



Original Article

Effect of Age, Gender, and Trauma-Type in Distribution of Pediatric Spine Fractures

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ABSTRACT

Objective: The study focused on evaluating the effect of Age, Gender, and Trauma-type in the distribution of pediatric spine fractures.

Material and Methods: All pediatric patients admitted to the Neurosurgery department over 5 years were retrospectively analyzed. Patients were divided into three groups. Levels of vertebral fractures were tabulated. Correlations with age, gender, and trauma type were then established.

Results: Of the 2956 pediatric patients, 38 had vertebral fractures. The mean age of patients was 11.7 years. Of these, 17 were male and 18 were female. By trauma type, 28 patients had fallen and 10 had road traffic accidents. There was a significant association between trauma types in the distribution of vertebral fractures in pediatric trauma patients.

Conclusion: The upper cervical spine should be carefully evaluated in all pediatric patients, especially those who had fallen as trauma-type. Careful screening of the thoracic spine is required in car accidents. Gender and age do not specifically contribute to the distribution of pediatric vertebral fractures.

Keywords: Pediatric spine, spine fractures, trauma type, road traffic accidents, spine injury.

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INTRODUCTION

Spinal cord injuries can be caused by direct trauma or by various disorders such as tumors, infections, and so on. A spinal cord injury affects around 250,000 persons in the United States, with an estimated incidence of 40 per million people each year. In Pakistan, the average yearly incidence rate is 10.23 per million people, and it predominantly affects men. The majority of patients were between the ages of 20 and 29. The most common cause of spinal cord damage is a fall from a great height, followed by car accidents and gunshot injuries.¹ Spinal cord injury (SCI) is a

devastating condition that requires chronic treatment. Life expectancy after spinal cord injury is shortened by complications such as pneumonia, sepsis, urological disease, and heart disease.²

Pediatric spinal cord injuries account for approximately 1 – 10% of all spinal cord injuries.³ Pediatric spinal traumas is a devastating and life-threatening condition that affects the affected child's family emotionally and financially. The incidence of spinal cord trauma in children is 1% to 10% of all spinal cord injuries. Pediatric spine injuries are considered to differ from the adult spine in anatomical and biomechanical features, trauma type, response to deformity, the pattern of injury, and outcome. Some types of injuries are unique or solely present in children, for instance, spinal cord injury without radiographic abnormality (SCIWORA) and pure ligamentous injury.⁴ Pediatric spinal cord injuries have a mortality rate of approximately 28%, but surviving children have a favorable neurological outcome⁴.

Thoracic and lumbosacral injuries are rare and occur more frequently in the elderly group. Falls from heights are the most common type of trauma under age 10, and high-energy trauma such as car crashes are common after age 10.³ Approximately 72% to 75% of spinal cord injuries in children under 8 years of age occur in the cervical spine.^{4,5} Lumbar spine fractures account for approximately 1 – 3% of all childhood fractures.⁶ Falls and accidents involving motor vehicles and pedestrians are the most common causes of injury in young children ages 0 – 9. Motor vehicle accidents are the leading cause of lumbar spine fractures in children aged 10 – 14, with falls and vehicle-pedestrian collisions being less common⁶.

There are important differences between the spine of children and adults.^{3,7} The basis for these differences is the developmental process of bone and muscle maturation. Ligament elasticity and bone maturation are not yet complete in childhood. Facet joints are smaller and more

horizontally oriented. The end plates are of cartilage consistency. Also, the muscles in childhood are weaker than in adults. Ligament laxity plays a protective role in low-energy trauma and is detrimental in high-energy trauma³.

A child's intervertebral disc contains 80% water, and by the age of 12 – 13, this value falls to 70%. This high water content greatly improves the shock-absorbing capacity of children's intervertebral discs.^{3,8} One of the anatomical differences is that children have a higher head-to-body weight ratio than adults. Cervical spine flexion and extension injuries occur more frequently with heavy head weight along with weak neck muscles.

This difference in proportion continues until about eight years age³.

