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Original research article

INVOLVEMENT OF REGION OF SPINE AND TYPE OF FRACTURES WITH RESPECTIVE MODE OF TRAUMA

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Abstract: *Spinal injuries are complex and often result from traumatic events such as falls, road traffic accidents, and impacts from heavy objects. Proper assessment of the injured spinal region, classification of the injury type, and evaluation of neurological impairment are critical for determining prognosis and guiding management.* ***Objective:*** *This study aims to assess the correlation between spinal regions involved and the mode of trauma, while also comparing the severity and prognosis of spinal injuries using the AO Spine Trauma Classification, Subaxial Cervical Spine Injury Classification (SLICS), Thoracolumbar Injury Classification and Severity Score (TLICS), and American Spinal Injury Association (ASIA) grading systems.* ***Methods:*** *After the ethical approval from the institutional review board, this cross-sectional was conducted at Shaheed Mohtarma Benazir Bhutto Institute of Trauma (SMBBIT), Karachi from 1st June 2022 to 31st December 2023 . Through non-probability consecutive sampling 100 patients aged 15-60 years, both gender, who had a spinal injury due to any sort of trauma (RTA, fall, or impact by an object, etc) were included in the present study.* ***Results:*** *The most common cause of spinal trauma was falls from height, accounting for 59% of cases, followed by road traffic accidents (22%), falls from heavy objects (16%), and assaults (3%) (Table 1). Lumbar spine fractures were the most prevalent, occurring in 41% of participants, followed by thoracic fractures (34%) and cervical fractures (25%). In terms of fracture classification, the AO-spine system identified 51% of subaxial cervical spine fractures as Type A, while thoracolumbar spine fractures were predominantly Type B (58%).SLICS classification revealed that 70% of fractures were compressions, and 51% of patients had nerve root injurie. The ASIA scale revealed 12% of patients had complete motor and sensory loss (Grade A), while 30% retained normal function (Grade E).* ***Conclusion:*** *This study supports the earlier works where spinal injuries are complex trauma and require more elaborate assessment and classification systems for patient management.*

Keywords: Trauma, Spinal Fractures, Classification, management.

Introduction

Fractures of the spine are one of the vital consequences of traumatic injuries that mostly result in considerable morbidity and mortality (1). Involvement of various regions of the spine, cervical, thoracic, lumbar and sacral, may have some difference in their clinical consequences and severity of these is normally proportional to the mechanism of the injury (2). These spinal fractures result from RTAs, falls from great heights, falls while sports, and high-energy traumas (3). Compression fractures are usually due to high axial load compressive forces, burst fractures are due to indirect forces causing both compression and tension forces, and flexion-distraction and fracture-dislocation are due to powerful forces causing shear forces in the spinal column (4). It is therefore important to determine the mode of trauma and correlated type of spinal fracture in order to arrive at the right diagnostic, therapeutic and prognostic measures. Fractures in the spine have been well researched based on the type of force applied and the part of the spinal column involved. Hauwe et al., referred to in their studies that cervical spine injuries are more prevalent in RTAs and high velocity accidents in which forces such as hyperflexion and hyperextension forces are usually high (5). Likewise, the fractures in Thoracic spine are also seen perhaps in highly energized trauma like a fall from the heights (6). Lumbar spine injuries are quite common, and they are more causally linked with falls and load-bearing accidents and there appears to be compressive fractures (7). Some of the prior studies pointed out that the nature of spinal fractures and the mechanism of injury are interrelated. Flexion-distraction injuries, for example, are common in cases in which the occupant of a car suddenly comes to a stop such as in a car accident (8). In clinical practice, burst fractures are any from the falls and occasionally in sports with gravity loads or axial compression (9). While sacral fractures are again more likely to happen during high energy mechanism like falls or motor vehicle accidents though less literature is available on this type of fractures (10). The purpose of investigating the roles of various spinal areas and kinds of fractures in regard to regimes of trauma resides in increasing the efficiency of the diagnostics and therapies, as well as in enhancing the quality of the outcomes for the patient. This evidence will help the healthcare practitioners to understand the specific spinal trauma mechanisms, minimize the complications and enhance the rehabilitation outcomes of the clients with spinal trauma. This study aims to assess the correlation between spinal regions involved and the mode of trauma, while also comparing the severity and prognosis of spinal injuries using the AO Spine Trauma Classification, Subaxial Cervical Spine Injury Classification (SLICS), Thoracolumbar Injury Classification and Severity Score (TLICS), and American Spinal Injury Association (ASIA) grading systems.

