Functional Outcomes of Displaced Diaphyseal Femoral Fractures in Adults at the University Teaching Hospital in Lusaka, Zambia

By

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A Dissertation Submitted As Partial Fulfillment of the Requirements

For The Award of Degree of Master of Science in Physiotherapy (Orthopaedics)

Of The University Of Zambia

The University of Zambia

Lusaka

2016

DECLARATION

I, NALONDWA NOVA, do hereby declare that the contents of this dissertation are based entirely on my findings and I have not in any respect used any persons work without acknowledgement. I therefore bare the absolute responsibility for the contents, errors, defects and any omission herein. I further declare that this Dissertation has not been previously submitted for a diploma, degree or for any other qualification at this or any other university. It has been written according to the guidelines for Master of Science in Physiotherapy (Orthopaedics) Degree dissertations of the University of Zambia.

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CERTIFICATE OF COMPLETION OF DISSERTATION

I, Dr Margaret Mweshi, having supervised and read this dissertation is satisfied that this is the original work of the author under whose name it is being presented. I confirm that the work has been completed satisfactorily and is ready for final submission.

Signature…………………………............ **Date……………………………**

Head of Department

Signature…………………………… **Date………………………….**

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CERTIFICATE OF APPROVAL

This dissertation by Nova Nalondwa has been approved as partial fulfillment of the requirements for the award of the Degree of Master of Science in Physiotherapy (Orthopaedics) by the University of Zambia.

Examiner I

Signature…………………………….. **Date…………………………………**

Examiner II

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Examiner III

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ABSTRACT

Introduction: Functional outcomes in patients with diaphyseal femoral fractures have been found to vary with the severity of the injury. Measuring outcomes is an important component of a physical therapists practice as it is important in the direct management of individual patients and also in comparing and determining effectiveness of management. Careful assessment, diligent planning, meticulous operative techniques and postoperative rehabilitation contributes to good outcomes. There has been very little follow up on how patients carry out their activities of daily living both in the case of those treated non-operatively and operatively after diaphyseal femoral fractures at UTH.

Objectives: To determine the functional outcomes of patients with diaphyseal femoral fractures managed non-operatively and those managed operatively at the University Teaching Hospital (UTH).

Materials and methods: A longitudinal study of patients that presented with diaphyseal femoral fractures was carried out at UTH in Lusaka, Zambia. Thirty-two patients were included in the study using purposive sampling technique. A checklist adopted and adapted from the Lower Extremity Functional Scale (LEFS) was used to assess function. Data analysis was done using Statistical Package in Social Science (SPSS) version 20.0 software for windows. The Fishers exact test and Chi-Square test were used to test for associations between independent and dependent variables and to compare the two types of management. Regression analysis was used to test for predictors of functional outcomes. Significance was set at 0.05.

Results: The majority of patients (n=84%) that were seen where males. Furthermore, the majority of patients (n=25%) in the study where between the age range of 26 to 30 years. There was found to be a statistical correlation between the male gender and functional outcome (p=0.044). A further correlation was found between age and functional outcomes (p=0.029). The younger you are the better the functional outcomes.

It was also found a significant statistical correlation between the cause of the fracture being a gunshot (p=0.017), physiotherapy intervention (p=0.032) and the functional outcomes of the patient after femoral diaphyseal fractures. It was found that there was no significant correlation (p=0.657) between the type of management used and the functional outcomes of the patients with diaphyseal femoral fractures.

Conclusion: Residual deficits in function were measurable in patients with diaphyseal femoral fractures 3 months after injury and management. Functional outcomes of diaphyseal femoral fractures are affected by age, gender, physiotherapy intervention and causes of the fracture.

DEDICATION

This dissertation is dedicated to my parents; Mr. Whiteson J.C Silondwa and Mrs. Chanila K.M Silondwa. Thank you for everything.

ACKNOWLEDGEMENTS

I would like to thank God for this chance to learn something. BE EXALTED!!

I would also like to thank my supervisors; Dr Margaret Mweshi and Ms Loveness Nkhata, whose guidance enabled me to do this research.

I would also like to thank the patients who volunteered to be participants without whom this study would not have been possible.

LIST OF ABBREVIATIONS

ICF	International Classification of Functioning, Disability and Health
UTH	University Teaching Hospital
WHO	World Health Organisation
ORIF	Open Reduction and Internal Fixation
VAS	Visual Analogue Scale
LEFS	Lower Extremity Functional Scale

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CHAPTER ONE

INTRODUCTION

1.1. Background

Functional outcomes are measures of the patient's ability to perform tasks of everyday living in rehabilitation (Kaplan, 2007; Medical Dictionary, 2009). They involve functional assessments in medical rehabilitation which is the objective measurement of the levels of a person's functional abilities in performing activities of daily living, including relevant psychosocial aspects. Assessment leads to appropriate interventions, so that a person can achieve the maximum possible functionality, toward a better quality of life (Granger, 2008).

Patient's functional outcomes vary with the severity of the injury and so do the complications (APTA, 2013). Some factors may play a role in individual outcomes, as outcomes are also impacted by the underlying disease state and not only a reflection of quality of care. Measuring outcomes is an important component of physical therapists practice. They are important in direct management of individual patient care and for the opportunity they provide the profession in collectively comparing care and determining effectiveness (APTA, 2013).

Low-velocity injuries without associated soft-tissue damage usually regain full function as a matter of course with appropriate treatment. High-velocity injuries with soft-tissue loss will not regain normal function, but careful assessment, preoperative planning, meticulous operative technique, preservation of soft tissues, and diligent postoperative rehabilitation will ensure the best possible results for any patient (de Boer *et al*, 2016). However, injuries affecting bone tissue could be a challenge when it comes to management especially in sub-Saharan Africa. For instance, diaphyseal femoral fractures resulting from significant force transmitted from a direct blow or from an indirect force transmitted at the knee could be a challenge that could lead to poor functional outcomes (de Boer *et al*, 2016). The diaphysis of a bone is the main or mid-section (shaft) of a long bong and is made up of cortical bone and contains bone marrow and adipose tissue. The diaphysis of a long bone has many functions, the two most important of which are to maintain its proximal and distal joints in their correct spatial relationship and to provide attachment for muscles which move them. (de Boer *et al, 2016).*

The incidences of femoral diaphyseal fractures caused by different injuries vary from 1.5:100 000 person-years to 9.9:100 000 person-years globally. The incidence of diaphyseal femoral fractures excluding the hip has been found to be 37.1 per 100,000 person-years in the United States of America (Salminen, 2005), whilst here in Zambia it is estimated that there were at least 9,000 fractures of the diaphysis of the femur in 2012 nationwide (Right Diagnosis, 2012). It has been found that the incidence of femoral, particularly diaphyseal, fractures due to severe trauma is greatest in young men whilst low energy falls are the most common cause in older adults accounting for sixty-five percent of fractures (Mezzanotte *et al.*, 2014).

Most traumatic femoral diaphyseal fractures are isolated without concomitant injuries (Salminen, 2005). Diaphyseal femur fractures can result from either high or low-energy trauma. These fractures commonly result from gunshots, motor vehicle accidents, pedestrian accidents, or falls from a height. They may also result from osteopenic conditions in older adults or pathologic conditions (Hans *et al*, 2016).

A lower-force incident, such as a fall from a standing position may cause a femoral diaphyseal fracture in an older person who has weaker bones (Mezzanotte *et al*, 2014).

These fractures can result in major physical impairment due to potential fracture shortening, mal-alignment, or prolonged immobilisation of the extremity with casting or traction (Mezzanotte *et al*, 2014). A large amount of force is required to fracture the diaphysis of the femurs because of its strength and length and its protective surrounding muscles. Once a fracture occurs, this same protective musculature is usually the cause of displacement, which commonly occurs with femoral diaphyseal fractures. Diaphyseal fractures vary greatly, depending on the forces that may cause the break. The pieces of the fractured bone may line up correctly or be out of alignment. These fractures can also result in major physical impairment due to potential fracture shortening, mal-alignment, or prolonged immobilisation of the extremity with casting or traction (Mezzanotte *et al*, 2014).

There are two commonly used types of management i.e. non-operative management and operative management. Non-operative management means that the patient will be in a form of traction for at least 6-8 weeks, often 10-12 weeks. The main form of traction used is skeletal traction. In skeletal traction, a pin is placed in the distal femur or proximal tibia, upon which traction can be placed against the patient's own weight. Skeletal traction is usually combined with one of many splinting systems. Proximal tibia skeletal traction is commonly chosen when femoral diaphyseal fractures are to be treated by skeletal traction. The main goal in traction is to regain the anatomic length of the limb. In most other cases, the proximal tibia is the choice location. The amount of traction needed varies with a patient's unique situation. The result is reduction and immobilization of the fracture (Eastwood, 2013).

Operative management means management of diaphyseal fractures using Open Reduction and Internal fixation (ORIF). The standard management of femoral diaphyseal fractures in adults is an anterograde, reamed, locked intramedullary (IM) rod. Intramedullary nailing is the management of choice for the majority of femoral shaft fractures occurring in adults. Other treatment options include plate and screw fixation as well as external fixation. The method of fixation is dependent upon the type of the fracture as well as associated injuries. The goal in operative treatment is to restore length, alignment, and rotation to the femur. There are several relative indications for retrograde IM rod insertion. These include morbid obesity, pregnancy, ipsilateral femoral neck fracture, bilateral femur fractures, skin about the hip which is unsuitable for insertion of an anterograde rod, floating knee, and ipsilateral acetabular fracture (Ricci *et al*, 2009).

With trauma-related femur fractures, physiotherapy following stable fixation of the fracture to improve hip and knee range of motion, strengthening and gait training is recommended. Weight-bearing status is dependent upon fracture pattern and operative intervention. Ambulatory aids, such as crutches, are used in the initial stages. The goal of the therapy program is to return the patient to full weight-bearing and restoration of normal function. Pulmonary therapy is often needed in patients sustaining major trauma requiring prolonged bed rest (Demmer *et al*, 2016).

Disability following a fracture of the femoral shaft is prolonged, even when bone union occurs without complication. It has been found that treatment with an antegrade locked intramedullary nail is generally considered to be successful when union occurs predictably and malalignment is avoided. In fact, union rates exceeding 95% and malalignment rates below 5% are expected after intramedullary nailing of mid-shaft fractures. Nonetheless, patients report disability long after femoral fracture, even when surgery is accomplished with technical success and union is achieved (Sanders *et al*, 2008). It was noted by the researcher that when it comes to parameters of measuring functional outcomes in Zambia, the commonest forms used were the radiological healing, clinical healing and knee function parameters. However, some parameters such as the patient's quality of life, challenges patients face in their own environment and how the patient adapts to function in their community or society have been found to be lacking. Furthermore, the level of functional status of the patient before and after management was found to also be lacking. Other factors such as to what extent pain affects the patient's level of functioning after the fracture has occurred were considered.

This precipitated the researcher to determine the functional outcomes of people with diaphyseal femoral fractures.

1.2 Statement of the Problem

It has been noted that the use of non-operative management in the treatment of diaphyseal fractures in UTH remains the most common method of management of diaphyseal fractures. A quick survey by the researcher in phases three and five theatres in UTH showed that an estimated 154 patients were inserted with Steinmann pins for Perkins traction in 2012 whilst 45 patients where managed operatively by the use of ORIF in 2012. In 2013 there were 122 patients that were treated by the use of Steinmann's pins for Perkins traction whilst 40 were managed operatively by ORIF. However no, records were shown to indicate which patients are eventually treated with operative means after the initial non-operative management of Perkins traction is used.

There has been an increase in the numbers of patients presenting with diaphyseal femoral fractures as a result of the increase in number of road traffic accidents thus there is need to know the impact of these fractures on morbidity in the social and economic national growth and the theoretical need to know the impact of the three components of the treatment i.e. traction, surgery and physiotherapy. Functional outcomes are normally assessed by various parameters such as radiological and clinical union and ROM of the ipsilateral hip and knee joints. However, there was little follow up of how patients carry out their daily activities after diaphyseal femoral fractures and there was no official record to show the functional outcomes of femur diaphyseal femoral fractures in Zambia.

1.3 Conceptual Framework

This study is guided by the International Classification of Functioning, Disability and Health (ICF) The ICF is a classification of health and health related domain. In 2001, the

World Health Organization (WHO) adopted the International Classification of Functioning, Disability, and Health, commonly referred to as the ICF (WHO, 2001) as shown in Figure 1.1, which is a bio-psychosocial classification system of health. It provides a common framework for describing consequences of health conditions and specifically for understanding the dimensions of health and functioning.

The domains that will be measured as per guideline of the ICF include the body function which will be measured using the variables of pain, leg length discrepancy and muscle grading. The functional assessment tool will be guided by the activity limitation and participation restriction domains of the ICF for example asking the patient whether he is able to dress himself up and walk around a block comes under activity limitation whereas asking the patient whether he is able to participate in a sporting activity or go to work comes under the participation restriction domain. Environmental factors that may contribute to the level of functioning will be measured as well such as whether a person is able to climb stairs, whether the ground they are walking on is even or not (WHO, 2014).

