THE UNIVERSITY OF NAIROBI

PATTERN OF ACUTE FOOT INJURIES IN PATIENTS SEEN AT KENYATTA NATIONAL HOSPITAL

Research dissertation in partial fulfilment of the requirement of the Masters of Medicine in Orthopaedics Surgery at the University of Nairobi.

PRESENTED BY

DR. NDEDA DUNCAN ANTONY OKELO

H58/80804/15

ORTHOPAEDIC SURGERY RESIDENT

UNIVERSITY OF NAIROBI

2020

UNIVERSITY OF NAIROBI

Declaration of Originality Form

This form must be completed and signed for all works submitted to the university for examination.

Name of student _____

Registration Number_____

College _____

Faculty/School/Institute _____

Department_____ _____

Course Name_____

Title of the work _____

_____

_____

_____

DECLARATION

1. I understand what plagiarism is and I am aware of the University's policy in this regard,
2. I declare that this (Thesis, project, essay, assignment, paper, report, etc) is my original work and has not been submitted elsewhere for examination, award of a degree or publication. Where other people's work or my own work has been used, this has properly been acknowledged and referenced in accordance with the university of Nairobi's requirements.
3. I have not sought or used the services of any professional agencies to produce this work.
4. I have not allowed, and shall not allow anyone to copy my work with the intension of passing it off as his/her own work.
5. I understand that any false claim in respect of this work shall result in disciplinary action, in accordance with University Plagiarism Policy.

   Signature_____

   Date_____

DECLARATION BY SUPERVISORS

This dissertation is being submitted for examinations with our approval as the university supervisors:

DR. TOM MOGIRE

Consultant Orthopaedics Surgeon

Lecturer department of orthopaedics surgery, University of Nairobi

MBChB (UON), Mmed Surg (UON), H. Dip Ortho (S.A), FCS Ortho (ECSA)

SIGNATURE……DATE……..

DR. EZEKIEL OBURU

Consultant Orthopaedics Surgeon

Lecturer department of orthopaedics surgery, University of Nairobi

MBChB (UON), Mmed Surg (UON), MRCSEd, FRCSEd (Trauma&Ortho)

SIGNATURE……DATE……

APPROVAL OF THE CHAIRMAN, DEPARTMENT OF ORTHOPAEDICS SURGERY, UNIVERSITY OF NAIROBI

DR. VINCENT MUTISO

MBChB (UoN), Mmed surgery (UoN), FCS, Fellow AO - International

SIGNATURE……DATE…….

DEDICATION

I dedicate this study to my wife Dr. Veronica Mutinda, for her unreserved love, support and inspiration and my wonderful son Nate, for enduring lonely days and nights while I was away on duty.

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to the almighty God for the gift of life, good health and strength.

My supervisors, Dr. Tom Mogire and Dr. Ezekiel Oburu for their invaluable input and support in the process of drafting the proposal to final dissertation and presentation.

I would also like to thank the reviewers at UoN/KNH review and ethics committee whose input helped to improve the quality of this study.

To the doctors working at KNH Accident and Emergency department, orthopaedics wards and outpatient orthopaedics clinic, your timely alerts whenever there was a potential participant cannot go unrecognized.

I would finally like to thank all the patients who agreed to be interviewed and be examined to ensure I collect the desired data.

To my dear parents, for your love, prayers and daily encouragement to keep soaring high in education.

ABBREVIATIONS

PIPJ……..PROXIMAL INTERPHALYNGEAL JOINT

IPJ**…….**INTERPHALYNGEAL JOINT

DIPJ…….DISTAL INTERPHALYNGEAL JOINT

MTPJ…….METATARSAL PHALANGEAL JOINT

RTA…….ROAD TRAFFIC ACCIDENT

SPSS……..STATISTICAL PACKAGE FOR SOCIAL SCIENCES SOFTWARE

KNH……..KENYATTA NATIONAL HOSPITAL

A&E……...ACCIDENT AND EMERGENCY

UON……..UNIVERSITY OF NAIROBI

FASS……..FOOT ANKLE SEVERITY SCALE

AOFAS……AMERICAN ORTHOPAEDIC FOOT AND ANKLE SOCIETY

UAE……..UNITED ARAB EMIRATES

AIS……ABBREVIATED INJURY SCORE

ISS…….INJURY SEVERITY SCORE

ARDS……ACUTE RESPIRATORY DISTRESS SYNDROME

UK…….UNITED KINGDOM

PGIMER....POST GRADUATE INSTITUTE OF MEDICAL EDUCATION AND RESEARCH

DGU…….DEUTSCHE GESELLSCHAFT FUR UNFALLCHIRURGIE

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

Background

Foot injuries are common worldwide and are among the leading causes of morbidity and disability in the human population. This study's aim was to establish the pattern of foot injuries seen at Kenyatta National Hospital (KNH).

Objectives: To determine the pattern of acute foot injuries in patients seen at KNH.

Methodology and Study setting: This was a cross sectional descriptive study carried out at KNH casualty, wards and clinic between November 2019 and February 2020.The target population was patients who presented with acute foot injuries and fulfilled the inclusion criteria. A sample size of 150 patients was established using the Cochrane's formula and consecutive sampling technique used to select participants. Data collected included the cause of injury, nature of injuries, severity of injury using Foot and Ankle Severity Scale (FASS) and associated injuries.

Data Analysis: Chi-Square test for categorical data to analyze the differences in patterns of foot injury among patients. The data was analyzed using SPSS version 24.

Results: Foot injuries were present in 18.1% of all orthopaedic surgery in –patients admitted in KNH. Majority of the patients who suffered foot injuries were males constituting 82.1% of all cases compared to females a 17.9%. The leading cause of the foot injuries was road traffic accidents (65.6%) followed by industrial injuries (10.6%).Fractures constituted majority of foot injuries (56.3%) followed by skin laceration and loss at 37.1% and tendon injuries 13.2%. Most patients suffered simple foot injuries (67.7%) and the rest (32.3%) severe foot injury based on the FASS. Only fall from height over 3 metres showed an association with severity of foot injuries. Majority of the foot injury patients seen had associated injuries (64.9%).

Conclusion: Males are more prone to foot injuries compared to females. Foot injuries are commonly caused by road traffic accidents, industrial injuries and falls. The largest proportion of foot injuries fall under the category of simple injuries though severe injuries also constitute a significant number statistically.

Recommendations: Further studies on motorcycle associated foot injuries, industrial foot injuries and long term outcomes of foot injuries should be carried out.

CHAPTER ONE:

INTRODUCTION

Foot injuries are common worldwide. Around 7-11% of all trauma cases worldwide involve the foot (1–3).

The foot despite being the principal weight bearing organ receives negligible attention from your average orthopaedic surgeon especially in acute trauma setting where the surgeon focuses on life-threatening and limb-threatening conditions. Studies have shown the most commonly missed extremity fractures in polytrauma patients are foot fractures, this may have serious clinical and medical legal ramifications (4,5).

The incidence, severity and mortality of polytrauma patients has been shown to be declining over the years (6,7) but injuries to the foot did not change in comparable ways in polytrauma patients (8,9). Improvements in safety measures in automobiles and motorcycles do not seem to affect injuries to the foot (9).

The foot is the most vulnerable part of the body to industrial accidents and injuries (10).

Various studies have been done in other settings to determine the causes, patterns and severity of these injuries. Most of these studied specific types of foot injuries (11,12), foot injuries in specific patient populations (13,14) or foot injuries related to specific mechanisms of injury (15–17).

The objectives of each of these studies were however different and the outcomes also differed depending on which part of the world the study was carried out.

There was no study or publication in our Kenyan setting on pattern of foot injuries and this was the justification for this study to establish the pattern of acute foot injuries seen in a tertiary trauma institution in Kenya.

1.1 Problem Statement

The cost of treating foot injuries is high, both directly and indirectly hence understanding the causes, severity and outcomes of these injuries in our setting is essential. Several studies have shown that multiply injured patients with foot injuries have worse outcomes and morbidity compared to those without foot injuries (18–21).

It was also paramount to establish the causes and severity of foot injuries for purposes of compensation, claims processing and psychological preparation of the patient regarding the outcome of these injuries.

Mitigation and prevention strategies against foot injuries can also be instituted after establishing the causes and severity of foot injuries including safety regulations and requirements at the workplace and automobile and motorcycle safety designs.

1.2 Study Question

What is the pattern of acute foot injuries seen at Kenyatta National Hospital?

CHAPTER TWO:

LITERATURE REVIEW

The foot is one of the most important part of a human body. It bears the full body weight on standing and aids in locomotion of the human body.

Understanding the foot anatomy and function, physical examination of injured foot is paramount on deciding the appropriate approach to use in formulating a management plan.

2.1 Bone Anatomy:

The foot and toes have plantar (volar) and dorsal surfaces, medial and lateral borders.

The foot has 26 bones and 4-5 sesamoid bones (22,23).

The foot is divided into forefoot, midfoot and hindfoot (22, 23).

The foot has 57 articulations. Subtalar joint, Chopart joint, Lisfranc joint, metatarsophalangeal joint (MTPJ) proximal interphalangeal joint (PIPJ), interphalangeal joint (IPJ) and distal interphalangeal joint (IPJ) are the main articulations in the foot (22, 23).

2.2 Blood supply:

Derived from anterior tibial artery and posterior tibial arteries which are terminal branches of popliteal artery (22,23).

Anterior tibial artery gives dorsalis pedis which gives off dorsal metatarsal and dorsal digital arteries which anastomose with the plantar distal branches of the plantar arteries. Posterior tibial artery gives peroneal, medial plantar, lateral plantar and lateral calcaneal arteries. Branches from the anterior tibial artery or posterior tibial artery can supply the foot in case of injury to the other because of the anastomosis.

2.3 Muscles:

The foot has 20 muscles, both extrinsic and intrinsic (22,23).

Extrinsic muscles have their muscle bellies in the thigh and leg while intrinsic muscles arise and insert in the foot.

2.4 Nerves:

The foot is supplied by the tibial, medial plantar, lateral plantar, superficial and deep peroneal nerves (22,23). The tibial nerve supplies foot plantar flexors. It terminates as medial and lateral plantar nerves. Superficial peroneal nerve supplies foot evertors. It gives sensory branches to the dorsum of the foot. Deep peroneal nerve supplies dorsiflexors of the foot. It gives sensory branches to area between the first two toes on the dorsum of the foot.

2.5 Ligaments

The foot has several ligaments. The main ligaments are plantar fascia, plantar calcaneonavicular ligament, calcaneocuboid ligament and Lisfranc ligaments (24).

2.6 Pathology:

2.6.1 Nerve injuries: Medial Plantar, lateral plantar, deep peroneal and superficial peroneal nerves or their branches can suffer injuries in the foot.

It can either be neuropraxia, axonotmesis or neurotmesis (25).

2.6.2 Dislocations: Subtalar dislocation is an uncommon injury forming 1% of all foot injuries with medial dislocation the most common at 80% (26,27).

Lisfranc dislocations are 1% of all dislocations in the body. The most common after simple toe dislocations in foot dislocations (28–30) .

Metatarsophalengeal (MTP) dislocation especially of the first MTP result from large forces. Interphalangeal (IP) and simple toe dislocations occur with axial and other large forces. The dislocations are mostly dorsal and lateral (31). Simple toe dislocations are the most common foot dislocation (30).

Other isolated dislocations of the foot are also described e.g navicular, cuboid and cuneiform fracture dislocations (30,31).

