

**THE PATTERN OF ANKLE FRACTURES IN
KENYATTA NATIONAL HOSPITAL**

BY

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**A DISSERTATION SUBMITTED IN PART FULFILMENT FOR
THE DEGREE OF MASTER OF MEDICINE IN
ORTHOPAEDIC SURGERY**

DECLARATION

This dissertation is my original work and has never been presented by me or any other person for a degree in any other university

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DEDICATIONS

This thesis is dedicated to my beloved parents who have always been a source of support and encouragement and also my lovely wife Sakina and my daughters Batul and Husseina for the patience and endurance throughout the study.

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ABBREVIATIONS

1. Mm-----millimeters
2. GRF----- ground force reaction
3. US----- United States
4. AO/ASIF-----Arbeitsgemeinschaft fur
Osteosynthesefragen/Association for the Study of Internal Fixation
5. OMA-----Olerud Molander Ankle Score
6. OA-----Osteoarthritis
7. DM----- Diabetes Mellitus
8. KNH-----Kenyatta National Hospital
9. BMI-----Body Mass Index

10. MVA-----motor vehicle accidents

11. MCA-----motor cycle accidents

ABSTRACT

Background

Ankle fractures are among the most common injuries treated by orthopaedic surgeons. The management is dependent on the extent of bony involvement, soft tissue and ligamentous injury.

Epidemiology of these fractures is changing with rise in incidence among elderly population as seen in the Western world and the young population in Africa. The commonest aetiology of these fractures in Africa is road traffic accidents. The treatment of ankle fractures is challenging despite several studies and the advancement of treatment modalities. Kenyatta National Hospital deals with these fractures on a daily basis. This study looked at the pattern of ankle fractures in Kenyatta National Hospital.

Objectives

To determine the pattern and modalities of treatment of adult ankle fractures among patients presenting at Kenyatta National Hospital.

Study design

A cross-sectional prospective analytical study.

Setting

Kenyatta National Hospital orthopaedic unit

Patients and method

Patients with ankle fractures were recruited by the investigator and the assistant. The patients who gave consent and met the inclusion criteria were recruited in the study. A questionnaire was used to determine the age, gender, socioeconomic status, mechanism and type of injuries.

Results

A total of 100 patients recruited over the period of 3 months period. The mean age was 40 years with range of 20-80 years. The sample had 70 males (70%) and 30 females (30%). Most fractures were as a result of motorcycle accidents accounting for 34% and least being assault 2%. 73% had closed injuries 27% open injuries. B2 type being the most common type (35%) of injury. Non-operative treatment of fractures was commonly employed with a proportion of 68% while operative treatment had a proportion of 28%. During the period of study the 54.2% cases healed with no complications while 45.8% cases were associated with complications. Two of the cases were lost to follow up.

Conclusion

The study showed a high rate of fractures due to road traffic accidents secondary to motorcycle injury. The majority were males in their third decade and older women. Weber type B was the commonest type of ankle fractures and most of them treated non-operatively..

INTRODUCTION

Ankle fractures are among the most common injuries treated by orthopaedic surgeons and their management depends on the extent of bone, soft tissue and ligamentous injury(1).

Ankle fracture are usually as a result of low energy and rotational forces(twisting mechanism)(1,2).

Observational studies have shown that the incidence and severity of ankle fractures have risen and mostly occur in elderly populations (3). The incidence of ankle fractures in the United Kingdom is estimated at about 400,000 injuries every year, while in United States of America it was found to be 492 000 per year (3). In Africa the incidence is expected to be higher due to road carnage. In Nigeria, 46.3% of ankle fractures were due to road traffic accidents (4) and in Kenya 69% of patients involved in road traffic accidents had fractures.(5)

Kenyatta National Hospital deals with ankle fracture on daily basis. This injury leads to loss of productive man hours of patients making them unproductive. This study looked at pattern of ankle fractures seen at Kenyatta National hospital and treatment modalities used for these fractures.

Anatomy

The ankle joint is a modified hinge joint which consists of three bones (tibia, fibula and talus) and the ligaments which bind these bones together as a unit(6). The stability of this joint is achieved by both osseous congruity and ligaments around the joint.. The lateral collateral ligament consists of three components: anterior talofibular, calcaneofibular and posterior talofibular ligament. The medial deltoid ligament consists of a superficial and deep portions, the deep being the main ankle stabilizer.

The distal end of the fibula lies on the tibial groove held by strong syndesmosis which has both anterior and posterior tibiofibular components and the thickest part of the interosseous membrane.

There are no muscles attached around the ankle. Eleven tendons and neurovascular structures cross it. Stability of this joint is purely relied on bony configuration and capsuloligamentous structures.

Biomechanical consideration

The ankle joint is subjected to enormous force on a small surface area of contact about 1.5 times body weight on normal gait and 5.5 times body weight during strenuous exercises(1). The three planes of motion in the foot and ankle are defined as sagittal plane, frontal plane and transverse plane. From these axis movements of the foot and ankle can be identified: (plantar) flexion/(dorsi) extension (sagittal plane), inversion/eversion (frontal plane) and abduction/adduction (transverse plane). Supination is a combined movement of adduction, inversion and flexion, and pronation the opposite with abduction, eversion and extension(7). As for kinetics, the foot and ankle must both absorb and transmit forces, both internal and external(8). Ground reaction force (GRF) is usually studied and magnitudes of vertical GRF of between 1.1 to 1.3 times body weight have been reported depending on walking speed(9).

While the ankle was previously known as a simple hinge joint many studies have now shown more complex biomechanics of the ankle joint(10)

Ankle movements range from 5-20 degrees dorsiflexion and 10-40 degrees planter flexion. For normal gait only 10 degrees dorsiflexion and 20 degrees planterflexion are required(2)

,6). The joint is most unstable in planter flexion due to the talus being narrower posteriorly and most of the injuries occur in this position(11).