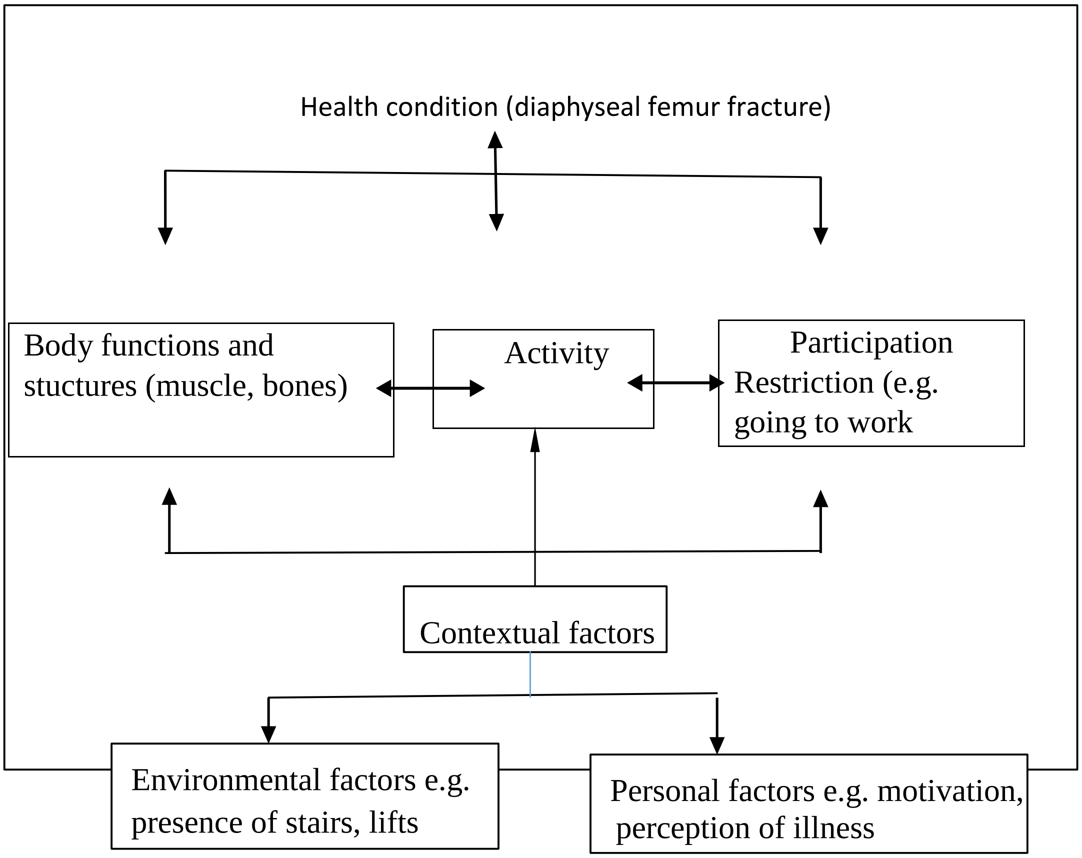

Figure 1.1: Interactions between the components of the ICF (WHO, 2001)

In the research with reference to the above Figure 1.1, the health condition or disorder is the fracture of the diaphysis of the femur. This involves the body functions and structures of the lower limb that is the distal and proximal joints which are the hip and knee joints. Other body structures that are affected included the muscles and soft tissues surrounding the femur. Body functions such as mobilisation in the case of walking are impaired. Some patients may end up with abnormal gait. Activity participation is limited in most patients such as walking. Patients have difficulty in everyday work related activities especially in cases where the use of the limb is required like lifting. Environmental factors such as stairs may also affect the functioning of an individual that may limit someone's participation in an activity such as climbing up the stairs at work. Where lifts or escalators are available, the functional limitation may be reduced. Personal factors may also affect the functional outcomes in the sense that the patient may feel depressed by their condition. This may in turn affect their rehabilitation as they may not be willing to get better.

1.4 Study Rationale/Justification

Disability following a fracture of the femoral shaft is prolonged, even when bone union occurs without complications. The time course of recovery is poorly understood, and the sources of disability are similarly unclear. There are various reasons for the lack of knowledge on disability following fracture of the femur. First, fractures of the femoral shaft often occur in a young, mobile population, thus long-term follow-up can be difficult. Second, these fractures are commonly associated with other injuries, thus ascribing disability to the fracture of the femoral shaft alone may be misleading. Third, issues such as muscle deconditioning are vague, generally nonsurgical issues. It is therefore necessary for further studies to establish causes of disability in fractures of the femur (Sanders *et al*, 2008).

This study was therefore aimed at assessing the functional outcomes of patients that had diaphyseal femoral fractures. By comparing the functional outcomes, the researcher aimed to find out which of the two treatment methods produce better functional outcomes in patients with diaphyseal fractures. The researcher in comparing these outcomes also aimed to provide data to aid in decision making which may aid in further management of patients. By assessing the outcomes, the researcher also aimed to find out what challenges patients face in function after fractures of the diaphysis of the femur. This is in line with the WHO-ICF conceptual framework as health is defined as the physical, mental and psychological wellbeing of the patient which also encompasses the functional outcome of a patient after diaphyseal femoral fractures.

1.5 Research Question

i. What are the functional outcomes of patients with diaphyseal femoral fractures at the University Teaching Hospital?

ii. Is there a difference in functional outcomes between patients with diaphyseal femoral fractures that are managed operatively in comparison to those that are managed non-operatively at UTH?

1.6 General Objective

To determine the functional outcomes of diaphyseal femoral fractures managed operatively and non-operatively at UTH.

1.7 Specific Objectives

i. To determine the demographic characteristics and clinical features of patients with diaphyseal femoral fractures

ii. To assess the factors associated with functional outcome of diaphyseal femoral fractures at the university teaching hospital

iii. To compare the functional outcomes of patients managed operatively and those managed non-operatively

CHAPTER TWO

LITERATURE REVIEW

2.0 Introduction

This chapter will address the current literature that looks at the functional outcomes of patients with diaphyseal femoral fractures. It will start with addressing functional outcomes followed by the definition, anatomy, aetiology and pathophysiology of diaphyseal femoral fractures as well as their management. Furthermore, this chapter addresses the current literature on factors affecting functional outcomes in patients with diaphyseal femoral fractures.

2.1 Background

2.1.1 Functional Outcomes

Functional outcomes are measures of the patient's ability to perform tasks of everyday living in rehabilitation (Kaplan, 2007; Medical Dictionary, 2009). Functional assessment in medical rehabilitation is the objective measurement of the levels of a person's functional abilities in performing activities of daily living, including relevant psychosocial aspects. Assessment leads to appropriate interventions, so that a person can achieve the maximum possible functionality, toward a better quality of life (Granger, 2008).

There are many tools and modes of testing available to describe and/or quantify the interactions among person skills, activity requirements, and environmental conditions. Many tests, for instance, utilize a performance-based format, wherein a test administrator observes and records a person's performance on a standardized activity. Other tests use a self-assessment or patient-centered format, wherein a person describes his or her perceived ability to perform routine daily tasks in his or her real-world environment. In addition, the scales of measurement (nominal, ordinal, interval, or ratio level data) are not uniform across tests within the same functional domains. Examples of these tools include the de Morton Index used to measure mobility and the Barthel Index which assesses self-care and mobility activities of daily living. The reliability, validity and overall utility for the above are rated as good to excellent. Other tests include the Functional Independence Measure (FIM) and Functional Assessment Measure (FAM) which measures the functional status of people in rehabilitation and reflects what a person usually does rather than what he/she can do respectively. The Short Form (36) Health Survey is a 36-item patient reported survey of patient health status which is commonly used in health economics whilst the Lower Extremity Functional Scale (LEFS) is used to determine the functional status in patients suffering from lower extremity disorders and disabilities (Granger, 2008).

Measuring outcomes is an important component of a physiotherapists practice. They are important in direct management of individual patient care and for the opportunity they provide the profession in collectively comparing care and determining effectiveness. The use of standardized tests and measures early in an episode of care establishes the baseline status of the patient/client, providing a means to quantify change in the patient's/client's outcome measures. These are provided along with other standardized tests and measures used throughout the episode of care, as part of periodic re-examination as they provide information about whether predicted outcomes are being realized (Bellamy, 2013). Functional outcomes in diaphyseal femoral fractures have been measured by the use of many assessment tools. Sanders et al, (2008) and el Moumni et al, (2008) studied the functional outcomes of patients with diaphyseal femoral fractures using the Western Ontario – McMaster University Osteoarthritis Index (WOMAC) and Short Musculoskeletal Functional Assessment (SMFA) whilst Thomson et al, (2008) studied functional outcomes in diaphyseal femoral fractures using the physical function component of the SF-36. The LEFS was used by Peskun et al, (2008), to study the functional outcomes of ipsilateral intertrochanteric fractures and femoral diaphyseal fractures.

2.1.2 Diaphyseal femoral fractures

The diaphysis of a bone is the main or mid- section (shaft) of a long bong and is made up of cortical bone and contains bone marrow and adipose tissue. The diaphysis of a long bone has many functions, the two most important of which are to maintain its proximal and distal joints in their correct spatial relationship and to provide attachment for muscles which move them (Network, 2008).

The diaphysis of the femur has a physiologic anterior curve which can increase in some cases such as fibrous dysplasia or Pagets disease. The external circumference of the femur has three surfaces i.e. anterior, lateral and medial surfaces (Salminen, 2005). On the posterior side of the femoral diaphysis attach the pectineus, adductor brevis, adductor magnus, adductor longus, and gluteus maximus muscles. From the femoral diaphysis originate m. vastus lateralis (upper half of the intertrochanteric line), m. vastus medialis (medial lip of linea aspera and spiral line of femur), m. vastus intermedius (anterior and lateral aspect of upper two thirds of femoral diaphysis), the short head of m. biceps femoris (linea aspera and lateral supracondylar line of femur), and m. articularis genus. The blood supply to the diaphysis of the femur has been found to be provided by one or two nutrient arteries arising from the profunda **femoris** in addition to the periosteal branches. The periosteal vessels supply the outer third or fourth of the cortex while the medullary arteries supply the inner two-thirds or three-quarters of the cortex (al Motabagani, 2002; Salminen, 2005).

The incidences of femoral diaphyseal fractures caused by different injuries vary from 1.5:100 000 person-years to 9.9:100 000 person-years globally (Salminen, 2005). The incidence of diaphyseal femoral fractures excluding the hip has been found to be 37.1 per 100,000 person-years in the United States of America (Salminen, 2005), whilst here in Zambia it is estimated that there were at least 9,000 fractures of the diaphysis of the femur in 2012 (Right Diagnosis, 2012). It has been found that the incidence of femoral, particularly diaphyseal, fractures due to severe trauma is greatest in young men whilst low energy falls are the most common cause in older adults accounting for sixty-five percent of fractures (Mezzanotte *et al.*, 2014).

Diaphyseal femoral fractures can be classified with the Winquist classification or the AO/OTA classification. The Winquist classification is based on the amount of comminution. Type I represent a femoral diaphyseal fracture with no comminution or a small butterfly fragment less than 25% of the bone. Type II is a comminuted femoral diaphyseal fracture with a butterfly fragment 50% or less of the width of the bone. Type III is comminuted with a large butterfly fragment greater than 50% of the width of bone. Type IV is severe comminution of an entire segment of bone. Type V is a fracture with segmental bone loss (Network, 2008). Diaphyseal femoral fractures result from significant force transmitted from a direct blow or from an indirect force transmitted at the knee. Pathological fractures may occur with relatively little force and may be the result of bone weakness from osteoporosis or lytic lesions (Eastwood, 2016).

2.2 Management of diaphyseal femoral fractures

2.2.1 Orthopaedic Management of diaphyseal femoral fractures

The management of diaphyseal fractures is evolving and progressing. New reduction and fixation concepts are emerging based on better understanding of the biology of fracture repair and of the role of the soft tissues in the healing process. Restoration of length, axial alignment, and rotation is essential, but anatomical reduction of every fracture fragment is not necessary for normal limb function**.** The emergent management of femur injuries is intended to restore alignment. If limb deformity is present, inline longitudinal traction is applied, realigning the extremity and maintaining limb perfusion (Eastwood, 2016).

Treatment maybe non-operative or operative; Non-operative treatment, usually by traction and/or cast, may be used for temporary or definitive management. This usually avoids the risk of infection and the equipment needed is minimal. Time until bony union is, however, longer and there are higher risks of mal-union, mal-alignment, and stiffness of the adjacent joints. It also requires regular follow-up, since secondary displacements before bony union are quite frequent. Non-operative management is very time-consuming and the incidence of shortening and angular deformity is high. If appropriate operating facilities and instrumentations do not exist locally, Non-operative treatment is still indicated for femoral diaphyseal fractures. Non-operative treatment of femoral diaphyseal fractures remains the treatment of choice in large areas of the world, even in the 21st century. The correct use of traction and splints remains a critical surgical skill in these areas of the world (de Boer *et al*, 2016).

Traction has been used for years, and the underlying central principle remains the same: alignment of a long bone fracture can be achieved and maintained by continuous isotonic traction over the lower extremity in line with its longitudinal axis. In general, skeletal traction is preferred to skin traction for adult femoral diaphyseal fractures. Studies have been done to evaluate the use of Perkins traction in the management of diaphyseal femoral fractures. In Africa, a prospective study was done in Ethiopia to evaluate the outcomes of Perkins' technique in the treatment of adult femur diaphyseal fractures from October 2007 – May 2009 *(*Bezabeh *et al*, 2012). Standard Perkins' system of traction was applied and the orthopaedic team composed of consultants, residents, physiotherapists and nurses using a Perkins' format/protocol prepared by the researchers followed patients. The study concluded that outcomes of non-operative treatment of femur diaphyseal fracture using Perkins' method are safe, easy, effective and very encouraging in a developing country set-up (Bezabeh *et al*., 2012).

Operative management is most commonly referred to as Open Reduction and Internal Fixation (ORIF). The most common method used is intramedullary nailing and is the treatment of choice for the majority of femoral diaphyseal fractures occurring in adults. Nailing can be performed in an antegrade or retrograde fashion. Currently, antegrade reamed interlocked intramedullary nailing is the treatment of choice for diaphyseal femur fractures as it is ideal in fracture stabilization. The exposure is small, and soft-tissue damage is limited. The nail itself has the advantage of being centrally located in the shaft and load sharing. Antegrade reamed locked nailing promotes healing through abundant callus formation. The fixation is solid and able to hold length even in the face of extensive comminution. It allows early and, in some cases, immediate weight-bearing. It is associated with easier nursing care, shorter hospital stays, and lower morbidity. The results of treatment have been excellent, with a 99% rate of union and 1% incidence of infection. Its use has been studied extensively, and it has proved effective in the short and long terms. Other treatment options include plate and screw fixation as well as external fixation. The method of fixation is dependent upon the personality of the fracture as well as associated injuries and surgeon skills, facility infrastructure and availability of sets and implants (Eastwood, 2016).