2.6.3 Ligamentous injuries: A tear of the ligaments is also called a sprain. The severity of sprains is from Grade I to Grade III (32).

The sprains commonly occur in two distinct areas – Midfoot, the central area that includes the arches and First MTP, at the base of the big toe (32).

2.6.4 Tendon injuries: Tendon tears can occur from a fall, sudden injury in sports and road traffic accidents. Posterior tibialis tendon is the most commonly torn after a fall. Peroneal tendons are also commonly torn after a blow to the ankle in motor vehicle accidents or crush injuries (33,34).

2.6.5 Fractures: Calcaneus, talus, tarsal bones, metatarsal or phalanges can be fractured after a foot injury, they account to 10% of all fractures in the body (30).

These foot injuries are rarely life threatening but have high incidence of disability (18).

Lack of proper management of foot injuries can lead to permanent disability and is a common cause of litigation and compensation claims (18).

2.7 Patterns

2.7.1 Age

Most studies show that the most affected age group to be 20 – 35 years (1-3). This constitutes the most productive age group in most societies in terms of labour and industrial workforce.

2.7.2 Gender Incidence

Male predominance in foot injuries is shown in most studies, ranging from 72% - 91% (1-3). Only one study by Van Staa et al in England and Wales (35) found a differing gender incidence with a slight female predominance of 50.3%.

2.7.3 Causes of Foot Injury

Foot injuries commonly occur through road traffic accidents, fall from height, heavy object trauma, industrial injuries, sports and recreational activities, assaults, burns and crush injuries. The causation of foot injuries vary in different study settings and populations. Majority of the studies from middle and low income economy populations show that RTAs are the most common causation, ranging from 67 – 74% followed by falls (2,3,36). In high income economies falls from height – accidental, suicidal and industrial injuries are the commonest cause followed by RTAs (1,19).

2.7.4 Nature of Injuries

The right foot is the most commonly involved foot in most foot injuries especially in RTA, ranging from 55-60% involvement (1,2). This may be attributed to its active role in driving and riding. Bilateral feet involvement ranges from 6 – 8% (1,2).

Osseous involvement is common in most foot injuries ranging from 76 – 88% involvement (2,3).

The region of the foot involved in the injury vary from study to study. Kighoma, VS et al in Uganda (3) found midfoot - tarsal bones and forefoot - metatarsal dominating. Jain M et al (2) found forefoot injuries were the commonest at 53.1%, hindfoot injuries at 33.9% and midfoot at 13%. Commonly injured bones were metatarsal at 27.29% and calcaneus at 25.42%. Eid HO et al (1) found that the hindfoot was the most commonly involved region at 56% then forefoot at 32% and multiple regions at 12%. Calcaneus was the commonest injured bone at 42.45% and metatarsals followed at 16.04%.Sharma G.K et al (36) found that metatarsal fractures were the most common foot fracture at 27.9% followed by calcaneal fracture at 21.4%.

The occurrence of open fractures differs depending on the study setting and mechanism of injury. Kighoma VS et al (3) and Jain M et al (2) reported 67% open fractures. Eid HO et al (1) reported only 11.3% open fractures. Open calcaneal fractures and metatarsal fractures were the most common (1–3,36). RTA caused the highest number of open fractures (2, 3).

Isolated foot injuries are the most common occurrence in most studies ranging from 44 – 76% of the patients seen with foot injuries (1 - 3).

Foot injury patients commonly have associated injuries in other regions of the body. Kighoma VS et al (3) found that 56% of the foot injury patients had associated injuries with 49.4% having associated limb injuries (excluding foot) and 20.1% head injury. Jain M et al (2) found that 47% of foot injury patients had associated injuries with 34.3% lower limb injuries (excluding foot), 9.7% upper limb injuries, 7% head injury, 6% spine injury and 3% abdominal injury.

2.7.5 Severity of Foot Injuries

Jain M et al (2) classified foot injury using their own modified classification criteria; “Severe foot injury” were patients with bilateral or segmental foot injuries, open foot fractures with significant lacerations or patients with traumatic or partial amputations and the other patients “simple foot injuries”. The study found that 41.79% had severe foot injury.

Eid HO et al (1) found that 41% had severe foot injuries and 59% had simple foot injuries using FASS to grade the severity of the foot injuries.

Sharma G et al (36) used FASS to grade severity and found that 72.8% had severe foot injuries.

The **Committee on Medical Aspects of Automotive Safety** in 1971 published the **Abbreviated Injury Score (AIS)** in the Journal of the American Medical Association (JAMA) (37). The original AIS was a 10 point scale (0-9) to assess injury severity of people involved in automobile crashes – impact or blunt trauma. It has been modified over the years being applied in both blunt and penetrating trauma (38).

AIS currently is a 7 point scale. This format has each injury assigned a unique six digit numerical code followed by a decimal point. The decimal point after the decimal point is the AIS e.g subtalar dislocation involving cartilage is coded 851206.1. Referring to the AIS manual is therefore necessary to code an injury.

AIS has a high correlation with probability of mortality resulting from an injury (39). AIS does not predict the outcome and long term complications of an injury (39,41).

AIS is not sensitive enough to identify the severity of foot injuries because most are listed as AIS 1 or AIS 2 as they are not life threatening. This limits the ability of AIS to differentiate between simple and complex foot and ankle injuries.

Poole GV et al (38) found that AIS and ISS appropriately reflect impact of extraskeletal injuries in patients with femur fractures but they do not reflect increased morbidity associated with multiple lower extremity fractures. They recommended that AIS may need to be upgraded for multiple long bone fractures of lower extremities.

Abbreviated Injury Scale

AIS code	Description
1	Minor
2	Moderate
3	Serious
4	Severe
5	Critical
6	Maximum
9	Unknown

In 1997, Manoli A et al (41) developed a **Foot and Ankle Severity Scale (FASS)** that was adopted by the American Orthopaedic Foot and Ankle Society (AOFAS) Trauma Committee. This scale developed a rank order list of 91 foot and ankle injuries that occur in vehicular accidents. The injuries are ranked according to severity **(FASS-S)** and estimated long term impairement for each injury **(FASS-I).** AOFAS believed that these general outline of relative values are to be used as a guide for further research on the subject.

Ramasamy A et al (42) found that FASS was significantly superior in predicting poor clinical outcomes of foot injuries than AIS. They concluded that FASS was a better quantitative measure of foot and ankle injury than AIS and AIS is not a predictor of long term outcome.

FASS has been used as a research tool to evaluate lower leg injuries in various cadaveric experiments and in some clinical studies to characterize the severity of foot and ankle injuries from various causes (1,18,36,43).

FASS was used in this study to assess severity of foot injuries.

Terms Used to Describe the Injury Severity Levels (FASS-S)

1	Minimal injury
2	Mild injury
3	Moderate injury
4	Severe injury
5	Very severe injury
6	Currently untreatable

Definitions of the Seven Levels of Long-Term Impairment (FASS-I)

0	No impairment	Patient has no residual signs or symptoms associated with the injury.
1	Minimal impairment	Able to do all desired activities but may be slightly limited at impact sports. May have occasional discomfort requiring an over the counter medication. Able to wear any type of footwear.
2	Mild impairment	Unable to do impact activities, for example, unable to participate in sports such as tennis, basketball, etc. Has some limitations at work. Cannot do a job requiring constant standing, walking, and climbing. Regularly uses an over the counter medication to control discomfort.
3	Moderate impairment	Walking is limited. Can do most activities but unable to walk for long periods. Can do normal shopping but excessive walking impossible. May occasionally use cane for support. May need occasional non-narcotic prescription medications for pain relief. Can do work requiring some walking but needs to be able to sit. Cannot do job requiring climbing. Limited from most sports requiring weightbearing. May need orthotic devices to control pain.
4	Severe impairment	Unable to walk about living quarters. Usually can bear weight, but often needs a single walking aid (cane). Can do work requiring minimal walking and standing but needs to sit most of the time. Cannot participate in sports requiring weightbearing. Regularly uses non-opioid medications to control pain.
5	Very severe impairment	Can barely get around living quarters without walking aids. Must use walking aids or wheelchair when out of the house. Usually can be partially weightbearing but at times has to be nonweightbearing. Able to do sedentary work without any standing, walking, or climbing. Regularly uses non-opioid medications for pain control and may occasionally need opioids to control pain. Only able to work in limited jobs requiring no standing, walking, or climbing.
6	Total impairment	Unable to weightbear; must use walking aids or wheelchair at all times. Unable to perform any type of work activities and/or household chores. Needs medication on a regular basis. Pain very poorly controlled.

Foot and Ankle Severity Scale

Injury	FASS-S	FASS-I
Ankle sprain—medial (deltoid)	1	0
Fibular fracture, diaphysis, undisplaced	1	0
Great toe fracture, phalanx, single, undisplaced	1	0
Laceration—dorsal, skin, subq.	1	0
Lateral malleolus fracture—undisplaced	1	0
Lesser toe fracture, single, displaced	1	0
Lesser toe fracture, single, undisplaced	1	0
Lesser toe fractures, multiple, undisplaced	1	0
Medial malleolus fracture, undisplaced	1	0
Laceration—plantar, skin subq.	1	1
Sesamoid fracture(s), single or multiple, undisplaced	1	1
Calcaneal fracture, nonarticular, undisplaced	2	0
Great toe fracture, phalanges, multiple, undisplaced	2	0
Metatarsal fracture, first, undisplaced	2	0
Ankle sprain, lateral (anterior talofibular/calcaneofibular)	2	0
Bimalleolar fracture, undisplaced	2	1
Fibular fracture, diaphysis, displaced	2	1
Great toe fractures, phalanx, single, displaced	2	1
Interphalangeal joint dislocation, first	2	1
Interphalangeal joint dislocation, single, two through five	2	1
Interphalangeal joint dislocations—multiple	2	1
Laceration, dorsal, skin, subq., muscle/tendon	2	1
Laceration, plantar, skin, subq., muscle/tendon	2	1
Lesser toe fracture, multiple, displaced	2	1
Maissonueve fracture (upper fibula, ankle sprain, undisplaced)	2	1
Medial malleolus fracture—displaced	2	1
Metatarsal fracture, single, second through fifth, undisplaced	2	1
Achilles tendon laceration/rupture	3	1
Ankle dislocation without fracture, displaced	3	1
Calcaneal fracture—nonarticular—displaced	3	1
Great toe fractures, phalanges, multiple, displaced	3	1
Lateral malleolus fracture with deltoid ligament tear, displaced	3	1
Metatarsal fracture, first, displaced	3	1
Metatarsal fracture, single, second through fifth, displaced	3	1
Metatarsal fractures, multiple, undisplaced	3	1
Metatarsophalangeal joint dislocation, first	3	1
Metatarsal joint dislocation, single, two through five	3	1
Talar fracture, head, undisplaced	3	1
Talar fracture, neck, undisplaced	3	1
Tarsal bone fracture, cuboid, undisplaced	3	1
Tarsal bone fracture, cuneiform(s), undisplaced	3	1
Tarsal bone fracture, navicular, undisplaced	3	1
Tibial fracture, diaphysis, undisplaced	3	1
Tibial-fibular fracture, diaphysis, undisplaced	3	1
Tibial-fibular fracture, metaphysis, nonarticular	3	1
Bimalleolar fracture—displaced	3	1
Single unsalvageable 2nd to 5th toes	3	1
Calcaneal fracture, articular, undisplaced	3	2
Maissonueve fracture/dislocation (upper fibula, ankle displacement), displaced	3	2
Metatarsophalangeal joint dislocations, multiple	3	2
Nerve laceration, other nerve (except tibial nerve)	3	2
Proximal tibiofibular joint dislocation with ankle ligament disruption	3	2
Sesamoid fracture(s), displaced	3	2
Syndesmotic ligament tear (distal tibiofibular joint disruption)-displaced	3	2
Talar fracture, body, undisplaced	3	2
Tarsal bone fracture, cuneiform(s), displaced	3	2
Tarsal bone fracture, navicular, displaced	3	2
Tarsal bone fracture, cuboid, displaced	3	2
Trimalleolar fracture < 33% posterior malleolus, undisplaced	3	2
Trimalleolar fracture > 33% posterior malleolus, undisplaced	3	2

