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Original Research Article

An Observational Study on Fractures around the Elbow in the Pediatric Age Group

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Abstract:

Background: Fractures around the elbow constitute a common injury in the pediatric population, with varying degrees of severity and potential long-term consequences. The intricate anatomy and dynamic growth patterns of the pediatric elbow present unique challenges in diagnosis, classification, and management. Despite its clinical significance, there remains a need for comprehensive observational studies examining the prevalence, distribution, mechanisms, and outcomes of such fractures to inform evidence-based approaches to treatment and rehabilitation in this age group.

Aim and Objective: This original research article aims to investigate the prevalence, patterns, mechanisms, and outcomes of fractures occurring around the elbow in the pediatric age group, utilizing a sample size of 226 participants.

Materials and Methods: A prospective observational study was conducted over a defined period, involving pediatric patients aged 0-14 years who presented with elbow fractures. Clinical, radiological, and demographic data were collected and analyzed. Fracture patterns were categorized according to specific anatomical locations and mechanisms of injury.

Results: The study comprised 226 participants with confirmed elbow fractures. The most common fracture site was the supracondylar region (69%), followed by the lateral condyle (17.3%) and the medial condyle (6.2%). Mechanisms of injury varied, with falls being the predominant cause (96.4%), followed and road traffic accident (3.6%). Supracondylar type of fracture was significantly higher in all age group less than 5 years, 6-10 years and 11-14 years. Similarly, lateral and medial condyle fracture was more common with 11-14 years and 6-10 years ($p=0.001$). Association between type of fracture and gender distribution was not significant in our study ($p>0.05$). However, numerically Supracondylar fracture was higher in male children as compared to female children, probably pertaining to more vigourous playful activities of boy children.

Conclusion: This observational study sheds light on the prevalence, distribution, and outcomes of elbow fractures in the pediatric age group. The findings emphasize the significance of falls as the primary cause of fractures and underscore the importance of prompt and accurate diagnosis and appropriate management strategies. These insights contribute to a better understanding of pediatric elbow fractures and aid in refining clinical approaches to enhance patient outcomes.

Keywords: Pediatric orthopedics, Elbow injuries, Fracture classification, Mechanisms of injury.

Introduction

Fractures in the pediatric age group represent a frequent and distinctive subset of orthopedic injuries, accounting for a substantial portion of hospital visits and healthcare expenditures. [1, 2] Among these, fractures around the elbow hold particular clinical significance due to the critical role of the elbow joint in upper extremity function and its susceptibility to trauma during the rapid growth and development stages of childhood. Elbow fractures encompass a diverse spectrum of injuries, ranging from subtle physeal injuries to complex supracondylar fractures, each presenting unique diagnostic and therapeutic challenges. [1]

Despite the prevalence of pediatric elbow fractures, the literature has predominantly focused on adult populations, leaving critical gaps in our understanding of the epidemiology, fracture patterns, mechanisms of injury, and subsequent outcomes specific to pediatric cases. Such insights are essential for tailoring accurate and effective treatment strategies, optimizing patient

outcomes, and minimizing potential long-term complications. [3, 4]

This observational study seeks to address this knowledge gap by conducting a comprehensive investigation into fractures occurring around the elbow in the pediatric age group. By prospectively analyzing a sample size of 226 cases, we aim to elucidate the prevalence, distribution, fracture patterns, mechanisms of injury, and clinical outcomes associated with these fractures. The resulting insights have the potential to significantly contribute to the body of evidence guiding the management and care of pediatric patients with elbow fractures.

Through an improved understanding of the factors influencing fracture occurrence and healing trajectories, clinicians can refine diagnostic protocols, therapeutic interventions, and rehabilitation approaches, ultimately enhancing functional recovery and minimizing the risk of complications. By shedding light on the unique characteristics of elbow fractures in children, this study endeavors to inform evidence-based clinical practices and contribute to improved patient care within the pediatric orthopedic landscape.

