

## ORIGINAL RESEARCH

### An Extensive Study of Children's Forearm Fracture Patterns and Treatment

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#### ABSTRACT

**Background:** The current body of scientific literature does not fully comment on the pattern of paediatric forearm fractures. This study's goal is to identify any recurrent patterns related to paediatric forearm fractures in India.

**Materials and Methods:** This retrospective study was conducted in a trauma centre designated as level I. The study population included patients up to the age of 18 who presented with forearm fractures between June 2020 to May 2022. Individuals who were recruited had their demographic information taken from their medical records, and plain films were used to locate any fractures that may have occurred. We calculated means and standard deviations when dealing with continuous variables, but frequencies and percentages when dealing with categorical variables.

**Results:** Patients' ages varied widely, from 1 year 2 months to 18 years; the average age was 10.42 years (SD = 4.56 years) in this study. Men made up 80.8% of the total, with women making up 53.1%. Patients who fell were more likely to be injured (82.1 percentage points,  $p < 0.001$ ) than those who did not. There was no statistically significant difference in the prevalence of any particular fracture location between the two age groups. After the distal third of the forearm (34.2%), the distal third of the forearm diaphysis was the most prevalent location for fractures to occur.

**Conclusion:** Children's of school-age often get forearm fractures in accidents. It was found in this research that distal radius fractures were the most common type. Falls were the leading cause of injury, highlighting the need for further monitoring and protection in areas frequented by large groups of youngsters.

**Keywords:** Fractures; Forearm, Children, Injuries, and Epidemiology.

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#### INTRODUCTION

Forearm fractures are the most common type of fractures found in children and adolescents; nevertheless, there are no comprehensive overviews of their epidemiology that are currently available.<sup>[1-3]</sup> A comprehensive understanding of the anatomy of the paediatric forearm provides essential instructions for therapy in both the nonoperative and surgical settings. In spite of the fact that the ulna is anatomically very straight and unmoving, it plays a more significant role in the maintenance of forearm stability, particularly when subjected to buckling and torsional stress. It is the proximal annular ligament, the interosseous membrane

along the diaphysis, and the ligaments of the distal radioulnar joint and the triangular fibrocartilage complex that hold the radius and ulna together. The range of pronation can be increased by adding a radial bow, which is a lateral apex bend in the radius. When in supination, the interosseous membrane experiences higher strain distally, as opposed to when in neutral or pronation, where it experiences higher strain proximally.<sup>[4-7]</sup> The distal radial and ulnar growth plates are accountable for 75% and 81% of the respective bones' longitudinal growth, respectively. Because of this polarisation of growth, distal fractures have a higher remodelling potential than fractures that are proximal to the elbow. The elevation of the thick osteogenic periosteum that occurs following a fracture is another factor that can be linked to further remodelling. Forearm fractures in children are most frequently caused by indirect trauma, such as a fall onto an outstretched hand that is accompanied by a rotational component. Fractures of a single bone in the forearm are much less prevalent than other types of fractures and are often the consequence of direct impact. On the other hand, if there is only one broken bone in the forearm, such as the ulna or the radius, one should always be suspicious of a Monteggia or Galeazzi fracture dislocation.<sup>[8-11]</sup>

