



**Patterns Of Pediatric Femur Shaft Fractures At St.Paul's
Hospital Millennium Medical College, AaBET
Hospital,Addis Ababa,Ethiopia,2019.**

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ACRONYMS / ABBREVIATIONS

SPHMMC	St. Paul Hospital Millennium Medical College
AaBET	Addis Ababa Burn, Emergency and Trauma
AA	Addis Ababa
IMN	Intramedullary Nail
RTA	Road Traffic Accident
SNNPRS	Southern Nations Nationalities and Peoples Regional State
GA	Gustilo-Anderson
SPSS	Statistical Package for the Social Sciences
ETB	Ethiopian Birr
IRB	Institutional Review Board
SIGN	Surgical Implant Generation Network
E.C.	Ethiopian Calendar

ABSTRACT

BACKGROUND: Seventy percent of femoral fractures involve the shaft. Femoral shaft fractures represent the most common pediatric orthopedic injury that requires hospitalization. The epidemiology of femur shaft fractures is well described in literature from developed countries. Few studies have been published on paediatric femoral fractures in resource-constraint environments like the sub-Saharan African region.

OBJECTIVES: To determine patterns of pediatric femur shaft fractures at st.paul's hospital millennium medical college, AaBET hospital.

METHODS: Institution based retrospective cross sectional study was conducted. All pediatric patients (cards) with femur shaft fractures who were treated between September 2015 and August 2018 were reviewed. All patients that fulfill the inclusion criteria were studied. Data abstraction format was used to collect data. The data was entered and analyzed by using SPSS version 20. Descriptive statistics was used to describe the patterns of the femur shaft fracture.

RESULT: ninety one patients who had femur shaft fractures were recruited in the study. Males were 67(73.6%). The mean age was 8.8 years. The most commonly involved age group was >6 years to 12 years i.e. 40 (44%). Majority of the fracture were due to fall (41.8%). Most fractures occurred in June to August (36.3%). Left side was involved in 45 (49.5%) of the cases. Eighteen patients (19.8%) had associated injury and the most common associated injury was head injury 7 (38.9%). Closed fracture was the most common type 84(92.3%). Traction followed by spica was the most common treatment modality (28.6%). The mean length of hospitalization was 15.3 days.

CONCLUSION:

The age group most affected was 6 years to 12 years. Fall accidents predominated as the etiology. Closed femoral diaphyseal fractures predominated.

The treatment most used was conservative.

1. INTRODUCTION

1.1. Background

The Arbeitsgemeinschaft für Osteosynthesefragen (AO) definition of femoral shaft in children is the area between the greater trochanter and the distal metaphyseal area (1). Seventy percent of femoral fractures involve the shaft (2). They are common amongst male (3, 4). The incidence of the femoral shaft fractures is bimodal, first peaking between two and four years and later during adolescence (4, 5).

The etiology of femoral fractures in children varies with the age of the child. Before walking age, up to 80 % of femoral fractures may be caused by abuse (6, 7). In older children, femoral fractures are most likely to be caused by high energy injuries; motor vehicle accidents account for over 90 % of femur fractures in this age group (8, 9).

Pathologic femur fractures are relatively rare in children. They may occur in patients with osteogenesis imperfecta, non ossifying fibroma, aneurysmal bone cyst, unicameral bone cyst or eosinophilic granuloma (10).

Stress fractures of femoral diaphysis are rare in children and account for only 4 % of all pediatric stress fractures (11).

Plain radiographs are sufficient for making the diagnosis. In rare circumstances, bone scanning and magnetic resonance imaging may be helpful in the diagnosis of small buckle fractures in limping children or stress fractures in athletes (12).

As with most diaphyseal fractures, classification of femoral shaft fractures is based on the radiographic examination and the condition of the soft tissue envelope (closed or open fracture). Radiographs are evaluated for fracture location (proximal, middle, or distal third), configuration (transverse, oblique, or spiral), angulation, the degree of comminution, and the amount of displacement, translation, and shortening (13).

