft structure tearing, vertebral bone shattering, ligament network failure, and spinal nerve damage. Causes involving high strength, such as automobile crashes, falls from heights, athletic incidents, and direct force application, have been identified as major reasons for cervical damage globally.[5]

Through a medical lens examination of upper spinal harm has been initially handled through nerve bone assessment.[6] Inspection within the bone discipline has concentrated on framework stability, detection of abnormal shape, noticeable displacements, and painful neck mechanical symptoms. On the other hand, the nerve inspection component has been performed through analysis of muscle force detection problems, reaction issues, and clear signs of spinal cord damage.[7] Well-known medical observations, like weakness in limbs, skin sensation loss, strange tingling issues with bladder or intestinal function, and modified body reflexes, have been utilized to guide doctors in understanding how much nerve damage has been suffered. Organized clinical grading tools, like the nerve trauma grading method developed by the spinal injury organization, have been commonly applied to objectively label nerve impairment.[8] This diagnostic uncertainty has resulted in the routine performance of body scanning for every suspected case involving upper spinal trauma.[9]

Scanning using radiological methods has been employed as a necessary complement to physical assessment, where direct internal imaging of bone and soft tissue damage has been achieved. Simple body images have historically been used first, especially during emergency room visits. Nevertheless, their lower accuracy concerning intricate upper spinal damage has caused them to be mostly used during first-level inspection or in situations where better imaging has been unattainable. Traditional X-ray techniques have commonly incorporated front-to-back, side-to-side, and specific open mouth positioning, which have been conducted to reveal significant bone breaks, vertebral misalignments, and improper joint positions.[10]

The advent of computed tomography (CT) has significantly enhanced the diagnostic accuracy of cervical spine trauma, especially in identifying bony injuries. High-resolution multiplanar CT scans have become the gold standard for detecting cervical fractures, facet joint disruptions, and canal encroachments. CT is particularly beneficial in high-energy trauma, unconscious patients, or those with high clinical suspicion despite normal radiographs. Furthermore, modern trauma protocols often include whole-body CT scanning (pan-scan) in polytrauma patients, automatically

covering the cervical spine.[11]

Magnetic resonance imaging (MRI) has established its superiority in evaluating soft tissue injuries, spinal cord integrity, and intervertebral disc pathologies. MRI is indispensable in cases where neurological symptoms are disproportionate to CT findings or in patients with normal radiographs but clinical signs of SCI. It provides high-contrast images that reveal spinal cord edema, hemorrhage, ligamentous disruptions, epidural hematomas, disc herniations, and prevertebral soft tissue swelling. Specific MRI findings, such as hyperintense signals on T2-weighted images, correlate with worse neurological outcomes and are crucial in surgical decision-making.[12]

The essential foundation of cervical injury evaluation has been formed through the association between neurological orthopedic assessments and diagnostic imaging observations. The immediate need and method of radiological scanning have been determined through the identification of neurological abnormalities, while diagnostic findings have been utilized to enhance identification and influence care planning. An association with spinal cord compression or contusion visualized by magnetic resonance scanning has been typically demonstrated through the identification of deficits such as four-limb weakness. In a similar way, skeletal instability indicated by visible deformity or tenderness along the centerline during assessment has been linked to dislocations or bone fractures revealed on computed tomography evaluations.[13]

The demand for cooperative team-based care has been emphasized further through occasional inconsistencies between physical findings and imaging data. Neural injury without visible diagnostic signs has been experienced by patients who exhibited neurological deficits but showed normal computed tomography, requiring confirmation via magnetic resonance imaging.[14] Patients have sometimes demonstrated radiographic injuries without initial nerve deficits, which has demonstrated the requirement for precise neurological assessments and careful review during care continuation. Elderly and pediatric patients present unique diagnostic challenges due to bone fragility and ligamentous laxity.[15]

In summary, cervical injury treatment has been supported through unified diagnostic and clinical strategies to assure proper identification, adequate care, and beneficial recovery. Patient prioritization, optimal use of medical resources, and prevention of unnoticed trauma have been accomplished through the connection between examination results and radiographic observations. The preferred method in modern trauma treatment has remained the balanced utilization of neurological orthopedic diagnostic techniques, which has been reinforced through medical progress.