The role of different ankle structures have been widely studied and the conclusion is that the primary stabilizer of the ankle joint is the lateral fibular complex with the talus(6,12). The tibiofibular dysfunction results in marked talar displacement which correlates with degerative changes (6,8).

In a cadavaric study it was shown that about 1 mm translation of talus reduces the surface area of contact by 42 % and 2mm translation reduces contact by 64%. Decreased area of contact may lead to abnormal distribution of joint forces and hence post traumatic arthritis(2).

LITERATURE REVIEW

Ankle fractures incidence has varied between various studies but most have shown a trend of increase incidence over time(3,14,15). Most of these studies, either had limited number of patients, limited areas or use of a single hospital. They too demonstrate a pronounced rise in elderly women(3,14,15,16). Several studies have shown a switch in sex by age with a greater incidence in younger men and older women(16).Currently in US, ankle fractures reported in as many as 8.3 per 1000, similarly in the Finish population showed a rise in ankle fractures in elderly patients. In Africa most ankle fracture were seen due to road traffic accidents(17). In a Nigerian study 46.3% of all fracture due to road traffic accident had ankle fractures ,while 88% of ankle fractures were due to road carnage in a Ghanian experience(4,61). In Kenya this incidence of ankle fractures is lacking, however 69% of cases seen at Kenyatta National Hospital who were involved in road traffic accidents had fractures.(5)

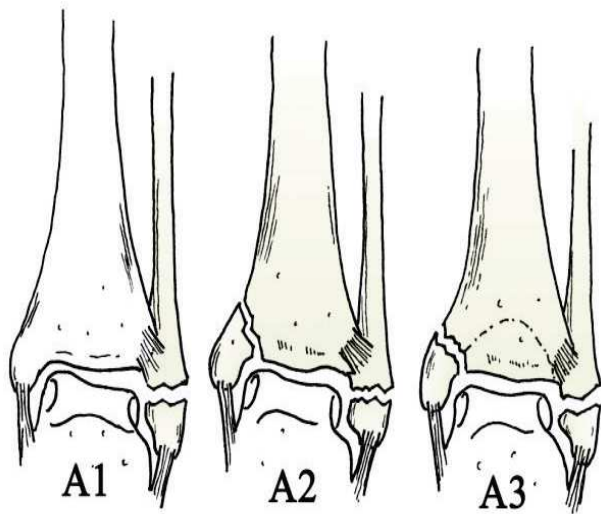
A classification system should be easy to use in daily practice. It should be based on information easily obtained such as patients history, clinical examination and radiological findings. It should also define severity and serve as a basis for treatment. The number of malleoli involved can describe ankle fractures: uni-, bi- and trimalleolar. During the last century, a number of classification systems have been developed. Ashurst and Bromer made the first classification in 1922(18). They divided the fractures according to the vector of trauma in 300 patients: external rotation, abduction and adduction included about 95% of all ankle fractures. The rest were mainly caused by compression in the long axis of the limb(19). The system was further developed by Lauge-Hansen who developed a classification in 1942 after cadaver experiments(20). He named each type by a double name, where the first part defines the position of the foot at the moment of trauma and the second part specified the direction of the dislocating force at the moment of trauma. Lauge-Hansen identified four groups of fractures, each with a number of subgroups: supination-eversion fractures, supination-adduction fractures, pronation-eversion fractures and pronation-abduction fractures(21). The most common fractures are in the group of supination-eversion fractures. Supination external rotation(eversion) accounts 40-75% of all ankle fractures. While others like supination adduction accounts for 10-20%, pronation abduction 5-15% pronation external rotation 7-19%.(6,22 ,23).Lauge-Hansen also described pronation-dorsiflexion injuries. This injury was combined with compression of the joint and is thus not a true ankle fracture. This classification could be used as a guide for closed reduction(24). The Lauge-Hansen classification has been recommended by several authors.(24) However, studies have

shown high interobserver variation and the system described thus became difficult to apply(10,26).

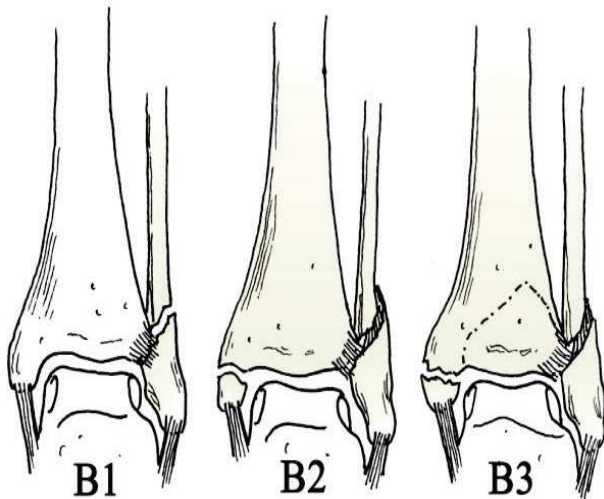
In 1949, Danis described a classification which was more pathological-anatomical and designed for application to operative treatment. This classification is based on the lateral malleolar fracture, syndesmotic disruption and talar instability. This system has later been further developed by Weber and the AO-group founded in 1958(27). The fractures are divided into three fracture types: A, B and C with further subgroups. This division is based on the level of the lateral malleolar fracture in relation to the level of the syndesmosis (Figure 1).The AO (Danis-Weber) classification system does not take the direction or force of injury into account but has been considered easier to use. The interobserver correlation has previously been shown to be good(28). The frequencies of the different fractures have been found to be more stable between studies than for the Lauge-Hansen classification.(29)

figure 1: Ankle fracture classification according to AO group ((Illustration Gunnar