The decision to manage a femoral shaft fracture by conservative or operative means is affected by a wide number of variables, which include age and weight of patient, the type of fracture, associated injuries/polytrauma and socioeconomic status of the family (14).

Over the past 20 years, there has been a dramatic and sustained trend toward the operative stabilization of femoral shaft fractures in school-aged children using flexible intramedullary nails, external fixation, locked intramedullary nails, and more recently, submuscular plate fixation. These advances have decreased the substantial early disability for the children as well as the family's burden of care during the recovery period (12).

The American Academy of Orthopaedic Surgeons developed a clinical practice guideline to assist in the management of pediatric diaphyseal femur fractures. A panel of surgeons critically evaluated existing literature and attempted to devise treatment recommendations based on current best evidence (15).

1.2. Statement of the problem

Pediatric trauma often results in activity limitation, hospitalization, and sometimes in permanent disability. Injuries requiring medical attention, or resulting in restricted activity, affect more than 20 million children and adolescents and cost \$17 billion annually for medical treatment. As the leading cause of death and disability in children, pediatric trauma presents one of the largest challenges to the health of children, as well as an important opportunity for positive impact (16).

Femoral fractures occur at a rate of 20 per 100,000 children in USA, representing 1.6 % of all pediatric fractures (3), yet they significant adverse physical, social, psychological, and financial impacts to both affected children and parents (17).

Femoral shaft fractures represent the most common pediatric orthopedic injury that requires hospitalization (4, 18).

Study findings in a Cameroonian tertiary center suggest that one out of every five paediatrics fractures encountered at surgical department, are femoral fractures (19).

Coffey C. reported that 67% of lower limb fractures in children less than 18 months of age were as a result of child abuse (20).

1.3. Literature review

A study done in Sweden by Von Heideken J et.al. Showed that there was a peak annual incidence at the age of 2 years for boys and girls. The overall boys/girls incidence ratio was 2.4: 1. The occurrence of femur shaft fractures during the year with peaks in March and August. In March sports accidents are responsible for the increase in incidence and in August the increase is caused by traffic accident. The treatment modalities shifted toward an increased use of operative treatment. Hospital stay was decreased by 81 %, from 26 days in 1987 to 5 days in 2005 (21).

In epidemiologic study of femoral fractures in children in the West Midlands region of England between 1991 to 2001, falls accounted for 49 % of the fractures. Traffic accidents were responsible for 26 % of fractures. The fracture rate in boys was greater than that in girls by from 1.6 times at 11 years of age and 4.7 times at 14 years of age. The peak overall age-gender-specific incidence was in two –year-old boys (22).

Retrospective cross sectional study on a population consisting of patients femoral shaft fractures, age between birth and 14 years & 11 months was done in Brazil. The study population was composed of 96 patients. The mean age found was 6.8 years. The cases were predominant among males. The proportion of open fracture was 10.4 %. Regarding etiology, traffic accidents predominated overall in the study. Most of patients (77.1 %) presented femoral fractures as their only injury. Conservative treatment predominated in the group younger than 6 years of age, and surgical treatment in the group aged 6 to 14 years & 11 months (23).

A total of 212 patients with femoral shaft fractures (treated between 1997 and 2020) were enrolled in a study done in Israel. Boys to girl's ratio were 2.4: 1 and mean age was 5 years (24).

The epidemiology of femur shaft done in university of Capetown in 2013 showed that the commonest mechanism of injury was a fall (39 %) with a peak at 2 to 3 years of age, followed by motor vehicle accident (33.7 %). The peak incidence at 4-5 years due to pedestrian vehicular accident was younger than the ≥ 6 years reported from developed countries. In children <1 year of age, 59.3% were due to non accidental injury and 23.7 % due to osteogenesis imperfecta. The male to female ratio was 2.2: 1. (25)

A study done in Nigeria reported that pedestrian vehicular accident was the most common cause of femoral shaft fractures (56.7%). This was followed by falls during sports or from heights (33.6%). The mean age was 6.5 years. There were associated injuries to other parts of the body (especially head injury) in 34.3 % of the patients. (26).