In children, the rate of fractures is significantly higher than the rate of other types of injuries, and medical professionals see patients with fractures quite frequently. The majority of broken bones in children's arms are found in the forearms, accounting for one quarter of all injuries. Some authors believe that forearm fractures account for between 30 and 50 percent of all paediatric fractures. This opinion is shared by others in the medical community. According to the findings of several studies that have revealed that boys are more likely to suffer from forearm fractures, the risk of fracture among children under the age of 16 years old has been reported to be 42% in boys and 27% in girls for boys.<sup>[12-16]</sup> This is in comparison to the risk of fracture among girls, which was reported to be 27%. Injuries to the forearm are most commonly sustained as a result of falls. One of the locations on the radius that experiences fractures the most frequently is the distal region. Forearm fractures can be classified according to their anatomical location (distal, middle, or proximal), the bone or bones that are broken (radius, ulna, or both), or the presence or absence of involvement of the radioulnar joint. As opposed to a fracture that only affects the radial or ulnar shaft, it is more common to have a fracture that affects both the radius and the ulna.<sup>[17-20]</sup> This type of fracture is known as a biradial fracture. It was found that the isolated ulnar shaft was the region with the lowest incidence of fractures in that particular region. This study's objectives were to evaluate the pattern of forearm fractures in children aged up to 18 years old who were treated at a level I trauma centre; identify differences between children aged 12 and younger than 12 years old in terms of sex, fracture location, side of fracture, and mechanism of injury; and (3) compare the pattern of forearm fractures in children aged 12 and older than 12 years old. The evaluation was scheduled to take place in a trauma centre with a level I designation.<sup>[21-26]</sup>

## MATERIALS & METHODS

The medical college was the location of this cross-sectional study that was based on records. In addition to this, it is considered a national referral centre for trauma because it treats roughly 35 instances of paediatric trauma every single month. It can accommodate a total of 600 guests in its rooms. In 2020, it was projected that there were roughly 10,000 instances of paediatric conditions each year. Children up to the age of 15 years old who were diagnosed with forearm fractures between June 2020 and May 2022 were included in the study as subjects.<sup>[26-29]</sup> All fractures of the forearm shaft (diaphysis) and distal forearm, including metaphysis and physis fractures, were included in the study. Additionally, cases in which the ipsilateral radioulnar joint was involved were also included (Monteggia or Galeazzi fracture-dislocation). It was determined that there were no olecranon, radial head, or ulnar head fractures, as well as any pathological fractures.<sup>[30-35]</sup> The medical records were searched for X-ray films, which were then read by two experienced authors. Their medical records

included information on their demographics as well as the circumstances behind their injuries.<sup>[36]</sup> A classification system was developed for fractures according to the anatomical site of the break: distal forearm (metaphysis and diaphy sealemetaphy seal junction), and forearm shaft (distal third, middle third, and proximal third).<sup>[37]</sup> The findings were broken down and analysed for two different age groups: those 12 years old, which is the age at which children are often more active and when gender preferences in activities begin to emerge, and those older than 12 years old.<sup>[38-42]</sup>

## RESULTS

Mean and standard deviation were both calculated to be 10.42 and 4.56 years for the patients in this investigation, whose ages varied from 1.22 to 18. There were 257 males, or 80.82 percent of the total, and 61 females, or 19.18 percent. The average age of male patients was 11.284.4 years, whereas the average age of female patients was 73.6 years; this difference was statistically significant (p 0.01). There were 149 patients in the 12-year-old group (46.9%), and 169 patients in the 0.001) group (53.1%). A total of 267 fractures (or 83.96%) were attributed to falls, making them the leading cause of injury in our population. Fifty-one cases (16.04%) of fractures were the result of direct impacts or hits, such as those experienced in motor vehicle accidents (MVAs). Younger children were more likely to incur injuries from falls than older children, although younger children were more likely to sustain injuries from direct strikes than older children. There was no significant difference in the ages of children in terms of fracture location, anatomical involvement, or side [Table 1]. An solitary ulnar shaft fracture was only observed in the younger age group (p less than 0.04). Of the three fracture-dislocations traced back to the Monteggia, two were found in children and one was a teenager.

**Table 1: General properties of Forearm fracture**

Sr. no	Parameters	Category	Age (< 12)	%	Age (< 12)	%
1.	Sex	Female	54	32	7	4.7
		Male	115	68	142	95.3
2.	Mechanism of Injury	Direct	14	8.3	37	24.8
		Fall	155	91.7	112	75.2
3.	Side fracture	Left	90	53.3	94	61.1
		Right	79	46.7	53	35.6
		Bilateral	0.0	0.0	2	1.3
4.	Both of Single bone	Ulna	7	4.1	0	0.0
		Radius	99	58.6	90	60.4
		Both	63	37.3	59	39.6
5.	Type of fracture	Distal Radius	81	47.9	72	48.3
		Distal 1/3 shaft	53	31.4	56	37.6
		Middle 1/3 shaft	31	18.3	20	13.4
		Proximal 1/3 shaft	4	2.4	1	0.7

