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Original Work

Traumatic long bone fractures in children seen in a metropolitan tertiary hospital in Enugu, Nigeria

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ABSTRACT: Injuries in children are a well-known occurrence and often lead to fractures. The fractures may affect long bones, occur in all ages and could be accidental or non-accidental with associated injuries that may cause disability or permanent deformity. Lack of epidemiological research on causes, mechanism of injury and site of long bone fractures in children in our environment prompted this study. The study evaluates variables that maybe responsible for long bone fractures in children and document them accordingly for use in planning injury prevention strategies in children. The study was carried out in a tertiary hospital in a metropolitan city (Enugu State University of Science and Technology [ESUT] Teaching Hospital, Enugu, Nigeria). Medical records of patients, ward admission register, accident and emergency register and theatre registers were used for data collection. Children under 16 years who presented to the hospital with long bone fractures between January 2015 and December 2017 were part of the study. Eighty-five children with 86 long bone fractures out of 258 children that presented and were admitted into the orthopedic service were noted. Mean age of patients was 7.2 years + 1.8 years. The commonest long bone fractured was the femur n- 23 (26.7%). Males-female ratio was 1.15:1. Fall from height was the commonest cause of injury and abrasion/laceration the commonest associated injuries. Long bone fractures in children occur mostly due to falls from height and affects the femur more than any other bone. Bimodal annual occurrence rate has been noted and caregivers ought to be more vigilant during those times to help reduce the rate of long bone fractures in children.

KEY WORDS: ***Children, Long bone fracture, Trauma***

INTRODUCTION

Over the years injuries have gradually become important causes of childhood morbidity and mortality in many parts of Africa[1,2]. An injury is defined as physical damage to the body or part of the body, produced by transfer of energy, which may be kinetic, thermal, chemical, electrical or radiant[3]. In 2002, about 875,000 children died as a result of injury worldwide and placing injuries among the leading causes of death among children who survive their first birth day[4].

Injuries in childhood are known to be a major public health challenge worldwide and tend to be a leading cause of death for all ages except in persons more than 60 years of age[5]. Injuries in children apart from affecting soft tissues may also lead to bone fractures and are known to be a leading cause of death and disability[6]. It is estimated that one out of four children in the US experience injury which is medically attended annually with varying degrees of risks depending on characteristics of the subgroups and cause of injury[7]. Fractures are known to constitute 10% to 25% of all injuries seen in peadiatrics[8]. And lifetime risk of fractures may be as much as 40% in girls and 64% in boys[9].

Fractures, resulting from injuries, in children have profound effects on the daily activities of living of the children. Apart from the medical burden they place on the child, the child is usually unable to go to school and may not be in a position to play with his/her mates. Admission of a child often requires

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the presence of a parent or guardian beside the child and this may disrupt the parent's economic engagement. When put together, an injury affects more than one individual – siblings, parents, relations, employers, communities and society at large[2,3]. Activity restriction due to fractures in children largely depends on the type of fracture[10]. Though most childhood fractures heal without obvious loss of function, they are associated with significant cost both to the child and the family as they may be away from school and work in addition to the medical costs[11].

Studies in different parts of the world have shown that there is an increasing trend in the incidence of childhood fractures[3,4,7]. Different parts of the world show various differences in the pattern of childhood fractures and even mechanism of injury may also vary within a geographical region. The activities which children indulge in tend to be the determinant of the mechanism and the severity of the injury. The neighborhood characteristics have been shown to contribute to the rate of fracture in a part of Washington DC[12]. A study in South Wales UK found that similar fracture rates in different electoral wards but different mechanism of injury between the affluent areas and resource deprived areas[13].

Documenting the pattern of fractures seen in childhood due to injuries is important in fashioning injury prevention and management guidelines. Data available now are mainly from the developed world and may not adequately address the challenges of childhood injuries and fractures in our environment. This study set out to determine the pattern of long bone fractures and the mechanisms of injury amongst children seen in our tertiary medical institution. We believe that accidents or their sequelae, like any other public health problem, can be prevented or managed better if approached scientifically. To formulate sound health initiatives directed at children, parents, caregivers, schoolteachers, road users and the community at large, there is need for this documentation.