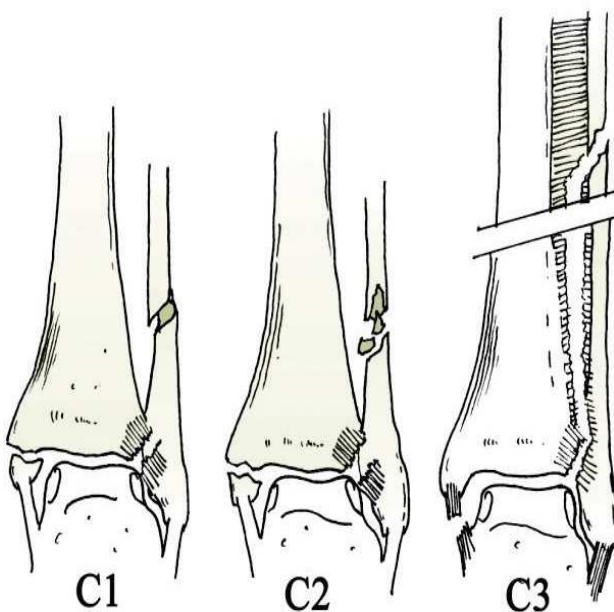
Sandersjö, Ortopediskt traumakompndium)



Fracture type A – injuries below the syndesmosis
A1 – isolated lateral lesion (ligament injury or fracture)
A2 – lateral lesion with a fracture of the medial malleolus
A3 – a lateral lesion associated with posteromedial fracture



Fracture type B – injuries at the level of the syndesmosis
B1 – isolated lateral malleolar fracture
B2 – lateral malleolar fracture associated with a medial lesion
B3 – lateral malleolar fracture associated with a medial lesion and a postero-lateral fracture



Fracture type C – injuries above the syndesmosis
C1 – simple diaphyseal fracture of the fibula with a medial lesion and/or a postero-lateral fracture
C2 – multifragmentary diaphyseal fracture of the fibula with a medial lesion and/or a postero-lateral fracture
C3 – proximal fracture of the fibula with a medial lesion and/or a postero-lateral fracture

According to the Danis-Weber system each fracture type can be correlated with an appropriate type of injury in the Lauge-Hansen classification as shown in table below

Table 1: Danis Weber correlation with Lauge- Hansen classification

Lauge-Hansen classification AO classification

Supination Adduction (S A)	
I	A
II	A
Supination Eversion (S E)	
I	B *
II	B
III	B
IV	B

Pronation Abduction (P A)

I	A †
II	B*
III	C

Pronation Eversion (P E)

I	A †
II	B*
III	C
IV	C

* Interpreted as a type B injury, even without a lateral malleolar fracture. † Medial malleolar fracture, interpreted as a type A injury.

To know the mechanism of injury is of great importance, especially when assessing the soft tissue around the fracture. The magnitude and the direction of force are important factors in determining resultant of injury. The mechanism of injury affects the displacement of the fracture at the injury and therefore the surrounding soft tissue.

Ankle fractures are most commonly caused by low-energy accidents such as fall in the same level which is a resultant of a twisting mechanism(30). High-energy trauma such road traffic accidents, crush injuries or a fall > 5m have been found to be risk factors for soft tissue complications(31). Sports injuries to the ankle are also common and accounts for 20-25%. Road traffic accident was the commonest mechanism of ankle fractures in Africa with higher percentage having open fractures (4,5,32).

The aim when treating ankle fracture is to re-establish the function of the injured joint. This includes reduction of fracture, retention of the reduced position and rehabilitation. This can be achieved either operatively or non-operatively. When deciding which method to use, the fracture, state of the surrounding tissues and patient characteristics and timing have to be considered. "A good closed reduction followed by cast immobilization certainly give a better outcome than a poorly planned and executed open reduction and internal fixation(33). The most common method of non operative treatment is plaster cast immobilization and this is frequently used(10,14,34,35). It is however, essential to master the art of "plastercraft". Charnley attributed the failure of non-operative treatment to inadequate plaster technique. A-O group recommendations for non operative management includes type A isolated fracture with no medial lesion as well as a non-displaced type B fracture with no medial lesion. The favourable outcome of closed treatment of supination external rotation type of injury(type

B) has been supported by many studies .(35,36,37). Closed treatment for displaced fractures has become a lost art, but there are some consideration for this form of treatment in imature skeleton,patient unfit for surgery, fracture through osteoporotic bone and where patient's skin precludes open surgery(35).

Fracture dislocation injuries with ankle mortise incongruity are treated with open reduction and internal fixation to restore joint congruity(26,33,38,39). Contraindication to internal fixation includes infection, paraplegic patient, elderlysedentary patients and patients with multiple life threatening injuries (3). There are varied methods of internal fixation. Palmer, Wiberg and Cedell described non-rigid, adaptive internal fixation techniques with cerclage wiring, staples, pins and small-threaded screws, enough to keep the malleolar fragments adapted, combined with a protective plaster cast during bone healing(39,40).This method is widely used in Sweden. However it is shown that the non rigid technique is not adequate for maintaining congruency in bi maleollar and trimalleolar fractures.Danis developed the principle of absolute fixation which restores bone congruity, allows immediate return of joint movement and allows direct union. This concept was taken up by AO group and spread world wide where the fracture is treated with metal plates and screws(41). Rigid fixation was found to be superior to non rigid fixation in retention of congruency.(13)

The timing of surgery vis a vis time of injury has been debated. Time is not always easy to determine, since time of injury to presentation at hospital may be difficult to specify.

Majority of authors prefered slight delay on the timing of surgery so as to allow the phase of acute inflammation to subside, however delay of more than 3 weeks made anatomic reduction difficult and led to poorer outcomes(1,6,11,42)

Open ankle fractures are considered severe injuries and the principles used in treatment of these fractures is still the same as developed by Gustillo and Anderson. They classified open fractures according to degree of soft tissue damage and contamination.

