Research Article

Pattern Of Paediatric Fractures Presenting To The Orthopaedic Outpatient Department of A Tertiary Care Teaching Hospital: A Cross-Sectional Observational Study

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Abstract

Objectives - To describe the epidemiological and anatomical pattern of paediatric fractures presenting to the Orthopaedic Outpatient Department of a tertiary care teaching hospital and to assess their distribution according to age, sex, and mechanism of injury.

Methods - A cross-sectional observational study was conducted in the Orthopaedic Outpatient Department of a tertiary care teaching hospital over 3 months. Fifty paediatric patients presenting within 2 weeks of fracture were included, and demographic, injury, radiological, fracture-pattern, and treatment-related data were recorded.

Results - Of 50 patients, 34 (68%) were males and 21 (42%) belonged to the school-age group. Upper-limb fractures were predominant (31; 62%), followed by lower-limb (17; 34%) and shoulder-girdle fractures (2; 4%). The humerus was the most commonly involved bone (16%), while metaphyseal fractures predominated (58%). Falls while playing were the leading mechanism (16; 32%), followed by road traffic accidents (9; 18%) and sports injuries (8; 16%). Most fractures were closed (92%) and single (88%), with 64% managed non-operatively. No significant association was observed between fracture location and age (p=0.212), sex (p=0.776), or mechanism of injury (p=0.253).

Conclusion - Paediatric fractures predominantly involved the upper limb and were commonly associated with falls during play. Preventive strategies focusing on safe play, sports safety, parental supervision, and road-safety awareness may help reduce paediatric fracture burden.

Keywords: Paediatric fractures; Fracture pattern; Epidemiology; Upper limb; Injury mechanism.

Introduction

The Paediatric fractures signify a considerable proportion of injuries encountered in emergency departments and orthopaedic outpatient services. Children are mainly prone to traumatic injuries because of their high levels of physical activity, developing motor coordination, immature risk perception, and participation in play and sports.[1] Although the skeletal system in children possesses distinctive biological and mechanical properties that often favour rapid healing and remodelling, fractures during the growing years can have important functional consequences, particularly when they involve the physis, articular surface, or are associated with significant displacement.[2]

The epidemiology of paediatric fractures is influenced by several factors, including age, sex, anatomical site, mechanism of injury, environmental exposure, and level of physical activity. The distribution of fractures tends to vary across different stages of childhood. Younger children are more frequently exposed to domestic falls and injuries occurring during play, whereas older children and adolescents are increasingly exposed to sports-related trauma, road traffic incidents, and other high-energy mechanisms.[2,3] Boys have traditionally been reported to sustain fractures more frequently than girls, possibly owing to differences in physical activity, participation in outdoor sports, and patterns of risk-taking behaviour. However, these trends may vary according to geographical region, cultural practices, and socioeconomic circumstances.[4]

The anatomical distribution of paediatric fractures also demonstrates considerable variation. Upper-extremity fractures, particularly those involving the forearm, are commonly encountered because children frequently use their

upper limbs instinctively to protect themselves during a fall.[5,6] Fractures may range from relatively stable injuries such as buckle and greenstick fractures to displaced, unstable, or physeal injuries requiring reduction or operative intervention. Understanding the distribution of these fracture patterns is therefore important for appropriate clinical assessment, treatment planning, allocation of healthcare resources, and preventive strategies.

The circumstances leading to paediatric fractures vary according to environmental and social factors. Falls during play, sports injuries, road traffic accidents, and injuries at home or school are common mechanisms, while differences in lifestyle, supervision, and recreational activities influence fracture patterns across populations.[7] In India, paediatric fractures represent an important orthopaedic and public health concern. However, regional variations in demographic profile, fracture distribution, and mechanisms of injury highlight the need for hospital-based epidemiological studies to understand local fracture patterns and identify children at greater risk.[8,9]

Therefore, the present study was undertaken to determine the epidemiological and anatomical pattern of paediatric fractures presenting to the orthopaedic outpatient department of a tertiary care teaching hospital. The study also aimed to examine the distribution of fractures according to age and sex, determine the anatomical distribution of fractures, evaluate the relationship between the mechanism of injury and fracture pattern, and assess the association between age group and fracture location.