METHODOLOGY

This was a retrospective study carried out in a tertiary hospital in a metropolitan city in South East Nigeria. The study covered the period from January 2015 to December 2017. The case notes of children under 16 years admitted into the orthopedic unit within the study period were used for data collection. Also ward admission register, accident and emergency department records and theatre register were used in data collection. The long bone involved, the cause of the injury, associated injury and the time or month of the injury, age and sex of the patient were noted using a proforma designed for such data collection.

Pathological fractures, healed fractures, and cases of patients who declined orthodox orthopedic treatment were excluded. Arbeitsgemeinschaft fur Osteosynthesefregen pediatric comprehensive classification of long bone fractures AO (pediatric comprehensive classification of long bone fractures) guidelines was used to classify the fractures noted into segments using the OA (PCCF) charts.

Data collected were analyzed using simple statistical methods into means and percentages, and was then presented as tables and charts.

Ethical approval was obtained from the ethical committee of ESUT Teaching Hospital.

RESULT

Eighty-five children who had 86 long bone fractures out of 256 children admitted into the orthopedic surgery service met the inclusion criteria. All long bone fractures due to trauma were included while pathological fractures due to mitotic lesions and chronic osteomyelitis were excluded. Our study noted that long bone fractures constituted 33.2% of admission during the study period. Males, n-46 (53.5%) were in the majority giving a male-female ratio of 1.15:1. The mean age of the patients was 7.2 years + 1.8 years. Only 1 patient (1.2%) had fractures involving two different long bones.

Table 1 shows that the 8-12 years age group was most commonly affected accounting for 38.19% of the fractures in both males and females. The least number of fractures occurred in the 12-16 years age group (n-14,16.3%). In all age groups, males sustained more fractures except for the 8-12 age group where females had more fractures.

As shown in **table 2**, males sustained more upper limb fractures than females while females had more, lower limb fractures than males. Overall, the lower limbs 45 (52.3%) were fractured more than the upper limbs. The femur n-23 (26.7%) was the most fractured bone followed by the radius n-20 (23.3%) and the least fractured was the humerus n-12 (14.0%). Using OA (PCCF) charts, the bone segment that suffered fracture most was the diaphysis n-46 (53.5%), followed by the distal metaphysis n-28 (32.5%). There was no record of involvement of the proximal epiphysis.

The commonest mechanism of injury was accidental (non-intentional) with fall from height accounting for n-35 (40.7%) of the fractures. The second commonest cause of fractures was road traffic accidents n-21 (24.4%). Injuries due to involvement in sports accounted for n-11 (12.8%) of the fractures. Non-accidental (intentional) injuries manifesting as domestic violence affected more females n-7

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(77.8%) than males but overall accounted for n-9 (10.4%) of all the fractures. Assault was only responsible for 3.5% of the injuries and involved males as shown in **table 3**.

Table 4 outlines the various injuries associated with the long bone fractures. Abrasion/Laceration was noted in over 61% of the cases and was the commonest associated injury. Head injury was noted in 32.5% of the cases but they were mild injuries and were managed conservatively with good result. Compartment syndrome was seen in 21% of cases. Fifteen (83/5%) of the compartment syndrome involved the upper limb and only 3 (17.7%) involved the leg. Three of the upper limb compartment syndrome presented fresh to the hospital while the other 12 (66.7%) presented several days after the injury and with tight splinting by native bone setters. Three cases of compartment syndrome had fasciotomy to relive the pressure while the rest were managed conservatively by limb elevation and strict monitoring.

One case of abdominal injury had laparotomy and the others were managed conservatively. Most of the fractures were managed conservatively (n-81, 94.2%) by manipulation under anesthesia and plaster of Paris or scotch cast application. Two cases of femoral fracture had open reduction and internal fixation using low contact plates and screws. Four (4.6%) cases of radius fracture had percutaneous pining and external cast application under anesthesia.

The injuries showed obvious seasonal peaks, occurring most in the February, March, April and September periods. Fractures in these four months constituted 54.6% of all the fractures. Highest numbers of fractures were recorded in March and April , as depicted in **figure 2**.