Type 1 clean wound laceration of less than 1 cm (size of the wound) without evidence of deep muscle crushing and contamination is minimal. Fracture typical of a low energy type.

Type 2 laceration more than 1 cm and less than 10 cm without extensive soft tissue damage fracture due to high energy trauma. Type 3 skin laceration is more than 10 cm and usually divided into three types as follows:-

Type 3a extensive soft tissue laceration flaps adequate to cover bone.

Type 3b extensive soft tissue laceration with exposed bone.

Type 3c open fracture with vascular injury requiring repair. (43)

Gustillo and Anderson classification has been found to have high interobserver variation, despite this limitation still remains the preferred system of classification system.

Some authors advocate for early internal fixation, however, it is advised that for grade 2 and 3 that external fixation should be used to allow soft tissue to heal. Usual sequence in the management of open fracture include Irrigation and debridement of the wound with internal or external fixation of the fracture. Lastly covering of the wound can be achieved primarily or secondary, assisted by skin grafting or by use of flaps(6,44). Irrigation is a key component in open fractures management as it serves to decrease bacterial load and remove foreign bodies. Many guidelines recommend the use of copious amount of irrigation however there is no data which suggests the volume of fluid required for adequate lavage. Early open reduction and internal fixation of open ankle fractures is advocated and leads to good functional outcome, reduced hospital stay and less joint stiffness as compared to conservative

or delayed fixation. Only when there is inadequate soft tissue coverage of osteosynthesis material should external fixators be used(44). Most orthopedic surgeons are now moving towards early closure of open wounds with local flaps and skin grafting after adequate debridement. Grade 1 and 2 types of wound are stitched primarily or left for secondary healing, while grade 3 wounds are closed with local flaps or split thickness skin grafts.(44). Unstable ankle fractures usually have syndesmotic disruption which leads to more pain and poorer functional outcome. A syndesmotic screw is used to fix the disruption of the syndesmosis. There is no consensus to whether use of one screw or two screws and tricortices or tetracortices. However there is no change in patients whose syndesmotic screw/s are removed on weight bearing and non removal of transyndesmotic screw on the outcome.(1,6,35).

The word “complication” commonly used in both clinical setting and scientific publication may not be clearly defined. It could be further explained by definition adverse events, which is any untoward medical occurrence, unintended disease, injury or clinical signs in a subject(46). When discussing local complication following ankle fractures both adverse events following course of healing(soft tissue complication,technical failure) as well as conditions that might be considered as sequelae(gait deviation, osteoarthritis) are usually mentioned. Early soft tissue complication following open reduction internal fixation of ankle fractures may include wound dehiscence,necrosis and infection. Rates of this different types of complication vary between 5-27% according to following studies(29, 47,48).

Reports on technical failure are infrequent in literature. Sometimes different terms such as failed reduction and loss of reduction are used, the latter indicating primary post operative radiograph have been good and failure of osteosynthesis occurred later during post operative period. Technical failure and failed reduction have been reported between 3-6% (29,47,48). Technical failure was found most commonly in unstable fractures treated with non operative measures leading to malunion and non union (34, 49)

Osteoarthritis (OA) is an irreversible condition resulting from mechanical and biological events affecting the articular cartilage and subchondral bone in a joint. The condition is frequently accompanied by pain and stiffness in the affected joint. OA can be divided into primary and secondary types. Primary OA usually develops after the age of 50 and the cause is largely unknown. In secondary OA the cause is identified: infection, ligamentous instability, congenital anomaly, physal separation, haemophilia and fractures are risk factors for developing secondary OA (50). OA in the ankle joint is most frequently of post-traumatic origin, 80% as compared to post-traumatic OA of the hip (2%) or knee (10%) (51). Of the patients presenting with post-traumatic ankle OA, malleolar fractures have been identified as the most common cause (37- 53%) (52).

When evaluating indication for surgery many risk factors must be taken into account. Many studies have evaluated risk factors and ankle surgery, however these have been mostly retrospective.

Age was considered a risk factor for soft tissue complication following ankle surgery, this has been defined by several studies(52). These studies have defined elderly as aged from 50-80 years(52). However these studies found no significant difference in soft tissue complications as compared to controls. Significant difference was found in another study when the cut off age was increased to 65 years(53). When studying age as a continuous variable, mean age of infected patients has been found to be higher, but this was not statistically significant(54). Age alone was not seen as an independent risk factor by Höiness et al. for sustaining a superficial wound infection(47)

These studies described several factors including advanced age beyond 50 years. Fracture type and fracture mechanism. High energy trauma have found to be a risk factor for soft tissue complication(48). Preoperative soft tissue affection after ankle injury is of great importance. Höiness et al. Found about 14% soft tissue affection after ankle injury and also noted that Type B2, Type B3 had higher soft tissue complication rates.(28).

Diabetes mellitus is a chronic disease leading to related comorbidities e.g. vasculopathy, neuropathy and neuroarthropathy of the foot. The burden of diabetes is increasing, especially in developing countries and therefore is an important risk factor to assess(56). Impact of diabetes on ankle fracture include :- increase in hospital mortality, increase in hospital post operative complication and prolonged hospital stay. Several studies conducted showed that the effect of DM on ankle fractures. These studies showed DM lead to higher rates of delayed wound healing, malunion, prolonged immobilization of the injured limb and increased rates wound infection(55).