METHODS

The present study was designed as a cross-sectional observational study and was conducted in the Orthopaedic Outpatient Department of a tertiary care teaching hospital over a period of 3 months. A total of 50 paediatric patients presenting with fractures during the study period were included. The primary focus of the study was to describe the anatomical pattern and distribution of paediatric fractures, particularly the body region and bone involved. Long-term treatment outcomes, functional recovery, and late complications were not considered as study outcomes.

Children and adolescents presenting with fractures involving one or more bones of the locomotor system, including the upper limbs, lower limbs, shoulder girdle, and pelvic girdle, were eligible for inclusion. Patients presenting within 2 weeks of sustaining the fracture were included. Patients whose initial fracture treatment had been performed at another institution, those with spinal fractures, and those with incomplete clinical records or inadequate radiographs were excluded from the study.

Relevant clinical information was obtained from the patient or caregiver at the time of presentation. The demographic parameters recorded included age and sex, while residence and school-going status were recorded where available. For analysis, patients were categorized into age groups based on the classification described by Landin et al.: infants (0–1 year 11 months), preschool children (2–6 years 11 months), school-age children (7–11 years 11 months), and adolescents (≥12 years). The mechanism and circumstances of injury were also documented, including falls while playing, falls from height, road traffic accidents, sports-related injuries, bicycle-related injuries, assault where relevant, and other causes. The place or circumstances of injury were categorized as home, school, playground, road, or sports activity.

The fracture pattern was assessed clinically and radiologically, with documentation of the anatomical region, bone involved, fracture location, side, open/closed status, displacement, number of fractures, physeal and intra-articular involvement. Fractures were categorized as epiphyseal, metaphyseal, or diaphyseal where applicable. The primary outcome was the anatomical distribution of paediatric fractures.

Treatment was recorded descriptively as conservative, manipulation with casting, or surgical, including K-wire fixation, ESIN, plating, or other procedures. Long-term treatment outcomes and complications were not assessed. Representative X-ray images may be included to illustrate different fracture patterns and their corresponding treatment.

Statistical Analysis

Data were entered into a structured data collection proforma and subsequently analysed using appropriate statistical methods. Categorical variables were expressed as frequency and percentage, while continuous variables such as age were summarized using appropriate descriptive statistics. The distribution of fractures according to age, sex, anatomical region, mechanism of injury, and other fracture characteristics was assessed. Appropriate tests of association, such as the Chi-square test or Fisher's exact test, were used wherever applicable, with a p-value <0.05

considered statistically significant.