MATERIALS AND METHODS

Study Design and Setting

This prospective observational study was conducted at the Department of Radiology and Orthopedics, Lady Reading Hospital, Peshawar, over one year from May 2024 to May 2025. The primary objective was to evaluate the correlation between clinical neuro-orthopedic findings and radiological imaging patterns in patients presenting with cervical spine trauma. Ethical approval for this study was granted by the Institutional Review Board of Lady Reading Hospital under approval number (234/LRH/MTI).

Study Population

The study included a total of 354 consecutive patients aged 14 years and above who presented with suspected or confirmed cervical spine trauma. All participants underwent comprehensive clinical, neurological, and radiological assessments during their hospital stay.

Inclusion Criteria

Patients were included if they were 14 years or older and presented with acute cervical spine trauma resulting from road traffic accidents, falls, sports injuries, or direct trauma. Only those who underwent both clinical neuro-orthopedic examination and radiological imaging (CT and/or MRI) were considered eligible. Written informed consent was obtained from all participants before inclusion in the study.

Exclusion Criteria

Patients were excluded if they had a history of previous cervical spine surgery or spinal deformities. Those with non-traumatic cervical spine conditions such as tumors or infections, incomplete clinical or radiological records, or those who refused consent or were lost to follow-up were also excluded from the study.

Clinical Assessment

All enrolled patients underwent detailed clinical and neuro-orthopedic examinations conducted by orthopedic residents in collaboration with the neurosurgical and neurology departments. The clinical evaluation involved neurological grading using the American Spinal Injury Association (ASIA) impairment scale. Examinations focused on assessing motor strength, sensory deficits, reflex responses, and identifying any signs of spinal cord involvement, such as urinary retention or bowel dysfunction. Additionally, orthopedic examination assessed neck tenderness, visible or palpable deformity, range of motion limitations, and the presence of palpable step-offs along the cervical spine.

Radiological Evaluation

Radiological imaging was performed according to standard hospital trauma protocols. All patients underwent computed tomography (CT) of the cervical spine using 1.5 mm slice thickness on a 128-slice CT scanner (Philips) at initial presentation. Magnetic resonance imaging (MRI) of the cervical spine using a 1.5 Tesla Toshiba MRI scanner was performed in cases where there was suspicion of spinal cord involvement, discrepancies between clinical findings and CT reports, or neurological deterioration during hospitalization. All imaging findings were interpreted by two senior radiologists who were blinded to the patients' clinical details. Radiological assessment included fracture morphology, such as compression, burst, or dislocation injuries; evaluation of ligamentous injuries, specifically posterior ligamentous complex disruption; spinal cord signal alterations, including edema, contusion, or hemorrhage; as well as identification of disc herniations, prevertebral soft tissue swelling, and facet joint malalignment. Any disagreement between the radiologists was resolved by consensus review.

Data Collection

Data were collected using a predesigned structured data collection form. The recorded variables included demographic information such as age and gender, mechanism of injury, detailed clinical neuro-orthopedic examination findings, radiological imaging patterns derived from CT and MRI reports, and the final management approach, whether surgical or conservative.

Statistical Analysis

Data analysis was performed using IBM SPSS Statistics version 26.0. Categorical variables were expressed in terms of frequencies and percentages, while continuous variables were reported as means with standard deviations. The correlation between clinical neurological status, graded by the ASIA impairment scale, and corresponding radiological findings was assessed using the Chi-square test for categorical variables. For continuous variables, independent sample t-

tests or Mann-Whitney U tests were employed based on data distribution. Pearson's correlation coefficient was applied to determine the strength of association between the severity of radiological findings and the degree of neurological impairment. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Demographic Characteristics

A total of 354 patients with cervical spine trauma were included in the study. The average age of patients was 37.2 years. There was a male predominance, with 65.5% of patients being male and 34.5% female.