Currently, non-operative management is indicated for most femur diaphyseal fractures because of the high rate of union, low rate of complications, and the advantage of early fracture stabilization, which decreases morbidity and mortality in patients with these fractures (de Boer *et al*, 2016). A study was done by Deepak et al, (2012), to study the effectiveness, advantages, disadvantages and failure rates of closed intramedullary interlocking nailing of diaphyseal fractures of the femur in adults. A total of 30 cases of diaphyseal femur fractures in adults, who had been treated with closed intramedullary interlocking nailing were studied from 2008 – 2010. The study concluded that closed intramedullary interlocking nailing has now become the treatment of choice for closed diaphyseal fractures of femur in adults, especially those with high comminution, long spiral, and segmental fractures and that the interlocking nail offers the added advantages of early joint mobilization, early weight bearing, early muscle rehabilitation, shortened hospital stays and most importantly early return to work and pre-fracture state (Deepak *et al*, 2012).

2.2.2 Physiotherapy Intervention

Physiotherapy intervention has been considered to be very important after management of the patient with diaphyseal femoral fractures. Physiotherapists teach the patient how to use a walking aid and depending on their weight bearing status to allow them to be mobilised. Patients are taught basic range of motion and strengthening exercises to maintain a degree of strength and reduce the risk of blood clots. Extensive physiotherapy usually follows operative fixation and immobilisation. Gait training is usually taught as it results in an increased bone formation. Most muscles around the affected limb are weakened after the fracture thus the need for strengthening exercises. Patients should also undergo balance and proprioceptive rehabilitation as these are lost with inactivity. Physiotherapy should be continued until an acceptable functional range has been achieved or until a static position has been reached. Research has shown that strengthening the abductor and adductor muscles of the hip increases the latero-lateral stability during walks resulting in an influence in the improvement of the patient's dynamic balance (Caneiro *et al*, 2013).

Studies have been carried out to show the effect and impact of physiotherapy in patients with fractures of the diaphysis of the femur. In a case study, the patient was a 28-year-old male manual labourer whose left femur was fractured in a head-on motor vehicle accident. The patient was treated with internal fixation of the left femur by use of an antegrade intramedullary nail. Following surgery, impairments in range of motion, knee extensor and hip abductor strength, and gait were observed. Physiotherapy intervention focused on immediate weight bearing and early progression of strengthening to address the observed impairments. It was found that all of the patient's impairments improved, and was able to return to work as a manual labourer within six months. The researcher concluded that immediate weight bearing with early strengthening activities following operative correction of a mid-diaphysis of a femur fracture may result in early resolution of impairments and functional limitations and decreased disability (Paterno *et al*, 2006).

2.3 Factors affecting functional outcomes in patients with diaphyseal femoral fractures

2.3.1 Patients Age

Age affects fracture repair. However, the underlying mechanisms are not well understood. Skeletal fracture healing is a significant clinical problem. Many studies have been done to try and find out the role age plays on fracture healing. A study done by Povorozynuk et al, 2014, to determine the effects of ageing on fracture healing in rats found that regardless of the age of the animal’s, fracture healing process proceeds from the general scheme and in the late stages callus takes the form of the mature bone but the stage-temporal parameters of regeneration in senile animals showed slowing of fracture healing process.

A study was done by Hagino et al, 2006, to examine the walking ability and survival outcome of patients aged 90 years and older who sustained proximal femoral fractures, and to compare the findings with those of younger patients reported in previous studies. In the study done between January 1997 and June 2004 inclusive, 56 patients (11 men and 45 women) aged 90 years and older (range, 90-103 years; mean, 93 years) with hip fracture were reviewed. Their walking ability and survival outcome at discharge was investigated. Comparison was made between patients aged 60 to 89 years and those aged 90 years and older with respect to sex, fracture type, and other characteristics. It was concluded that patients older than 90 years have a lower rate of regaining pre-injury walking ability and a higher in-hospital death rate than younger patients (Hagino et al, 2006). However, another study done by Taormina et al, 2014 in elderly patients that had hip fractures found that the patient's age at the time of surgery was not associated with achieving union. Advanced age was generally not associated with poorer non-union surgery outcomes.

2.3.2 Pain

Pain is a symptom of fractures. Younger et al, 2009, stated that pain is a difficult outcome to measure due to its multifaceted and subjective nature and that there currently exists no valid and reliable method of objectively quantifying an individual's experience of pain. Therefore, most clinicians rely mainly on self-report measures to determine the impact of pain. There are many studies that have been done to look at pain as an outcome measure. A retrospective study was done to evaluate the long-term functional outcome after antegrade or retrograde intramedullary nailing of traumatic femoral shaft fractures one of the variables being pain complaints. In this study, patients with a femoral shaft fracture but no other injuries to the lower limbs or pelvis were included. The Visual Analogue Scale (VAS) was used to determine pain complaints of the lower limb. It was found that even years after surgery, 17% of the patients still reported moderate to severe pain. A substantial correlation was observed between VAS and the patient-reported outcome scores. It was concluded in this study that the most significant predictor of functional outcome was pain in the lower limb. However, pain in the lower limb is an important predictor and source of disability after femoral shaft fractures, even though most patients achieved good functional outcome scores (el Moumni *et al*, 2012).

2.3.3 Limb Length Discrepancy

A true limb length difference may simply be a mild variation between the two sides of the body. Limb length discrepancy is usually not large (about 1 cm) and is observed in about 3-15% of the population. The cause of the disparity is usually not known in 95% of cases. For those in the group with a known reason there are two groups that should be distinguished i.e. those as a result of processes directly causing the change of leg length and the second group being those processes causing asymmetrical growth

(Grzegorzewski *et al*, 2005). The first group includes lower limb diaphysis fracture with incomplete union or growth disorders and congenital or acquired bone deformations and hip joint deformations, including iatrogenic, e.g. after hip joint alloplasty (Goldstein, 2005). Group two comprises inhibition or stimulation of limb growth on one side. The inhibition of limb growth may result from an injury to the epiphysis, or may be related to paralysis, inflammation, ischaemia, tumours, necrosis or congenital deformation of extremities. Limb length discrepancies may be due to various reasons i.e. previous injury to the bone, bone pathologies, bone dysplasias, neurologic conditions etc. Limb length discrepancy is not unusual. For example, 32 percent of military recruits in one study had a 1/5- to 3/5-inch difference between the lengths of their legs. This is a normal variation. Greater differences in length, however, can affect a patient's well-being and quality of life (American Academy of Orthopaedic Surgeons, 2016).

The effects of limb length discrepancy vary from patient to patient, depending on the cause and size of the difference. Patients who have differences of 3-1/2 to 4 percent of total leg length (about 4 cm or 1-2/3 inches in an average adult) may limp or have other difficulties when walking. Because these differences require the patient to exert more effort to walk, he or she may tire easily. Studies show that patients with limb length discrepancies are more likely to experience low back pain and are more susceptible to injury (American Academy of Orthopaedic Surgeons, 2016).

Femoral diaphyseal fractures often heal with a true leg length discrepancy (LLD). Nailing comminuted femur fractures may result in leg shortening, producing significant complications including pelvic tilt, narrowing of the hip joint space, mechanical and functional changes in gait, an increase in energy expenditures, and strains on spinal ligaments, leading to spinal deformities. A study was done in 2014 by Herscovici & Scaduto, to assess the frequency of leg length discrepancy after fixation of comminuted fracture femur. They determined the frequency of LLDs, whether a specific fracture pattern was associated with LLDs, the frequency of reoperation, and whether revision fixation ultimately corrected the LLD. A total of 83 patients with 91 AO/OTA Type B or Type C fractures fixed with either an antegrade or retrograde IM nail from July 2002 through December 2005 where studied. They all underwent a digitized CT scan in the immediate postoperative period. Measurements of both legs were performed. Any fixation producing a discrepancy and requiring a return to surgery was identified. A mean LLD of 0.58 cm was found in 98% of the patients, but only six (7%) patients had an LLD of greater than 1.25 cm. Although residual LLDs may be common in comminuted femurs treated with IM nails, most LLDs do not appear to be functionally relevant (Herscovici & Scaduto, 2014).

2.3.4 Range of Motion

Range of motion is the measurement of movement around a specific body part or joint. Normal range of motion is usually measured using a goniometer. Normal range of motion in the knee is considered to be 0 degrees in extension to 135 degrees in flexion. Most functional activities require 0 to 117 degrees of motion at the knee. Walking requires complete knee extension at heel strike and up to 60 degrees of flexion at the initiation of swing phase. In the past, 90 degrees of knee flexion has been considered an "acceptable" result. The average range of motion required for sitting is 93 degrees, for climbing stairs is 100 degrees, for tying shoes is 106 degrees and for squatting to lift an object is 117 degrees (Gorgan, 2013).

In a case study done by Paterno et al, (2006), the patient was a 28-year-old male manual labourer whose left femur was fractured in a head-on motor vehicle accident. The patient was treated with internal fixation of the left femur by use of an antegrade intramedullary nail. Following surgery, impairments in range of motion, and gait were observed. Range-of-motion deficits were noted in knee flexion, hip flexion, and hip rotation. The patient had full knee extension at the initial examination, but he had only 90 degrees of knee flexion. He also had limitations in hip flexion (70°) and in hip medial (internal) rotation (30°) and lateral (external) rotation (40°). These limitations resulted in functional impairments of activities of daily living as well as recreational activities, as per the patient's report. In addition, the patient was unable to return to work. Following early rehabilitation all of the patient's impairments improved, and he was able to return to work as a manual labourer within 6 months (Paterno *et al*, 2006).

2.3.5 Muscle strength of the lower limb

Muscular strength is a measure of how much force muscles can exert (Jacobs et al, 2013). Muscle strength can be graded using the Oxford Muscle Grading scale. In this grading scale, muscle strength is graded 0 to 5. The grades are summarised below:

Grade 1: Flicker of movement

Grade 2: Through full range actively with gravity counterbalanced

Grade 3: Through full range actively against gravity

Grade 4: Through full range actively against some resistance

Grade 5: Through full range actively against strong resistance (Porter, 2013)

Studies have been done to look at the effect of muscle strength in the lower limb on functional outcome. A study was done by Paterno et al, 2006, in which they assessed the effects of muscle strength on functional outcomes of patients with diaphyseal femoral fractures. They found that strengthening activities following operative correction of a mid diaphyseal femur fracture may result in early resolution of impairments and functional limitations and decreased disability. Another study was done by Larsen et al, 2014, whose aim was to examine the long-term outcome after intramedullary nailing of femoral diaphyseal fractures measured as disease-specific patient reported function, walking ability, muscle strength, pain and quality of life (QOL). The study concluded that decreased muscle strength for knee flexion, knee extension and hip abduction was associated with worse long-term functional outcome after intramedullary nailing of diaphyseal femoral fractures (Larsen *et al*, 2014).

CHAPTER THREE

METHODOLOGY

3.0 Introduction

This chapter looks at the research methods used to carry out the research. It includes the study design, the study site, the study population, the sampling methods, data analysis and ethical clearance.

3.1 Study Design

The study was a longitudinal and assessed functional outcomes of patients that had fractures of the diaphysis of the femur. Quantitative methods were used to measure outcomes of management at first (baseline) assessment, second and third assessment.

3.2 Study Site

The study was conducted at the University Teaching Hospital (UTH) Orthopaedics outpatient's clinic and the main Orthopaedics wards. UTH is the biggest hospital in Zambia. It has approximately 2000 beds and provides a full range of primary, secondary and tertiary medical services on both inpatient and outpatients' basis. This site was used because it is the biggest referral hospital, its convenience and for ease of accessibility.

3.3 Study Population

The study population included all patients that presented with diaphyseal fractures of the femur at UTH during the data collection phase.

3.4 Sampling method and Sample Size

The sampling method that was used to recruit the patients was purposive sampling. Purposive sampling, also known as judgmental, selective or subjective sampling, is a type of non-probability sampling method (Dudovskiy, 2016). The initial number of patients recruited was 42 of which 10 dropped out due to them opting out of the study, change of management and loss of contact with the patients. Therefore, a sample size of 32 patients was used in the study. The following was the inclusion and exclusion criteria;

3.4.1 Inclusion Criteria

- Adult patients between 18 and 65 years that presented with diaphyseal fracture of femur during the time of data collection
- Patients that consented to be participants of the study
- Patients that had the fractures less than 6 weeks old in the non-operative stream
- Patients that had fractures managed within two weeks' post-op in the operative stream

3.4.2 Exclusion Criteria

- Patients that had fractures of the neck of femur, and supracondylar fractures and open fractures
- Patients that did not consent
- Patients with fractures older than 6 weeks in the non-operative group and those older than two weeks in the operative group

3.5 Data Collection Tools

a. The checklist used was adapted from the Lower Extremity Functional Scale (LEFS) questionnaire (Binkley *et al*, 1999). The LEFS is a twenty item self-report measure of physical function. It was chosen because of its reliability, validity and responsiveness of the LEFS to inpatients of an Orthopaedic ward (Yeung *et al*, 2009). The objective of the Lower Extremity Functional Scale (LEFS) is to measure "patients' initial function, ongoing progress, and outcome" for a wide range of lower-extremity conditions. The LEFS is intended for use on adults with lower extremity conditions.