Table 1: Sex distribution of fractures by age group

	Males				**Females**			
Age group (Years)	<4	4-8	8-12	12-16	<4	4-8	8-12	12-16
Humerus	3		3	1			4	1
Radius/Ulna	2	9	7	5		5	1	
Femur	5		1	3	8		4	2
Tibia/fibula		2	5			3	10	2
Total	10	11	16	9	8	8	19	5

Table 2: Distribution of fracture by bone segment AO (PCCF)

Males	**Proximal Epiphysis**	**Proximal Metaphysis**	**Diaphysis**	**Distal Metaphysis**	**Distal Epiphysis**	
Humerus		2	1	3	1	8.1%
Radius/Ulna			12	8	3	26.8%
Femur			7	2		10.5%
Tibia/fibula			5	2		8.1%
FEMALES						
Humerus			3	2		5.8%
Radius/Ulna			4	1	1	7.0%
Femur		1	8	5		16.3%
Tibia/fibula			6	5	4	17.4%
		3.5%	**53.5%**	**32.5%**	**10.5%**	**100**

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Table 3: Mechanism of injury

Cause of injury	Males		Females		Total (%)
Fall from Height	21	24.4%	14	16.4%	40.8
RTA	11	12.8%	10	11.6%	24.4
Sports	8	9.3%	3	3.5%	12.8
Assault	3	3.4%	0	-	3.4
Domestic violence	2	2.3%	7	8.1%	10.4
Others	1	1.2%	6	7.0%	8.2
	46	53.4%	40	46.6%	100

Table 4: Associated injuries

Injuries	No	%
Abrasion/Laceration	53	61.6%
Head Injury	28	32.6%
Compartment Syndrome	18	20.9%
Others – Rib fractures/Pelvic fracture clavicular fractures	13	15.1%
Visceral rupture/Blunt Abdominal Injury	9	10.4%
Avulsion injury	8	9.3%
Nerve injury	5	5.8%

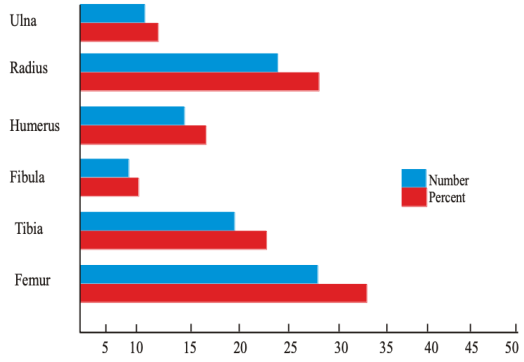

Figure 1: Fracture distribution by bone involved

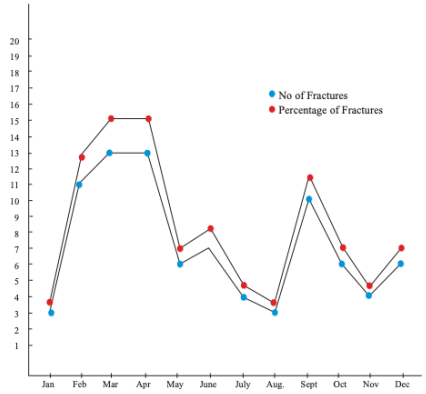

Figure 2: Monthly distribution/occurrence of fractures

DISCUSSION

Our study found long bone fractures in children accounted for 38.2% of children admitted into the orthopedic surgery service within the study period. This is a significant number that the issue of long bone fracture in children should receive greater attention in every pediatric orthopedic outfit in our environment. The fractures were seen more in males than in females. This result is similar to the findings in studies conducted in Naples, Italy and Nairobi, Kenya[14,15]. However considering fractures in age groups, our study found that females predominate in the 8-12 years group. This is similar to the study in Kenya which also found female predominance in the 10-12 years age group[15]. Studies have shown that at this age , females have reached their peak height-velocity with resultant decrease in bone mineral density and increased bone fracture risk[16,17]. The overall dominance of males can be attributed to the general adventurous behavior of boys and the cultural expectations that boys must be more outgoing and engage in strong physical activities. The mean age of patients in our study was 7.2 years and was well within the findings by other studies[15,18].

The fracture distribution showed increasing occurrence from the toddlers' age group (4 years) to the peak occurrence age group (8-12 years) and then a sharp decrease in the 12-16 years age group. Increased mobility and curiosity about their

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surrounding with little supervision may explain fractures in the younger age group while decrease in bone mineral density with growth has been highlighted in the older children[17].

Lower limb fractures occurred most in 52.3% of cases. This is very similar to the finding of Nganga *et al*[15]. This contrasts well other studies where the upper limb predominated[13]. Our finding cannot be explained by only one factor as several events like place of occurrence of the incident, age of the victim and energy transfer all must come into consideration.