Table 1: *Demographics Summary.*

Parameter	Value
Total Patients	354
Mean Age (years)	37.2
Male (%)	65.5
Female (%)	34.5

Mechanism of Injury Distribution

The most common cause of cervical spine trauma was road traffic accidents, accounting for 59.3% of cases. Falls contributed to 24.9% of injuries, followed by sports injuries (9%), direct blows (5.1%), and other causes (1.7%).

Table 2: *Mechanism of Injury Distribution.*

Mechanism of Injury	Frequency (n)	Percentage (%)
RTA	210	59.3
Falls	88	24.9
Sports Injuries	32	9.0
Direct Blows	18	5.1
Others	6	1.7

RTA: *Road Traffic Accident*

Radiological Findings in Cervical Spine Trauma

Radiological assessment revealed that compression fractures were the most frequent finding, noted in 39.5% of patients. Burst fractures (19.8%), facet dislocations (14.1%), disc herniations (11.9%), and cord signal changes (14.7%) were also observed.

Table 3: *Distribution of Radiological Findings.*

Radiological Finding	Frequency (n)	Percentage (%)
Compression Fractures	140	39.5
Burst Fractures	70	19.8
Facet Dislocation	50	14.1
Disc Herniation	42	11.9
Cord Edema/Contusion	52	14.7

Neurological Status Based on ASIA Scale

According to the ASIA impairment scale, the most common neurological grades were ASIA C (25.4%) and ASIA D (28.2%). Complete neurological deficits (ASIA A) were observed in 11.3% of patients, while 18.6% had normal neurological examination (ASIA E).

Table 4: *Clinical Neurological Grading (ASIA Scale).*

ASIA Grade	Number of Patients	Percentage (%)
A (Complete Injury)	40	11.3
B	58	16.4
C	90	25.4
D	100	28.2
E (Normal)	66	18.6

ASIA: *American Spinal Injury Association*

Correlation Between Cord Signal Changes and Neurological Deficit

Pearson's correlation coefficient was used to assess the relationship between the presence of cord signal changes on MRI and ASIA grade. A statistically significant moderate positive

correlation was observed (r = 0.61, p < 0.001), indicating that cord signal changes were associated with worse neurological impairment.

Table 5: *Correlation Between MRI Cord Changes and ASIA Grade.*

Statistical Test	Result
Pearson's Correlation Coefficient (r)	0.61
p-value	<0.001

MRI: *Magnetic Resonance Imaging;* **ASIA:** *American Spinal Injury Association*

DISCUSSION

This prospective observational study was conducted to evaluate the relationship between neuroorthopedic clinical findings and radiological patterns in patients presenting with cervical spine trauma. The results of this study have shown that integration of clinical examination with radiological imaging provided a more comprehensive assessment of injury severity, neurological impairment, and appropriate management. It has been demonstrated that cervical spine trauma remains a complex condition with variable clinical and radiological presentations, and therefore, a multidisciplinary approach is required for optimal outcomes.[16]

Cervical spine injuries are recognized as conditions of major clinical importance because of their ability to cause profound neurological deficits, including paralysis and, in severe cases, death. The cervical region is the most mobile segment of the spinal column, and it also encloses the spinal cord, which makes it highly vulnerable to trauma affecting both skeletal and neural components. In the present study, most of the injuries were related to high-energy mechanisms, and road traffic accidents were the leading cause.[17] This finding is in agreement with international data, where vehicular trauma has consistently remained the most frequent mechanism, especially in low and middle-income countries such as Pakistan. The average age of 37 years has confirmed that these injuries have occurred predominantly in the economically productive age group, which adds further social and financial burden on patients' families and healthcare systems. Male predominance was observed, which is similar to previously reported studies.[18] This distribution is explained by the higher exposure of young males to occupational hazards, road travel, and high-risk activities.