Each item is rated on a five-point scale (0–4), with lower scores representing greater difficulty and the total scores can range from 0 to 80. In this scale, function is defined as follows:

- extreme difficulty or unable to perform activity (0–19 points),
- quite a bit of difficulty (20–39 points),
- moderate difficulty (40–59 points),
- little bit of difficulty (60–79 points),
- No difficulty (80 points) (Binkley, 1999).

b. **The research apparatus and material**

The following research tools were also used in this study

- Goniometer
- Measuring tape
- The Visual Analogue Scale

- The Oxford Muscle Grading chart

The goniometer was used to measure the range of motion. The measuring tape was used for measuring the leg length disparity. The Visual Analogue Scale (VAS) was used to measure the perception of the level of pain the patients experienced whilst the Oxford Muscle Grading Chart (OMGC) was used to test for muscle strength in the affected limb.

3.6 Data Collection Procedure

Upon receiving ethical approval, permission was sought from UTH management to carry out data collection. The checklist adapted from the LEFS scale as well as the questionnaire, information sheet and consent form were translated into two main local languages i.e. Bemba and Nyanja due to their more common usage in Lusaka, Zambia. Patients were identified by the use of ward registers in the Orthopaedic wards and the Outpatients Orthopaedic clinic. Thirty-two patients who met the inclusion criteria were identified from the Orthopaedic and Trauma wards and recruited into the study. Permission from the participants to take part in the research was sought. The participants were assessed using the research tools i.e. the checklist and the questionnaire. The data collection was done in three phases of interviews and assessments.

The first phase was done to identify the patients. The ward registers kept by the nurses where checked to identify patients with diaphyseal femoral fractures. Baseline data was collected in this phase as this part of the assessment focused on the bio-data of the participants and thus helped in the determination of the demographic characteristics of the participants. Measurement of the leg length and pain levels was also done using the measuring tape and Visual Analogue Scales (VAS) respectively. Muscle strength and range of motion were also done for patients who could tolerate movement and pain using the oxford muscle grading chart and a goniometer. A full functional assessment of the patients identified using the LEFS score chart was also done. Each person was graded according to the LEFS score.

The second phase included a full assessment of the patient's functional capabilities using the LEFS score chart and was done six weeks after the fracture management was done. In this assessment a full functional assessment using the checklist and the questionnaire was done and each person was graded according to the LEFS scores. Measurement of range of motion using the goniometer, muscle strength using the oxford grading chart and leg length using the measuring tape was also done.

The third and final phase was done twelve weeks after initial management. This was a follow up assessment as was done in the second assessment. A full assessment of functional outcomes using the LEFS score chart of the patients was done. Measurement of range of motion using the goniometer, muscle strength using the oxford grading chart and leg length using the measuring tape was also done.

3.7 Data Analysis

The Statistical Package in Social Science (SPSS) version 20.0 software for windows was used to manage and analyse data. Inferential statistics were used to analyse demographic characteristics while the results were presented in tables and charts. The Chi-Square and Fisher's Exact test were used to analyse the categorical and independent variables. Linear regression was used to analyse the key predictors of functional outcomes. Significance level was set at 0.05.

3.8 Ethical Consideration

Approval to conduct the study was sought from ERES Converge IRB in Lusaka, Zambia. Permission was sought from the Orthopaedics Outpatients Clinic at UTH and the Orthopaedics wards. Further permission and consent was sought from the patients that were included in the study.

CHAPTER FOUR

RESULTS

4.0 Introduction

The chapter presents first the demographic characteristics and the clinical findings of the patients who took part in the current study. This is followed by results of functional outcomes and subsequently a comparative representation of the factors affecting functional outcomes of the patients presented in tables.

4.1 Basic characteristics of study participants

A total number of 32 patients with diaphyseal femoral fractures took part in the study. The majority of patients that were seen were male (n=84%) whilst the minority were females (n=16%) as shown in Figure 4.1. The median age was 33 years (range: 23-62). The majority of patients seen fell in the age range category of 26-30 years of age (n=25%) as shown in Figure 4.2.

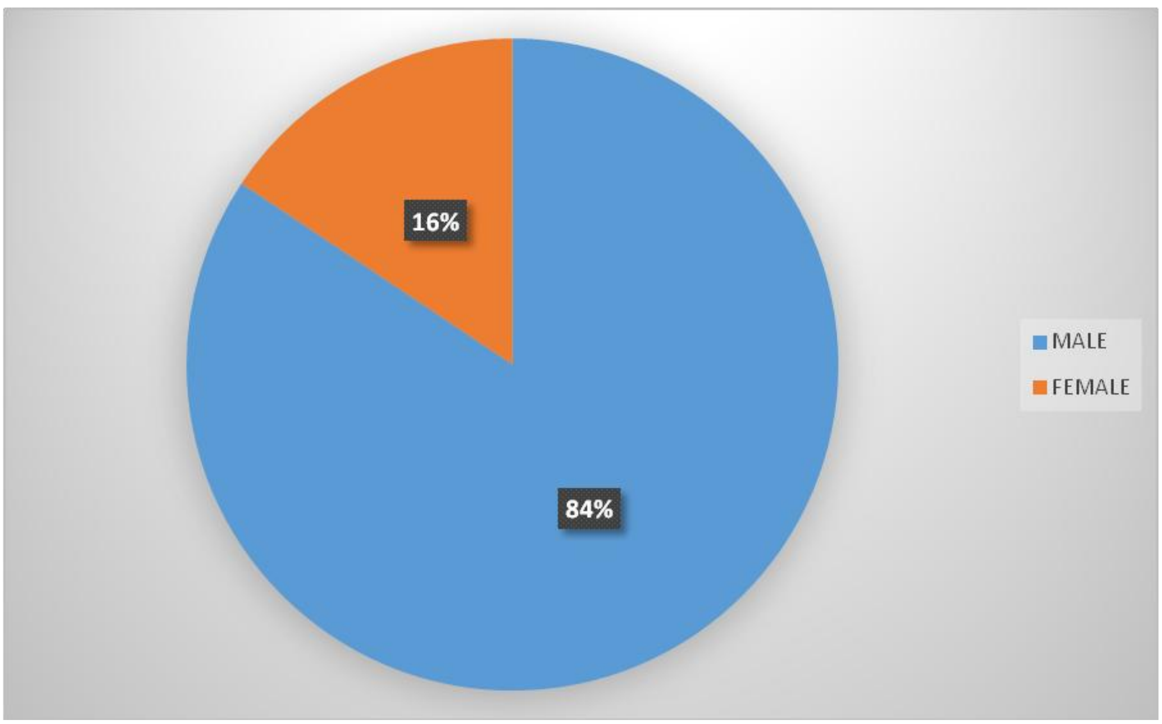

Figure 4.1: The distribution according to gender in fracture of the diaphysis of the femur.

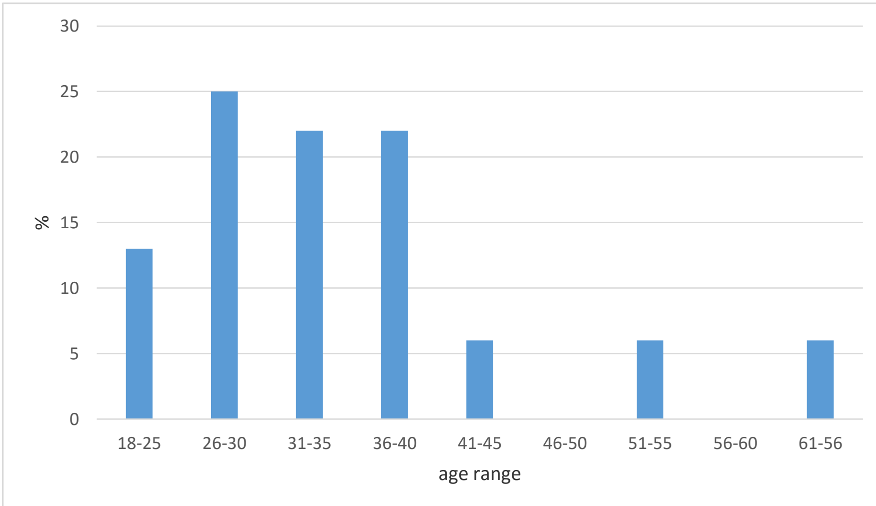

Figure 4.2: Distribution according to age range in fracture of the diaphysis of the femur

4.2 Clinical presentation of study participants

4.2.1 Location and cause of fractures of the diaphysis of the femur

The majority (n=66%) of the fractures were located in the mid diaphysis of the femur followed by the distal diaphysis (n=22%) and lastly the proximal diaphysis (n=12%) as shown in Figure 4.3. Most of the patients (n=75%) as shown in Figure 4.4 sustained their fractures as a result of road traffic accidents (RTA's) followed by falls (n=16%) whilst the remaining were as a result of assault and gunshots (n=6%).

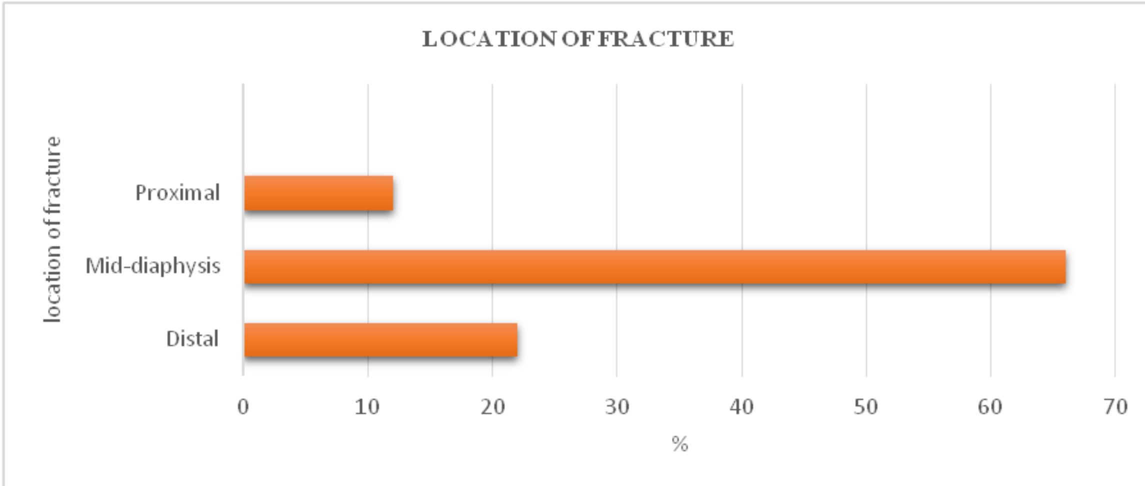

Figure 4.3: The distribution of the location of the fracture in the diaphysis of the femur.

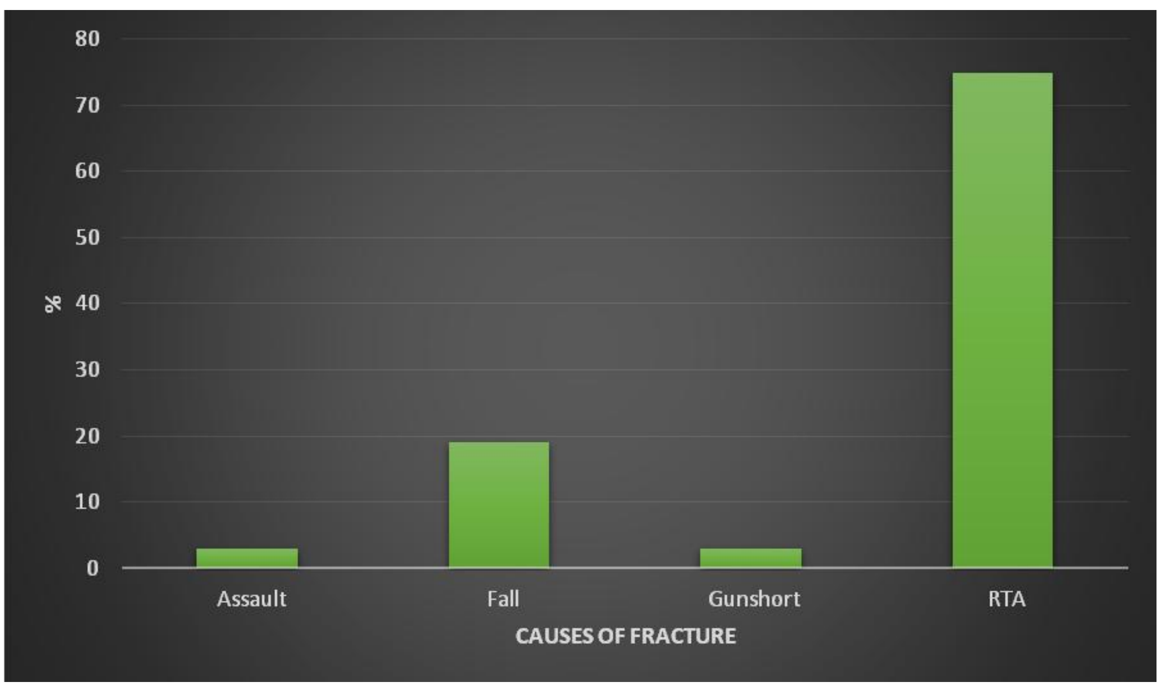

Figure 4.4: The causes of the fracture of the diaphysis of the femur.

4.2.2 Pain and Location of Pain

Figure 4.5 shows that the majority of patients (n=84%) reported pain in the first assessment whilst in the second assessment there were 66% of patients that reported the presence of pain and in the third assessment 44% of patients reported the presence of pain. It was noted that there was a steady reduction in pain during the follow up period of the patients. With regards to the location of the pain, the majority of the patients reported pain in the thigh in all the assessments; first assessment (n=48%), the second assessment (n=48%) and the third assessment (n=50%) as shown in Table 4.1.