Prospective cohort study was done on femoral shaft fractures in patients younger than 16 years managed between 2011 and 2015 in Cameroon. There were 30 femur shaft fractures. Male to female ratio was 1.6: 1. The most affected age group was 0 – 5 years (76 %). The main mechanism of injury was accidental falls (38 %) and RTA (31 %). Non operative management was the mainstay of treatment, in 26/30 cases (18).

An analysis of seasonal variation in many studies shows fractures are more common during the summer, when children are out of school and exposed to more vigorous physical activities (27).

Regarding Ethiopia, there is limited published data. A prospective study was done on treatment of adult (older than 16 years) femur shaft fracture using Perkins traction at Addis Ababa Tikur Anbesa Hospital. A total of 68 patients with 69 femur shaft fractures were involved in the study. Male to female ratio was 8:1. The most common mechanism of injury was RTA (49.2%). The right side was more commonly involved (60%). Two thirds of the fracture were closed (28).

1.4. Significance of the study

The epidemiology of femur shaft fractures is well described in literature from developed countries. Few studies have been published on paediatric femoral fractures in resource-constraint environments like the sub-Saharan African region (29). To the best of my knowledge, there is no published research on epidemiology of femur shaft in children in Ethiopia.

For development of any program aimed at reducing injuries, impacts of injuries and interventions, reliable data is necessary. In other countries, it has been showed that childhood injuries can be reduced by implementation of simple safety guidelines .

2. OBJECTIVES

2.1. General objectives

- To identify pattern of pediatric femur shaft fracture at St.Paul's Hospital Millennium Medical College, AaBET Hospital, Addis Ababa, Ethiopia, 2019.

2.2. Specific objectives

- To determine the sociodemographic characteristics of pediatric femur shaft fractures in SPHMMC, Aabet hospital, A.A, Ethiopia.
- To determine the prevalence of pediatric femur shaft fracture in SPHMMC, Aabet hospital, A.A, Ethiopia.
- To identify causes of pediatric femur shaft fractures in SPHMMC, Aabet hospital, A.A, Ethiopia.
- To identify the treatment patterns of pediatric femur shaft fractures in SPHMMC, Aabet hospital, A.A, Ethiopia

3. METHODOLOGY

3.1. Study setting

The study was conducted at SPHMMC, AaBET hospital which is found at Addis Ababa (the capital city of Ethiopia) .The hospital was established in August 2015 and it is the first trauma center established by the Federal Ministry of Health (FMOH) in collaboration with St.Paul Hospital. Currently the hospital is giving service at neurosurgery, orthopedics & trauma, burn, emergency medicine and critical care departments. It has 37 emergency beds, 11 intensive care unit beds, 22 neurosurgery, 10 general surgery beds, and 65 orthopedic surgery beds (from this 16 are for pediatric cases). Totally there are 4 operating tables.

All children treated in the hospital for femur shaft fractures in the three year period from September 2015 to August 2018 were eligible for recruitment into study.

3.2. Study design

- Institution based retrospective cross sectional study was conducted.

3.3. Source population

-All pediatric patients (cards) with fracture visited SPHMMC,AaBET hospital from September 2015 to August 2018.

3.4. Study population

All pediatric patients' cards treated for femur shaft fractures in SPHMMC,AaBET hospital from September 2015 to August 2018.

3.5. Inclusion criteria

- Patients' age should be between birth and 14 years
- Clearly documented data had to be available in the medical files.

3.6. Exclusion criteria

- Patients with isolated hip fractures (femoral neck and intertrochanteric fractures, slipped upper femoral epiphyses) or physeal injuries.

3.7. Sample size and sampling techniques

All pediatric patients' cards (that were treated between September 2015 and August 2018) that fulfill the inclusion criteria were studied.