Patients with a high body mass index(BMI) of more than 25 are said to be over weight, BMI exceeding 30 are obese. As for soft tissue complication or self reported functional outcome, no association with increased BMI was found, although these patients had a high risk of sustaining typeB and C injury. Patients who have higher BMI were found to have displaced ankle fractures(57). Patients with higher BMI also are also very poor in non weight bearing hence leading to poor outcomes.(58)

Alcoholism and smoking have also been shown to have impact on complication rates following surgery. These have been found to increase post operative morbidity especially due to infection, among patients who are consuming five or more bottles of malt beer, 125 mls of whiskey or more then 5 glasses of wine all this equiuvalent to 60 g of ethanol in a day (56,59) . This findings were explained partly by suppressed immune defence by ethanol and inhibited wound healing associated with alcoholism. Further more may lead to delayed bone healing secondary to defective osteoblastic function by ethanol.

Smoking ceasation prior to surgery has been shown to reduce post operative wound infection(59).

JUSTIFICATION

Ankle fractures are among the common injuries and most of them are treated conservatively in our set up. However no data is available on the type of ankle fractures, modalities of treatment and subsequent outcomes seen at Kenyatta National Hospital. This study is designed to be able to discover the sequence in which this fractures presents at Kenyatta National Hospital and modes of management used for this fractures. This study is also aimed to provide a baseline for future studies of this problem. Results from this research will also facilitate change of practice among orthopedic surgeons and residents in Kenyatta National Hospital.

STUDY QUESTION

Is there any difference in the pattern of ankle fractures and their management at the Kenyatta Natonal Hospital as compared to other geographical areas.

OBJECTIVES

Broad objective

To determine the pattern and modalities of treatment of ankle fractures among patients presenting at the Kenyatta National hospital .

Specific objectives

1. To determine the type, mechanism and modes of ankle fracture.
2. To determine the treatment measures used for ankle fractures.
3. To assess the complications of the treatment used.
4. To determine the comobidities affecting ankle fractures

HYPOTHESIS

There is no difference in the pattern of ankle fracture and management as seen in Kenyatta National hospital and other geographical areas(alternative hypothesis)

SELECTION CRITERIA

Inclusion criteria

1. All adult patients above 18 years seen in the accident and emergency, orthopaedic wards, and clinic no. 5 with ankle fractures, who have consented were included in the study.

Exclusion criteria

1. Patients who did not consent .
2. Pediatric age group was excluded
3. Old ankle fractures (more than 3 months)
4. Concomittent fractures on the ipsilateral side.

MATERIALS AND METHOD

Study design

A cross sectional prospective analytical study from 1st May 2014 to 31st Oct 2014

Setting

The patients as seen in accident and emergency,orthopaedic clinic and orthopaedic wards in Kenyatta National hospital. This is a teaching and refferal hospital located in the capital city of Nairobi.

Sample size

Determination of sample size was based on a Ghanain study in the journal medical and biomedical science, where ankle fractures seen accounted about 7% of all skeletal fractures seen(57)

Using Fishers' formula

$$n = \frac{Z^2 PQ}{D^2}$$

Where

n is the estimated sample size.

Z² is the score of confidence interval at 95% and is 1.96².

P is the prevalence in this case at 7% and Q is 1 – P.

D² is the degree of error which is 0.05²

Therefore

$$n = \frac{1.96^2 \times 0.07 (1 - 0.07)}{0.05^2}$$

N= 100 patients

Table 2 : results of a survey done on the number of ankle fractures seen

Y e a r	Plaster applied	Inpatient care	t o t a l
2 0 1 0	3 8 0	6 7	4 4 7
2 0 1 1	3 7 4	7 8	4 5 2
2 0 1 2	4 0 0	7 0	4 7 0

average patient seen per month is about 38 patients and in 3 months comes to about 114 patients.

ETHICAL CONSIDERATION

Ethical approval was sort from KNH/UON ethical committee. Consent was obtained from the patients.

Information obtained from the patients was treated with utmost confidentiality and questionnaires were destroyed on completion of the study

DISSEMINATION

Information acquired will be distributed as follows:-

A copy to department of orthopaedics, copy to the school library and excerpts extracted and published in peer review journals

METHOD OF COLLECTIONS

Patients with ankle fractures as they came in to Kenyatta National Hospital were seen by the medical officers, plaster technicians and orthopedic residents. The above group was alerted and through the research committee for KNH posters were printed with contacts of the primary investigator. The assistant was trained by the principal investigator on collection of data from patients, so that in the event the primary investigator was not able to capture patients then it was done by the assistant. All patient follow up was done by the principal investigator.

METHODOLOGY

Patients with ankle fractures as evidenced by radiographs were selected from accident and emergency, orthopaedic clinic and orthopaedic wards in Kenyatta National Hospital.

Collection of data was case based as patients presented to Kenyatta National hospital. The patient who gave consent the following data was extracted by use of a questionnaire i.e. the patient's age, sex, body mass index (BMI), diabetes status and other risk factors such as alcohol use and smoking. Additionally, the fractures mechanism was also examined in terms of a fall from same level, fall from height, road traffic accident and assault. Ankle fracture of each individual was then classified according to AO Weber classification. The treatment modality used was indicated at the first meeting of the patient. Patients were then followed up and came for review after 6 weeks and 12 weeks. Two Radiographs (AP and lateral) were done at 6th and 12 weeks of the follow up for all patients. During the follow up period patient were assessed in terms of healing and maintenance of reduction for the non-operative method, and wound complications healing and maintenance of reduction for the operative group. Most of the data collected by the chief investigator and a trained assistant. During the descriptive analysis, the frequency and percentages were obtained. The association between the outcomes and the independent variables including risk factors type of ankle fractures and treatment modalities was obtained through the use of chi-square test.

RESULTS

This study collected data from 100 participants. A descriptive analysis was done of the age, sex, type of fracture, types of treatment, alcohol consumption, smoking use, diabetes history and the aetiology of fracture.