Table 4.1: Distribution of location of pain according to the follow up period

Location of pain	1st Assessment (0 weeks), n (%)	2nd Assessment (6 weeks), n (%)	3rd Assessment (12 weeks), n (%)
Groin	4%	0%	7%
Groin/Thigh	7%	0%	0%
Groin/Thigh/Knee	7%	0%	0%
Knee	15%	28%	43%
Knee/Thigh	4%	0%	0%
Thigh	48%	48%	50%
Thigh/Knee	11%	19%	0%
Thigh/Knee/Groin	4%	0%	0%
Groin/knee	0%	5%	0 %

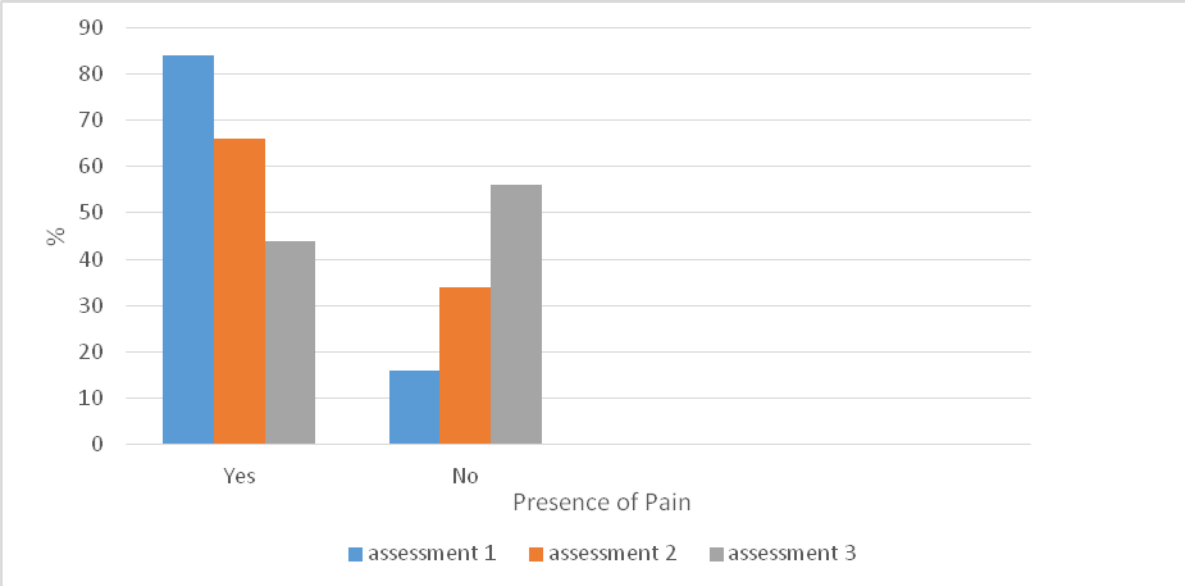

Figure 4.5: Trend of pain according to the follow up period.

4.2.3 Range of Motion of the Knee

Figure 4.6 shows the distribution of the functional range of motion of the knee. The majority of patients in the first and second assessment (n=66, n=63) had non-functional range of motion of the knee whilst in the third assessment the majority (n=84%) of the patients had functional knee range of motion.

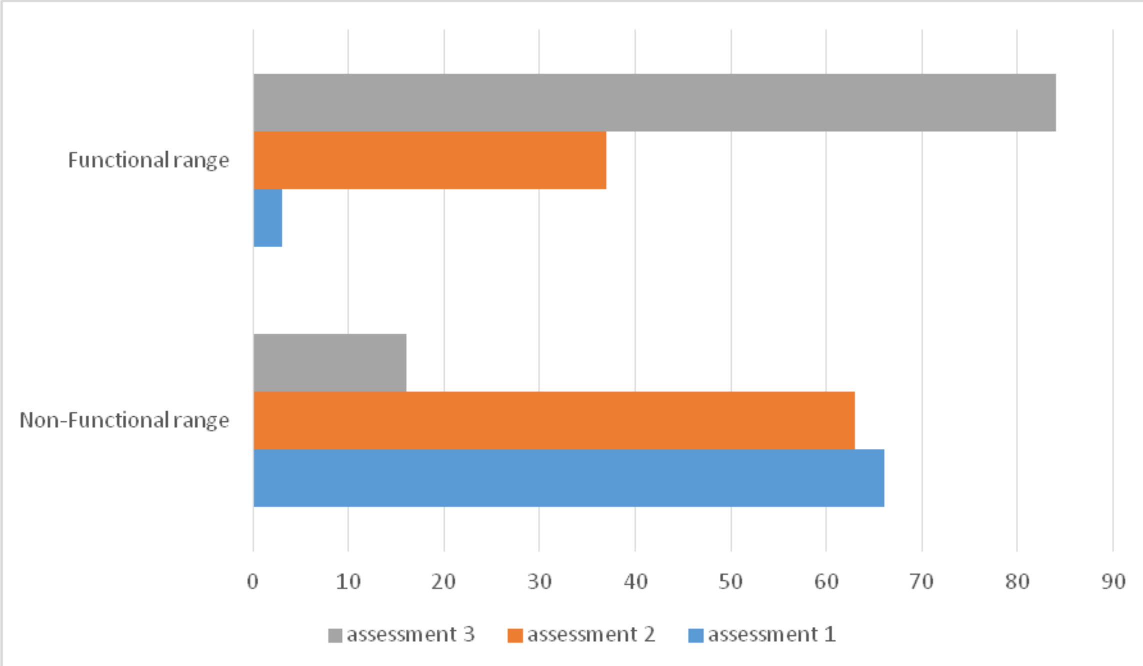

Figure 4.6: Showing the change in functional range of the knee during the follow-up period

4.2.4 Muscle Grading

Figure 4.7 shows that the majority of patients (n=72%) had muscle grade one in the first assessment whilst the majority of patients in the second assessment had muscle grade 3 (n=41%). In the 3rd assessment, the majority of patients (n=63%) had muscle grading of grade 4 (Figure 4.7).

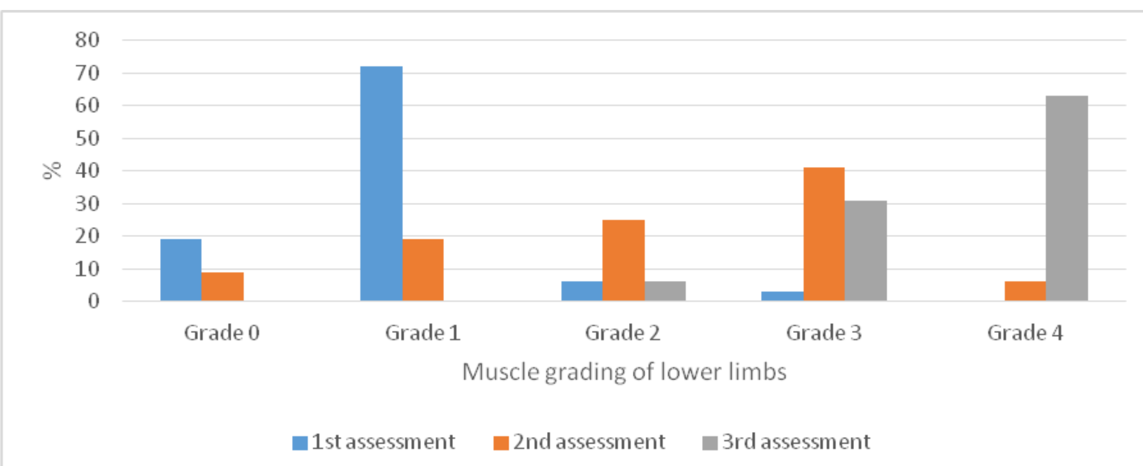

Figure 4.7: Distribution of muscle power according to follow up period

4.2.5. True Leg Length discrepancy

With regards the true leg length discrepancy as shown in Figure 4.8; in the first assessment there was an equal number of patients with a leg length discrepancy of less than 2 cm as well as greater than 2 cm. In the second assessment there was an increase (n=75%) in the number of patients with a leg length discrepancy of less than 2 cm, whilst still in the third assessment the majority (n=91%) of patients had a leg length discrepancy of less than 2 cm.

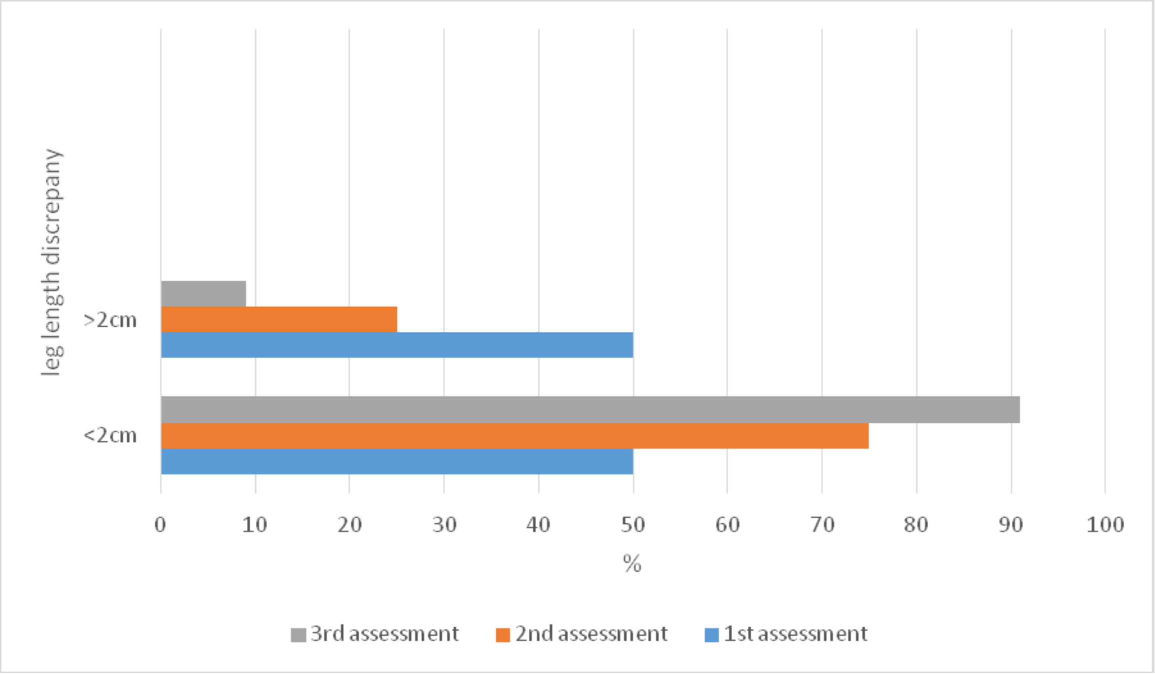

Figure 4.8: Trends in leg length discrepancy in fractures of the diaphysis of the femur

4.3 Management of Diaphyseal femoral fractures

4.3.1 Orthopaedic Management of diaphyseal femoral fractures

The majority of the patients (n=59%) underwent non-operative methods (Figure 4.9) whilst the minority (n=41%) underwent operative methods (ORIF) i.e. intramedullary nailing and plate and screws.

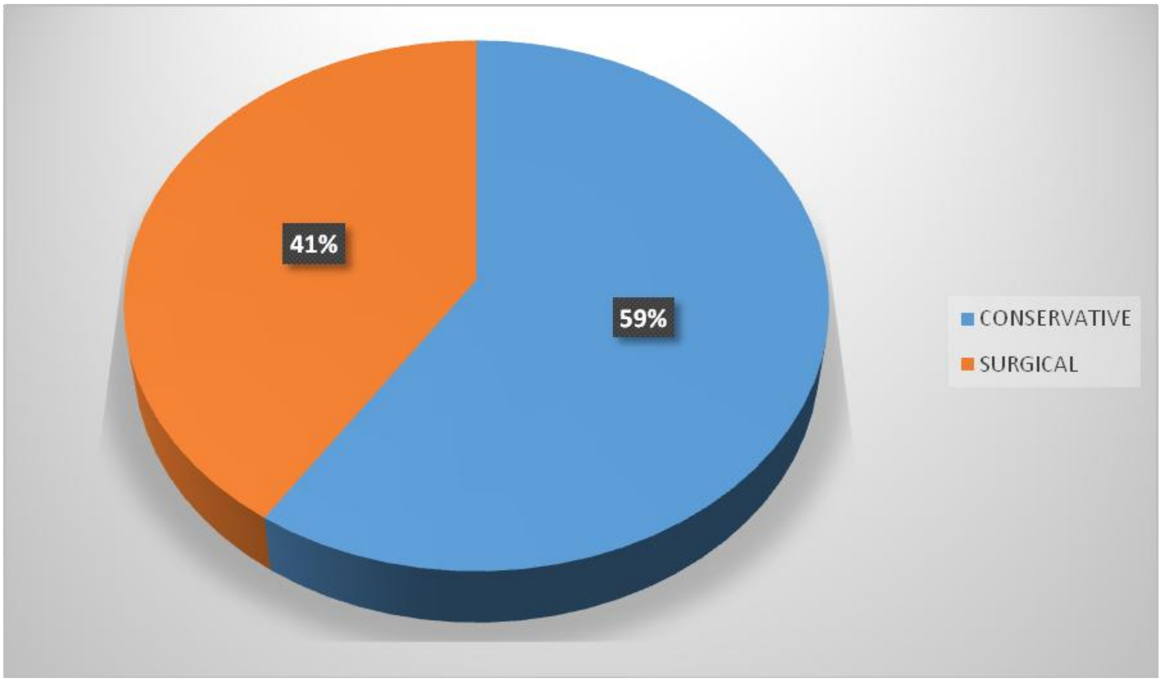

Figure 4.9: Type of management used in fracture of the diaphysis of the femur.

4.3.2 Physiotherapy

Figure 4.10 shows that there were more patients (n=66%) attended to by physiotherapists in the third assessment than in the first two assessments during the follow up period. Figure 4.11 shows that the majority of patients received combined physiotherapy interventions of both, mobilisation and strengthening in all three assessments during the follow up period.