3.8. Operational definition

Pediatrics : age from birth to 14 years

Closed fracture: when there is no communication between fracture or fracture hematoma and external environment. When the fracture was not described whether it was closed or open in a patient's card , it was considered as closed fracture.

3.9. Data collection tools and procedures

The data was collected using data collection templates. The patients were divided into five age groups with little modification of the divisions proposed by Kasser and Beaty: group I: Birth to 6 months, group II: >6 months to 2 years, group III: >2 years to 6 years, group IV: >6 years to 12 years, group V: >12 years to 14 years.

The following data was collected using the template: socio-demographic data, causes of fracture, type of fracture (open or closed), season in which fracture occurred, mode of treatment, length of hospital stay. The data was collected by trained orthopedic residents.

3.10. Data processing and analysis

The collected data was checked for completeness. Then it was entered to SPSS version 20.0 statistical package for windows and analysis was made. Data entry was conducted by a trained data clerk.

Descriptive statistics was used to describe the patterns of pediatric femur shaft fracture in Aabet Hospital.

3.11. Data quality assurance

Data collectors were trained. The template was tested before the actual data collection in order to avoid any ambiguity. There was daily supervision. Patient cards with unclear, incomplete data were not included in the study.

3.12. Ethical clearance

Ethical clearance was obtained from institutional review board (IRB) of Saint Paul Hospital Millennium Medical College. Administration of Aabet Hospital asked to get permission to retrieve and review patients' records. Patients medical data were kept confidential.

4. RESULTS

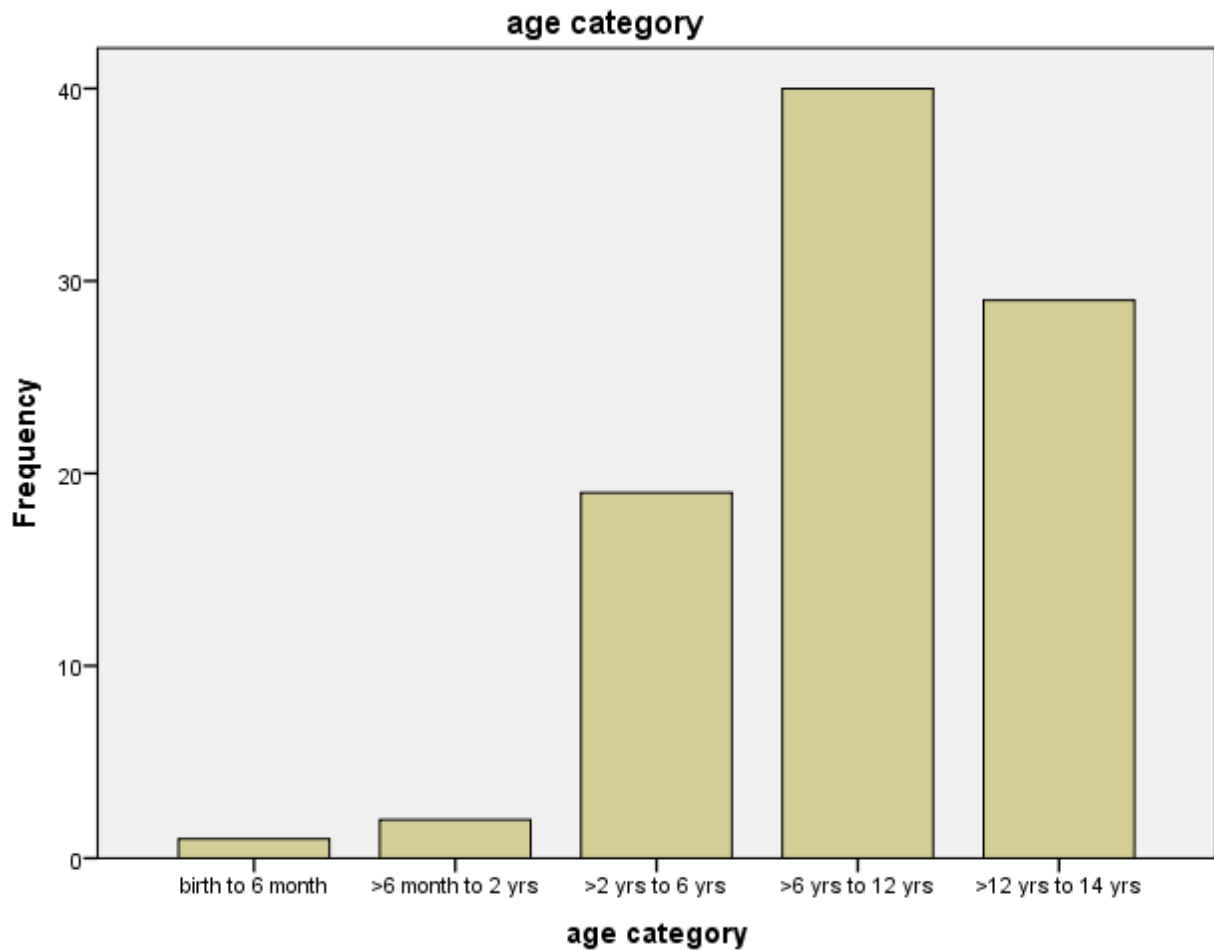
The study was carried out between September 2015 and august 2018. Ninety one patients with total of 94 fractures met the inclusion criteria. The mean age found was 8.8 years, with standard deviation of 3.8 years and median of 9 years. The age ranged from 6 months to 14 years. Majority of the patients i.e. 40 (44%) were in >6 years to 12 years age group, followed by 29 (31.9%) patients in >12 years to 14 years group.