Clinical findings in this study were classified by the American Spinal Injury Association impairment scale, which remains the established tool for grading neurological deficits in spinal cord injuries. A significant proportion of patients were categorized as ASIA grade C and D, which represented incomplete spinal cord injuries with partial preservation of function. This finding is important because incomplete injuries have shown greater potential for neurological recovery compared to complete injuries.[19] The presence of ASIA grade A in more than ten percent of patients reflected the severity of trauma in a subset of the population and emphasized the importance of timely diagnosis and aggressive treatment.

The findings of this study demonstrated that sole reliance on clinical evaluation may underestimate the severity of spinal cord injury.[20] This limitation was particularly evident in patients who presented with spinal cord injury without radiographic abnormality, also known as SCIWORA. In such cases, patients had neurological deficits, but radiological imaging, either CT or MRI, failed to demonstrate definite structural damage. The recognition of SCIWORA has been highlighted in the literature, especially in children and elderly populations, where ligamentous laxity and degenerative changes influence the radiological appearance.[21] In our study, no confirmed case of SCIWORA was documented, but its possibility remains important to consider in symptomatic patients with normal imaging. This emphasizes the critical need for correlation between clinical examination and imaging findings.[22]

Radiological assessment played a central role

in the evaluation of cervical spine trauma. Computed tomography was confirmed as the gold standard for detecting fractures, dislocations, and bony canal compromise. Magnetic resonance imaging added further diagnostic value by identifying cord edema, contusion, hemorrhage, ligamentous injury, and disc herniations. The most significant finding of this study was the statistically significant positive correlation between cord signal changes on MRI and neurological impairment graded by the ASIA scale. A correlation coefficient of 0.61 with a p-value less than 0.001 demonstrated a strong relationship.[23] This means that patients with hyperintense cord signals on T2-weighted images were more likely to present with severe neurological deficits and poor functional recovery. These findings are consistent with other prospective and retrospective studies that reported a direct association between cord signal abnormalities and clinical outcomes.[24]

Variations were observed between clinical findings and radiological images in certain cases. Some patients demonstrated marked bony deformities such as compression or burst fractures, yet maintained preserved neurological function. Conversely, a few patients had only minor bony changes but presented with significant cord edema and severe neurological deficit. These patterns reinforced the principle that clinical assessment and radiological imaging must be interpreted together and not in isolation. The ASIA impairment scale proved useful as a structured clinical tool that consistently corresponded with radiological severity in most patients and guided the planning of rehabilitation and prognosis.[25]

The clinical implications of this study are important. Firstly, early MRI should be included in the standard diagnostic pathway for patients with suspected cervical spine trauma, especially those with neurological deficits or high-energy trauma mechanisms. Secondly, neurological examination by ASIA grading should remain an essential step, but it must be correlated with CT and MRI to avoid underestimation of injury severity. Thirdly, collaboration between radiologists, orthopedic surgeons, and neurosurgeons should be established as routine practice to ensure timely diagnosis and effective management.[26]

The strengths of this study included the prospective design, which reduced recall bias and allowed systematic data collection. The relatively large sample size of 354 patients gave sufficient statistical power to establish meaningful correlations between clinical and radiological findings. Another strength was the combined use of CT and MRI, which provided a holistic overview of both osseous and soft tissue injuries.

Several limitations of the study should be acknowledged. The single-center design may limit the generalizability of findings to other populations and healthcare settings, especially those with limited imaging facilities. Advanced modalities such as diffusion tensor imaging or functional MRI were not employed, which might have provided further insight into microstructural cord damage. Long-term follow-up was not included, which prevented the evaluation of final recovery outcomes. Inter observer variation among radiologists was also not assessed, which could influence the reproducibility of imaging interpretation.