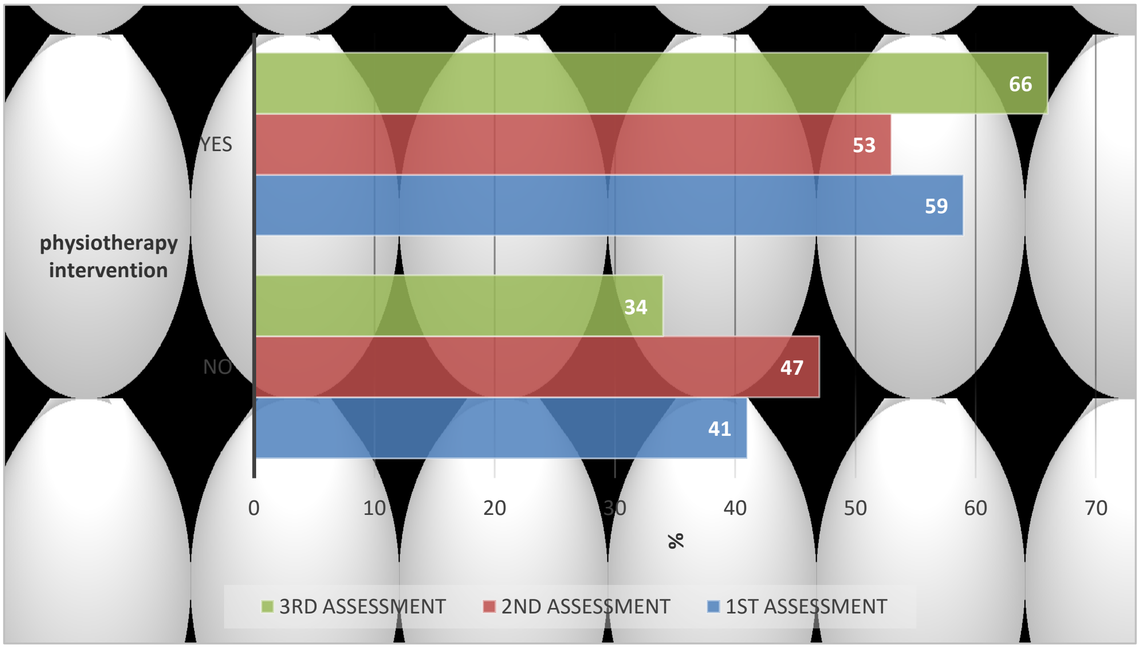

Figure 4.10: Trend in distribution of physiotherapy intervention in patients who had fracture of the diaphysis of the femur according to follow up period.

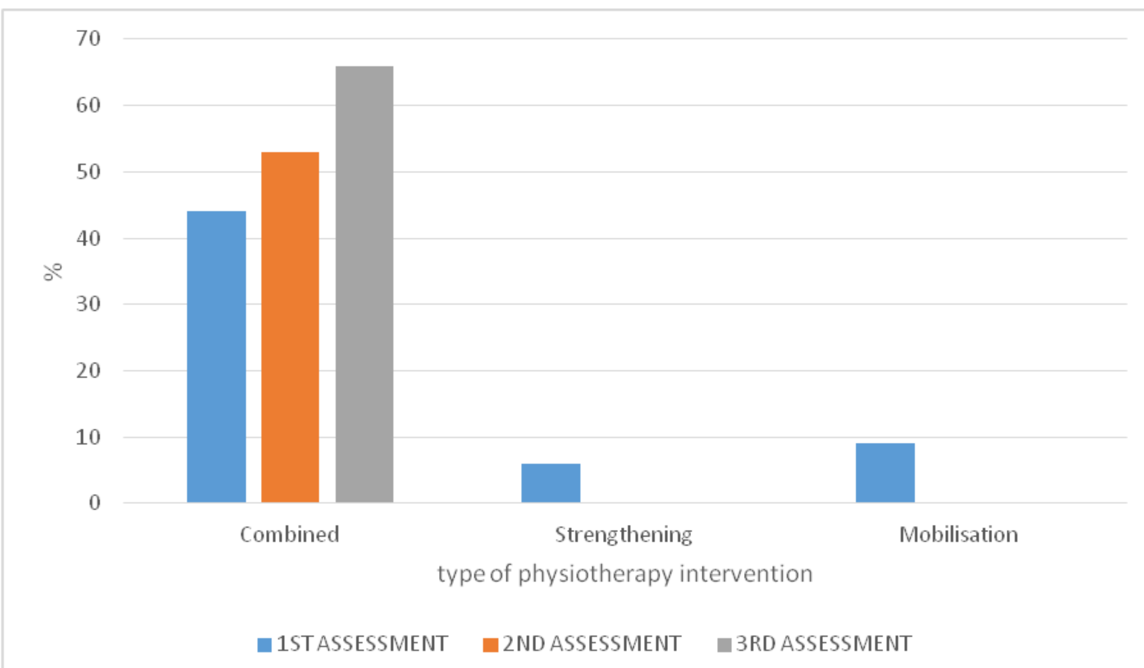

Figure 4.11: Distribution of the type of physiotherapy management used in patients in fracture of the diaphysis of the femur according to follow up period.

4.4 Functional outcomes of diaphyseal femoral fractures

In the first assessment as can be seen from Table 4.2 below, the majority (n=100%) fell within the category range of 0-19 (extreme difficulty and where unable to perform any activities). In the second assessment the majority of the patients seen (n=56%) fell in the LEFS subcategory of 0-19 (extreme difficulty and where unable to perform any activities) followed by the subcategory of 20-39 (Quite a bit of difficulty) (n=44%). In the third assessment, the majority of patients (n=41%) fell in the subcategories of 40-59 (moderate difficulty) as well as the subcategory of 60-79 (little bit of difficulty), (n=41%).

Table 4.2: Distribution of functional outcome among the study participants by follow-up period

Score	**Meaning**	**Follow-up period**		
		First (0 weeks), n (%)	Second (6 weeks), n (%)	Third (12 weeks), n (%)
0-19	Extreme difficulty or unable to perform activity	100	56	0
20-39	Quite a bit of difficulty	0	44	18
40-59	Moderate difficulty	0	0	41
60-79	little bit of difficulty	0	0	41

4.5 Factors affecting functional outcomes in patients with diaphyseal femoral fractures

Table 4.3 presents the factors that were assessed during the follow up period which included the location of the fracture, cause of fracture, pain and location of pain, muscle grading of the lower limbs, knee range of motion, leg length discrepancy, general management, physiotherapy and the type of physiotherapy intervention.

4.6 Statistical representation of factors affecting functional outcomes of patients with diaphyseal femoral fractures

From the table below, there was found to be a correlation between muscle grading and functional outcome score on the LEFS scale (Table 4.3) during the second and the third assessment of the patient.

Table 4.3: Study characteristics and factors affecting functional outcomes sorted according to Lower Extremity Functional Scale (LEFS) by follow-up period

	First follow-up (0 weeks)					Second follow-up (6 weeks)					Third follow-up (12 weeks)				
	LEFS scale n (%)														
Variable	0-19	20-39	40-59	60-79	P-value	0-19	20-39	40-59	60-79	P-value	0-19	20-39	40-59	60-79	P-value
Pain															
No	16	0	0	0	N/A	39	29	0	0	0.712[f]	0	50	46	69	0.526[f]
Yes	84	0	0	0		61	71	0	0		0	50	54	31	
Gender															
Female	16	0	0	0	N/A	17	14	0	0	1.000[f]	0	17	15	15	1.000[f]
Male	84	0	0	0		83	86	0	0		0	83	85	85	
Leg length discrepancy															
<2cm	50	0	0		N/A	67	86	0	0	0.217[f]	0	100	85	92	1.000[f]
≥2cm	50	0	0	0		33	14	0	0		0	0	15	8	

Physiotherapy intervention															
No	41	0	0	0	N/A	50	43	0	0	0.688	0	50	38	23	0.630[f]
Yes	59	0	0	0		50	57	0	0		0	50	62	77	
Location of fracture															
Distal	22	0	0	0	N/A	22	21	0	0	0.869[f]	0	17	8	38	0.094[f]
Midshaft	66	0	0	0		61	72	0	0		0	83	61	62	
Proximal	12	0	0	0		17	7	0	0		0	0	31	0	
Cause of fracture															
Assault	3	0	0	0	N/A	0	7	0	0	0.808[f]	0	0	0	8	0.093[f]
Fail	19	0	0	0		17	21	0	0		0	33	0	31	
Gunshot	3	0	0	0		5	0	0	0		0	0	8	0	
RTA	75	0	0	0		78	72	0	0		0	67	92	61	
Type of physiotherapy intervention															
Combined	74	0	0	0	N/A	100	100	0	0	N/A	0	100	100	100	N/A
Mobilization	10	0	0	0		0	0	0	0		0	0	0	0	
Strengthening	16	0	0	0		0	0	0	0		0	0	0	0	
Muscle grading															
0	19	0	0	0	N/A	11	7	0	0	0.007[f]	0	0	0	0	0.003[f]
1	72	0	0	0		33	0	0	0		0	33	0	0	

2	6	0	0	0		33	14	0	0		0	50	46	8	
3	3	0	0	0		17	72	0	0		0	17	54	92	
4	0	0	0	0		6	7	0	0		0				
Range of motion knee															
Functional	3	0	0	0	N/A	28	50	0	0	0.198	0	67	85	92	0.376[f]
Non-functional	97	0	0	0		72	50	0	0		0	33	15	8	

LEFS: Lower Extremity Functional Scale, n: number of times participants were followed up, ORIF: open reduction internal fixation (operative procedure), RTA: road traffic accident, extreme difficulty or unable to perform activity (0–19 points), quite a bit of difficulty (20–39 points), moderate difficulty (40–59 points), little bit of difficulty (60–79 points), [f]Fisher's exact test.

4.7 Comparison between the two types of management of diaphyseal femoral fractures It can also be noted from Table 4.4 below that there where statistical significant correlations between the type of management and the functional outcome score in the third assessment as compared to the 1st and 2nd follow ups where there was found to be no significance.

Table 4.4: Showing the comparative statistics relative to the functional outcomes sorted according to the LEFS score by follow up period

	First follow-up (0 weeks)					Second follow-up (6 weeks)					Third follow-up (12 weeks)				
	LEFS scale n (%)														
Variable	0-19	20-39	40-59	60-79	P-value	0-19	20-39	40-59	60-79	P-value	0-19	20-39	40-59	60-79	P-value
Type of treatment															
Non-operative	19 (59)	0 (0)	0 (0)	0 (0)	N/A	12 (67)	7 (50)	0 (0)	0 (0)	0.341	0 (0)	5 (83)	11 (85)	3 (23)	0.003[f]
Operative	13 (41)	0 (0)	0 (0)	0 (0)		6 (33)	7 (50)	0 (0)	0 (0)		0 (0)	1 (17)	2 (15)	10 (77)	

4.8 Univariate and Multivariate analysis of key predictors of LEFS score

Table 4.5 below shows the univariate and multivariate analysis of key predictors of LEFS score. During adjusted analysis, it was shown that a unit increase in age significantly reduced LEFS score by 0.08 (coef. -0.08; 95%CI -0.017, -0.01; p=0.044). Without taking account of other variables (unadjusted analysis), those individuals with pain had significantly reduced LEFS score of about 15.54 (coef. -15.54; 95%CI -24.36, -6.72; p=0.001) as compared to those without pain. Taking account of other variable (adjusted analysis), males compared to females had a significantly increased LEFS score of about 2.62 (coef. 2.62; 95%CI 0.26, 4.98; p=0.029). During unadjusted analysis, those participants with leg length discrepancy of ≥2cm had a reduced LEFS score of 17.71 (coef. -17.71; 95%CI -27.00, -8.42; p<0.001) when compared to the ones with leg length discrepancy of <2cm, and the findings were statistically significant. Taking account of other variables, individuals who had physiotherapy intervention had a significantly increased LEFS score of about 2.25 (coef. 2.25; 95%CI 0.19, 4.31; p=0.032) in comparison to those without. In consideration of other variables, a fracture caused by a gunshot compared to that of an assault had a significantly increased LEFS score of about 8.72 (coef. 8.72; 95%CI 1.74, 15.70; p=0.014). After performing the investigator led stepwise regression, the best predictors' model for LEFS score was found to be age, gender, physiotherapy intervention and cause of fracture as shown in Table 4.6 below.

Table 4.5: Key predictors of LEFS score (univariate and multivariate linear regression)

	Unadjusted Coef. (95%CI)	P-value	Adjusted coef. (95%CI)	P-value
Age	-0.05 (-0.14,0.04)	0.297	-0.08 (-0.17, -0.01)	0.044
Type of treatment				
Non-operative	RG	RG	RG	RG
Operative	6.16 (-2.87, 15.19)	0.182	-0.49 (-2.64, 1.67)	0.657
Pain				
No	RG	RG	RG	RG
Yes	-15.54 (-24.36, -6.72)	0.001	-1.15 (-3.64, 1.33)	0.363
Gender				
Female	RG	RG	RG	RG
Male	2.29 (-10.04, 14.61)	0.716	2.62 (0.26, 4.98)	0.029
Leg length discrepancy				
<2cm	RG	RG	RG	RG
≥2cm	-17.71 (-27.00, -8.42)	<0.001	-0.56 (-2.58, 1.45)	0.585
Physiotherapy intervention				
No	RG	RG	RG	RG
Yes	6.88 (-2.12, 15.89)	0.134	2.25 (0.19, 4.31)	0.032
Location of fracture				
Distal	RG	RG	RG	RG
Midshaft	-3.13 (-14.21, 7.96)	0.580	-0.56 (-3.33, 2.21)	0.693
Proximal	-4.80 (-20.72, 11.13)	0.555	-1.86 (-6.41, 2.29)	0.338
Cause of fracture				
Assault	RG	RG	RG	RG
Fall	-6.17 (-33.77, 21.44)	0.661	1.45 (-3.90, 6.81)	0.596
Gunshot	-7.33 (-43.47, 28.81)	0.691	8.72 (1.74, 15.70)	0.014
RTA	-7.40 (-33.49, 18.68)	0.578	0.53 (-4.30, 5.36)	0.829

Coef.: coefficient, RG: reference group, ORIF: open reduction internal fixation (operative procedure), RTA: road traffic accident.