The pattern of spinal cord injury in infants differs from that occurring in adults. The diagnostic tests and imaging needed to rule out spinal cord injury may also be different for children and adults. Interpretation of the radiographs in children must be done by knowledge of age-related bony and ligamentous anatomy.⁹ This study aimed to assess the impact of age, gender, and mechanism of trauma in the distribution of pediatric spine fractures in our setting. The outcome will add to the existing body of knowledge. Because the evidence will be based on data from the local community, practitioners may use the findings for evidence-based practice.

MATERIAL AND METHODS:

Study Design and Setting

A case series study was carried out at the Department of Neurosurgery, Ayub Medical Institute, Abbottabad, for five months (31-10-2022 to 31-03-2023).

Patients Included

To retrospectively analyze, all pediatric patients

(< 16 years old) admitted to the Neurosurgery Unit, ATH, Abbottabad with vertebral fractures and spinal cord injuries from 2017 to 2022 were included in the study. Patients were divided into three equal age groups, 0 – 5 years, 6 – 10 years, and 11 – 15 years.

The extent of vertebral fractures is also tabulated, according to anatomical similarities. Cranio-cervical (C0 – C2), mid-cervical (C3 – C6), cervico-thoracic (C7 – T1), thoracic (T2 – T10), thoracolumbar (T11 – L1), and lumbar (L2 – L5) and sacral regions. Trauma type included fall from height and road traffic accidents.

Inclusion Criteria

All pediatric patients less than 16 years of age with spine fractures or neurologic injuries were included in the study.

Exclusion Criteria

Cases of infectious spine disease, neoplastic spine disease, and congenital spine disorders, were excluded from the study.

Data Collection

All pediatric patients with spine fractures or neurologic injuries admitted in the neurosurgery unit and ICU were analyzed and information including name, age, gender, trauma type, and level of the spine fracture were all recorded on predesigned proforma. The data was gathered with the permission of the institutional ethics committee.

Data Analysis

Frequencies and percentages were used to

describe the categorical variables. The results were stratified among the age, gender, and trauma type concerning outcome variables. Post-stratification chi-square test was used.

RESULTS

Age Distribution

Of 1956 pediatric patients, 38 patients had vertebral fractures. The mean age of patients was 11.7 years. 3 fractures are present in the 0 – 5 years age group, 9 fractures are present in the 6 – 10 years group and 26 fractures are present in the 11 – 15 years group. Considering all age groups, 11 patients had thoracic fractures, 10 had upper cervical spine fractures, 9 had thoracolumbar fractures, 4 had lumbar spine fractures, and 3 patients had middle cervical spine fractures. Although the neck appears to be affected in general in the 0 – 5 years – old group and the dorsal and thoracolumbar in the 11 – 15 years – old group, chi-square analysis showed no significant difference in the distribution of vertebral fractures. No Age effect was seen (p-value. 13).

Gender Distribution

There were 17 (44%) males and 21 (55%) females and the distribution of vertebral fractures in men and women. Of these, 17 fractures were found in male patients and 21 in female patients. The dorsal and thoracolumbar region was most commonly affected. Chi-square analysis showed no effect of gender on the distribution of pediatric vertebral fractures (p-value 0.12).

Table 1: Age group vs. Fracture level.

Age Group	C0-C2	C3-C6	T2-T10	T11-L1	L2-L5	Sacral	Total	Chi-square	p-value
1 – 5	3	0	0	0	0	0	03	14.955	0.134 (Insignificant)
6 – 10	4	1	3	1	0	0	09	14.955	0.134 (Insignificant)
11 – 15	3	2	8	8	4	1	26	14.955	0.134 (Insignificant)

Table 2: Gender vs. Fracture level.

Gender	C0-C2	C3-C6	T2-T10	T11-L1	L2-L5	Sacral	Total	Chi-square	P value
Male	5	0	8	2	2	0	17	8.726	0.12 (Insignificant)
Female	5	3	3	7	2	1	21	8.726	0.12 (Insignificant)
Total	10	3	11	9	4	1	38		

Table 3: Trauma Type vs. Fracture Level.