TABLE 5—*Continued*

Injury	FASS-S	FASS-I
Compartment syndrome, leg (isolated)	4	1
Tibial fracture, diaphysis, displaced	4	1
Unsalvageable great toe (distal to IP joint)	4	1
Compartment syndrome, foot (isolated)	4	2
Metatarsal fractures, multiple, displaced	4	2
Multiple unsalvageable 2nd to 5th toes	4	2
Talar fracture head—displaced	4	2
Tarsal bone dislocation (navicular, cuboid, cuneiform)	4	2
Subtalar dislocation (talocalcaneal), medial	4	2
Tibial pilon fracture—undisplaced	4	2
Trimalleolar fracture < 33% posterior malleolus—displaced	4	2
Unsalvageable great toe (distal to MP joint)	4	2
Calcaneal fracture, articular, displaced	4	3
Subtalar dislocation (talocalcaneal)—lateral	4	3
Talar fracture—neck—displaced	4	3
Talotarsal (Chopart's) dislocation	4	3
Tibial-fibular fracture, diaphysis, displaced	5	2
Talar fracture, body, displaced	5	3
Talus fracture with dislocation of fragment	5	3
Tarsometatarsal (Lisfranc) dislocation	5	3
Tarsometatarsal (Lisfranc) fracture/dislocation	5	3
Trimalleolar fracture > 33% posterior malleolus, displaced	5	3
Unsalvageable forefoot (needs immediate mid-tarsal amputation)	5	3
Nerve laceration—tibial nerve	5	4
Unsalvageable forefoot (distal to Lisfranc's Joint)	6	3
Unsalvageable foot (needs immediate amputation)	6	3
Tibial pilon fracture—displaced	6	4
Add for compartment syndrome, leg (associated with other injuries)	1	1
Add for compartment syndrome, foot (associated with other injuries)	1	1
Add for open dislocation	1	1
Add for open fracture	1	1

2.8 Study Justification/Rationale

Foot injuries are common in orthopaedic practice in our country and setting. There was no study on the causes and severity of foot injuries in our country. This study aimed to bridge this gap by analyzing the patterns and assessing the severity of foot injuries seen.

The results of this study will help the patient, public and private employment institutions and government to come up with measures, strategies and policies to prevent and minimize foot injuries after establishing the common causes and severity of the same.

The automobile and motorcycle manufacturing industries may also come up with designs and measures to minimize foot injuries. The results will also help KNH, UON and other health institutions to adequately prepare and address foot injuries in terms of human resource required, equipment and treatment modalities.

Literature review conclusion:

Several studies on foot injuries have been done in different parts of the world focusing on specific types of foot injuries, foot injuries in specific patient populations or foot injuries related to specific mechanisms of injury. The objectives of each of these studies were however different and the outcomes also differed depending on which part of the world the study was carried out. Though FASS has been used by different researchers to determine the severity of foot injuries, majority of these studies focused on assessment of severity without determining the causes of these injuries. Those studies which focused on causes and nature of foot injuries did not assess the severity of the same using FASS.

CHAPTER THREE:

OBJECTIVES

3.1: Broad objective

To study the pattern of acute foot injuries in patients seen at KNH.

3.2: Specific objectives

1. To determine the causes of foot injuries in patients seen at KNH.
2. To determine the nature of foot injuries in patients seen at KNH.
3. To assess the severity of foot injuries using Foot and Ankle Severity Score (FASS).
4. To describe associated injuries in patients with foot injuries.

CHAPTER FOUR:

METHODOLOGY

4.1 Study Design

This was a cross sectional descriptive study. The setting was KNH A&E department, wards, clinics and theatre from November 2019 to February 2020.

4.2 Study Population

Any patient who presented with acute foot injuries at the Accident and Emergency (A&E) department, wards and orthopaedic clinic of KNH was eligible for recruitment in this study. The patients were interviewed through face to face structured interviews. Data from admission files, operations notes, clinic files and examined participants was used to document the pattern and assess severity of the injuries. Informed consent from the patient/guardian was sought before commencement of data collection. The questionnaire included questionnaire's number, patients' particulars: age, occupation, nature of the injury, foot involved, workplace injury or elsewhere.

4.3: Inclusion criteria

Patients presenting with acute foot injuries up to 7 days post injury were included.

After 48-96hrs, wound enters into proliferative phase which involves wound contraction and reduction of wound size. After 4-7 days some lacerations and bruises are obliterated and estimating initial size is difficult. Tenderness and pain also reduces significantly after day 7 which would have affected the results when calculating severity score. Acute foot injuries were therefore described as foot injuries less than 7 days post injury and used as the inclusion criteria in this study.

4.4: Exclusion Criteria

Patients with non-traumatic foot pathologies or pre-existing foot pathologies.

4.5 Sample size calculation

According to a study done in Uganda in 2012 (3), the prevalence of foot injuries in a tertiary hospital similar to KNH was 10.8% of all trauma cases. Using the Cochrane's formula;

$$n = \frac{Z^2 pq}{e^2}$$

Where

n…… Sample size

Z…… Standard deviation of 95th percentile (1.96)

p …… expected proportion of foot-injured patients among patients seen at A&E department (0.108).

q……(1-p)

e…… confidence interval (0.05)

$$n = \frac{1.96^2 \times 0.108 \times (1 - 0.108)}{0.05^2}$$

$$n = 148.03$$

The sample size for this study was **150 respondents**.

4.6 Sampling Procedure/Technique

The sampling frame for this research was the KNH A&E department/admission and orthopaedic clinic register of all patients who presented with acute foot injuries at Kenyatta National Hospital during the period this research was carried out.

The study used consecutive sampling procedure where every patient meeting the inclusion criteria was selected until the sample size of 150 patients was achieved. This method controlled for bias as all patients were captured as they came without any preference of day or time. This sampling method involved identification of the first 150 patients with acute foot injuries who consented to participating in the study and recruiting them.

The aim of this approach was to ensure that the sampling process was not affected by biased selection of the participants in terms of day or time and all patients had an equal chance of being selected. The selected participants who gave written informed consent were included. The orthopedic residents and Medical officers working at A&E section of KNH informed the principal investigator when there was a patient with foot injury. The principal investigator recruited patients in the orthopedics wards and outpatient clinics.

4.7: Recruitment, Consenting and Data Collection

Patients with acute foot injuries presenting within 7 days were recruited. Detailed explanation of what the study entailed was given and written consent sought from the participants. The principal investigator was the sole data collector. The details were filled in a questionnaire which had the patients' demographics. Other information sought included the cause of injury, setting of the injury and radiological assessment of severity of the injuries. X-rays were interpreted by the principal investigator.

The wound sizes were measured using Sliding jaw Vernier calipers. Standard examination techniques were used and care taken not to cause unnecessary pain in the injured part by the principal researcher. Any extra investigations deemed necessary for the patient's management were ordered and the primary physician informed. The data was collected by the principal investigator between November 2019 and February 2020 through face to face interviews as well as utilizing data from admission files, operation notes and examining participants to document the pattern and calculate severity using FASS. Injuries with FASS <4 were classified as simple foot injury and injuries with FASS > 3 were severe foot injury.

4.8 Data analysis and Presentation

Chi square for categorical data was used to analyze the differences in severity and causes of foot injuries among the patients.

The severity of foot injuries was determined through descriptive analysis of the data collected from the respondents. The analysis allowed the researcher to investigate the number of participants in the research falling under each of the established categories. SPSS software was used to generate charts, histograms and tables.

4.9 Quality Control

The researcher was a senior orthopaedic surgery resident well trained on the examination of the foot and wounds, basic x-ray interpretation and the use of FASS. In case of complex cases, the supervisors, one of whom is a foot and ankle surgeon were consulted.

Consultation of a radiologist was sought in cases of complex x-rays and other imaging modalities.

Data was cleaned daily for accuracy before entry to avoid errors.

Data analysis was done with the help of a statistician.

4.10 Ethical considerations

Written consents were sought from patients/guardians after being informed on the purpose of the study.

Utmost confidentiality of the patients' details was maintained. The principal researcher kept the filled questionnaires in a secure briefcase and lockable file cabinet. In the hospital the paper records were kept in a secure briefcase and bag while in transit. Electronic data was stored in coded numbers and password-protected computer databases.

Those who declined to give consent were not prejudiced and their decision was fully respected.

Ethical approval was sought from the department of orthopaedics surgery, UoN and ethics review committee of KNH prior to data collection in relation to the study.

4.11 Limitations and Delimitations

Patients who declined to give consent.

Incorrect information from patients.

Patients and relatives were encouraged to give the correct information and were assured there will be no victimization whatsoever.
The principal investigator liased with the surgeons operating on the patients to ensure accurate intraoperative findings were noted and documented for patients who underwent surgery.

4.12 Dissemination and utility

The outcome of this study will be relayed to the UON and KNH departments of orthopaedic surgery and may be published in orthopaedic and surgical journals and may be useful in policy making in this country.

This is after it established the causes, severity and associated injuries of foot injuries of our patients.

4.13 Conflict of interest

None to declare.

CHAPTER FIVE

RESULTS

The pattern of acute foot injuries in 151 participants who met the inclusion criteria was analyzed. A total of 164 injured feet were analyzed.

Majority of the foot injury patients were seen in the orthopaedic wards, 108 patients (constituting 71.5%) of those sampled while the rest, 43 patients (constituting 28.5%) were seen in KNH A&E and the orthopaedic clinic. During the duration of the study, 108 out of 598 in-patients admitted to the orthopaedic surgery wards (constituting 18.1%), had a foot injury.

5.1 Age

The overall mean age of the patients was 33.2 (SD=13.1) years, while the median age was 32 (IQR=18) years. The minimum age was 6 years while the maximum age was 80 years.

The participants were classified according to their ages in decades. Majority of the patients who suffered foot injuries were in their third decade (49 patients) representing 32.5% of the study population, followed by those in the fourth decade (36 patients) at 23.8%, those above 50years were 13 patients representing 8.6%. Notably children below 10years were minority with just 5 patients constituting 3.3% of the study population. 3 out of 5 of the children (60%) were injured in RTAs.