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Methodology

After the ethical approval from the institutional review board, this cross-sectional was conducted at Shaheed Mohtarma Benazir Bhutto Institute of Trauma (SMBBIT), Karachi from 1st June 2022 to 31st December 2023. Through non-probability consecutive sampling 100 patients aged 15-60 years, both gender, who had a spinal injury due to any sort of trauma (RTA, fall, or impact by an object, etc) were included in the present study. Patients with pathological and degenerative fractures were excluded from the present study. Written consent was obtained from each participant to ensure confidentiality. Independent variables include age, gender, spinal fracture level, and mode of trauma, while dependent variables are trauma classifications via AO Spine, SLICS, TLICS, and ASIA scales. Data was collected using a three-section questionnaire: Section A for demographics (age, gender, occupation, comorbidities), Section B for injury details (mode of trauma, spinal fracture level), and Section C for trauma classification scales. The AO Spine classification considers fracture morphology, neurological status, and clinical modifiers, while SLICS and TLICS assess injury severity based on radiological findings, with TLICS focusing on morphology, neurologic condition, and ligamentous integrity. The ASIA scale classifies spinal cord injuries as complete or incomplete, based on motor and sensory functions. Data was analysed using IBM SPSS 26, with continuous variables reported as mean and standard deviation, and categorical variables as frequencies and percentages. Statistical comparisons involved t-tests for quantitative variables and chi-square tests for qualitative variables, with a significance level of $p < 0.05$.

Results

The study involved 100 participants with a mean age of 33.03±9.0 years, with males representing 63% of the sample and females 37%. The most common cause of spinal trauma was falls from height, accounting for 59% of cases, followed by road traffic accidents (22%), falls from heavy objects (16%), and assaults (3%) (Table 1). Lumbar spine fractures were the most prevalent, occurring in 41% of participants, followed by thoracic fractures (34%) and cervical fractures (25%). Of these, 80% had single-level injuries, with the most frequently affected vertebrae being L1 (28%) and D12 (26%) (Table 2) .

In terms of fracture classification, the AO-spine system identified 51% of subaxial cervical spine fractures as Type A, while thoracolumbar spine fractures were predominantly Type B (58%)(Table 3). Clinical modifiers indicated that 80% of cervical fractures and 100% of thoracolumbar fractures had possible posterior capsuloligamentous complex injury (M1) (Table 4). SLICS classification revealed that 70% of fractures were compressions, and 51% of patients had nerve root injuries (Table 5). TLICS data showed that 55% of injuries were compression fractures, with 67% involving nerve roots, and the posterior ligamentous complex was suspected or injured in 95% of cases (Table 6). The ASIA scale revealed 12% of patients had complete motor and sensory loss (Grade A), while 30% retained normal function (Grade E) (Table 7).

In examining the correlation between trauma type and spinal fracture location, falls from height were the most frequent cause of fractures across all spinal levels, but no statistically significant correlation was found between the type of trauma and the specific spinal region affected (p=0.128). This suggests that while certain trauma types are more common, they are not strongly linked to a specific region of spinal injury (Table 8).

Table 1: Demographic Parameters of the study participants

Parameters	Mean and Frequency (n=100)
Age	33.03±9.0
Gender	
Male	63 (63%)
female	37 (37%)
Mode of Trauma	
RTA	22 (22%)
Fall from Height	59 (59%)
Fall from Heavy Object	16 (16%)
Assault	3 (3%)

Table 2: Injury-related information of the study participants

Parameters	Frequency (n=100)
Level of Spine Fracture	
Cervical	25 (25%)
Lumbar	41 (41%)
Thoracic	34 (34%)
Number of levels injured	
Single	80 (80%)
Double	20 (20%)
Level Involved	
C3 C4	7 (7%)
C4 C5	2 (2%)

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C5 C6	13(13%)
C6 C7	4 (4%)
D4	5 (5%)
D5	4 (4%)
D12	26 (26%)
L1	28 (28%)
L3	8 (8%)
L4	3 (3%)

Table 3: AO-spine trauma classification system

Parameters	Frequency (n=100)
Sub axial cervical spine (C3 -C7)	
Type A	51 (51%)
Type B	36 (36%)
Type C	13 (13%)
Thoracolumbar spine (T1 - L5)	
Type A	29 (29%)
Type B	58 (58%)
Type C	13 (13%)

Table 4: Clinical modifiers

Parameters	Frequency (n=100)
Sub axial cervical	
Possible posterior capsuloligamentous complex injury (M1)	80 (80%)
Critical disc herniation in presence of facet dislocation (M2)	20 (20%)
Thoracolumber	
Possible posterior capsuloligamentous complex injury (M1)	100 (100%)
Critical disc herniation in presence of facet dislocation (M2)	0

Table 5: Sub axial Injury Classification and Severity Scale (SLICS) Classification

Parameters	Frequency (n=100)
Morphologic Features	
No morphologic abnormality (0)	5 (5%)
Compression (1)	70 (70%)
Burst (2)	20 (20%)
Distraction (3)	3 (3%)
Rotational and / or translational (4)	2 (2%)
Integrity of the discoligamentous complex	
Intact (0)	7 (7%)
Indeterminate (1)	85 (85%)
Disrupted (2)	8 (8%)
Patient's neurologic status	
Intact (0)	10 (10%)
Nerve root injury (1)	51 (51%)
Complete (2)	12 (12%)
Incomplete (3)	27 (27%)
Persistent cord compression (in the setting of a neurologic deficit) (+1)	0

Table 6: Thoracolumbar injury classification and severity score (TLICS) Classification

Parameters	Frequency (n=100)
Morphology	
Compression fracture (1)	55 (55%)
Burst fracture (2)	35 (35%)
Translational /rotational (3)	10 (10%)
Distraction (4)	0