RESULTS

Among the 50 paediatric patients included in the study, the majority belonged to the school-age group (7–11 years), comprising 21 patients (42.0%), followed by adolescents aged ≥12 years with 15 patients (30.0%). Preschool children accounted for 12 patients (24.0%), while infants represented 2 patients (4.0%). Regarding sex distribution, males predominated, with 34 patients (68.0%), whereas females accounted for 16 patients (32.0%). With respect to residence, 29 patients (58.0%) were from urban areas, while 21 patients (42.0%) were from rural areas. Overall, the study population demonstrated a higher proportion of school-age children, males, and urban residents. (Figure 1)
More patients were from urban areas (58.0%) compared with rural areas (42.0%).
Fall while playing was the most common mechanism of injury, accounting for 16 patients (32.0%), followed by road traffic accidents in 9 patients (18.0%) and sports-related injuries in 8 patients (16.0%). Falls from height accounted for 7 patients (14.0%), while bicycle-related injuries were observed in 5 patients (10.0%). Assault and other causes accounted for 1 (2.0%) and 4 (8.0%) patients, respectively.
In the anatomical distribution and fracture location among paediatric patients, upper-limb fractures were the most common, accounting for 31 (62.0%) cases, followed by lower-limb fractures (34.0%) and shoulder-girdle fractures (4.0%). Among individual bones, humerus was most frequently involved (16.0%), followed by radius (14.0%) and radius with ulna (12.0%). Regarding fracture location, metaphyseal fractures predominated (58.0%), followed by diaphyseal (34.0%) and epiphyseal fractures (8.0%). (Table1)
According to fracture characteristics right-sided fractures were slightly more common (54.0%) than left-sided fractures (42.0%). The majority of fractures were closed (92.0%), while 56.0% were displaced. Most patients had a single fracture (88.0%). Physeal involvement was observed in 14.0% and intra-articular involvement in 12.0% of cases. (Table 2)
In the Distribution of paediatric fractures according to treatment modality and management, most fractures were managed non-operatively (64.0%), while 36.0% required surgical intervention. Manipulation with casting was the most common treatment modality (40.0%), followed by conservative treatment without manipulation (24.0%). Among surgical procedures, K-wire fixation was most frequently performed (16.0%), followed by ESIN (10.0%) and plating (6.0%). (Figure 2)
The distribution of fracture location across different age groups showed that upper-limb fractures were the most common in all age categories. Among infants, all 2 patients had upper-limb fractures. In the preschool group, 9 (75.0%) had upper-limb and 3 (25.0%) had lower-limb fractures. Among school-age children, upper-limb fractures accounted for 14 (66.7%) cases and lower-limb fractures for 7 (33.3%). In adolescents, 6 (40.0%) had upper-limb fractures, 7 (46.7%) had lower-limb fractures, and 2 (13.3%) had shoulder-girdle fractures. Overall, 31 (62.0%) fractures involved the upper limb, 17 (34.0%) the lower limb, and 2 (4.0%) the shoulder girdle. The association between age group and fracture location was not statistically significant (p=0.212). (Table 3)
The distribution of fractures according to sex is presented in the table. Among the 50 patients, 34 (68%) were males and 16 (32%) were females. In males, 22 (64.7%) had upper-limb fractures, 11 (32.4%) had lower-limb fractures, and 1 (2.9%) had a shoulder-girdle fracture. Among females, 9 (56.3%) had upper-limb fractures, 6 (37.5%) had lower-limb fractures, and 1 (6.3%) had a shoulder-girdle fracture. Overall, upper-limb fractures were the most common, accounting for 31 (62%) cases, followed by lower-limb fractures in 17 (34%) cases and shoulder-girdle fractures in 2 (4%) cases. There was no statistically significant association between sex and fracture location (p = 0.776). (Figure 3)
The distribution of fractures according to the mechanism of injury is presented in the table. Among the 50 patients, fall while playing was the most common mechanism, accounting for 16 (32%) cases, followed by road traffic accidents in 9 (18%), sports injuries in 8 (16%), falls from height in 7 (14%), and bicycle-related injuries in 5 (10%) cases. Assault accounted for 1 (2%) case, while other mechanisms accounted for 4 (8%) cases. Upper-limb fractures were most frequently associated with falls while playing (11 cases), followed by sports injuries (7 cases) and road traffic accidents (4 cases). Lower-limb fractures were most commonly observed following falls while playing (5 cases), followed by falls from height and road traffic accidents (4 cases each). Shoulder-girdle fractures occurred in 2 cases, one following a road traffic accident and one due to another mechanism. There was no statistically significant association between the mechanism of injury and the anatomical site of fracture (p = 0.253). (Table 4)