There were 67 males and 24 females with a sex ratio of 2.8: 1. Most of the patients 50 (54.9%) came from Oromia region.

Table 1: General characteristics

Characteristics	Frequency	Percent
Sex		
Male	67	73.6
Female	24	26.4
Age group		
Birth to 6 months	1	1.1
>6 months to 2 years	2	2.2
>2 years to 6 years	19	20.9
>6years to 12 years	40	44.0
>12 years to 14 years	29	31.9
Address : region		
Addis Ababa	26	28.6
Oromia	50	54.9
Amhara	8	8.8
SNNPRS	3	3.3
Somali	2	2.2
Afar	1	1.1
Benshangul-Gumuz	1	1.1

Fig. 1: Distribution of femur shaft fracture by age category



Mechanism of injury

The commonest mechanism was fall 38 (41.8%), followed by RTA 35 (38.5%). RTA was leading cause fracture in >6 years of age (44.9%). Pathological fractures occurred in 8 patients (8.8%. six were due to chronic osteomyelitis and two were due to bone tumor.

Table 2: Mechanism of injury

Mechanism of injury	Frequency	Percent
RTA	35	38.5
Fall	38	41.8
Bullet	2	2.2
Struck by falling object	4	4.4
Pathologic	8	8.8
Hit by stone	2	2.2
Other	2	2.2

Seasonal distribution

Majority of the fractures 33 (36.3%) occurred in a season of *Sene-Nehassie/Pagume* (June to August: this is a season in Ethiopia when children are out of school).

Number of patients with femur shaft fractures seen annually increased from 19 in 2008 E.C to 46 in 2010 E.C.

Side affected

Left femur was involved in 45 (49.5%) patients and right femur in 43 (47.3%) patients. Three patients had bilateral femur shaft fracture.

Associated injury

In addition to femur shaft fracture, 18 (19.8%) patients had another injury. Majority 7 (38.9%) had head injury.