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Neurologic involvement	
Intact (0)	33 (33%)
Nerve root (2)	67 (67%)
cord, conus medullaris	
Incomplete (3)	35 (35%)
Complete (1)	52 (52%)
cauda equina (3)	13 (13%)
Posterior ligamentous complex	
Intact (0)	5 (5%)
Injury suspected / indeterminate (2)	83 (83%)
Injured (3)	12 (12%)

Table 7:American Spinal Injury Association (ASIA) impairment scale

Parameters	Frequency (n=100)
IMPAIRMENT STATUS	
(A) Complete No motor and sensory level preserved below level of injury	12 (12%)
(B) Incomplete Sensory present but no motor preserved below the level of injury	22 (22%)
(C) Incomplete Motor preserved below the level of injury but muscle power is<3	14 (14%)
(D) Incomplete Motor preserved below the level of injury and power is below norm	5 (5%)
(E) Normal Motor and sensory function are normal	30 (30%)

Table 8: Correlation of Trauma type and level of spine involved

Trauma Type	Level of Spine Fracture			Total	P value
	Cervical	Lumbar	Thoracic		
RTA	5	7	10	22	0.128
Fall from Height	16	23	20	59	
Fall from Heavy Object	2	11	3	16	
Assault	2	0	1	3	
Total	25	41	34	100	

Discussion

The results of this study therefore have important implications in understanding the demographic description, mechanisms of injury, types of spinal injuries sustained by the participants, and classification of these injuries. The mean age of 33.03 years is compatible with previous studies because spinal injuries are found to occurred more frequently in young adults, as a result of trauma including fall and road traffic accidents (11, 12). The male participants are dominant (63%) in this study, which is in line with previous studies conducted on spinal associated injuries as they observed that men engage in riskier activities that lead to spinal injuries (13). The study revealed that fall from height constituted the most common mode of trauma (59%) and this was in agreement with Mittal et al., (14) who observed an increase in spinal fracture and dislocations resulting from falls. Road traffic accidents, although remain high (22%), have also been increasingly attributed to spinal trauma and particularly where road safety is low (15). Regarding the location of the spinal fracture, the study identified that the lumbar region was the most affected, with 41% of the participants, thoracic area affecting 34% and cervical 25% of the participants. This distribution is in line with previous research findings that have depicted that frequent lumbar spine injuries result from the high force affecting the region during falls and accidents (10). Also, analyzed data shows that single-level fractures (excluding C7-T12) were found in 80% of the cases, which also corresponds to other sources since isolated vertebral injuries occur more often than multi-level ones (16). AO-spine system classification to the easily distinguish between the cervical injuries revealed that all subjects have type A cervical fracture which corroborate with Peev et al., (17) who postulated that type A (stable) cervical fractures are prevalent in low energy impact injuries such as falls. On the other hand, Type B was observed in the higher percentage (58%) in the thoracolumbar region which have been identified with severe mechanisms of injury (13). Clinical modifiers corroborated with study results, especially on understanding spinal injuries, as 80% of cervical injuries were highlighted to involve posterior capsuloligamentous complex injuries. This is in concordance with Alejandro et al., (16) who highlighted that ligamentous stability should be carefully assessed in an acute spinal trauma because it determines treatment planning and patients' prognosis. The analysis of the classifications SLICS and TLICS showed that almost half and even two-thirds of participants received nosocomial injuries of the nerve root. These findings should contribute to the increasing appreciation of the importance of neurologic status in determining the outcomes related to spinal injuries (18). The ASIA classification showed a significant proportion of complete injuries (Grade A, 12%); the complete injuries point to severe effects on the prognosis of patients, as is noted in the literature concerning the long-term outcomes of patients with complete spinal cord injuries (19). Last there is also weak evidence that would indicate that trauma type does not strictly determine the levels of the spine affected as there was no significant correlation

between the trauma type and spinal level involvement (p = 0.128). This conforms with earlier work that looked at multifactorial factors that affect spinal injury outcomes and the present study was in agreement with Aarabi et al., (13).

Conclusion

In conclusion, falls from heights were identified to be the major source of spinal injuries, and lumbar fractures dominated the other fracture types. Most of the lesions were single-level and L1 and D12 were found to be the most frequently injured vertebrae. Classification of AO-spine showed 86% cervical spine and 90% of the thoracolumbar spine injuries belonged to Type A and B respectively, SLICS and TLICS classifications showed significant number of nerve root involvement. Complete spinal cord injury rates were significantly higher according to assessed by the ASIA scale. These findings also demonstrated that there were no similarities of trauma type and spinal level in the pattern of injury.

Declarations

Data Availability statement
All data generated or analyzed during the study are included in the manuscript.
Ethics approval and consent to participate.
Approved by the department Concerned. (IRBEC-232-KRI-22)
Consent for publication
Approved
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Not applicable

Conflict of interest

The authors declared an absence of conflict of interest.

Authors Contribution

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Syed Ahtisham Halim (3rd year mbbs) & Muhammad Zain Ul Haq (Student MBBS)
Concept & Design of Study

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