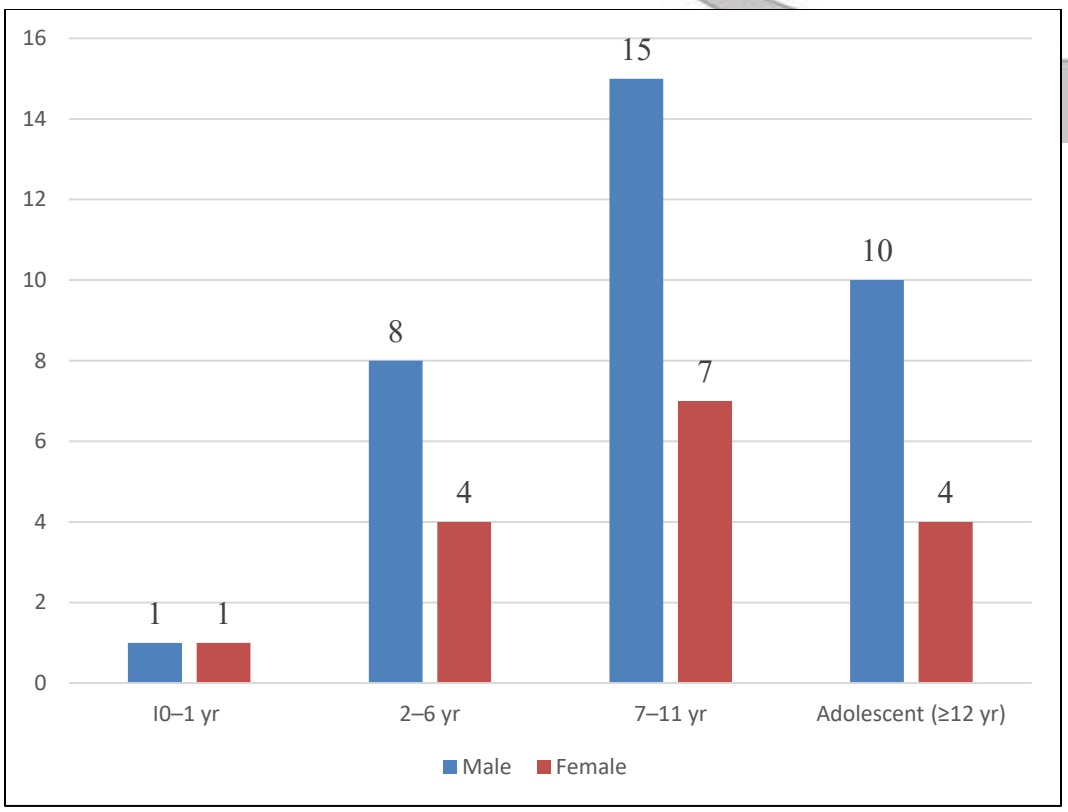

Figure 1 – Age & Gender distribution

Table 1 Anatomical distribution and fracture location among paediatric patients (n=50)

Parameter	Category	Number (n)	Percentage (%)
Major anatomical region	Upper limb	31	62
	Lower limb	17	34
	Shoulder girdle	2	4
	Total	**50**	**100**
Bone/body part involved	Clavicle	2	4
	Humerus	8	16
	Radius	7	14
	Ulna	3	6
	Radius + Ulna	6	12
	Hand/Metacarpals/Phalanges	5	10
	Femur	4	8
	Tibia	5	10
	Fibula	2	4
	Tibia + Fibula	3	6
	Foot/Metatarsals/Phalanges	3	6
	Pelvis	2	4
	Total	**50**	**100**

Fracture location	Epiphyseal	4	8
	Metaphyseal	29	58
	Diaphyseal	17	34
	Total	**50**	**100**

Table 2 Distribution of paediatric fractures according to fracture characteristics (n=50)

Parameter	Category	Number (n)	Percentage (%)
Side involved	Right	27	54
	Left	21	42
	Bilateral	2	4
Fracture type	Closed	46	92
	Open	4	8
Displacement	Displaced	28	56
	Non-displaced	22	44
Number of fractures	Single	44	88
	Multiple	6	12
Physeal involvement	Present	7	14
	Absent	43	86
Intra-articular involvement	Present	6	12
	Absent	44	88
Total		**50**	**100**