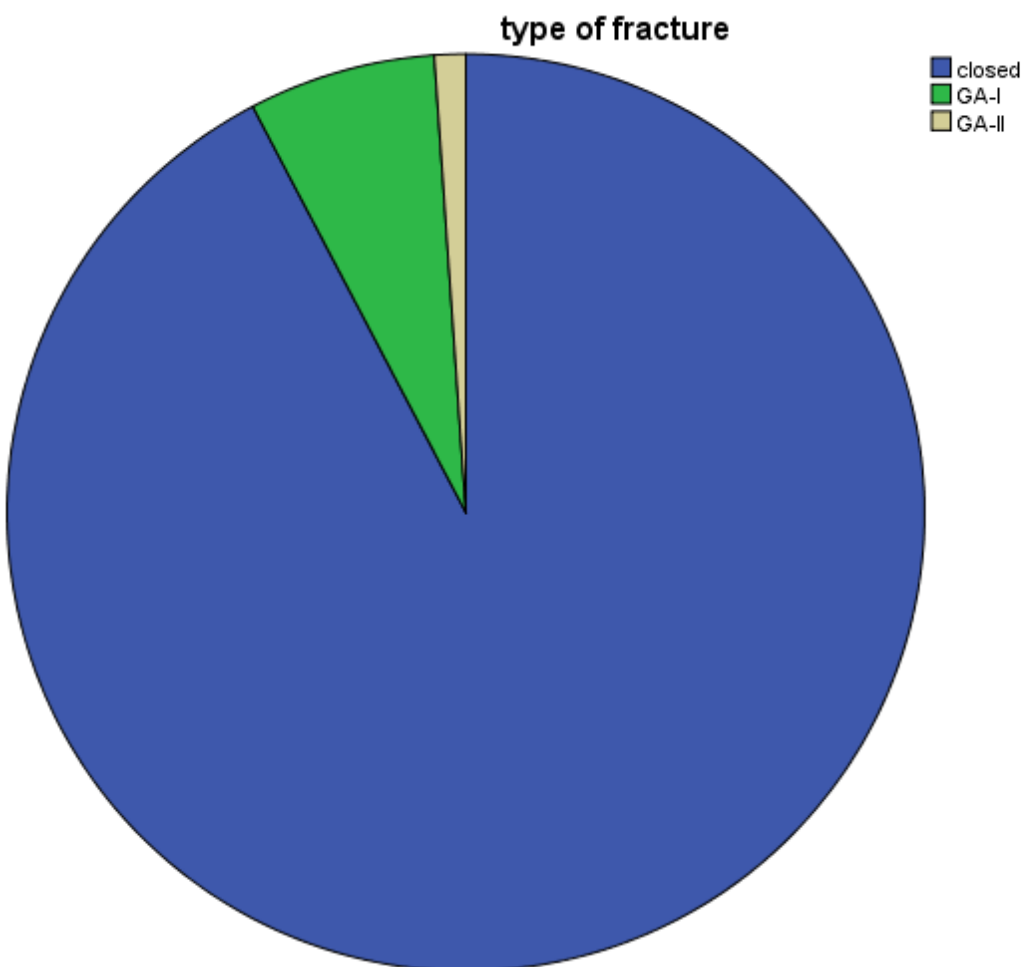
Table 3: Associated injury

	Frequency	Percent
Head	7	38.9
Pelvis, acetabulum	1	5.6
Upper limb	4	22.2
Lower limb	6	33.3

Type of fracture

Most of the fractures 84 (92.3%) were closed.

