

## EPIDEMIOLOGY AND TREATMENT OUTCOME OF PAEDIATRIC FOREARM FRACTURES AT THE GREATER ACCRA REGIONAL HOSPITAL

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### Abstract

**Objective:** To investigate the epidemiology forearm fracture in the paediatric age group and its treatment outcome among patients presenting at the Greater Accra Regional Hospital (GARH).

**Materials and Methods:** Twenty-Four patients with paediatric forearm fractures presenting at the Trauma and Orthopaedic unit between November 2018 and October 2019 were prospectively followed up for six weeks; assessing re-displacement after one and 2 weeks and degree of supination and pronation at the end of the 6<sup>th</sup> week.

**Results:** A total of 24 children were recruited in this study. The median age of presentation was 5 years with a male to female ratio of 2:1. Sixty seven percent (n=16) of the patients reported to the facility within the first 24 hours of injury. Majority of the injuries (n=22) were as a result of fall on the outstretched hand (FOOSH). The

school (n=13, 59.1%) and home environments (n=7, 31.8%) were the common places of injury; other places include recreational areas and footpath. Twenty-three (95.8%) of all patterns of forearm fractures were closed, with the commonest site being the distal third (n=17, 70.8%). Conservative treatment of the fractures sufficed in 19 patients (79.2%); with re-displacement occurring in 3 patients (12.5%). The remaining 5 cases were managed operatively. Functional assessment by way of supination and pronation was excellent in all the patients with no residual deformity.

**Conclusion:** The findings from this study point to the fact that, FOOSH occurring at the school environment is the commonest cause of forearm fractures in the paediatric age group. Conservative treatment sufficed in the majority of cases and remains a viable option if patients are carefully selected.

**Key Words:** Paediatric, Forearm, Fractures, Epidemiology, Treatment outcome.

### Introduction

Globally, a quarter of all children sustain non-fatal injuries in a year<sup>1</sup>. Approximately 18 percent of children will experience a fracture by age 9 with children between the ages of 5 and 14 having the highest incidence<sup>2</sup>. Forearm fractures are the most common fractures among children and adolescents, with some studies showing an increasing trend in incidence<sup>3,4</sup>. It is noted that the majority of these fractures are located in the distal part of the forearm<sup>5,6</sup>, with major risk factors being falls from playground equipment (e.g. monkey bars) and from backyard trampolines; however, any fall with adequate force may result in a fracture<sup>7</sup>. These risk factors may defer from those in sub-Saharan Africa. Knowing the risk factors and the circumstances under which these injuries occur affords policy makers the opportunity to put in place the necessary preventive measures in our environment. Traditionally most of these injuries were managed conservatively with closed reduction and the application of Plaster of Paris (POP) casts because of the excellent remodelling potential in

younger patients; of late, there is an increasing trend towards operative treatment in the western world<sup>2</sup>. A National Database Study from 2000 to 2012 revealed that, the proportion of patients treated with surgery increased from 59.3% in 2000 to 70.0% in 2012 in the United States<sup>8</sup>. Other studies have indicated that conservative management remains the gold standard<sup>9,10</sup>. Documenting the outcome of treatment of these injuries and comparing the results with those from other centres and regions will help make modifications to treatment if need be. This study sought to provide baseline data with respect to gender, age, mechanism of injury, treatment approach and outcomes for patients presenting at the Greater Accra Regional Hospital.

### Materials and methods

#### Study site and design

A hospital based longitudinal study was conducted at the Greater Accra Regional Hospital. The 420-bed capacity facility is the Regional Hospital for the Greater Accra Region with a wide catchment area.

This study received ethical clearance from the protocol review committee of the research and development division of the Ghana Health Service, with a Protocol ID NO: GHS-ERC: 002/06/18. The participants of this study were prospectively recruited from paediatric patients presenting with a radiologically confirmed forearm fracture at the orthopaedic clinic or emergency unit between November 2018 and October 2019.

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Inclusion criteria: Patients with forearm fractures occurring in a skeletally immature bone with open physis were considered eligible.

Exclusion criteria: Patients with forearm fractures as a result of birth trauma or those presenting with pathological fractures were excluded from the study.

The patients' parents or guardians were interviewed after appropriate consent had been sought to ascertain the date and time of injury, time elapsed before reporting at facility, place where injury occurred and mechanism of injury. The criteria for conservative or operative treatment were dependent on the age of patient, the fracture characteristics, including the location and the degree of displacement of the fracture ends. Conservative management was indicated in all closed fractures with minimal or no displacement, or all closed fractures with acceptable reduction after closed manipulation predicted by the Price criteria<sup>11</sup>, which uses a cut off of 15 and 10 degrees of residual angulation as being acceptable alignment for children 8 years old or less and 9 or more respectively. Indication for operative management were as follows: failed closed reduction of metaphyseal or diaphyseal fractures, unacceptable closed reduction as predicted by the Price criteria, open fractures requiring debridement, open fractures with associated neurovascular injury, or fractures with associated compartment syndrome.