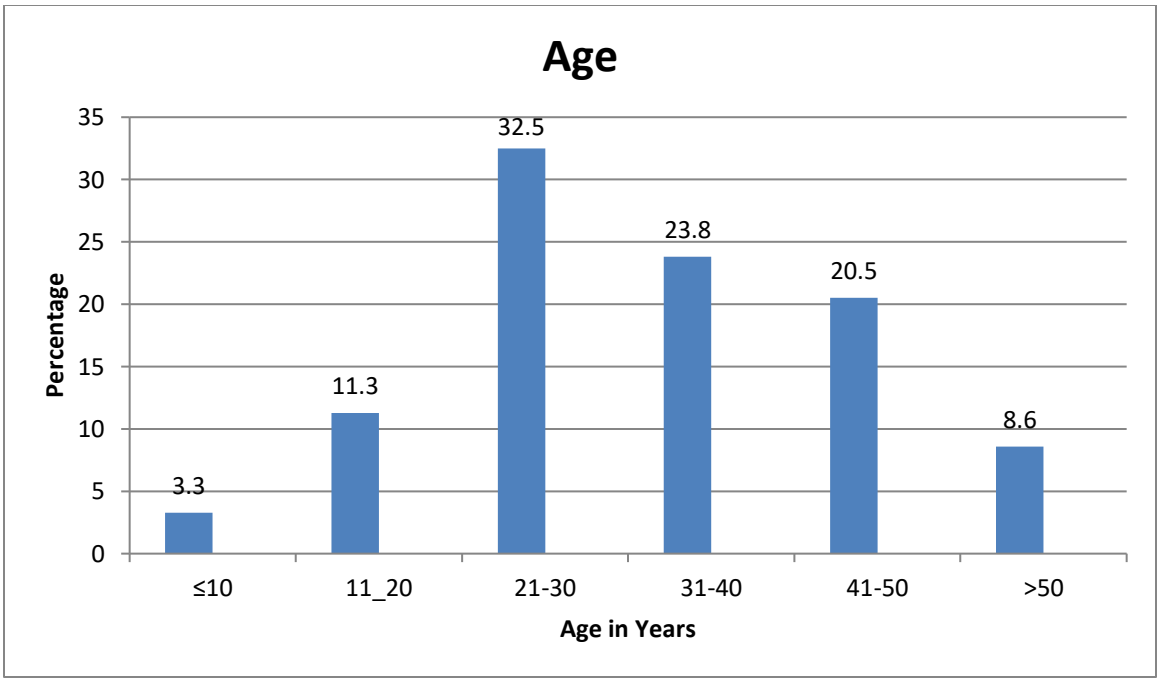


Fig 5.1 Age Distribution

5.2 Gender Incidence

Males were predominantly involved in acute foot injuries (124 patients) representing 82.1% while there were 27 female patients representing17.9% of the total study population.

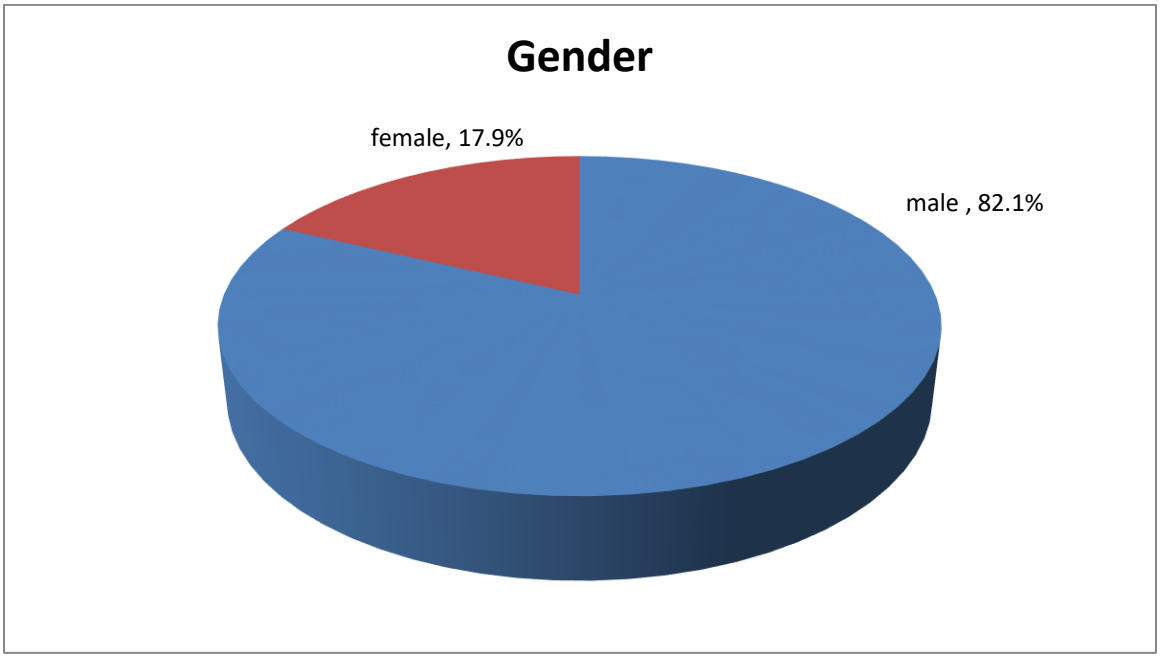


Fig 5.2 Gender Incidence

5.3 Causes of Foot Injury

RTA was the leading cause of foot injury with 99 patients (representing 65.6% of the study population), Majority resulting from motorcycle accidents, 61 patients constituting 40.4% of all foot injuries. Industrial foot injuries were the second most common cause with 16 patients (10.6%) mainly being objects falling on the foot or equipment directly injuring the foot. Assault foot injuries also constituted 6% of all foot injury patients evaluated. Fall from height (over 3 Meters) had 8 patients (5.3%) while fall from standing height constituted 4.6% with 7 patients. Patients who sustained sporting injuries were 3 (2%). There were 9 patients (6%) whose injuries could not be classified in any of the above categories, with three being injured by penetrating injuries, two by gunshot wounds and the other four who hit stationary objects while walking.

Cause of injury		**Percentage**
RTA	99	65.6
Industrial injury	16	10.6
Assault	9	6.0
Others	9	6.0
Fall from height>3M	8	5.3
Fall	7	4.6
Sports	3	2.0

Table 5.1 Causes of Foot Injury

The Chi-Square test for the relationship between the cause of the injury and the injury severity. The relationship between most of these factors was not significant (P>0.05) showing that there was no association between the factors. Only fall from height over 3 metres shows an association with severity (p=0.013).

*Table 5.2 Chi – Square Test for Cause * Severity*

Characteristics	Simple	Severe	p-value
	N=103	N=48	
RTA	67	32	0.846
Fall	5	2	1.000
Industrial injury	11	5	1.000
Assault	6	3	1.000
Others	9	0	0.058
Fall from height>3M	2	6	0.013
Sports	3	0	0.552

5.4 Nature of Foot Injury

5.4.1 Foot Involvement

The right foot was the most commonly involved with 75 patients constituting 49.7%. Left foot injuries occurred in 63 patients constituting 41.7%. Bilateral feet involvement occurred in 13 patients (8.6%).

Table 5.3 Foot Involvement

Characteristics	Frequency	Percent
Foot injured		
Right	75	49.7
Left	63	41.7
Both	13	8.6

5.4.2 Region of Foot Injured

Forefoot injuries were the most common at 74, constituting 45.1%. Multiple segment injuries were the second most common at 37 (22.6%) followed by hindfoot injuries at 34 (20.7%) and the least common being midfoot injuries at 19 (11.6%).

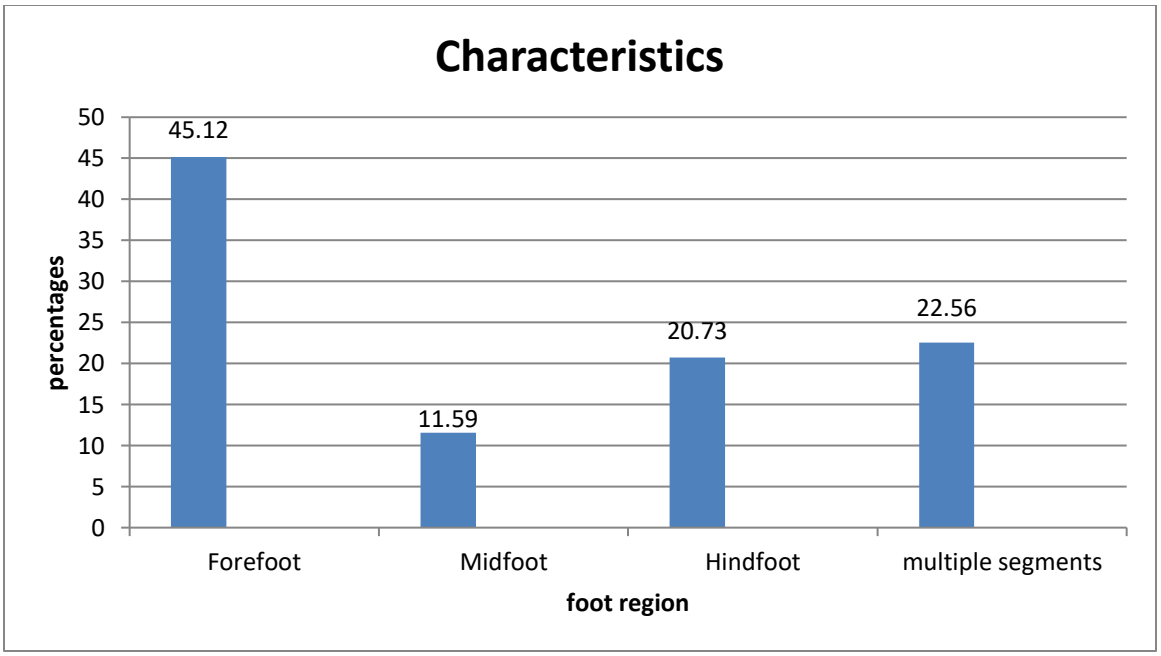


Fig 5.3 Foot Region Injured

5.4.3 Skin Lacerations and Skin Loss

There were 56 patients which had skin lacerations or skin loss without any other foot injury. This comprised 37.1% of all cases studied.

5.4.4 Osseous Involvement

Eighty five patients had foot injuries with osseous involvement. This represented 56.3% of all cases studied.

Table 5.4 Osseous Involvement

Characteristics	Frequency	Percent
Bone involved		
Osseous involvement	85	56.3
Non-Osseous involvement	66	43.7

Metatarsals were the most commonly fractured bones, found in 53 patients constituting 62.4% of all foot fracture injuries. Phalangeal fractures were the second most common in 17 patients (20% of all foot fractures) followed by calcaneal fractures in 13 patients (15.3%). Talus fractures seen in 7 patients constituting 8.2% of all foot fractures.

Twenty patients had open fractures constituting 23.5% of all foot fractures seen. Open Metatarsal fractures were the commonest, seen in 14 patients (70% of open fractures) followed by open calcaneal and phalangeal fractures seen in 4 patients each.

Table 5.5 Foot Fractures

Characteristics	**Closed**	**Open**	**Total**
Bone involved	**N=65**	**N=20**	**N=85**
Calcaneus	9 (13.8)	4 (20.0)	13
Cuneiform	1 (1.5)	1 (5.0)	2
Metatarsal	39 (60.0)	14 (70.0)	53
Navicular	2 (3.1)	2 (10.0)	4
Phalanges	13 (20.0)	4 (20.0)	17
Talus	6 (9.2)	1 (5.0)	7

5.4.5 Foot Dislocations

Fifteen patients had foot dislocations representing 9.9% of the foot injuries. Toe dislocations and MTPJ dislocations were the commonest occurring in 4 patients each (26.7% each). Lis Franc Dislocations were seen in 3 patients constituting 20% of foot dislocations. Subtalar dislocations were seen in 2 patients constituting 13.3% of all dislocations.