Despite these limitations, the results of this study contribute useful evidence regarding the correlation between neuroorthopedic findings and radiological imaging in cervical spine trauma. The observed relationship between MRI cord signal changes and ASIA impairment scale highlights the prognostic role of MRI in acute trauma. The integration of structured clinical evaluation and advanced imaging ensures accurate diagnosis, guides treatment decisions, and improves patient outcomes. Future research is recommended to include multicenter prospective studies with long-term follow-up and advanced MRI techniques for a better understanding of prognostic markers.

CONCLUSION

This study establishes a significant association between neuro-orthopedic clinical findings and radiological patterns in patients with cervical spine trauma. The integration of clinical neurological grading systems, such as the ASIA scale, with advanced imaging modalities, particularly MRI, improves diagnostic accuracy and guides effective management strategies. MRI-detected spinal cord signal changes strongly correlate with the severity of neurological deficits and should be prioritized in the initial assessment of such patients. A multidisciplinary neuro-ortho-radiological approach enhances overall patient care and facilitates timely intervention.

REFERENCES

1. Vaccaro AR, et al. AO Spine Subaxial Injury Classification System: 2021 update. Eur Spine J. 2021;30(8):2341-2353. Doi: 10.1007/s00586-021-06895-0
2. Badhiwala JH, et al. The influence of timing of surgical decompression for acute spinal cord injury: A systematic review and meta-analysis. J Neurotrauma. 2021;38(23):3147-3156. Doi: 10.1089/neu.2020.7453
3. Yuksel KZ, et al. Predictive value of MRI findings on neurological recovery in cervical spine trauma: a prospective cohort study. J Neuroimaging. 2022;32(1):65-73. Doi: 10.1111/jon.12934
4. Fehlings MG, et al. MRI as a biomarker in cervical spondylotic myelopathy: From imaging to clinical decision making. J Clin Med. 2021;10(18):4047. Doi: 10.3390/jcm10184047
5. Scholtes F, et al. Neurological outcomes after traumatic cervical spinal cord injury: A retrospective analysis. World Neurosurg. 2022;158:e273-e281. Doi: 10.1016/j.wneu.2021.11.118
6. Yuh EL, et al. MRI-based classification of cervical spine injuries improves interobserver reliability. Spine J. 2023;23(3):466-474. Doi: 10.1016/j.spinee.2022.09.012
7. Fiani B, et al. Traumatic cervical spine injury: A comprehensive review of diagnostic imaging. J Spine Surg. 2022;8(1):151-165. Doi: 10.21037/jss-21-117
8. Batty NJ, et al. Role of early MRI in predicting outcomes after traumatic cervical spinal cord injury: A meta-analysis. Neurosurgery. 2022;90(5):584-594. Doi: 10.1227/NEU.0000000000001857
9. Wilson JR, et al. Early decompression for traumatic cervical spinal cord injury: Where do we stand? World Neurosurg. 2021;149:59-66. Doi: 10.1016/j.wneu.2021.01.009
10. Prasad S, et al. Spinal cord injury without radiographic abnormality (SCIWORA): Current perspectives and future directions. World Neurosurg. 2022;157:e585-e594. Doi: 10.1016/j.wneu.2021.10.094
11. Lin Y, et al. Diffusion tensor imaging in spinal cord injury: A meta-analysis. Front Neurosci. 2023;17:1136271. Doi: 10.3389/fnins.2023.1136271
12. Moghaddam N, et al. Cervical spine injuries in elderly trauma patients: A review of management considerations. Geriatr Orthop Surg Rehabil. 2022;13:21514593221090161. Doi: 10.1177/21514593221090161
13. Li Y, et al. MRI evaluation of spinal cord compression: Current status and future directions. Quant Imaging Med Surg. 2021;11(9):4280-4293. Doi: 10.21037/qims-20-1117
14. Rasouli MR, et al. Predictors of neurological outcomes in cervical spine injuries: A systematic review. Eur Spine J. 2023;32(1):87-100. Doi: 10.1007/s00586-022-07346-5
15. Zhang C, et al. Spinal cord injuries from cervical fractures in trauma: Imaging predictors of outcome. Emerg Radiol. 2022;29(4):635-642. Doi: 10.1007/s10140-022-02096-2
16. Wang H, Zhang Y, Lv Y, Xu H, Li C. Clinical outcomes and prognostic factors in subaxial cervical spine injury: a retrospective study. BMC Musculoskelet Disord. 2021;22(1):702. Doi: 10.1186/s12891-021-04579-2
17. Walter CM, Theologis AA, Yue JJ. The role of early decompression in acute traumatic spinal cord injury: a review of the literature. Global Spine J. 2021;11(1_suppl):26S-34S. Doi: 10.1177/2192568220934493
18. Hu W, Wang X, Chen X, Yu X, Wang C. Risk factors for mortality in cervical spinal cord injury: a retrospective study. World Neurosurg. 2023;172:e482-e488.