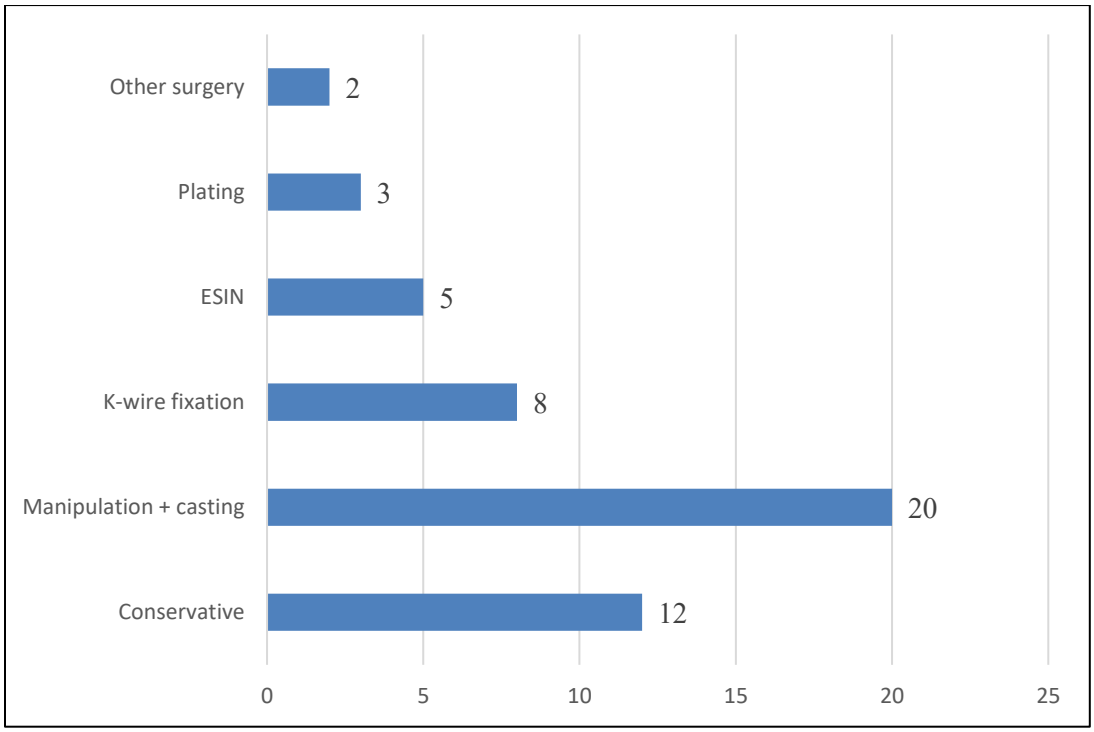

Figure 2 - Distribution of paediatric fractures according to treatment modality and management

Table 3 Association between age group and anatomical fracture location

Age group	Upper limb	Lower limb	Shoulder girdle	Total	p-value
Infant	2	0	0	2	
Preschool	9	3	0	12	
School-age	14	7	0	21	**0.212**
Adolescent	6	7	2	15	
Total	**31**	**17**	**2**	**50**	