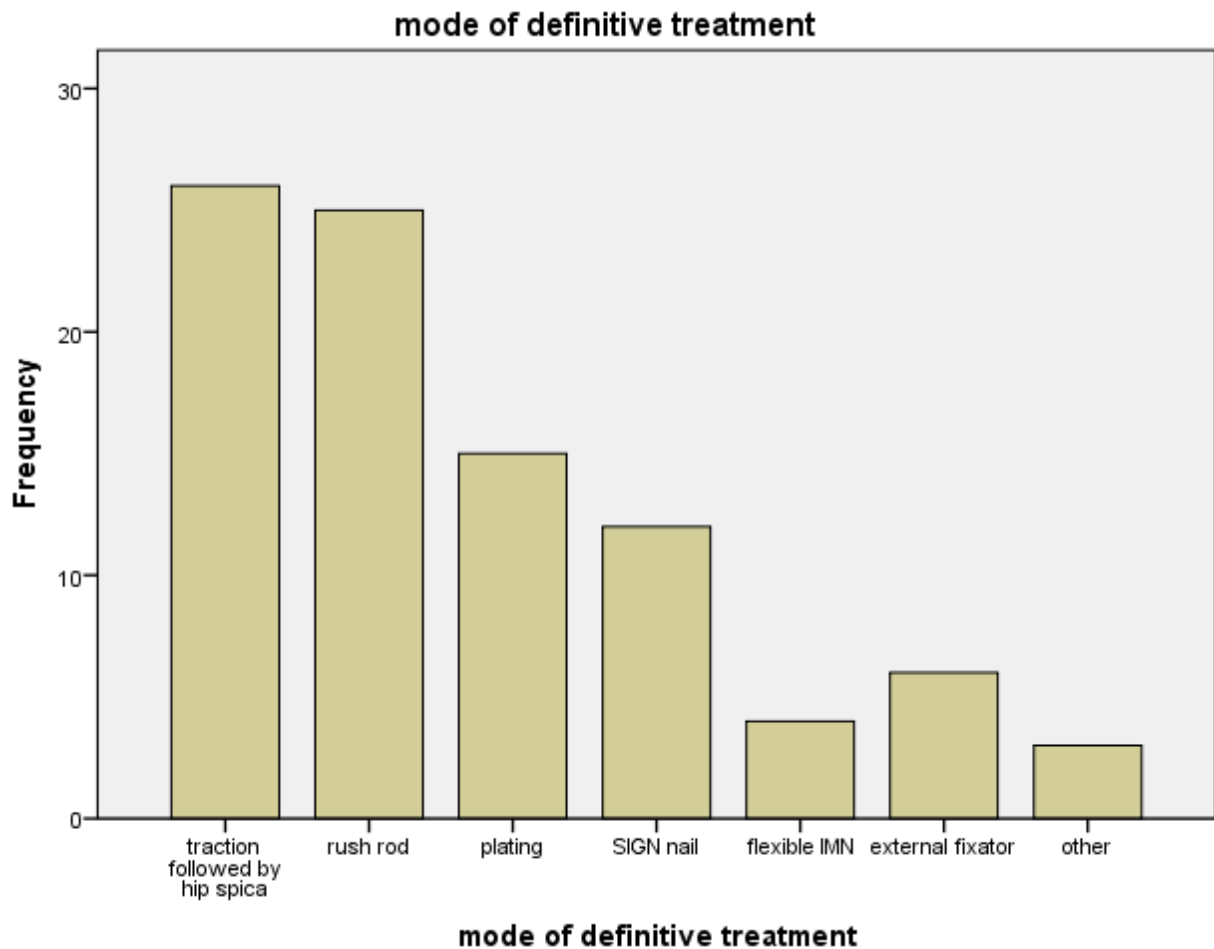
Fig. 2: type of fracture



Mode of definitive treatment

Overall, traction followed by hip spica was the most frequently 26 (28.6%) used treatment method. The second was Rush rod 25 (27.5%).

Fig.3: Mode of treatment



All patients in age group I and II were treated conservatively (hip spica). In age group III traction followed by hip spica was the most common method. SIGN intramedullary nail was the most frequently used treatment method in age group V.

Table 4: Therapeutic pattern by age category

Mode of treatment	Group I : Birth to 6 months	Group II : >6months to 2 years	Group III : > 2years to 6 year	Group IV : >6 years to 12 years	Group V : >12 years to 14 years
Traction followed by hip spica	1	2	16	6	1
Rush rod				17	8
Plating				12	3
SIGN nail					12
Flexible IMN			1	1	2
External Fixator			2	2	2
Other				2	1

Length of hospitalization

Duration of hospitalization ranges from 3 days to 90 days. The mean was 15.3.