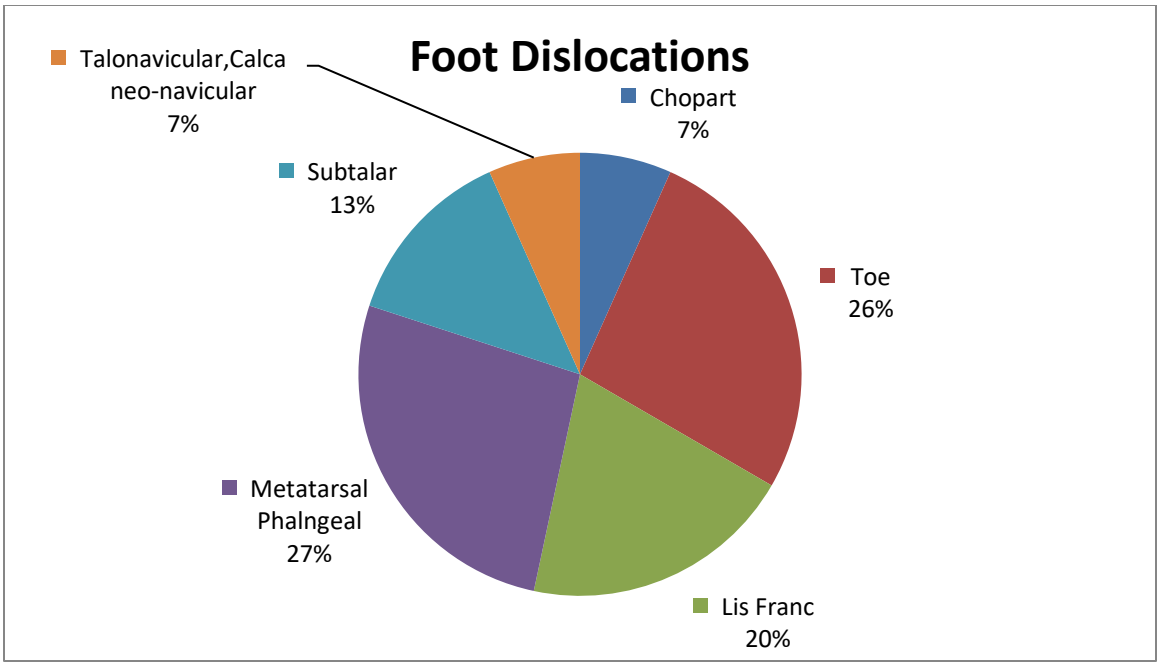


Fig 5.4 Foot Dislocations

5.4.6 Traumatic Foot Amputations

Seven patients had traumatic foot amputations constituting 4.6% of foot injuries. Toe amputations were the most common occurring in 6 patients (85.7% of all amputations). Only one metatarsal amputation was encountered (14.3% of all traumatic amputations).

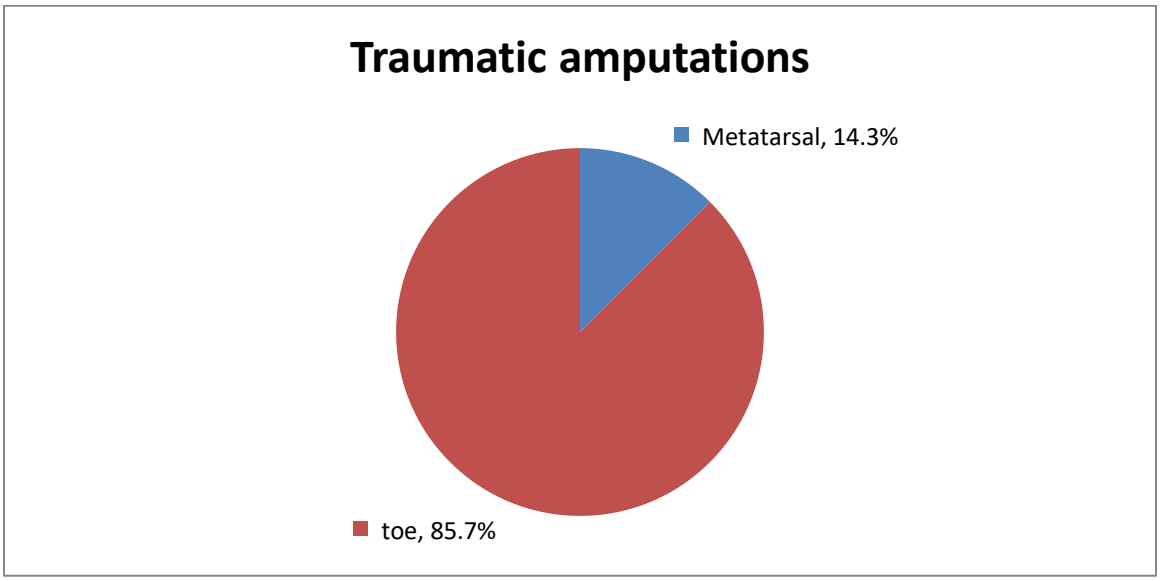


Fig 5.5 Traumatic Foot Amputations

5.4.7 Tendon Injuries

There were 20 patients with tendon injuries forming 13.2% of all foot injuries. All of these were open. Extensor tendons were the most commonly injured at 16 patients (80% of all tendon injuries). Peroneal tendons were the second most common at 3 patients (15% of all tendon injuries).

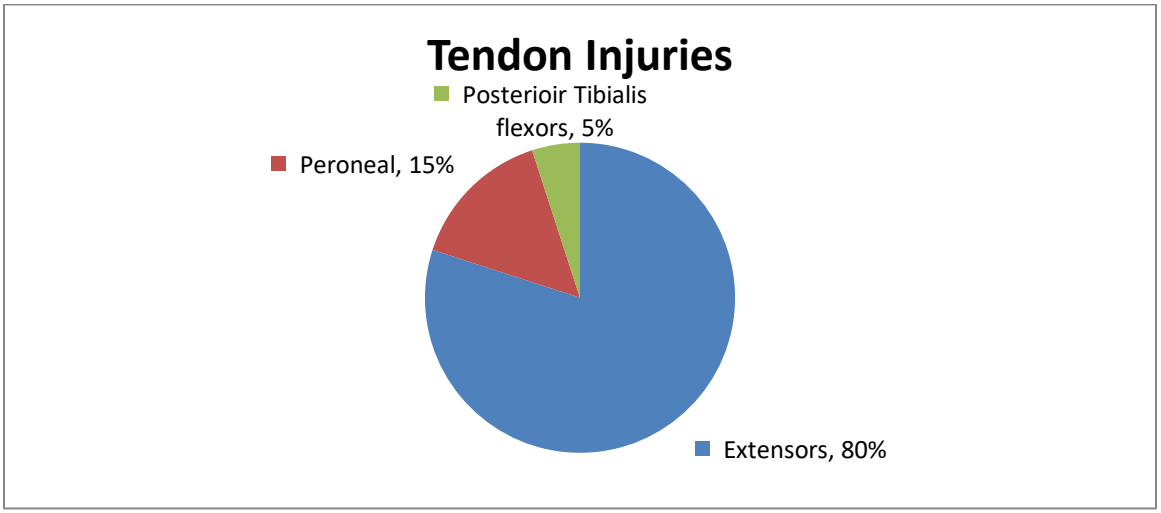


Fig 5.6 Tendon Injuries

5.4.8 Nerve Injuries

There were 11 patients with nerve injuries constituting 7.3% of foot injuries. Digital Nerve injuries were commonest, found in 7 patients (63.6% of all nerve injuries). Three patients (27.3%) had sural nerve injuries.

Table 5.6 Nerve Injuries

Characteristics	Frequency	Percent
Nerves		
Digital Nerves	7	63.6%
Sural	3	27.3%
Posterior Tibial	1	9.1%

5.4.9 Arterial Injuries and Compartment Syndrome

Only 2 patients had severed arteries - one dorsalis pedis artery and the other posterior tibial artery.

Five patients (3.3%) had compartment syndrome of the foot.

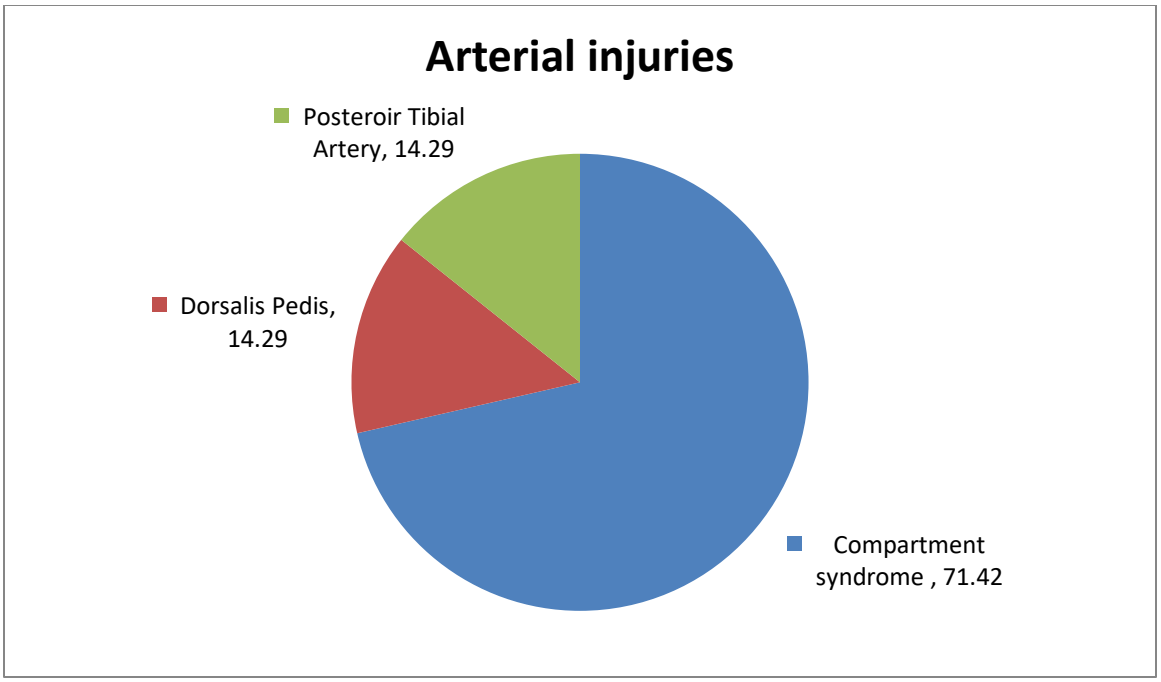


Fig 5.7: Arterial Injuries

5.5 Severity of Foot Injury

The severity score of foot injuries was calculated for every foot using FASS. Majority of the feet, 111 (67.7%), had simple foot injuries while 53 (32.3%) had severe foot injuries.