Materials and Methods

Study Design and Participants

This prospective observational study was conducted at Department of Orthopaedics Gandhi Medical College, Bhopal, between 2020 to 2023. The study received ethical approval from the institutional review board (IRB). Pediatric patients aged 0 to 14 years, presenting with fractures around the elbow, were consecutively enrolled in the study after obtaining informed consent from their legal guardians. A sample size of 226 participants was targeted based on power calculations to achieve statistically meaningful results.

Data Collection:

Comprehensive data collection was carried out through a combination of clinical assessment, radiological evaluation, and patient interviews. Demographic information including age, sex, and relevant medical history was recorded for each participant. Clinical details such as mechanism of injury, initial symptoms, and physical examination findings were documented by experienced orthopedic surgeons. Radiographic images, including X-rays and, when necessary, computed tomography scans, were obtained to accurately assess fracture patterns and confirm diagnoses.

Classification and Fracture Patterns:

Fractures were classified according to established criteria based on anatomical location and fracture pattern. The specific sites examined included the supracondylar region, lateral condyle, olecranon, and other less common regions.

Data Analysis

Descriptive statistics were utilized to summarize demographic data, fracture characteristics, treatment modalities, and outcomes. Categorical variables were presented as frequencies and percentages, while continuous variables were expressed as means with standard deviations or medians as appropriate. Subgroup analyses were conducted to explore associations between fracture types with age and sex. Statistical significance was determined using appropriate tests (e.g., chi-square test, Fisher's exact test), with a significance level of $p < 0.05$. Statistical analysis was performed using SPSS ver. 25. P value of <0.05 was considered as significant.

Results

There were a total of 226 elbow fractures patients meeting the criteria of inclusion; 148 (65.5%) fractures were observed in 6-10 years of age followed by 11-14 years (20.4%) and less than 5 years (14.2%). Majority of the patients with elbow fractures 154 (68.1%) occurred at male patients and 72 fractures (31.9%) occurred at female patients.

Majority of the patients in study population belongs to lower socioeconomic class (39.4%) followed by middle (30.5%) and upper (30.1%) socioeconomic class (Modified kappuswamy scale). The most common etiology of fracture was a fall (96.4%) followed by road traffic accident (3.6%). Left elbow was affected in majority of the patients (61.5%) followed by right elbow (38.5%) in our study.

Supracondylar type of fracture was the most common type of the fracture in 69% of study patients followed by lateral condyle fracture type in 17.3% patients. Other less common type of fracture observed includes: Medial condyle (6.2%), Olecranon (2.7%), Radial heal (1.8%), and Trochlea (3.1%). Majority of the patients (224) had closed type of fracture (99.1%). There were two patients who had open fracture in our study.

Table 1: Comparison between type of fracture with age distribution

Type of fracture	Age groups			Total	P value
	≤5	6-10	11-14		
Supracondylar	31 (96.9)	101 (68.2)	24 (52.2)	156 (69)	0.001
Lateral condyle	0 (0)	23 (15.5)	16 (34.8)	39 (17.3)	
Medial condyle	1 (3.1)	10 (6.8)	3 (6.5)	14 (6.2)	
Olecranon	0 (0)	3 (2)	3 (6.5)	6 (2.7)	
Radial head	0 (0)	4 (2.7)	0 (0)	4 (1.8)	
Trochlea	0 (0)	7 (4.7)	0 (0)	7 (3.1)	
Total	32 (100)	148 (100)	46 (100)	226 (100)	

On comparing type of fracture with age group, there was a significant difference obtained as revealed by significant p value of 0.001. Supracondylar type of fracture was significantly higher in all age group less than 5 years, 6-10 years and 11-14 years. Similarly, lateral and medial condyle fracture was more common with 11-14 years and 6-10 years.

Table 2: Comparison between type of fracture with sex distribution

Type of fracture	Sex		Total	P value
	Female	Male		
Supracondylar	53 (73.6)	103 (66.9)	156 (69)	0.952
Lateral condyle	11 (15.3)	28 (18.2)	39 (17.3)	
Medial condyle	4 (5.6)	10 (6.5)	14 (6.2)	
Olecranon	1 (1.4)	5 (3.2)	6 (2.7)	
Radial head	1 (1.4)	3 (1.9)	4 (1.8)	
Trochlea	2 (2.8)	5 (3.2)	7 (3.1)	
Total	72 (100)	154 (100)	226 (100)	

Association between type of fracture and gender distribution was not significant in our study ($p>0.05$). However, numerically Supracondylar fracture was higher in male children as compared to female children.