More than half of all forearm fractures (48.11 percent, n = 153) occurred in the distal forearm, with the next most common place being the distal third of the forearm shaft (34.28%, n = 109). There were 16.04% (n = 51) forearm fractures in the middle third of the forearm shaft and 1.57% (n = 5) in the proximal third. 14.4% (n = 22) of distal forearm

fractures, 17.4% (n = 19) of distal third of forearm shaft fractures, 17.6% (n = 9) of middle third of forearm shaft fractures, and 20% (n = 1) of proximal forearm shaft fractures were caused by direct hits, with no statistically significant difference (p = 0.63) between the distal, middle, and proximal thirds of the forearm shaft. We found a statistically significant (p = 0.02) difference between direct hit injuries involving a single bone (15.8%; n = 31) and those involving both the radius and ulna (16.4%; n = 20).

## DISCUSSION

Children's forearms make up 30-50% of all broken bones. Distal radial fractures are the most prevalent type of radial bone fracture in children, it has been reported. [Insert citation here] Children's forearm fractures are quite costly to cure. There appears to be an upward trend in the incidence of distal radial fractures in children during the past four decades, but the cause of this trend is not easily identified. Some research suggests this is due to an increase in kids' engagement in sports and other forms of physical activity. There has been an increase in the number of operations conducted over the past decade. Age is a major factor in determining remodelling potential because of the age-related decline in remodelling capacity. Functional outcomes following closed reduction of forearm fractures in children aged 4-12 were determined to be satisfactory. Most fractures were found to occur at the distal forearm, specifically the distal radius. When comparing the rates of distal forearm fractures between boys and girls, Ryan and coworkers found a statistically significant difference, with boys accounting for 64% of all fractures. Consistent results have been seen in other studies. At 16 years old, the risk of a forearm fracture is 42% higher in boys than it is in girls. Among the people we looked at, the incidence of fractures was 4.2% greater among boys than among girls. With those younger than 0.001) these results are consistent with previous research showing that fractures are more common in males than females. [Insert citation here] [Insert citation here] The average age of presentation was found to be 9 years and 3.9 months in male patients by Ryan and coworkers<sup>2</sup>, and 7.3 years and 3.9 months in female patients. There was a discernible statistical gap here. Valerio<sup>22</sup> found that male patients had a mean age of 12, whereas female patients had a mean age of 9. Similarly, we found that there was a statistically significant gap between the ages of male and female patients, with the median age of male patients being 11.28 4.4 years and the median age of female patients being 7 3.6 years (p 0.01). This may be because of the competitive nature of the sports and other forms of physical activity that most men like. Forearm fractures are most common between the ages of 11 and 12 in girls and 13 and 14 in boys, according to research by Hedstrom et al.<sup>10</sup>. It is possible that school-aged children and teenagers are more likely to sustain injuries as a result of being pushed or falling from playground equipment while in public places or schools, but we were unable to determine the specific activity that a child was engaged in due to the lack of complete documentation.

### Drawbacks of the study:

Due to the design of the study, we were unable to control for some factors, including the child's dexterity and the activity and setting in which the injury occurred. Since not all cases were treated in our institute due to a lack of eligibility, treatment modalities were not mentioned. It was challenging to include more centres for a bigger study sample due to variations in record keeping and hospital policies. The true prevalence of forearm fractures in children could not be identified in this hospital-based investigation; however, a bigger study covering most centres in a specific region would be useful in that regard.

## CONCLUSION

Forearm fractures are a common injury in youngsters, especially boys. Teenagers and preteens are especially vulnerable. The most frequent site of fracture in the radius is the distal region, which includes the distal metaphysis-diaphysis and physis. Most injuries among

children occur from falling; therefore it's important to take extra measures to ensure their safety in high-traffic locations.

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