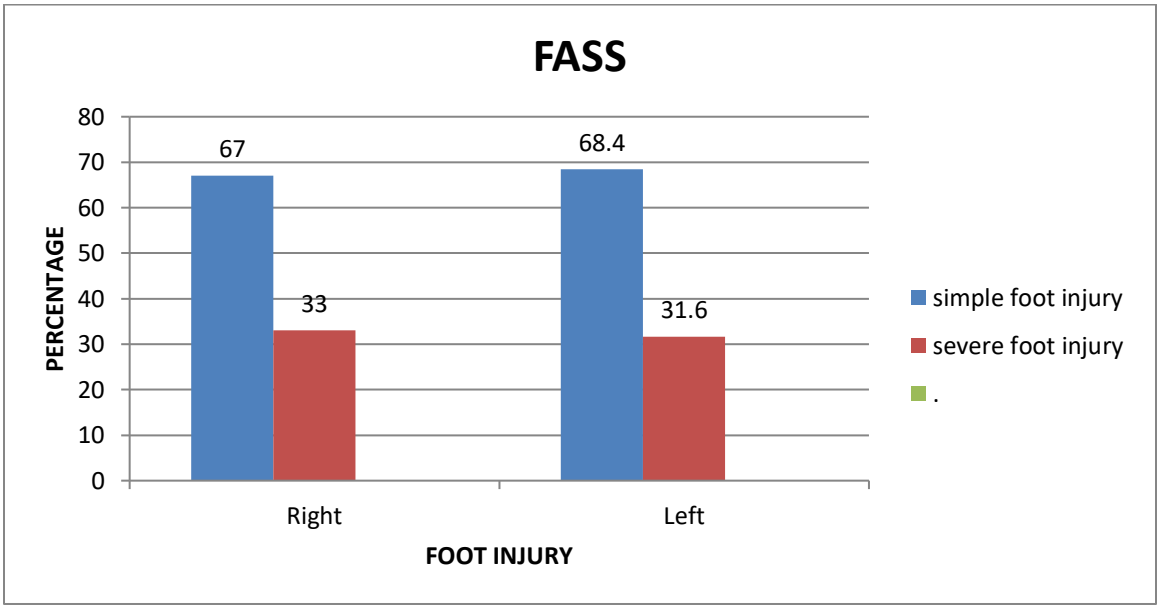


Fig 5.8 Severity of Foot Injury

5.6 Associated Injuries

There were 53 patients with isolated foot injuries comprising 35.1% of the foot injury patients.

Most of the patients, 98 (64.9%) with foot injury had associated injuries in other parts of the body. Lower Limb Injuries proximal to the ankle were the most common associated injury found in 57 patients (37.7%). This was followed by patients with ankle injuries who were 24 constituting 15.9% and Head Injury patients were 24 constituting 15.9%.

Table 5.7 Associated Injuries

Characteristics	**Frequency**	**Percent of patients**
Associated injuries		**N=151**
Ankle injury	24	15.9%
Lower limb injury	57	37.7%
Head injury	24	15.9%
Upper limb injury	15	9.9%
Spine injury	5	3.3%
Pelvic injury	7	4.6%
Chest injury	1	0.7%
Abdominal injury	1	0.7%
None	53	35.1%

CHAPTER SIX

DISCUSSION, CONCLUSION, AND RECOMMENDATIONS

The purpose of this study was to determine the causes, nature and severity of foot injuries in patients seen at Kenyatta National Hospital.

Foot injury is fairly common in our setting. It was found that 18.1% of all the in-patients admitted to the orthopaedic surgery wards had a foot injury during the study.

6.1 Age

Patients with foot injury were commonly found to be in their third and fourth decade constituting 56.3% of all foot injuries. These were also the findings of Eid HO et al (1), Jain M et al (2) and Kighoma V et al (3). This may be because these age groups tend to be the most productive and active members of any society in terms of industrial workforce and income generation thus more likely to be involved in accidents, industrial injuries and other causes of foot injury.

6.2 Gender Incidence

A significantly large number of men, 82.1% compared to women, 17.9% sustained foot injuries. Eid HO et al (1), Jain M et al (2) and Kighoma V et al (3) also had similar findings. This could be explained by the fact that men are the majority in the commercial motorcycle industry also known as boda boda as riders and motor vehicle industry as drivers. In addition, men are more involved in manual work in industries and in the farms. Only one study by Van Staa et al in England and Wales (35) showed a differing gender incidence at equal ratios with a slight female predominance of 50.3%.

6.3 Causes of Foot Injury

RTA was the most common cause of foot injury constituting 65.6%. Industrial injuries were the second commonest cause of foot injuries at 10.6% followed by assault at 6% and fall from height >3Metres at 5.3%. Jain M et al (2) in India in 2012 found similar findings with RTA being the most common cause of foot injury at 73.8% but fall from height>3M were the second most common cause at 20.2%. Kighoma V et al (3) in Uganda in 2012 also found that RTA being the commonest cause at 67.1%. The results differ with what Eid HO et al (1) in UAE, 2010 found fall from height >3M as the commonest cause of foot injury at 52%. Probst C (19) et al in Germany, 2010 found that fall from height >3M was the commonest cause of foot injury. This explains that causes of foot injuries differ in different countries depending on the occupation and socioeconomic status of people in the region under study. This may

also be explained by the reduced level of road traffic rules and safety precautions (road and industrial) adherence in low and middle income economies as compared to high income economies.
Only fall from height over 3 metres shows an association with severity of foot injury probably due to the high energy mechanism involved.

6.4 Nature of Foot Injury

6.4.1 Foot Involvement

The right foot was found to be the most commonly involved, 49.7%. Eid HO et al (1) and Jain M et al (2) also had similar findings of the right foot being most commonly involved. This may be explained partly by its active role in driving and riding.

6.4.2 Foot Region Injured

Forefoot injuries were the most common at 45.1%. Jain M et al (2) had similar findings of forefoot injuries being a majority at 53.1%. Eid HO et al(1) had a different finding with hindfoot injuries at 56%.This can be accounted for by the predominant cause of foot injury with those with RTAs as the main cause having forefoot predominance due to the dependence and exposure of forefoot while those with fall from height predominantly injuring the hindfoot.

6.4.3 Skin Lacerations and Skin Loss

Skin laceration and skin loss without any other foot injury constituted 37.1% of all cases studied. Other studies had a slightly lower occurrence of these 12-24% (2, 3). This may have an association with the commonest cause of the injuries and footwear – which was not extensively studied in this study.

6.4.4 Osseous Involvement

Fractures constituted majority of the injuries sustained at 56.3% of all fractures. Metatarsal fractures were the commonest at 62.4% followed by phalangeal fractures at 20% and calcaneus at 15.3%. Jain M et al (2) had similar findings with the same order. Eid HO et al (1) had different findings with calcaneal fractures dominating. These findings can also be attributed to the predominant cause of injury.
Open fractures constituted 23.5% of all foot fractures seen. This is attributed to the thin exposed dorsal skin cover susceptible to injury easily. Jain M et al (2) and Kighoma V et al (30) had higher incidences of open foot fractures at 67% while Eid HO et al (1) had a lower occurrence at 11.3%.These differences may be attributed to mechanism of injury and footwear – not extensively studied here.

6.4.5 Foot Dislocations

Toe dislocations were the most common dislocation at 53% followed by Lis Franc Dislocations at 20%. These finding are almost similar to what DeOrio M et al (28) and Semin R et al (29) found, toe dislocations at 65% and Lis Franc Dislocation at 25%. This may be due to the precarious exposed toes as the distal part of the foot.

6.4.6 Traumatic Foot Amputations

Toe amputations were the most common amputations at 85.7%. Schnaue- Constatorius et al (31) had similar findings. This can be explained by the toes being the most distal and exposed part of the foot.

6.4.7 Tendon Injuries

Extensor tendons were the most commonly injured tendons at 60% of all tendon injury. This may be explained by their presence on the exposed dorsal side of the foot. Peroneal Tendons were the second most commonly injured tendons. This is in keeping with what is found in literature (33,34). This may be attributed to the commonest cause of injury being RTAs via injury to exposed dorsal surface and blows to the ankle tearing the peroneal tendons.

6.5 Severity of Foot Injury

Majority of the feet had simple foot injuries, 67.7%, with 32.3% having severe foot injury. Eid HO et al (1) found slightly higher numbers of severe foot injuries, 41%. The patients with severe foot injuries will have future impairment in foot function invariably with poorer prognosis as shown by Manoli A et al (40) and Ramasamy MA (41).

6.6 Associated Injuries

Isolated foot injuries constituted 35.1% of the foot injuries seen. 64.9% of the foot injury patient had associated injuries. Lower Limb Injuries proximal to the ankle were the most common associated injury at 37.7%. These were followed by patients with ankle injuries who constituted 15.9% and Head Injury patients at 15.9%. This is similar to the associated injury values found in other studies by Jain M et al (2) and Kighoma V (3). This may be so as the majority of patients seen were in-patient and KNH is a tertiary centre for trauma cases. The prognosis of these patients with multiple injuries or polytrauma with foot injuries is worse as shown by Turchin DC et al (18), Probst C et al (19) and Tran T et al (21).

6.7 CONCLUSION

1. Foot injuries are fairly common in our setting. RTA is the most common cause of foot injury with motorcycle involvement being the most dominant. Industrial injuries also constitute a major cause of foot injuries. Only fall from height over 3 metres showed an association with severity of foot injuries.

2. Men are the predominant gender at risk of foot injury and the foot injuries mostly involve people between 20-40years

3. The right foot is the most commonly injured foot. Metatarsal fractures are the most common followed by phalangeal fractures. Tarsal bone fractures have the least occurrence and are likely to occur after a fall from height. Traumatic toe amputations are the most common foot amputations. Toe dislocations are the most common foot dislocation followed by Lis Franc Dislocation. Extensor tendons are the most injured tendons.

4. Majority of foot injuries fall under the category of simple injuries although severe foot injuries also constitute a significant number of the statistics.

6.8 RECOMMENDATIONS

Recommendations on further studies on:

(i) Burden of motorcycle associated foot injuries.

(ii) Long term outcomes of foot injuries.

(iii) Pattern of Industrial Foot Injuries

REFERENCES

1. Eid HO, Abu-Zidan FM. Epidemiology of foot injury in a high-income developing country. Injury. 2010;41:137–40.

2. Jain M, Dhatt S. Epidemiological Pattern of Foot Injuries in India: Preliminary Assessment of Data from a Tertiary Hospital. J Postgrad Med Educ Res. 2012;46(3):143–7.

3. Kighoma V. Prevalence and Patterns of Traumatic Foot Injuries at Mulago Hospital. Makerere Univ Postgrad Thesis. 2012;

4. Wei CJ, Tsai WC, Tiu CM, Wu HT, Chiou HJ, Chang CY. Systematic analysis of missed extremity fractures in emergency radiology. Acta radiol. 2006;47:710–7.

5. Mounts J, Clingenpeel J, McGuire E, Byers E, Kireeva Y. Most frequently missed fractures in the emergency department. Clin Pediatr (Phila). 2011;50(3):183–6.

6. Kinzl L, Gebhard F, Liener UC, Liebig V. Unfallchirurgie 2020: Entwicklungen der vergangenheit - Forderungen und perspektiven der zukunft. Teil III: Thesenpapier zur kunftigen versorgung. Unfallchirurg. 1999;102(9):741–5.

7. Probst C, Pape HC, Hildebrand F, Regel G, Mahlke L, Giannoudis P, et al. 30 years of polytrauma care: An analysis of the change in strategies and results of 4849 cases treated at a single institution. Injury. 2009;40(1):77–83.

8. Parenteau CS, Viano DC, Lövsund P, Tingvall C. Foot-ankle injuries: Influence of crash location, seating position and age. Accid Anal Prev. 1996;28(5):607–17.

9. Richter M, Pape HC, Otte D, Krettek C. Improvements in passive car safety led to decreased injury severity - A comparison between the 1970s and 1990s. Injury. 2005;36(4):484–8.

10. N. G. Safety Shoes For Industry. Foot Sci Vol 2. 1976;67–105.

11. Atkins RM, Allen PE, Livingstone JA. Demographic features of intra-articular fractures of the calcaneum. Foot Ankle Surg. 2001;2001(7):77–84.

12. Frink M, Geerling J, Hildebrand F, Knobloch K, Zech S, Droste P, et al. Etiology, treatment and long-term results of isolated midfoot fractures. Foot Ankle Surg. 2006;12:121–5.