The femur was the commonest bone fractured at 26.7%, and femoral fractures demobilize the child and tend to attract more attention and force parents to seek early orthodox treatment. The children falling from height usually land on their feet and the femur may fracture if it cannot absorb the shock fully. Fracture of the radius was the second commonest at 23.3%. This shares similarity with studies done by Tandon *et al*[19] which recorded 23.0% and 22.4% femur fractures in Mumbai, India. The fibula was the least bone fractured with 7.0% of all fractures. The fibula in the presence of the tibia bear less stress and is encased by muscles which bear most of the energy transfer thereby sparing it except when a high energy injury is involved.

Analysis of bone segment indicates that the diaphysis of the bones was the commonest fracture site 53.5%, followed by the distal metaphysic that accounted for 32.5% of the fracture sites. The distal epiphysis was involved in 10.5% of the fracture while the proximal epiphysis was not involved at all. These findings are in agreement with findings of Nganga *et al*[15] in Nairobi, Kenya. Segmental classification of long bone fractures in children is very important as it serves as a guide to treatment options as well as to monitor treatment outcomes of epiphyseal fracture which may affect the overall growth of the child.

The majority of fractures found in our study were due to fall from height and that was 40.7% of cases. Falls from different heights like chairs, beds, and school play facilities also formed the most common cause of fractures in other studies[10,20].

The majority of falls in our study were from mango and cashew trees, school play facilities and uncompleted houses. Close supervision of children in the homes to ensure they do not wander away to climb trees could be very helpful in preventing injuries. Also, provision of protective barriers around uncompleted buildings will be an important legislation that will reduce these injuries in children.

Road traffic accidents accounted for the second commonest mechanism of injury in 24.4% of the fractures. The work of Nganga *et al*[15] had a similar result at 21.0% while our result differs from the finding of studies in Bergan, Norway[21] and China[22]. Notably, most of the accidents involved pedestrians. The high level of pedestrian involvement can be explained by the fact that most roads lack pedestrian walkways and regular road furniture like road rails and signs.

Adequate road safety education of children and vehicular drivers and provision of road furniture will go a long way in minimizing road traffic accidents. Sports related fractures at 12.8% show a good comparison to what other studies found[15,21]. An emerging mechanism in injury in our environment was noted in our study: domestic violence constituted 10.4% of the fractures and about 77.7% of the victims were females. These were probably children of low socio-economic background who live with other relations as maids/house helps and may get abused by their guardians.

Long bone fractures in children are commonly associated with other injuries. Abrasions and lacerations were noted in 61.6% of the fractures. Cuts and bruises have been reported to be the most frequently encountered injuries in chidlren[1]. Other associated injuries like head injuries were seen in 33.5% of children and compartment syndrome in 21% of children are injuries that are to be prioritized in treating the child to prevent long term disability. Blunt abdominal injuries which were seen in 10.5% of cases must seriously be considered while managing children with fractures as these may increase the danger because undiagnosed other injuries (multiple trauma) increase the threat to life[23,24].

Seasonal variations in childhood fractures have been noted in a study in Wales where forearm fractures in the three months of winter were about half of those observed during the remainder of the year[25]. Our study identified that February, March, April, and September account for more than 50% of the fractures. The period February to April is the period that tasty mango and other fruits come to season. Children often are unable to resist the temptation of climbing such fruit trees to harvest the delicacy which they offer, thus increasing the risk of falls from trees. September is usually the beginning of the new school year after more than two months of long school holidays. Children usually return to school with excitement and in the process engage their peers in challenging plays that may be risky. Other studies in parts of Europe have also demonstrated seasonal variations in the occurrence of fractures[18,26]. Care givers and guardians need to note these periods/seasons and intensify surveillance of

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children so as to prevent or minimize injuries in general and long bone fractures in particular.

The small number of samples and the retrospective nature of our study are limitations of the study. A large, case-controlled study of traumatic long bone fractures in children will be of value in pediatric fracture evaluation in our environment.

CONCLUSION

Long bone fractures in children affect children adversely and tend to affect the diaphysis more. These fractures occur mostly due to fall from heights and show seasonal variation. This suggests that vigilance by responsible adults to stop children from climbing trees can prevent or minimize these fractures. When a fracture has occurred, critical evaluation of the patient in a good health centre is important in other to provide proper medical care that will ensure full recovery for the child.

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