Table 4.6: A model with best predictors of LEFS score

	Adjusted Coef. (95%CI)	P-value
Age	-0.09 (-0.17, -0.02)	0.010
Gender		
Female	RG	RG
Male	2.55 (0.53, 4.56)	0.013
Physiotherapy intervention		
No	RG	RG
Yes	2.80 (1.28, 4.32)	<0.001
Cause of fracture		
Assault	RG	RG
Fall	2.36 (-2.08, 6.81)	0.298
Gunshot	6.96 (1.26, 12.65)	0.017
RTA	0.93 (-3.25, 5.11)	0.663

Coef.: coefficient, RG: reference group.

4.10 Summary of findings

The results of the study show that the majority of patients that were seen were males as compared to females. Furthermore, the majority of patients in the study were between the age range of 26 to 30 years. The clinical features that were assessed during the follow up period included; location of the fracture, cause of fracture, leg length discrepancy, muscle grading of the lower limbs, pain, location of pain and the range of motion of the knee. The majority (n=66%) of fractures were located in the mid diaphysis of the femur whilst most of the patients (n=75%) sustained their fractures as a result of RTA's. There was noted to be a gradual improvement in the muscle grading of the patients during the follow up period. The majority of patients showed a gradual decline in limb length discrepancy over the follow up period from 50% of patients in the first assessment to 91% of the patients in the third assessment. There was noted to be a steady reduction in pain over the follow up period. The majority of patients reported pain to be in the thigh as compared to other regions of the lower limb during the follow up period. The majority of patients had non-functional knee range of motion in the first and second assessment whilst in the third assessment the majority had functional knee range of motion.

The orthopaedic types of management assessed for diaphyseal femoral fractures included non-operative and operative methods. Physiotherapy intervention and the type of physiotherapy intervention were also assessed. The majority of patients (n=59) were managed operatively whilst the majority of patients were seen by a physiotherapist during the follow-up period.

The functional assessment was carried out. In both the first and second assessment the majority of patients fell in the 0-19 category on the LEFS scale whilst in the third assessment the majority of patients fell in the subcategories of 40-59 as well as the subcategory of 60-79 on the LEFS scale. The factors that affected the functional outcomes were assessed from the demographic characteristics, the clinical features as well as the type of management. There was found to be a statistical correlation between the male gender and functional outcome (p=0.044). A further correlation was found between age and functional outcomes (p=0.029). There was a significant statistical correlation between the cause of the fracture being a gunshot (p=0.017), physiotherapy intervention (p=0.032) and the functional outcomes of the patient after femoral diaphyseal fractures thus the best predictors for LEFS score was found to be age, gender, physiotherapy intervention and cause of fracture. The location of the fracture (p=0.693), type of management used (p=0.657), leg length discrepancy (p=0.585), pain and (p=0.363) were found to not significantly affect the functional outcomes of the patients.

A comparative analysis was done on the type of management used and it was found that there was no significant correlation (p=0.657) between the type of management used and the functional outcomes of the patients with diaphyseal femoral fractures.

CHAPTER FIVE

DISCUSSION

5.0 Introduction

In this chapter the findings of the study are discussed. The chapter is divided into sub themes. The discussion starts with the demographic characteristics of the study participants and their clinical features. The discussion will also look at the factors affecting functional outcomes and the results regarding the type of treatment in relation to the functional outcomes. Furthermore, recommendations and limitations as a result of the findings will be discussed and provide conclusions to the study.

5.1 Demographic characteristics

In the study it was found that the age range of the patients seen was from 23 years to 62 years and that the mean age was 33 years. Of the 32 patients that were seen, the majority were male patients (84%) and the majority of these were below 40 years of age. The results in this study were in agreement with a study done by Asplund, (2014), who found that the incidence of diaphyseal femoral fractures peaks among the young. He concluded that the incidence of femoral, particularly diaphyseal, fractures due to severe trauma is greatest in young men. He also concluded that patients younger than 40 are more likely to sustain high energy trauma (eg, motor vehicle crash) and fracture the mid-shaft of the femur, while those over 40 are more likely to sustain low energy trauma (e.g., fall) and fracture the proximal third of the femur. This concurs with this study in which, the majority of the patients seen sustained high energy fractures as a result of road traffic accidents and the majority of these fractures occurred in patients below 40 years of age (Asplund, 2014).

Another study was done in Nigeria and found similar results to this study as well as Asplund, (2014), in regards to epidemiological data i.e. they found that femoral diaphyseal fractures constitute over 50% of all femoral fractures and most of them occur in the middle third of the femur. Furthermore, they also found that the mean age of adults involved was 35 years which was close to our range in the study of mean age of 33 years. They also found that more males than females are affected in the ratio 1.5:1 to 2.5: 1. They further concluded that most adult femoral diaphyseal fractures are traumatic in origin (Dim, 2012). In this study all the patient's fractures where of traumatic origin and our study population ratio of males to females was 5.4:1 which is in agreement with the study as the ratio of men to women who had diaphyseal femoral fractures was higher. This ratio compares well with the ratio found by Bezebeh *et al*, (2012) in which the study participants included 60 men (88.2%) and only 8 women (11.8%), giving a ratio of 8 men to 1 woman.

5.2 Clinical features of patients with diaphyseal femoral fractures

5.2.1 Location of fracture and cause of fracture

In this study, the majority of fractures were located in the mid diaphysis of the femur. This does not compare well with literature as it has been found that the majority of diaphyseal femoral fractures occur in the proximal one third of the femur (Aspland & Mezzanotte, 2016). This could be because the majority of the patients that were participants in this study were young adults below the age of forty. The majority of proximal femoral fractures occur in adults older than 50 years of age. This is because femoral proximal fractures are usually pathological, resulting from minimal to moderate physical trauma to areas of bone significantly affected by osteoporosis. It has also further been found that the risk of sustaining proximal femoral fractures doubles every 10 years after age 50. Other risk factors for proximal femoral fractures include excessive alcohol consumption, high caffeine intake, physical inactivity, low body weight and visual impairments (Evans & McGrory, 2002).

In this study, the main cause of fractures of the diaphysis of the femur was trauma as a result of RTA's followed by falls from a height. This augurs well with current literature as femoral shaft fractures especially in young people are frequently due to some type of high-energy collision. The most common cause of femoral shaft fracture is a motor vehicle or motorcycle crash. Being hit by a car as a pedestrian is another common cause, as are falls from heights and gunshot wounds. Lower force incidents such as falls from standing, may cause femoral shaft fractures in older people who have weaker bones (Eastwood, 2015).

5.2.2 Pain

In this study it was found that the majority of patients (84%) presented with pain and of these we noted that the majority of patients reported pain in the thigh (48%) than in any other anatomical location i.e. the knee, hip and groin regions. This could be attributed to the location of the fracture site. This does not correlate with a study done by Sanders et al, (2008) who found in their study that the majority of their patients reported pain in the knee joint in comparison to other related anatomical structures. They further noted that there was a correlation between knee pain and function and there was a weaker correlation between thigh, groin and buttock pain and the functional outcome of their patients (Sanders et al., 2008). The difference in findings could be attributed to the time frame in which the findings where done. In our study we collected data 6-12 weeks after the fracture occurred and at the time there was still pain at the fracture site of most patients compared to Sanders, 2008 who collected results 6-12 months after the fracture. By that time fracture union and healing would have progressed much further than at 3 months thus the difference in pain. There are currently no definite reasons as to why there is knee pain after fracture of the diaphysis of the femur but several theories propose an intra-articular pathology, intraosseous hypertension, prominent hardware and muscle deconditioning as possible sources of knee pain following diaphyseal femoral fractures (Sanders et al., 2008).

5.2.3 Muscle Strength

It was found in this study that the lesser the muscle grading in a patient, the lower their functional score and vice versa. This means that patients with low muscle grading had poor functional outcomes than patients with higher muscle grading on the oxford muscle grading scale. These results reflect what a study done by Larsen et al, 2014, found in their research whose aim was to examine the long-term outcome after intramedullary nailing of femoral diaphyseal fractures measured as disease-specific patient reported function, walking ability, muscle strength, pain and quality of life (QOL). The study concluded that decreased muscle strength for knee flexion, knee extension and hip abduction was associated with worse long-term functional outcome after intramedullary nailing of femoral shaft fracture (Larsen *et al*, 2014).

5.2.4 Range of motion of the knee

Most functional activities require 0 to 117 degrees of motion at the knee. In this study, functional knee range was defined as range of motion above 117 degrees as this has in the past been considered an acceptable range. Thus non-functional range was defined as range of motion of the knee below 117 degrees (Sanders et al., 2008). During the follow up period, those who were found to have non-functional motion of the knee mostly had functional outcome of 0-19 points (88%) in this category of patients and those with functional motion were mostly in the category of 60-79 points (92%) in this category of patients.

5.2.5 True Leg length discrepancy

In this study, it was noted that the majority of patients presented with a leg length discrepancy in the first assessment. However, with the follow up period there was a reduction in the number of patients presenting with true leg length discrepancy. This is because as the as the fracture heals, the limb length is returned to its normal and thus the discrepancy reduces. However, the limb length discrepancy may persist if the bone heals in a shortened position as may occur in segmental/complicated fractures and also if the skin and the muscle tissue are severely injured and exposed as occurs in an open fracture (Anon., 2016).

5.3 Functional outcomes after diaphyseal femoral fractures

It was found in this study that in the first and second assessment, the majority of patients fell in the 0-19 category of the LEFS scale. This meant that the patients found it extremely difficult or were unable to carry out any activities. This could be because most of the patients were bedbound at this point as management was still ongoing for those on traction and those from operative management were recovering. The other reason this could have been was because the majority of patients also reported pain in these two assessments and fracture healing was still taking place thus patients could not weight bear and thus carry out any functional activities on their own.

However, there was an improvement in the LEFS score with the third assessment as fracture healing progressed and pain reduced. The majority fell in the 40-59 category which means that they had moderate difficulty in carrying out functional activities as well as the subcategory of 60-79 which means that they had a little bit of difficulty carrying out functional activities. This could be because the majority of the patients were discharged and were more likely to carry out functional activities on their own especially as they were in their home environments.

Sanders et al, 2008, also assessed functional outcomes after diaphyseal femoral fractures and found that recovery from femur fractures occurs most rapidly in the first 6 months after injury. Residual deficits in functional outcome were still measurable 12 months after injury. This augurs well with our study in the sense that a lot of the patients in as much as they had shown improvement still did not report complete return to normal functioning.

5.4 Factors affecting functional outcomes

5.4.1 Demographic Characteristics

5.4.1.1 Patients Age

In this study a significant correlation was found between the functional outcomes of the patients and their age. It was also found that a unit increase in age significantly reduced LEFS score. This implies that the older the person is the less their functional score in relation to fracture of the diaphysis of the femur. These results concur with a study done by Hagino et al, 2006, in which they concluded that patients older than 90 years have a lower rate of regaining pre-injury walking ability and a higher in-hospital death rate than younger patients thus the older an individual the less their chances of gaining their pre-fracture functional state. The findings however do not agree with the findings by Taormina et al, 2014, who found that the patient's age at the time of surgery was not associated with achieving union. Advanced age was generally not associated with poorer non-union surgery outcomes. Furthermore, the findings in this study also contradict with a study done by Elmi et al, (2014), who concluded that there is no significant difference between the functional outcomes of femoral shaft fracture treatment with Intramedullary Nailing (IMN) and fixation in younger patients when compared with elderly patients. However, they found that elderly patients with IMN have more symptoms i.e. knee pain, loss of motion, and dependence on cane when compared with younger patients (Elmi *et al*, 2014).

5.4.1.2 Gender

In this study, the majority of patients that were seen were male. There was a significant statistical correlation between the male gender and functional outcomes thus males had better functional outcomes than females. There were no other studies to correlate this finding in humans. However, a study done on rodents found that in their radiographic analysis of the male rodents, there was earlier bridging and callus formation in comparison to the female rodents. They concluded that their results suggest that the female gender represents an independent risk factor for bone healing in middle-aged rats and that for clinical relevance studies should be carried out in humans (Mehta *et al*, 2011).

5.4.2 Clinical Features

5.4.2.1 Cause of fracture

It was found in this study that there was a significant statistical correlation between gunshot wounds and functional outcomes of patients with diaphyseal femoral fractures. The correlation can be explained by the fact that the majority of patients seen suffered fractures due to high energy trauma and gunshots being high energy trauma injuries (Eastwood, 2015).

5.4.2.2 Pain

It was found that there was a significant decrease in pain with an increase in the Lower Extremity Functional Scale score. Without taking account of other variables, those individuals with pain had significantly reduced LEFS score as compared to those without pain. This means that in most patients the greater the pain the less the LEFS score that they got. As shown in the results, patient with pain fell in the 0-19 LEFS score category (crippled category). Conversely this also meant that the less the pain the patient felt the better their LEFS score thus the better their functional outcomes. These study findings compare well with el Moumni et al, (2009), who were looking at functional outcomes after fractures of the diaphysis of the femur after intramedullary nailing(IM). They concluded that the most significant predictor of functional outcome was pain in the lower limb and that pain in the lower limb is an important predictor and source of disability after femoral shaft fractures, even though most patients achieved good functional outcome scores (Moumni *et al*, 2009). In this study however, there was no statistically significant correlation of pain with functional outcomes.