13. Hasselman CT, Vogt MT, Stone KL, Cauley JA, Conti SF. Foot and ankle fractures in elderly white women incidence and risk factors. J Bone Jt Surg - Ser A. 2003;85-A:820–4.

14. Oleske DM, Hahn JJ, Leibold M. Work-related injuries to the foot. Data from an occupational injury/illness surveillance system. J Occup Med. 1992;34:650–5.

15. Jeffers RF, Boon Tan H, Nicolopoulos C, Kamath R, Giannoudis P V. Prevalence and patterns of foot injuries following motorcycle trauma. J Orthop Trauma. 2004;18:87–91.

16. Williams RL, Haddad FS, Fazal MA. Complex forefoot injuries in motorcycle couriers. Foot. 1997;7:210–4.

17. Wilson LS, Mizel MS, Michelson JD. Foot and ankle injuries in motor vehicle accidents. Foot Ankle Int. 2001;22:649–52.

18. Turchin DC. Do foot injuries significantly affect the functional outcome of multiply injured patients? J Orthop Trauma. 1998;13:1–4.

19. Probst C, Richter M, Lefering R, Frink M, Gaulke R, Krettek C, et al. Incidence and significance of injuries to the foot and ankle in polytrauma patients-An analysis of the Trauma Registry of DGU. Injury. 2010;41(2):210–5.

20. Zelle BA, Brown SR, Panzica M, Lohse R, Sittaro NA, Krettek C, et al. The impact of injuries below the knee joint on the long-term functional outcome following polytrauma. Injury. 2005;36:169–77.

21. Tran T, Thordarson D. Functional outcome of multiply injured patients with associated foot injury. Foot Ankle Int. 2002;23:340–3.

22. Fallis A. Moore - Clinically Oriented Anatomy 7th Ed. Lippincott Williams & Wilkins. 2014.

23. Sarrafian SK, Kelikian AS. Cross-sectional and topographic anatomy. In: Sarrafian's Anatomy of the Foot and Ankle: Descriptive, Topographic, Functional: Third Edition. 2012. p. 35–106.

24. Rettedal DD, Graves NC, Marshall JJ, Frush K, Vardaxis V. Reliability of ultrasound imaging in the assessment of the dorsal Lisfranc ligament. J Foot Ankle Res. 2013;6(1):6–7.

25. Seddon HJ. Three types of nerve injury. Brain. 1943;66(4):237–88.

26. Prada-Cañizares A, Auñón-Martín I, Vilá y Rico J, Pretell-Mazzini J. Subtalar dislocation: management and prognosis for an uncommon orthopaedic condition. Vol. 40, International Orthopaedics. 2016. p. 999–1007.

27. Bohay DR, Manoli A. Subtalar joint dislocations. Foot Ankle Int. 1995;16(12):803–8.

28. Englanoff G, Anglin D, Hutson HR. Lisfranc Fracture-Dislocation: A Frequently Missed Diagnosis in the Emergency Department. Ann Emerg Med. 1995;26(2):229–33.

29. DeOrio M, Erickson M, Usuelli FG, Easley M. Lisfranc Injuries in Sport. Vol. 14, Foot and Ankle Clinics. 2009. p. 169–86.

30. D. K. Fractures and Dislocations of the Foot. Semin Roentgenol. 1994;29(22):152–75.

31. Schnaue-Constantouris EM, Birrer RB, Grisafi PJ, Dellacorte MP. Digital foot trauma: Emergency diagnosis and treatment. J Emerg Med. 2002;22(2):163–70.

32. Burge AJ, Gold SL, Potter HG. Imaging of Sports-Related Midfoot and Forefoot Injuries. Sports Health. 2012;4(6):518–34.

33. Slater HK. Acute Peroneal Tendon Tears. Foot Ankle Clin. 2007;12(4):659–74.

34. Sammarco GJ. Peroneus longus tendon tears: Acute and chronic. Foot Ankle Int. 1995;16(5):245–53.

35. Van Staa TP, Dennison EM, Leufkens HGM, Cooper C. Epidemiology of fractures in England and Wales. Bone. 2001;29(6):517–22.

36. Sharma GK, Dhillon MS, Dhatt SS. The influence of foot and ankle injury patterns and treatment delays on outcomes in a tertiary hospital; a one-year prospective observation. Foot. 2016;26:48–52.

37. Rating the Severity of Tissue Damage: I. The Abbreviated Scale. JAMA J Am Med Assoc. 1971;215(2):277–80.

38. TA G, Wodzin E. The Abbreviated Injury Scale (AIS) - 1990 Revision (1998 Update). Update

[Internet]. 1998; Available from: http://AAAMI@aol.com

39. Baker SP, O'Neill B, Haddon W, Long WB. The injury severity score: a method for describing patients with multiple injuries and evaluating emergency care. J Trauma. 1974;14(3):187–96.

40. Poole G V., Tinsley M, Tsao AK, Thomae KR, Martin RW, Hauser CJ. Abbreviated Injury Scale Does Not Reflect the Added Morbidity of Multiple Lower Extremity Fractures. J Trauma - Inj Infect Crit Care. 1996;40(6):951–4.

41. Manoli A, Prasad P, Levine RS. Foot and ankle severity scale (FASS). Foot Ankle Int. 1997;18(9):598–602.

42. Ramasamy MA, Hill AM, Phillip R, Gibb I, Ed F, Bull AMJ, et al. FASS is a Better Predictor of Poor Outcome in Lower Limb Blast Injury Than AIS : Implications for Blast Research. 2012;0(0):1–7.

43. McKay BJ, Bir CA. Lower extremity injury criteria for evaluating military vehicle occupant injury in underbelly blast events. Stapp Car Crash J. 2009;53:229–49.

APPENDICES

Appendix I: Work plan

APRIL 2019-AUGUST 2019

Pilot Study

Proposal writing and submission

Proposal presentation to the department of orthopaedics surgery, UoN.

SEPTEMBER 2019

Submit to ethical committee for approval

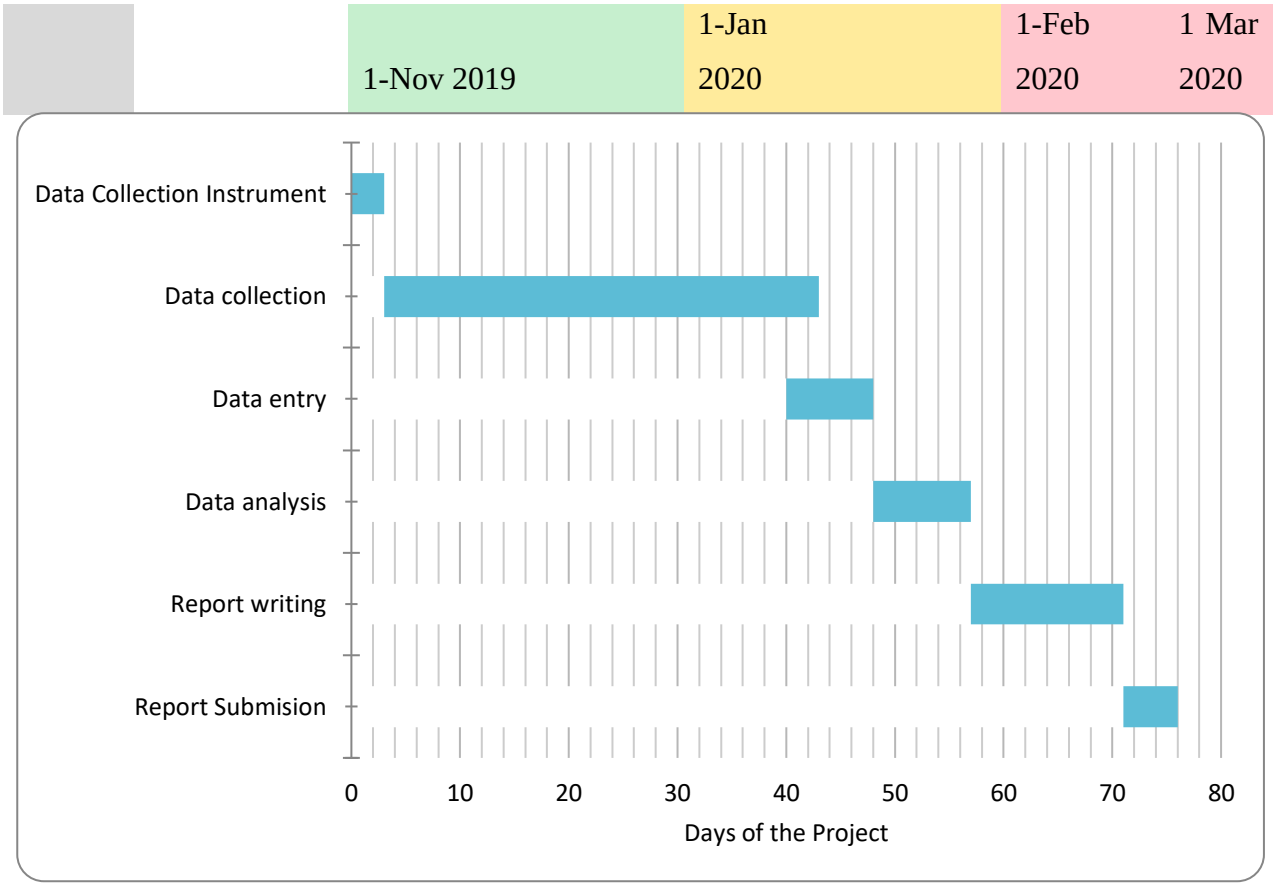
NOVEMBER 2019-FEBRUARY 2020

Data collection and analysis

FEBRUARY-MARCH 2020

Thesis writing and presentation of results

WORK SCHEDULE GANTT CHART



Appendix II: CONSENT FORMS
ENGLISH

TITLE

PATTERN OF ACUTE FOOT INJURIES IN PATIENTS SEEN AT KENYATTA NATIONAL HOSPITAL

INVESTIGATOR (PRINCIPAL RESEARCHER)

Dr. Duncan A.O. Ndeda

SUPERVISORS

Dr. Tom Mogire
Dr. Ezekiel Oburu

Introduction

The purpose of this consent form is to give you the information you will need to help you decide whether or not to be a participant in this study. You are free to ask any questions about the purpose of the research, what happens if you participate in the study, the possible risks and benefits, your rights as a volunteer, and anything else about the research or this form that is not clear. When all your questions are answered to your satisfaction, you may decide to participate in the study or not. This process is called 'informed consent'. Once you understand and agree to be in the study, I will request you to sign your name on this form.

This study has approval by The Kenyatta National Hospital-University of Nairobi Ethics and Research Committee protocol No…….

Study Background

Foot injuries are any injuries that occur to any part of the lower limb beyond the ankle. The injuries may include injuries to the skin, soft tissues, nerves and bones. This study seeks to establish the pattern of acute foot injuries seen in patients at Kenyatta National Hospital which include patient age and sex, cause of injury and nature of injury.

The researcher listed above is interviewing individuals who have foot injuries presenting at Kenyatta National Hospital.

Study Procedures

If you agree to participate in this study, you will be interviewed by a trained interviewer in a private area where you feel comfortable answering questions. The interview will last approximately 10 minutes.

Injuries and wounds will be assessed by a trained examiner who is a senior orthopaedic surgery resident.

Benefits of participation

The results of the examination and investigations taken may also be used by your doctor in your management. You shall not incur any extra costs due to this study as the above are the standard required examinations and tests. Your participation in this research will help to get information that will help guide health institutions, health care providers and health policy makers in approach to management of foot injuries.