#### Data collection and analysis

Data were collected in case report forms including the variables: patients' demographics and past medical history, marital status and level of education of the guardians, date, time, place and mechanism of injury, time from injury to presentation to hospital, Landin's modified trauma severity<sup>12</sup>, type and pattern of fracture, anatomic location of injury with neurovascular assessment, type of treatment and follow-up results at 1, 2, and 4 to 6 weeks. The data were processed using the Microsoft Excel® 2010 Version 14.0 (Microsoft Corporation, WA, USA) and analysed with SPSS Version 21.0 (IBM Corp., Somers, NY, USA). Numerical data that were not normally distributed were reported with median and interquartile ranges (IQR). Ordinal variables were compared using the chi-square test with linear-by-linear association. Two-sided *p* values <0.05 were considered statistically significant.

#### Results

A total of 24 participants were recruited for this study. The median age of the patients was 5 years with a male to female preponderance of 2:1 (Table 1). A fall on the outstretched hand (FOOSH) was the commonest mechanism of injury (n=22, 91.7%), followed by road

traffic accident (n=1, 4.2%) and direct blow (n=1, 4.2%). Sixteen patients (66.7%) presented to the hospital within 24 hours of injury. For the patients with the FOOSH injury, school was the most common place where the injury occurred, followed by home; 68.2% of these patients with forearm fractures were brought to the facility within 24 hours of injury (Table 2). Time of injury to presentation at the hospital was significantly shorter in guardians with higher level of education (*p*=0.019, Table 3). Twenty-three patients (95.8%) had closed fractures, with other characteristics as described in Table 4. The pattern of injury and severity of the trauma verses age and sex are depicted in Figures 1 and 2. Nineteen patients (79.2%) were treated conservatively (table 5). Re-displacement was observed in three patients, two (8.3%) during the first week and one (4.2%) during the second week. Twenty-three patients (95.8%) had excellent outcome with respect to acceptable residual angulation by PRICE criteria. Pronation and supination were acceptable in all 24 patients at 4 or 6 weeks after the injury.

**Table 1.** Demographics of the patients and their guardians

Variables	N=24 (%)	
Age (years, median, interquartile range)	5, (3.3-9.5)	
Sex		
Male	16 (66.7%)	
Female	8 (33.3%)	
Known Medical history		
Yes	1 (4.2%) <sup>a</sup>	
No	20 (83.3%)	
History of any fracture more than 3 months ago		
Yes	2 (8.3%)	
No	20 (83.3%)	
Marital status of the guardian		
Yes	20 (83.3%)	
No	2 (8.3%)	
Divorced	2 (8.3%)	
Level of education	1 <sup>st</sup> guardian	2 <sup>nd</sup> guardian
None	0	1 (4.2%)
Primary school	0	0
Junior secondary school	3 (12.5%)	0
Senior secondary school	3 (12.5%)	3 (12.5%)
Tertiary school	18 (75.0%)	16 (66.7%)

<sup>a</sup> autism

**Table 2.** Time from injury to visit to hospital, place of injury and Landin's severity grade in patients whose mechanism of injury was FOOSH

N=22 (%)	
Place of injury	
Home	7 (31.8%)
Recreational area	1 (4.5%)
School	13 (59.1%)
Others	1 (4.5%) <sup>a</sup>
Time from injury to visit to hospital	
Less than 24 hours	15 (68.2%)
After 24 hours to 72 hours	3 (13.6%)
After 3 to 7 days	0
More than 7 days	4 (18.2%)
Landin's modified trauma severity	
Slight	8 (36.4%)
Moderate	12 (54.5%)
Severe	2 (9.1%)

<sup>a</sup> hospital**Table 3.** Time from injury to visit to hospital according to the level of education of their first guardians

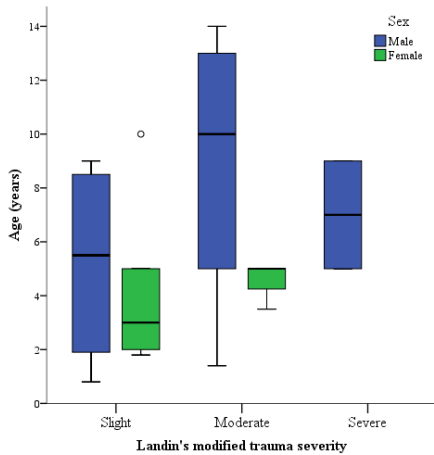
Time from injury to visit to hospital	Junior school (n=3)	secondary	Senior school (n=3)	secondary	Tertiary school (n=18)	p-value
Less than 24 hours	1 (33.3%)		2 (66.7%)		13 (72.2%)	0.019
After 24 hours to 72 hours	0		0		4 (22.2%)	
After 3 to 7 days	0		0		0	
More than 7 days	2 (66.7%)		1 (33.3%)		1 (5.6%)	