Table 3: Summary table of characteristics of study participants

	Frequency	Percent
S e x		
F e m a l e	30	30
M a l e	70	70
A g e		
20 - 35	4	4
36 - 50	4	4
51 - 65	1	1
66 - 80	5	5
Smoking status		
N o	72	72
Y e s	28	28
Alcohol use		
N o	50	50
Y e s	50	50
Diabetes mellitus		
N o	95	95
Y e s	5	5
B M I		
Underweight	5	5
Normal Range	73	73
Overweight	19	19
O b e s e	3	3

The mean age is of 40 years with a range of 20 years to 80 years. The sample had 70 male cases, and 30 female cases. A majority of the cases did not smoke. Alcohol consumption was evenly distributed amongst the participants. Five of the participants had diabetes mellitus.

Table 4 Age sex difference among the group

Age group	Females	Males	Proportion of males (%)			
20 - 35	8	3	2	8	0	
36 - 50	2	3	0	6	8	. 7 5
51 - 65	6	1	7	5	4	. 5 4
66 - 80	4	1	6	6	6	. 6 7

Most common age group being 36-50 years and also 20-35years with both groups having male preponderance.

Causes of fractures

Most of the fractures resulted from motorcycle accident. These accounted for 34.00% (n=34) of the fractures. Assault accounted for the least number of fractures with a proportion of 2.0% (n=2)

Table5: Patient distribution by fracture Cause

	Frequency	Percent		
A s s a u l t	2	2	.	0
Fall from Height	8	8	.	0
Fall at level ground	2	6	2	6
M C A	3	4	3	4
M V A	1	0	1	0
Pedestrian type	2	0	2	0
T o t a l	11	0	0	1 0 0

MCA(motorcycle accidents), MVA(motorvehicle accidents)

Fracture classification and types

Table 6: Patient distribution by AO Weber classification

	Frequency		Percent	
A 1	1	1	11.00	
A 2	1	1	11.00	
B 1	1	2	12.00	
B 2	3	5	35.00	
B 3	5	5	5.00	
C 1	1	5	15.00	
C 2	1	0	10.00	
C 3	1	1	1.00	
Total	1	0	0	1 0 0

B2 was found to be the most common type accounting for 35% with C3 being the least common type of fracture according to AO weber classification.

Table 7: Patient distribution by fracture type

	Frequency		Percent	
Closed	7	3	73.00	
Open	2	7	27.00	
Total	1	0	0	1 0 0

Table 8: Patient distribution by management

	Frequency		Percent	
Non-operative fractures	6	8	68.00	
Operative	2	8	28.00	
Late presentations	2	2	2.00	
Lost to follow up	2	2	2.00	
T o t a l	1	0	0	1 0 0

Non-operative modality of treatment was the most commonly used with a proportion of 68% (n=68) while operative cases had a proportion of 28% (n= 28). Two patients presented late and required operative treatment but was not done due to finances, while two patients were lost to follow up during analysis

Outcomes.

Table9: Patient distribution by outcomes

	Frequency	Percent
Fracture united with no complication	5	25.4%
Fractures with complications	4	44.5%
T o t a l	19	61.0%

Table 10: patient distribution with non operative treatment

A O	W e b e r	Closed fractures	Open fractures	Complications(delayed union, malunion, non union)
A	1 1	1 0		3 (27%)
A	2 6		1	2 (28.5%)
B	1 1	1 0		4 (36.3%)
B	2 1	8 3		10 (47.6%)
B	3 2		0	2 (10.0%)
C	1 9		0	6 (67%)
C	2 4		2	4 (67%)

Table 11: patient distribution with operative treatment

A O	W e b e r	Closed fractures	Open fractures	Complication(wound infections, malunion, non union)
A	2 4		1	1 (20%)
B	1 1			0
B	2 8		6	4 (28.5%)
B	3 1		0	0
C	1 3		3	1 (17%)
C	2 2		2	2

Most of the fractures beyond B2 type treated non operatively had higher rates of complications then treated operatively. Least complications found in both A1,A2 non operatively treated and C1,C2 treated operatively

Table 12: patient outcomes with risk factors

V a r i a b l e	Fracture healed	complications	Chi square test	P-value
	n	n		
S m o k i n g				
N	6	6	0	1
Y	1	1	8	9
A l c o h o l				
N	3	4	0	1
Y	1	2	8	9
Diabetes mellitus				
N	5	0	4	1
Y	1	2	3	0.581
Fracture type				
C l o s e d	3	6	3	0
O p e n	1	6	1	5
Management*				
Late presentation		0	2	0
Non operative	3	4	3	2
o p e r a t i v e	2	0	8	6

*information missing for two participants

5% of patients had diabetes and 60% of these had complication following treatment.

Alcohol usage among patient is 50% and 56% associated with complications. Cigarette smoking among patients is 28% with 64% with complication.

DISCUSSION

In six months study period 100 patients who sustained ankle fractures were recruited over 3 months. This corresponds to approximately 6 patients per week. Thus burden of ankle fractures is quiet significant. Overall percentage found in this study is somewhat lower than previously reported(3,14,15). This could be attributed to lack of funds to seek medical help

and also use of traditional bone setters in management of fractures. In many developing countries traditional care of diseases remain popular despite civilization and availability of modernised health care. Study done in Nigeria showed a higher numbers of traditional bone setters as compared to other care givers(60). There are also bone setters in kenya of which information regarding them is scanty in literature.

Studies have shown fairly equal sex distribution, However this study had male preponderance(14,29). This was also different from a local study in Kenya which had a female preponderance and it could be due to lower numbers seen in the study(49). The mean age also differed among men and women. In the study Men had their peak incidence in third decade of life while women in their third and fifth decade which was consistent with other studies(49). The bimodal distribution of this fracture is as a result of younger men with higher incidence of road traffic accidents while older women most commonly sustaining injuries secondary to trivial falls.