5.DISCUSSION

A total of 91 patients were involved in the study and the result showed that male to female ratio was 2.8: 1. Other studies have also found that males outnumber in childhood femur shaft fractures (21, 22, 23). This generalized male predominance is probably due to risk taking behavior that is more common in males.

The mean age of the patients in this study was 8.8 years and it is within the range that other studies have found (23,24).

The most affected age group was 6 years to 12 years. This is probably attributed to decrease in bone mineral density and increased activity in older age group. Other studies showed bimodal age distribution (25).

The main mechanism of injury was fall (41.8%), consistent with findings obtained in Cameroon (18). The study done in England also reported that falls accounted for majority of femur shaft fractures (22).

The study result showed that occurrence of femur shaft fracture during the year peaks in Sene-Nehassie/Pagume (June to August). This may be explained by Sene-Nehassie is a season in Ethiopia when students are out of school. Children during this season (particularly July and August) are frequently involved in different sport activities, play different games. This probably increases risk of fracture. The study done in Sweden found that fracture peaks in March and August. In March sports accidents are responsible for the increase in incidence and in August the increase is caused by traffic accident. (21).

The annual number of patients with femur shaft fractures seen in our hospital increased from 19 in 2008 E.C to 46 in 2010 E.C. This could be due to increased awareness of the community and local health facility to refer to our hospital, which was opened recently in August 2015. The other explanation could be relative advancement of the hospital service over the last three to four years.

In this study 18 patients had femur shaft fracture and associated injuries. Head injury was the most common 7 (38.9%). Six patients had lower limb injuries. The study done by Rajesh K et.al. showed similar finding: head injury was the most common associated injury and the next was tibial fracture (30).

Similarly head trauma was the most common injury (16%) associated with femur shaft fractures in Saudi Arabian trauma center, followed by bilateral femur fractures (31).

This study result indicated that majority of femur shaft fractures 84 (92.3%) were closed. The proportion of open fracture (7.7%) was close to what was found by Cramer et al (8,5%), Ferguson and Nico (9%), Hutchins et al (10%) and Linhart and Roposch (9.8%). (23).

Non operative treatment was the most commonly applied method of treatment (28.6%) in this study. This could be lack of adequate appropriate instruments. Other factors that affect the decision to manage a femoral shaft fracture by conservative or operative means include age and weight of the patient, type of fracture, associated injury/polytrauma and socioeconomic status of the family.

Epidemiological study of children diaphyseal femoral fractures by Cassiano et al found that conservative treatment predominated in the group younger than 6 years of age, and surgical treatment in the group aged 6 to 14 years & 11 months (23).

In our study duration of hospitalization was long. The mean was 15.3 days. This could be due to multiple reasons including lack of operating time and table, lack of standard fixation method, patients may be kept long at emergency OPD waiting for free bed to be admitted.

Von Hedeken et.al. reported that the treatment modalities shifted toward an increased use of operative treatment and hospital stay was decreased by 81 %, from 26 days in 1987 to 5 days in 2005. (21).

5.1. Limitation of the study

The study was retrospective by reviewing patients medical records. Incomplete data from chart was a problem in obtaining information. There was no single case of femur shaft fracture secondary to child abuse encountered during the review, in literatures it is not uncommon to get fractures secondary to child abuse.

5.2. Conclusion

The patients attended at the Orthopedics and Traumatology Service of Aabet Hospital with a diagnosis of femoral diaphyseal fractures were mainly males. The age group most affected was 6 years to 12 years. Majority were from Oromia region. Fall accidents predominated as the etiology. Closed femoral diaphyseal fractures predominated. The most common season was June to August. The number of patients seen annually was increasing. Head injury was the most common associated injury. The treatment most used was conservative.

5.3. Recommendations

Development of safety guidelines, safe playing ground for children at home and school to prevent fall accidents.

Implement road traffic policies to reduce the fracture burden secondary to road traffic accidents.

Increasing surgical treatment option, establishing orthopedic services in other hospitals to reduce duration of hospitalization.

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