Discussion

The pediatric musculoskeletal system possesses a remarkable capacity for growth and adaptive remodeling, rendering it an intriguing subject of investigation within the domain of pediatric fractures research. [1] Unraveling the nuanced disparities between immediate post-treatment conditions and the enduring functional and radiological outcomes of fractures within the pediatric age group assumes paramount significance. [2] Understanding the intricacies of elbow fractures is particularly critical due to their potential to induce neurovascular complications, thereby constituting a genuine orthopedic emergency. [1]

Within the pediatric population, a substantial proportion (65-75%) of fractures localizes to the upper extremity, with elbow fractures constituting a distinct subset (8-10%). This subset poses unique therapeutic challenges, particularly in the context of pediatric trauma centers. [1] Our study, echoing previous research, underscores a peak incidence of elbow fractures among children aged 6-10, accounting for 47.5% of cases. [1] This age-related predilection is noteworthy and deserves focused attention. Importantly, supracondylar fractures emerged as the dominant fracture type across various age groups, demonstrating heightened prevalence among children aged <5, 6-10, and 11-15. [1]

Sex-based patterns of fractures also exhibited disparities, with a clear male predominance among fracture patients. [1] This observation aligns with the findings of Esen and Sapmaz [3], Anjum et al. [4], and Mehmet et al. [5], underscoring the robustness of this trend. However, Emery et al.'s retrospective analysis contests the notion of gender-based distinctions [6], highlighting the complex interplay at play. Socioeconomic status was subtly linked to fracture incidence, with a majority of cases originating from low-income backgrounds.

Mechanisms of injury primarily involved falls from elevated positions, serving as the precipitating factor in the majority of cases. [1] In contrast, car accidents played a relatively minor role. Our findings resonate with those of Sananta et al. [7], emphasizing the multifaceted etiology of pediatric fractures, interwoven with elements of sports and recreational activities. The overarching consensus reinforces the pivotal role of falls onto outstretched hands as the predominant causative mechanism, aligning with Kumar and Singh's observations. [8]

Discernible discrepancies in fracture occurrence on dominant versus non-dominant sides underscore the potential protective attributes of the latter. [1] This intricate interplay assumes significance, particularly within the context of the predominantly right-handed Indian population. [1] The observed patterns of fracture sides align with established trends, affirming the enduring consistency across demographic dimensions.

Supracondylar fractures, constituting a substantial proportion of pediatric elbow fractures, reinforce the prevailing literature, underscoring their prominence.1 Lateral condyle fractures, while ranking second within our cohort, exhibit slight deviation from established norms. The mechanisms of hyperextension underpinning proximal radius and lateral condyle fractures align harmoniously with Kang and Park's elucidations. [9]

Nonetheless, our study is subject to certain limitations. Most notably, the absence of comprehensive clinical data encompassing nuanced fracture subtypes, outcomes, and potential sequelae constitutes a noteworthy constraint. [1] The need for an expansive and all-encompassing dataset, encapsulating clinical, epidemiological, therapeutic, and follow-up dimensions, is evident. It is pertinent to acknowledge the inherent severity bias arising from the inclusion of emergency room presentations, which may skew the distribution towards more severe cases. [1] Additionally, certain patients, while lacking severe dislocation, sought orthopedic consultation, necessitating nuanced interpretation.

Conclusion

The age, gender, and fracture side frequencies for elbow fractures were consistent with those reported in prior research. Our hospital saw 226 cases of paediatric elbow fractures, the majority of which were supracondylar fractures in children aged 5 to 10. Our research found that fractures to the lateral condyle were the second most common kind of elbow fracture. Male patients outnumber their female counterparts. Most bone breaks happened because of a fall or car accident.

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