As in previous studies, fall in the same level was dominating mechanism of injury. In this study injuries relating to motorcycle accidents accounting for 34% (9,15,62). This was consistent to study by Gichuhi, where motorcycle injury incidence is much higher than pedestrian(4,61). This high rate could be attributed to rise in motorcycle as means of transport in the region around Nairobi. According to the regional traffic unit majority of motorcycle drivers are without proper driving licence leading to careless and reckless driving culminating to high rates of road traffic accidents. High energy trauma was more common in males and most of them were open injuries. This findings emphasizes the pattern of ankle fractures with younger men with higher rates of high energy fractures.

Fracture classification according to AO weber, type B2(35%) is shown to be the most common type of fracture which is consistent with most of the studies(9,27,30). Besides bone classification it is necessary to evaluate surrounding soft tissues. Most of the fractures found to be closed injuries accounting to 73%. Open ankle fractures are rare with reported rates of 2-5%(11). However this study found a rate 27.0 % attributed to increase in high energy injuries due to motorcycle and motor vehicle accidents.

Most common mode of treatment of ankle fractures was non operative at 68.00% while 28.00% of ankle fractures were operated. Some studies suggest that non operative management should be reserved for undisplaced, stable ankle fractures and for patient who are medically unfit for operation. While unstable fractures are better operated.(11).In a recent cochrane review, surgical treatment was compared with non surgical treatment with long term functional outcome. This review included four studies and were unable to sufficiently conclude whether to operate or not(62). High rate of non operative treatment was thought to be due overcrowding of orthopaedic wards, lack of funds and patient choice for the non operative management.

The study found high rate of complication for type B and C treated non operatively than treated operatively. This was similar to Pugh et al who also showed high complication and failure rates for type B and C which were treated non operatively.(63). Type B and C are considered to be unstable fractures and similar study done by Makana showed better outcome in patients who were operated than the non operative group in terms of range of motion, pains and swelling and instability of the ankle joint(34).

Risk factors including alcohol, cigarette smoking, diabetes mellitus and high body mass index were assessed. In this study only 5% patients were found to have diabetes and 60% of these had complications and fracture did not heal. These results are consistent with many studies which demonstrated that patients with diabetes have higher rate of complications and more severe complications than other patients(55). However specific outcomes were difficult to compare in this study due to the small number of patients. There is a positive correlation between alcohol and cigarette smoking to poor fracture healing, failure rates and wound complications following surgery this was consistent with other studies reporting high rates of non union wound complications infection in patients who consumed alcohol.

LIMITATIONS

1. Risk factors were assessed clinically using patient's history and no special test was done to evaluate the risk factors.
2. Follow up was short because of student time constraints

3. Inadequate funds.

CONCLUSIONS

In conclusion the study showed high rate of fractures due to motorcycle accidents. Majority were males in their twenties and older women. Type B being the commonest type of ankle fractures. Non operative treatment was the commonest mode of treatment offered even for fractures which needed operations the lead to higher complication rates among the mode of treatment offered.

RECOMMENDATIONS

From this study accident and fall were shown to be the most common cause of ankle fractures. Accidents were seen in three categories pedestrian, motorcycle and motor vehicle. A significant number was due to motorcycle injuries. There is need for good road safety measures concerning especially motorcycle to reduce the trauma burden.

Most of ankle injuries were treated non operatively, there is need for a protocol to be developed to ensure appropriate management of ankle fractures. This will reduce the number of fractures inappropriately managed .

There is need for a larger, longer and multicentre study of ankle fracture management to make more appropriate recommendations..

Quantitative study for risk factors is proposed as there is a positive correlation with risk factors and fracture also subsequent healing.

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APPENDIX

CONSENT BY THE PARTICIPATING PATIENT/ GUARDIAN

Study No.....

HospitalNo.....

Principal investigator: Dr Mustafa. Khanbhai

Authorized by : Kenyatta National Hospital Ethics & Research Committee

Introduction

Ankle fractures are among the commonest injuries that occur in the society at large. Most of these fractures are managed conservatively. Patterns and modality of management are poorly studied. This study aims to fill this gap.

You are invited to participate in this study which will look at patterns of ankle fracture and modalities used in management. Kindly read this form and understand it well before agreeing to this study. Any questions you have will be answered.

Purpose of the study

The purpose of this study is to determine the patterns of ankle fractures in Kenyatta National Hospital and modalities used in their management. Lastly, information obtained will be used for purposes of obtaining a Master degree in Orthopedic Surgery for the principal investigator.

Study procedure

If you agree to participate in this study, your particulars will be recorded in the data collection sheet. Patients who meet the criteria history of injury will be taken in terms of mechanism of injury, history of alcohol, cigarette smoking and diabetes mellitus. The type of fracture will be noted and management used. Post management check x-ray and achievement of reduction. Routine follow up at 6 and 12 weeks. The radiographs taken after 6 and 12 weeks on routine follow up will be reviewed. Complication following all modalities of treatment will be assessed clinically.

Risks and benefits

There is no harm or risk anticipated in participating in this study. There is no added radiation risk associated with taking of x-rays. Participation in this study will result in better management of patients with fractures of the ankle.

Study costs

If you accept to take part in this study, there will be no payment expected from you or to you.

No added investigations will be required and x-rays done will be as per routine post-operative management and follow up of these fractures.

Confidentiality

The data collection sheet is strictly confidential. Your name will not appear in it and your telephone number is strictly for follow up purposes. If you so wish you will be given a copy of this consent form.

Participant information

Your participation in this study is voluntary and failure to participate or withdrawal from the study will not affect your management in any way at any stage.

Participant consent form

I have understood the above information which has been fully explained to me by the investigator and I voluntarily consent to participate.

Signature.....

Or participants thumb print.