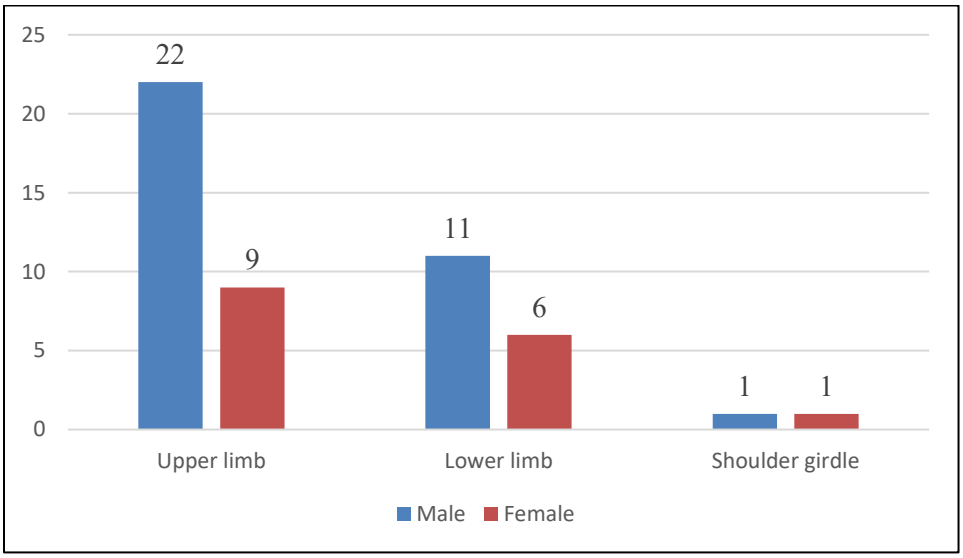

Figure 3 Association between sex and anatomical fracture location

Table 4 Association between mechanism of injury and anatomical fracture location

Mechanism of injury	Upper limb	Lower limb	Shoulder girdle	Total	p-value
Fall while playing	11	5	0	16	
Fall from height	3	4	0	7	
Road traffic accident	4	4	1	9	
Sports injury	7	1	0	8	**0.253**
Bicycle-related injury	3	2	0	5	
Assault	0	1	0	1	
Other	3	0	1	4	
Total	**31**	**17**	**2**	**50**	

DISCUSSION

In the present study, paediatric fractures were most commonly observed among school-age children (7–11 years), accounting for 42.0% of cases, followed by adolescents (30.0%), preschool children (24.0%), and infants (4.0%). This finding is comparable with the study by Yadav RK et al.,[10] in which paediatric fractures were reported to be more frequent in the 6–10-year age group. Similar age-related patterns have also been reported in other paediatric

fracture studies. The higher frequency among school-age children may be attributed to increased participation in indoor and outdoor play, greater physical activity, developing coordination, and greater exposure to injury-producing environments. Changes in skeletal properties with growth may also contribute to the variation in fracture patterns across age groups.[11.12]

In the present study, males predominated (68.0%), with a male-to-female ratio of approximately 2.1:1. This finding is consistent with the study by Yadav RK et al.,[10] which reported a male predominance of 67.92%, and with the findings of Gupta et al.,[13] who also observed a higher frequency of fractures among boys. The male predominance may be related to greater participation in outdoor activities and sports, increased physical exposure, and differences in activity and risk-taking behaviour between boys and girls.

In terms of residence, 58.0% of the children were from urban areas, compared with 42.0% from rural areas.

In the present study, fall while playing was the most common mechanism of injury, accounting for 16 (32.0%) cases, followed by road traffic accidents (18.0%), sports-related injuries (16.0%), and falls from height (14.0%). Bicycle-related injuries accounted for 10.0% of cases, while assault and other causes contributed 2.0% and 8.0%, respectively. These findings indicate that play-related and fall-related injuries constitute an important source of paediatric fractures in the study population.

The findings are comparable with those reported by Yadav RK et al.,[10] who identified playground injuries as one of the most common causes of paediatric fractures, followed by falls from height and road traffic accidents. The authors suggested that increased physical activity and outdoor play contribute substantially to childhood injuries. Similar findings were reported by Sural et al.[14] in children presenting with musculoskeletal injuries in Delhi, where falls occurring during play were the most common mechanism, followed by road traffic accidents. They also observed that fractures were predominantly seen in the extremities, with upper-limb involvement being more frequent. The predominance of fall-related injuries in the present study is also supported by a large North Indian study by Singh O et al.,[15] which reported that falls accounted for 59.4% of paediatric musculoskeletal injuries, followed by road traffic accidents (32%).

In the present study, upper-limb fractures constituted the majority of paediatric fractures (62.0%), while lower-limb fractures accounted for 34.0% and shoulder-girdle fractures for 4.0%. Among individual bones, the humerus was the most frequently involved bone (16.0%), followed by the radius (14.0%) and combined radius and ulna fractures (12.0%). Hand/metacarpal/phalangeal fractures accounted for 10.0% of cases. With respect to fracture location, metaphyseal fractures predominated (58.0%), followed by diaphyseal (34.0%) and epiphyseal fractures (8.0%).

These findings show some similarity as well as differences from the study by Yadav RK et al.,[10] in which distal radius fractures were reported as the most common paediatric fracture, followed by supracondylar fractures of the distal humerus. The predominance of upper-limb fractures in the present study is consistent with their findings and may be explained by the protective role of the upper extremity during a fall, when children instinctively extend their hands and use the forearm to absorb the impact. Similar predominance of upper-limb fractures, particularly distal radius and distal humerus fractures, has also been reported by Hedström et al.[16] in the Swedish population and Naranje et al.[17] in the American population.