Risks and Discomforts

Answering some questions in the interview may be uncomfortable for you. If there are any questions you do not want to answer, you can skip them.

You may feel some discomfort when examining the wounds. The examiner will use standard examination techniques and will be as gentle as possible with the calipers.

In case of an injury, illness or complications related to this study, contact the study staff right away at the number provided at the end of this document. The study staff will treat you for minor conditions or refer you when necessary.

The researcher will also bare the cost of any extra radiological investigation(s) and procedures deemed necessary for the patient's management and for purposes of this study. The patient and primary doctor shall duly be informed.

Voluntariness and right of withdrawal

Please note that your participation is voluntary and you have a right to decline or withdraw your consent to participate at any time. This will not affect your management in any way.

Confidentiality

The information obtained from you will be treated with confidentiality and will be handled only by the principal researcher. Only your study number will be used. Your identity will not be revealed in any publication. We will use a code number to identify you in a password-protected computer database and will keep all of our paper records in a locked file cabinet.

CONSENT CERTIFICATE

I certify that the study has been fully explained to me and I am willing to participate in the study.

Participant's Signature (or thumbprint)……

Date……

I confirm that I have clearly explained to the participant the nature of the study and the contents of this consent form in detail and the participant has decided to

Participate voluntarily without any coercion or undue pressure.

Investigator's Signature……. Date ……

For any inquiries before, during or after the study, please contact:

1. Dr. Duncan A. O. Ndeda
Mobile number: 0723915214
E-mail: duncanokelo@gmail.com

2. Dr Tom Mogire
Consultant Orthopaedic and Trauma Surgeon,
Lecturer, Department of Orthopaedic Surgery,
University of Nairobi
E-mail: tmogire@yahoo.com

3. Dr. Ezekiel Oburu
Consultant Orthopaedic and Trauma Surgeon,
Lecturer, Department of Orthopaedic Surgery,
University of Nairobi.
Email: oburue@gmail.com

4. Kenyatta National Hospital/University of Nairobi Ethics
and Research Committee, College of Health Sciences
P.O. Box 19676-00202 Nairobi
Telephone: +254202726300-9 Ext 44355
Email: uonknh_erc@uonbi.ac.ke

The study staff will pay you back for your charges to these numbers if the call is for study-related communication.

FOMU YA IDHINI

FOMU YA IDHINI YA MSHIRIKA KWENYE UTAFITI

KICHWA

UTAFITI JUU YA MIFUMO YA MAJERAHA YA MGUU KATIKA WAGONJWA WANAOTIBIWA KATIKA HOSPITALI KUU YA KENYATTA

MTAFITI

Dkt. Duncan A.O. Ndeda

WASIMAMIZI

Dr. Tom Mogire
Dr. Ezekiel Oburu

UTANGULIZI

Sababu ya cheti hiki nikukupatia maelezo unayohitaji ili kuamua kwamba ungetaka kushiriki katika utafiti huu au la.

Kuwa huru kuuliza swali lolote kuhusu utafiti huu.

Utakapokubali kushiriki katika utafiti huu,nitakuuliza utie jina lako na sahihi katika cheti hiki.

Utafiti huu umekubaliwa na kamati ya maadili ya hospitali kuu ya Kenyatta na chuo kikuu cha Nairobi nambari……

Umuhimu wa utafiti

Majeraha ya mguu ni majeraha yoyote chini ya kifundo cha mguu. Majeraha haya yanaweza kuwa kwa ngozi, mishipa au mifupa.

Utafiti huu unatumia kujua mifumo ya majeraha ya mguu katika wagonjwa wanaotibiwa hospiatali kuu ya Kenyatta ikizingatia umri na jinsia wa mgonjwa, usababishaji wa majeraha na aina na ukali wa majeraha

Utaratibu

Unapokubali,utaulizwa maswali na mtafiti faraghani na maswali yatachukua takriban dakika kumi. Majeraha na vidonda vitapimwa na mtafiti ambaye ni daktari aliyehitimu na anafanya masomo ya utalamu wa majeraha na mfupa.

Manufaa ya kushiriki

Matokeo ya vipimo vya vidonda na picha yanaweza kutumika katika matibabu yako. Kuhusika kwako hakutakugharimu malipo yoyote. Matokeo ya utafiti huu inaweza tumika na madaktari, hospitali na viungo vya serikali vinavyohusika na kuunda sera za afya kuweza kukumbatiana na majeraha ya mguu.

Madhara

Unaweza ukaruka yale maswali ambayo hutaki ama unaona haya kujibu au yanakutatanisha.

Unaweza hisi uchungu kiasi tunapoangalia kidonda chako lakini tutahakikisha tutakuwa wapole tunapochunguza majeraha yako.

Madhara yatakayo tokea kufuatia kupimwa na kuumizwa kutokan kwa utafiti huu, utatibiwa na mtafiti na kutumwa kupata matibabu inayofaa na mtafiti mkuu atakaye gharamia.

Kujitolea ni kwa hiari

Ni muhimu kuelewa ya kwamba kushiriki ni kwa kujitolea. Sio lazima kushiriki katika utafiti huu, na pia waweza kubadili nia yako wakati wowote kuhusu kuendelea kushiriki, bila kuathiri huduma zako za afya.

Usiri

Habari utakayotoa au itakayopatikana kukuhusu itakuwa siri wakati wote na itatumika kwa huu utafiti pekee yake. Tutatumia nambari maalum kukutambua na wala sio jina lako. Tutahakikisha cheti tutakachokijaza kitawekwa pahali salama ambapo ni mtafiti mkuu pekee ataweza kukipata.

Asante sana kwa ushirikiano wako.

AZIMIO

Nimekubali kwamba nimeelezwa kikamilifu kuhusu utafiti huu na nakubali kushiriki.

Sahihi..... Tarehe.....

Ninathibitsha ya kwamba nimetoa maelezo sahihi kwa mhusika kuhusu pana ya utafiti na yale yote yaliyomo kwa ustadi, naye mhusika ametoa uamuzi wa kushiriki bila ya kushurutishwa.

Sahihi ya mchunguzi……Tarehe……

Ukiwa na maswali yoyote kuhusu utafiti huu, wasiliana na:

1. Dr. Duncan A. O. Ndeda
Nambari ya simu: 0723915214
E-mail: duncanokelo@gmail.com

2. Dr. Tom Mogire
Consultant Orthopaedic and Trauma Surgeon,
Lecturer, Department of Orthopaedic Surgery,
University of Nairobi
E-mail: tmogire@yahoo.com

3. Dr. Ezekiel Oburu
Consultant Orthopaedic and Trauma Surgeon,
Senior Lecturer Orthopaedic Surgery, University of Nairobi.
Email: eoburu@gmail.com

4. Kenyatta National Hospital/University of Nairobi Ethics
and Research Committee, College of Health Sciences
P.O. Box 19676-00202 Nairobi
Telephone: +254202726300-9 Ext 44355
Email: uonknh_erc@uonbi.ac.ke

Gharama yote ya simu zitakazopigwa kuhusiana na utafiti huu zitarudishwa na mchunguzi.

Appendix IV: Questionnaire

Background information

Name (initials)……

Gender: Male [ ] Female [ ]

Age ……

Occupation……..

Foot injured: Right [ ] Left [ ] Both [ ]

Cause of the injury: RTA [ ] Falling [ ] Industrial Injury [ ] Assualt [ ]

Others [ ]

Specify (Motor vehicle, motorcycle, standing height fall, fall over 3 metres)……

…….

Nature of the injuries

Part injured **specify**

Skin lacerations (site and size) ……..

……

Skin loss (site and size) …….

……..……

Nail bed damage yes { } No { }

Wound crushed, dirty or contaminated yes { } No { }

Tendon injuries

……..……

……..(Crushed or avulsed) yes { } No { }

Fractures- (specify-open, closed, simple, communited, intraarticular)

……...

……

……

Dislocation

……..…….

……..…….

……

Ligamentous injury

……

……

……

Traumatic amputations (Exact level of amputation)

……..

……

……..…..

Nerve injuries

……

……

……

Arterial injuries

…….

…….

Associated Injuries……

TOTAL FASS: a) Right Foot……..

b) Left Foot ……..

UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
P O BOX 19676 Code 00202
Telegrams: varsity
Tel:(254-020) 2726300 Ext 44355

KNH-UON ERC
Email: uonknh_erc@uonbi.ac.ke
Website: http://www.erc.uonbi.ac.ke
Facebook: https://www.facebook.com/uonknh.erc
Twitter: @UONKNH_ERC https://twitter.com/UONKNH_ERC

KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP, Nairobi

Ref: KNH-ERC/A/420

7th November 2019

KENYATTA NATIONAL HOSPITAL
APPROVED
07 NOV 2019
KNH/UoN-ERC
BOX 20723 - 00202 NAIROBI

Dr. Duncan Antony O. Ndeda
Reg. No.H58/80804/2015
Dept.of Orthopaedic Surgery
School of Medicine
College of Health Sciences
University of Nairobi

Dear Dr. Ndeda

RESEARCH PROPOSAL: PATTERN OF ACUTE FOOT INJURIES IN PATIENTS SEEN AT KENYATTA NATIONAL HOSPITAL (P781/09/2019)

This is to inform you that the KNH- UoN Ethics & Research Committee (KNH- UoN ERC) has reviewed and **approved** your above research proposal. The approval period is 7th November 2019 – 6th November 2020.

This approval is subject to compliance with the following requirements:

a. Only approved documents (informed consents, study instruments, advertising materials etc) will be used.
b. All changes (amendments, deviations, violations etc.) are submitted for review and approval by KNH-UoN ERC before implementation.
c. Death and life threatening problems and serious adverse events (SAEs) or unexpected adverse events whether related or unrelated to the study must be reported to the KNH-UoN ERC within 72 hours of notification.
d. Any changes, anticipated or otherwise that may increase the risks or affect safety or welfare of study participants and others or affect the integrity of the research must be reported to KNH- UoN ERC within 72 hours.
e. Clearance for export of biological specimens must be obtained from KNH- UoN ERC for each batch of shipment.
f. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. (*Attach a comprehensive progress report to support the renewal*).
g. Submission of an *executive summary* report within 90 days upon completion of the study. This information will form part of the data base that will be consulted in future when processing related research studies so as to minimize chances of study duplication and/ or plagiarism.

For more details consult the KNH- UoN ERC website**http://www.erc.uonbi.ac.ke**

Protect to discover

ATTERN OF ACUTE FOOT INJURIES IN PATIENTS SEEN AT ENYATTA NATIONAL HOSPITAL

RIGINALITY REPORT

10%	1%	9%	3%
IMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

RIMARY SOURCES

1	Arthur Manoli, Priya Prasad, Robert S. Levine. "Foot and Ankle Severity Scale (FASS)", Foot & Ankle International, 2016 Publication	4%
2	Ramasamy, Maj Arul, Adam M. Hill, Rhodri Phillip, Iain Gibb, Anthony M. J. Bull, and Jon C. Clasper. "FASS is a Better Predictor of Poor Outcome in Lower Limb Blast Injury Than AIS : Implications for Blast Research", Journal of Orthopaedic Trauma, 2013. Publication	2%
3	Galen V. Poole. "Abbreviated Injury Scale Does Not Reflect the Added Morbidity of Multiple Lower Extremity Fractures", The Journal of Trauma Injury Infection and Critical Care, 06/1996 Publication	1%
4	Submitted to University of Dundee Student Paper	1%