**Table 4.** Characteristics of the fractures

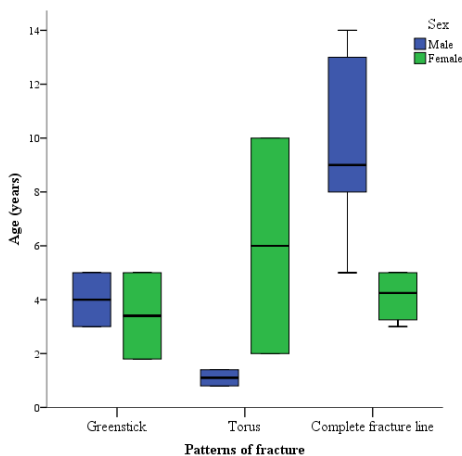
Variables	N=24 (%)			
Landin's modified trauma severity				
Slight	9 (37.5%)			
Moderate	13 (54.2%)			
Severe	2 (8.3%)			
Type of fracture				
Open	1 (4.2%)			
Closed	23 (95.8%)			
Patterns of fracture				
Greenstick	4 (16.7%)			
Torus	4 (16.7%)			
Complete fracture line	16 (66.7%)			
Location of fracture				
		Proximal 1/3	Middle 1/3	Distal 1/3
Ulna only	1 (4.2%)	1 (100%)	0	0
Radius only	11 (45.8%)	0	1 (9.1%)	10 (90.9%)
Both ulna & radius	12 (50.0%)	1 (8.3%)	4 (33.3%)	7 (58.3%)

**Table 5.** Types of treatment

Treatment	N=24 (%)	Treatment in detail	N=24 (%)
Conservative	19 (79.2%)	Cast immobilization	10 (41.7%)
		Closed reduction & cast application	9 (37.5%)
Operative	5 (20.8%)	Closed reduction & K-wire	3 (12.5%)
		Open reduction & K-wire	1 (4.2%)
		Open reduction & plating	1 (4.2%)



**Figure 1.** Age distribution in each sex according to Landin's modified trauma severity



**Figure 2.** Age distribution in each sex according to patterns of fracture

## Discussions

This study showed a preponderance of males in accordance with studies carried out in different regions of the world<sup>3,7,13-15</sup>. It can be reasoned that, males are more likely to be injured because of the socialization process which leads males, from the time they are little boys, to partake in more risky behaviour than females. This is supported by the evidence from this study that showed that more males suffered from moderate to severe degrees of trauma using the Landin's modified trauma severity scale.

In this study, the commonest mechanism of injury was a fall on the outstretched hand with a majority of them being closed fractures of the distal radius, which is in agreement with previous reports<sup>16,17,18</sup>.

The most common place of injury in this study was in the school. This is in contradiction to what is in literature, identifying the playground as the most common place of injury<sup>2,7,13,16</sup>. There are very few designated playgrounds in Ghana, and the school environment in school-age children and home serve as a playground. Intensive supervision in schools and at

home should be emphasized to protect children from hazards or harm that may arise in their daily experiences in play. As a nation we may have to consider adopting the safety round method as done in some western countries<sup>19</sup>. This is done once a year and entails the headteacher, group of teachers and pupils walking around the school yard to identify risks that may lead to injury. The importance of involving the pupils is that, they perceive risk from a different perspective to adults. This study revealed a statistically significant relationship between time of injury to presentation at the hospital and educational level of the guardian; parents with tertiary education are likely to report with their children to hospital within the first 24 hours of injury. There is reason to believe that educated parents understand the implications of these injuries and are likely to report earlier than the less educated parents.

Historically, most of these injuries have been managed conservatively with closed reduction and the use of POP casts because of the excellent remodelling potential in younger patients; but there is an increasing trend towards operative treatment in the western world<sup>2</sup>. However, Tarmuzi and his colleagues reported on the successful conservative management of 48 patients aged 4 to 12 years, with an 86% rate of excellent functional outcome<sup>20</sup>. In this study, conservative treatment gave satisfactory results in more than 79% of the children with an acceptably low rate of re-displacement in keeping with some studies<sup>21-24</sup>. This finding suggests that conservative treatment is still a viable option so far as the patient meets the inclusion criteria. Conservative treatment is cost effective, decreases length of hospital stay and avoids all anaesthesia related complications associated with relatively prolonged operative treatment as compared to conservative treatment.

## Conclusion

Fracture of the bones in the forearm of children occurred more commonly in males; this was as a result of falls on the outstretched hand. In contrast, in the western world, the school environment accounted for the most injuries to the bones of the children's forearm. This contrasting finding calls for proactive measures to be put in place to forestall such injuries within the school environment. Although there is an increasing trend towards operative management for these fractures, conservative treatment in this series yielded very good results and could be a viable option when working in a resource constrained environment.

## Limitation

The major limitation for this study was the small sample size which makes it difficult to generalize the results for the entire region and the nation as a whole.

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