However, in the present study, humeral fractures (16.0%) were more frequent than isolated radial fractures (14.0%), unlike the findings of Yadav RK et al.,[10] where distal radius fracture was the leading fracture type.

The predominance of metaphyseal fractures (58.0%) in the present study is consistent with the observation that the metaphyseal region is commonly affected during childhood because of its anatomical and biomechanical characteristics.

In the present study, right-sided fractures were slightly more common (54.0%) than left-sided fractures (42.0%), while bilateral involvement was seen in 4.0% of cases. The majority of fractures were closed (92.0%), displaced (56.0%), and single (88.0%). Physeal and intra-articular involvement were observed in 14.0% and 12.0% of cases, respectively. These findings indicate that most injuries were isolated, closed fractures without physeal or articular involvement.

Regarding treatment, 64.0% of fractures were managed non-operatively, while 36.0% required surgical intervention. Manipulation with casting was the most common treatment modality (40.0%), followed by conservative treatment (24.0%). Among operative procedures, K-wire fixation was most frequently performed (16.0%), followed by ESIN (10.0%) and plating (6.0%).

The findings are broadly comparable with Yadav RK et al.,[10] & Tandon et al [18] reported a predominance of upper-limb fractures (67.68%) and predominantly conservative management, with approximately 85% of fractures treated

with slabs or casts and only 15% requiring surgery. The higher proportion of operative management in the present study (36.0%) may be related to differences in fracture severity, displacement, referral patterns, and the case mix of patients attending a tertiary care teaching hospital. The predominance of conservative treatment in both studies may be explained by the generally favourable healing and remodelling capacity of paediatric bones, particularly in low-energy injuries.

In the present study, upper-limb fractures constituted the predominant fracture location (31/50; 62%), followed by lower-limb fractures (17/50; 34%) and shoulder-girdle fractures (2/50; 4%). Upper-limb fractures remained the most frequent anatomical pattern across the infant, preschool and school-age groups, whereas in adolescents, lower-limb fractures (46.7%) slightly exceeded upper-limb fractures (40.0%). Although this variation suggests that the pattern of injury may change with increasing age and activity level, the association between age group and fracture location was not statistically significant (p=0.212). This finding is consistent with the observations of Tandon et al.,[18] who reported that upper-extremity injuries were common in paediatric trauma and that fracture patterns varied with age, with elbow injuries predominating in younger children and distal radius fractures becoming more frequent in older children.

The present study showed a male predominance, with males accounting for 34 (68%) cases compared with 16 (32%) females, giving a male-to-female ratio of approximately 2.1:1. However, the anatomical distribution of fractures did not differ significantly between males and females (p=0.776). The higher proportion of males may reflect greater participation in outdoor play, sports and physically active activities, as well as greater exposure to injury-prone environments. This observation is comparable with the study by Rennie L et al,[19] which reported that approximately 61% of childhood fractures occurred in males.

In the present study, falls while playing were the most common mechanism of injury (16; 32%), followed by road traffic accidents (18%), sports injuries (16%), falls from height (14%) and bicycle-related injuries (10%). This finding is comparable with Sural et al.,[14] who reported falls during play as the commonest mechanism of paediatric musculoskeletal injuries, followed by road traffic accidents. Although fracture location varied with the mechanism of injury, the association was not statistically significant (p=0.253), possibly due to the small sample size. The findings highlight the importance of safe play environments, parental supervision, sports safety and road-safety measures in preventing paediatric fractures.

CONCLUSION

The present study demonstrates that paediatric fractures predominantly involved school-age children and males, with upper-limb fractures being the most frequent anatomical pattern. Falls during play were the leading mechanism of injury, followed by road traffic accidents and sports-related injuries. Most fractures were closed and isolated, with conservative management being more commonly employed. Although variations in fracture location were observed across age groups, sex, and mechanisms of injury, these associations were not statistically significant. These findings emphasize the need for effective injury-prevention strategies, parental supervision, safer play and sports environments, and improved road-safety awareness. Strengthening community-based preventive measures and early access to appropriate orthopaedic care may help reduce the burden and long-term impact of paediatric fractures.

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