Doi: 10.1016/j.wneu.2022.12.160
19. Al Eissa S, Alrashidi M, Alghamdi F, et al. MRI-based evaluation of spinal cord injury in cervical trauma: findings and prognostic value. Neurosciences (Riyadh). 2021;26(3):214-219. Doi: 10.17712/nsj.2021.3.20210041
20. Ghogawala Z, Martin B, Benzel EC. Cervical spondylotic myelopathy—contemporary treatment strategies and future directions. Nat Rev Neurol. 2022;18(5):286-297. Doi: 10.1038/s41582-022-00628-5
21. Furlan JC, Fehlings MG. Is age a determinant of neurological recovery after traumatic cervical spinal cord injury? J Neurotrauma. 2021;38(8):1101-1111. Doi: 10.1089/neu.2020.7253
22. Lee CH, Hyun SJ, Kim YJ, et al. Post-traumatic spinal cord injury management: Korean guideline update. Neurospine. 2021;18(4):843-851. Doi: 10.14245/ns.2142564.282
23. Arifin M, Lo J, Phan K, Mobbs RJ. Early versus delayed surgical decompression in traumatic spinal cord injury: a meta-analysis. Glob Spine J. 2022;12(5):1082-1091. Doi: 10.1177/2192568220982293
24. Burns AS, Marino RJ, Flanders AE, Furlan JC. Clinical diagnosis and prognosis following spinal cord injury. Handb Clin Neurol. 2022;184:67-84. Doi: 10.1016/B978-0-12-819905-1.00006-5
25. Malhotra NR, Birk DM, White CH, et al. Evaluation of the American Spinal Injury Association impairment scale in cervical spine trauma: a multi-institutional analysis. Spine J. 2023;23(2):172-179. Doi: 10.1016/j.spinee.2022.08.009
26. Dvorak MF, Fisher CG, Aarabi B, et al. Clinical practice guidelines for the management of acute spinal cord injury: an update. Glob Spine J. 2022;12(1_suppl):5S-22S. Doi: 10.1177/21925682211071373

Additional Information

Conflict of Interest: The authors declare no conflict of interest.

Funding Disclosure: No funding was received for this study.

Ethical Approval: Ethical approval for this study was obtained from the Institutional Review Board of Lady Reading Hospital, Peshawar.

Informed Consent: Informed consent was waived due to the retrospective nature of the study.

Author Contributions: All authors contributed significantly to the research and manuscript preparation as detailed in the author contribution table.

Data Availability Statement: For data sharing, interested researchers can contact the corresponding authors.

AUTHOR CONTRIBUTION

Author Name	Contribution
Hafiz Abdul Basir	Conceptualization, Data Collection, Final Approval of Manuscript.
Muhammad Younas Khan	Study Design, Neurological Data Interpretation, Manuscript Writing.
Uroosa Naz Hussain	Data Analysis, Literature Review, Referencing.
Duaa Zainab	Statistical Work, Tables and Figures Preparation.
Saneela Mumtaz	Neuroimaging Review, Critical Revision of Neurological Sections.
Absaar Alam	Proofreading, Manuscript Submission Process.