For any enquiries or further clarification, please contact the following people

1. PRINCIPAL INVESTIGATOR :- DR MUSTAFA. KHANBHAI TEL :- 0733 248147/
0721444369

For any conformation of authority and complains please contact

1. CHAIRMAN, KENYATTA NATIONAL HOSPITAL ETHICS & RESEARCH COMMITTEE –
Tel 0722 70880

KIBALI CHA RUHUSA YA KUHUSIKA

Numbariyahospitali_____

Utafiti ya matokeo ya wagonjwa waliovunjika mguu karibu na kisigino. Ninafanya utafiti kuhusu wagonjwa waliovunjika mfupa wa mguu karibu na kisigino. Namna walivunjika, tumizi ya pombe na sigara, ugonjwa wa

sukari.Tafadhali soma fomu hii na kuielewa vizuri kabla ya kukubali utafiti. Maswali yoyote utakayokuwa nayo yatajibiwa.

Sababu ya utafiti

Lengo ni kupata taarifa juu ya wagonjwa waliovunjika mifupa ya mguu karibu na kisigino.Huu utafiti utasaidia pia katika mabadiliko ya usimamizi wa sera ya majeraha hayo katika hospitali na nchi kwa ujumla. Taarifa itakayopatikana ni muhimu pia kwa kufikia shahada ya uzamili katika upasuaji wa mifupa (orthopaedic surgery) kwa mpelelezi mkuu.

Utaratibu wa utafiti

Habari kuu inayohitajika kutoka kwako ni maelezo yako kama katika karatasi ukusanyaji. Namna ya majiraha, utumizi ya sigara na pombe, matibabu kama plaster ama upasuaji ilitumika kwa hiyo frakchari ya mguu.Picha ambazo zitapigwa kama mandelezo ya matibabu yako zitafanywa baada ya wiki sita na mwezi tatu. Utafuatiliwa kwa muda wa mwezi tatu.

Hatari na manufaa

Hakuna hatari zozote zinaweza kutokea kwa kushiriki katika utafiti huu.Hakuna hatari zaidi itatokana na kupigwa picha ya mkono na pia hakuna gharama zaidi zitatozwa kwa kushiriki katika utafiti huu.

Usiri

Ukusanyaji wa karatasi takwimu ni madhubuti ya siri. Jina lako hatilitaandikwa na nambari yako ya simu ni madhubuti kwa ajili ya kufuatilia makusudi. Kama unataka utapewa nakala ya fomu hii ya ridhaa.

Habari kwa mshiriki

Ushiriki wako katika utafiti huu ni hiari yako na kushindwa kushiriki au kujiondoa kutoka utafiti huu, hautaadhiri usimamizi wako na matibabu yako katika njia yoyote katika hatua yoyote.

Fomu ya mshiriki wa ridhaa.

Mimi nimeshaelewa maelezo nimeyoambiwa kikamilifu na mpelelezi na nitashiriki kwa hiari yangu kwa kutia sahihi kwa ridhaa.

Sahihi

Au kidole gumba cha mshiriki.

Kama una maswali yoyote au wasiwasi kuhusu utafiti huu unaweza kuwasiliana na mtafiti anayefanya utafiti huu Dkt mustafa numbari ya simu 0721444369, barua pepe kwa musu052@yahoo.com au Mkurugenzi,KNH / Chuo Kikuu cha Nairobi - Maadili Kamati ya UchunguziSimu:- 726300 – 9 or (254 - 020) 2726300 Ext 44102

APPENDIX 2

Data collection sheet

Study no _____ patients contact _____
 Age : _____
 Sex : male _____ female _____ weight _____ height _____ BMI _____
 Cormodities _____
 History of smoking, alcohol abuse, if having diabetes _____
 If alcohol usage how much either social drinker or everyday consumption. _____
 Smoking how many pack years _____
 Mechanism of injury _____
 Classification of injury according to radiographic views _____
 AO weber classification type _____
 Type of fracture _____
 Open _____ closed _____
 Mode of treatment used nonoperative _____ operative _____
 If non operative was fracture well reduced, how many times was it maniulated _____
 Joint congruity in post reduction plus paster xrays achieved _____
 If not was there remanipultion yes or no _____
 If above is operative timing of surgery _____ days
 Rigid or non rigid fixation _____
 Hospital stay _____
 If open fracture mode of treatment used _____
 Infection accessed clinically present absent during hossipital stay _____
 Restoration of joint congruity on post operative xrays _____
 Reoperation _____
 Fusion _____
 Follow up _____

	6 w e e k s	1 2 w e e k s
Type of complication		
Wound status		
Well healed		
dehiscence		
Necrosis		
Infection if presence of p		
P a i n		
S w e l l i n g		
Healing assesed using radiographic evidence of callus,		
Function of the joint		
Dorsiflexion (degrees)		
Planterflexion		
(measured using a goniom		
Implant failure		
Plaster failure		
Neglected ankle		

Appendix 3.

IMPLEMENTATION SCHEDULE

P r o p o s a l w r i t i n g	O C T 2 0 1 3 - A P R I L 2 0 1 4
P a t i e n t r e c r u i t m e n t	M A Y 2 0 1 4 - J U L Y 2 0 1 4
F o l l o w u p	A U G 2 0 1 4 - O C T 2 0 1 4
Data analysis and dissertation writing	N O V - D E C 2 0 1 4
R e s u l t s p r e s e n t a t i o n	J A N 2 0 1 5

BUDGET

<u>R e s e a r c h f e e s (K N H / E R C)</u>	<u>3 , 0 0 0</u>
<u>S t a t i o n e r y</u>	<u>1 0 , 0 0 0</u>
<u>S t a t i s t i c i a n</u>	<u>4 0 , 0 0 0</u>
<u>R e s e a r c h a s s i s t a n t s</u>	<u>4 0 , 0 0 0</u>
<u>C o n t i n g e n c i e s</u>	<u>1 0 , 0 0 0</u>
<u>T o t a l (K S h s)</u>	<u>1 0 3 , 0 0 0</u>