Trauma-Type	C0-C2	C3-C6	T2-T10	T11-L1	L2-L5	Sacral	Total	Chi-square	P value
Fall	10	03	6	5	3	01	28	11.779	0.038 (Significant)
RTA	0	0	05	04	01	0	10	11.779	0.038 (Significant)
Total	10	3	11	9	4	1	38		

Trauma-Type Information

The trauma type was fall in 28 patients, 10 of these patients had upper cervical spine fractures, 3 had middle cervical spine fractures, 6 had thoracic spine fractures, 5 had thoracolumbar and 3 had lumbar and one had a sacral fracture.

Only 10 patients had motor vehicle accidents as trauma-type, and of these 5 patients sustained thoracic spine fractures and 4 patients had thoracolumbar fractures. Fall was the most common trauma type in cervical spine fractures, and road traffic accidents were mostly seen in thoracic and thoracolumbar spine fractures. Chi-square analysis showed a significant effect of trauma type in the distribution of vertebral fractures in children (odd ratio 0.03).

DISCUSSION

The current study shows that pediatric spine fractures are relatively rare with an incidence of 1.28% and it was 1-4% in another study conducted by Cirak et al.^{13,15} There are anatomical differences between the children and adult spines.¹⁶ Trauma to the pediatric spine can present bony, disco-ligamentous, or neurologic deficits.¹⁷ The head-to-body ratio is larger in children than in adults and it continues to increase until age eight years.³ Because of this difference, fractures of the upper cervical spine

are common in children, especially those who have fallen from great heights. This is supported by our study, as the high head weight with relatively weak neck muscles puts the upper cervical spine at risk during falls, and the upper cervical spine is more frequently injured in children who have fallen as a trauma type. Approximately 34.2% of the patients in our study had cervical spine fractures, whereas another study conducted by Bilal et al,¹ reported 22.4%. Another study conducted by Platzer and Jaindl¹⁴ showed cervical fractures around 60 – 80%. No patient with cervical injury in our study had associated maxillofacial injuries though the reported rate of associated maxillofacial trauma was. 169% by Helen et al.¹² Since we received patients mainly from the hilly region and children do not go to school and are mostly associated with livestock and this lifestyle contributed significantly to the falls from a height which lead to cervical spine injuries.

Since the thoracic spine is bounded by their Bs, also the horizontal alignment of the facets and ligamentous laxity contributes to spine stability.³ In road traffic accidents, the thoracic spine was found to be commonly involved in our study and constituted 50% of the thoracic fractures, however, the incidence of thoracic spine fracture was 58% in another study,¹ conducted by Bilal et al.¹ In another study by Saul D et al,¹¹ the

thoracolumbar region was most commonly involved and accounts for 33% of road traffic accidents.¹¹ This difference is because the majority of our patients had fallen as trauma type rather than road traffic accident and also the sample size of our study is less as compared to other studies.

As females had ligamentous laxity, early maturation of the bones due to the effect of estrogen progesterone and more kyphotic angulation of the spine to maintain the sagittal balance of the head over the pelvis.¹⁰ Despite these potential differences, our study did not show any effect of gender in distribution of the pediatric spine fractures. In our study, the thoracic and thoracolumbar regions were most frequently affected in children more than 10 years and it was also supported by Gavira N et al.¹⁶

CONCLUSION

Vertebral fractures in children are not very common at our institution. The neck and chest are most commonly affected in any pediatric patient. The upper cervical spine should be carefully evaluated in all pediatric patients, especially those who had fallen as trauma type. Careful screening of the thoracic spine is required in car accidents. Gender and age do not specifically contribute to the distribution of pediatric vertebral fractures.

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Additional Information

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Human Subjects: Consent was obtained by all patients/participants in this study.

Conflicts of Interest:

In compliance with the ICMJE uniform disclosure form, all authors declare the following:

Financial Relationships: All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work.

Other Relationships: All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

AUTHOR CONTRIBUTION

S. No.	Author's Full Name	Intellectual Contribution to Paper in Terms of:
1.	Saad Sultan	1. Study design & methodology.
2.	Saad Sultan, Amer Zaman	2. Paper writing.
3.	Junaid Alam	3. Data collection & calculation.
4.	Ibrahim	4. Analysis & interpretation of results.
5.	Baynazir Khan	5. Literature review & referencing.
6.	Fizza Gul	6. Editing & quality insurer.