5.4.2.3 True Leg length discrepancy

In the study it was noted that there was a reduction in the number of patients with a leg length discrepancy greater than 2 cm from the first assessment to the third assessment. We found that the greater percentage of patients with an LEFS score range of 60-79 (little bit of difficulty) were more in patients with leg length discrepancy of <2cm. This implies that the less the leg length discrepancy, the better the LEFS score.

Statistically it was found that leg length discrepancy was not a significant predictor of function. These results are supported by a study done by Herscovici &Scaduto (2014), who found that although residual leg length discrepancies may be common in comminuted femurs treated with IM nails, most leg length discrepancies do not appear to be functionally relevant (Hesrcovici & Scaduto, 2014).

5.4.2.4 Knee Range of Motion

In this study it was found that knee function was not a key predictor of functional outcome. There was however a slight correlation between functional outcome and knee functional range of motion. el Moumni et al, (2009), found similar results to this study in that they found that there was a fair to moderate correlation between ROM of the knee and functional outcomes in patients with femoral shaft fractures (Moumni *et al*, 2009).

5.4.2.5 Muscle strength of the Lower Limbs

It was noted that the majority of patients reported an improvement in muscle power with time during the follow-up period of the participants. However, it was noted that there was a significant correlation between muscle grading and functional outcomes in the second assessment of the participants during the follow-up period. This could be attributed to an increase in mobility as patients reported walking using walking aids and the use of physiotherapy intervention as well. These results are in agreement with another study in which they found that decreased muscle strength for knee flexion, knee extension and hip abduction was associated with worse long-term functional outcome after intramedullary nailing of femoral shaft fracture (Larsen *et al*, 2014).

5.4.2.6 Physiotherapy intervention

It was found that individuals who had physiotherapy intervention had a significantly increased LEFS score in comparison to those without physiotherapy intervention in this study. This finding agrees with a research done by Paterno et al, (2006), in which they found that immediate weight bearing with early strengthening activities following operative correction of a mid-shaft femur fracture may result in early resolution of impairments and functional limitations and decreased disability (Paterno *et al*, 2006).

5.5 Functional outcomes following Operative management versus Conservative management

The results in the study indicated that the type of treatment was not a predictor of functional outcome of the patients with diaphyseal femoral fractures. It was concluded that there was no difference in functional outcomes between the patients that been managed by non-operative means via Perkins traction and those that had operative management by use of intramedullary nailing. Many studies have looked at the individual methods of management and one such study being done in Nigeria by Arpacioğlu, (2003), who evaluated the functional outcomes of patients with diaphyseal femoral fracture managed with interlocking intramedullary nailing. They found in their study that that the high success rate obtained with interlocking intramedullary nailing makes it an appropriate method in the treatment of diaphyseal femoral fractures in adults (Arpacioğlu, 2003).

With regards to non-operative management a study by Bezabeh et al, (2012), they found that non-operative treatment has been proven to be a safe and effective method and should be encouraged in developing countries (Bezabeh *et al.,* 2012). From the findings in this study, they were in agreement with Bezebeh et al, (2012), especially that Zambia is a developing country. However, a study by de Boer et al, (2014), contrasted these findings in which they concluded that conservative management is very time-consuming and the incidence of shortening and angular deformity is high and recommended it only when appropriate operating facilities and instrumentations do not exist locally, non-operative treatment is still indicated even for femoral diaphyseal fractures (de Boer *et al*, 2016). With regards to time, the findings in this study agree with de Boer et al, 2014, as most patients included in the research that were managed non-operatively stayed much longer in the hospital for approximately 5-6 weeks whilst those that were managed operatively stayed for a shorter period on average 2 weeks in the hospital after management.

In conclusion, it was found that the best predictors of functional outcomes were the age of the patient, gender, cause of fracture and physiotherapy intervention.

CHAPTER SIX

CONCLUSIONS, RECOMENDATIONS AND LIMITATIONS

6.0 Introduction

This chapter is divided into Conclusions reflecting the main findings of the study, recommendations with regard to the findings of the study as well as the limitations this study faced. It further lists the references of all the work cited within this research.

6.1 Conclusions

The majority of fractures occurred in the younger adult population. The male gender was mostly affected. Most of the fractures are due to high energy trauma secondary to road traffic accident. Furthermore, it was found that the key predictors to functional outcomes include the patient's age, the gender, physiotherapy intervention and the cause of the fracture. There was a strong correlation between the patients age and the functional outcomes of the patient as it was found that the older the patient the poorer the functional outcomes. It was also found that there was a strong correlation between the male gender and the functional outcomes. There was a strong correlation between the cause of the fracture and the functional outcomes. In this study the strongest correlation was with patients who had suffered diaphyseal fractures as a result of gunshots. Finally, it was found that patients who had physiotherapy intervention/management also had better functional outcomes than patients who did not. There was no statistical difference found in functional outcomes between patients with diaphyseal femoral fractures that are managed operatively in comparison to those that are managed non-operatively at UTH.

6.2 Recommendations

Following the results of the current study, it is recommended that further studies to look at the management of diaphyseal femoral fractures over a longer period of time be done. This will ensure more detailed results and ensure a guide to their management.

It is also recommended that both methods of management be used in the management of diaphyseal femoral fractures. It is also recommended that physiotherapy intervention in the management of patients with diaphyseal femoral fractures be emphasised as there was a significant correlation in the functional outcomes of the patients with the presence of physiotherapy management.

6.3 Limitations

The study sample size was small thus the results of the study cannot be taken to represent the general population of the country.

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Appendix 1: **Checklist**

SECTION 1: BIO-DATA

GENDER: Male ☐

Female ☐

AGE:

OCCUPATION:

SECTION 2: OBSERVATIONAL AND PHYSICAL EXAMINATION

Cause of the Fracture:

Type of treatment used: Operative (ORIF) ☐

Conservative (Skeletal Traction) ☐

Leg Length Discrepancy: Less than 2cm ☐

Greater than 2cm ☐

Physiotherapy Intervention

1. Strengthening
2. Mobilization
3. Gait training
4. Combination treatment

MUSCLE STRENGTH OF LOWER LIMBS (OXFORD MUSCLE GRADING)

GRADE 0 (No Contraction)	
GRADE 1 (Visible/Palpable muscle contraction but no movement)	
GRADE 2 (Movement with gravity eliminated)	
GRADE 3 (Movement against gravity only)	
GRADE 4 (Movement against gravity with some resistance)	
GRADE 5 (Movement against gravity with full resistance)	

Visual Analogue Scale

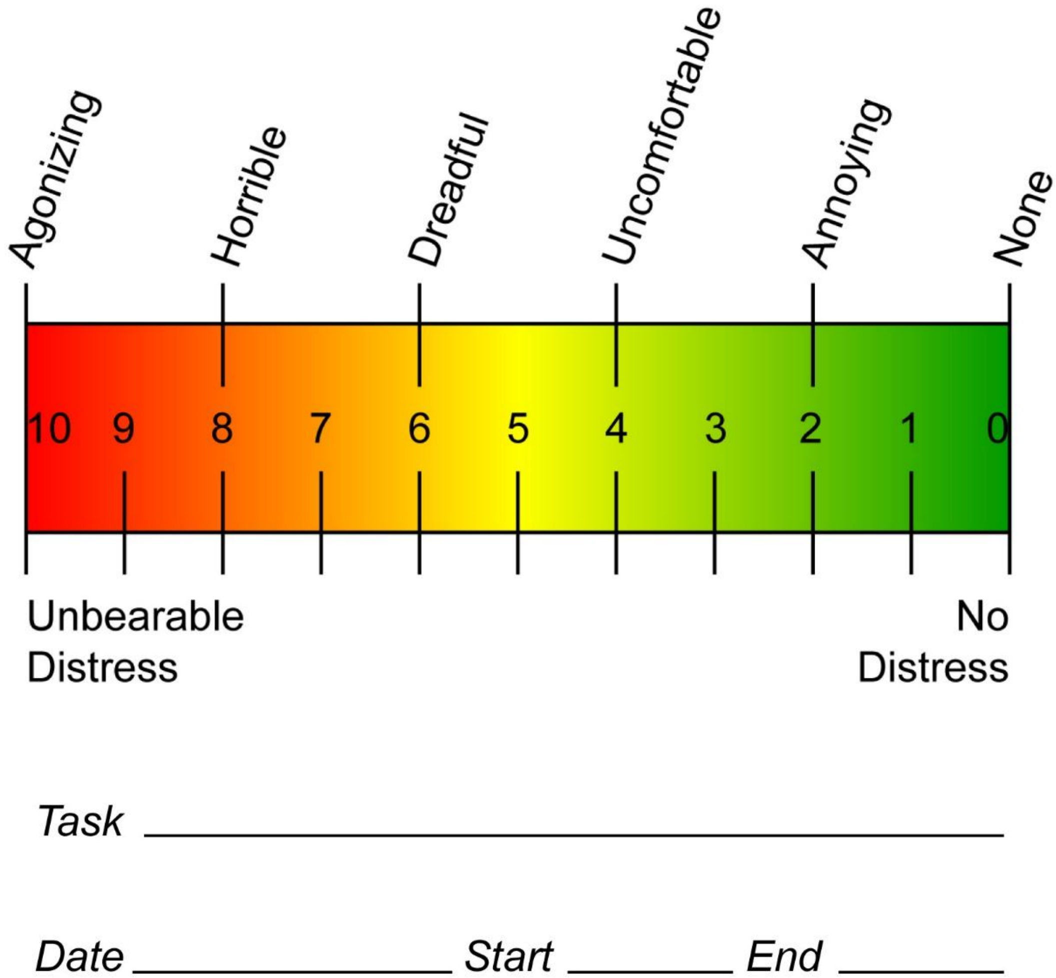
Location of Pain:

Groin:

Thigh:

Knee:

VISUAL ANALOGUE SCALE



Range of Motion

Range of motion in the Hip:

Range of motion in the knee:

APPENDIX 2: QUESTIONNAIRE

Instructions

I am interested in knowing whether you are having any difficulty at all with the activities listed below **because of your lower limb problem** for which you are currently seeking attention. Please provide an answer for **each** activity.

Today, *do you* or *would you* have any difficulty at all with: Activities	**Extreme difficulty or unable to perform activity**	**Quite a bit of difficulty**	**Moderate difficulty**	**A little bit of difficulty**	**No difficulty**
1. Any of your usual work, housework or school activities.	0	1	2	3	4
2. Your usual hobbies, recreational or sporting activities.	0	1	2	3	4
4. Walking between rooms.	0	1	2	3	4
5. Putting on your shoes or socks.	0	1	2	3	4
6. Squatting.	0	1	2	3	4
7. Lifting an object, like a bag of groceries from the floor.	0	1	2	3	4
8. Performing light activities around your home.	0	1	2	3	4
9. Performing heavy activities around your home.	0	1	2	3	4
10. Getting into or out of a vehicle.	0	1	2	3	4
11. Walking 2 blocks.	0	1	2	3	4
12. Walking a mile.	0	1	2	3	4
13. Going up or down 10 stairs (about 1 flight of stairs).	0	1	2	3	4
14. Standing for 1 hour.	0	1	2	3	4
15. Sitting for 1 hour.	0	1	2	3	4
16. Running on even ground.	0	1	2	3	4
17. Running on uneven	0	1	2	3	4

ground.					
18. Making sharp turns while running fast.	0	1	2	3	4
19. Hopping.	0	1	2	3	4
20. Rolling over in bed.	0	1	2	3	4
Column Totals:	0	1	2	3	4

Interpretation: **Lower Extremity Functional Scale** is scored via summation of all responses (one answer per section) and compared to a total possible score of 80.

Total Score: / 80

% of Disability: %

LEFS score = SUM (points for all 20 activities) Interpretation:

 Minimum score: 0

 Maximum score: 80

Percent of maximal function = (LEFS score) / 80 * 100 Performance:

Interpretation:

% Disability Score Level of Disability Description

81-100%: Minimal Disability - Copes with most daily living activities

- Usually no treatment is needed apart from self-care advice on lifting, sitting, posture,
  physical fitness and diet.

61-80%: Moderate Disability - Experiences more pain/problems with sitting, lifting and standing.

- Travel and social more difficult
- May be of work
- Conservative management usually helps

41-60% Severe Disability - Pain is the main problem, but travel personal care, social life and sleep are also affected.

21-40% Crippled - Pain impinges on all aspects of life at home and at work

0-20% Bed bound - Careful observation should be made during the exam as these patients are

typically:

- Bed-bound or
- Exaggerating symptoms

APPENDIX 2: QUESTIONAIRE (Bemba translation)

Ifyakukonka

Ndefwaya ukwishiba nga mulakwata amafya nokuchita ifilifyonse ofo muchita nshiku shonse pantu mwali ichena kumolu elo mulefwaya uku pola. Munjafwilisheko na ubwasukilo pali yonse imipusho.

Leo, namukwata olo mwalikwatako ifi mi shupa uku chita ifilifyonse?	**Ukushupa sana ukuchita ifili fyonse**	**Ukushupa ku sana but not kwati teti mukwanishe ukuchita fyonse**	**Ukushupako ukumfwika but te sana**	**Ukushupa panono fye**	**Tapali ifi shupa**
1. ifili fyonse muchita ku ngangada, kunchito olo ku skulu?	0	1	2	3	4
2. ifyo mwatemwa ukuchita ngatamulebomba, ama sports?	0	1	2	4	4
5.ukwenda munganda	0	1	2	4	4
6.Ukafwala nsapato na nsokoshi	0	1	2	3	4
6. ukufukama	0	1	2	3	4
7. ukwimya ifinta kwati ama bag ya fyakulya ukufuma panshi.	0	1	2	3	4
8. ukuchita infintu ifitafyashupa panganda	0	1	2	3	4
9. ukuchita infintu ifyashupa panganda	0	1	2	3	4
10. ukwingila nokukwikila mu motocar.	0	1	2	3	4
11. ukwenda imisebo shibili umwa amayanda	0	1	2	3	4
12. ukwenda mile imo	0	1	2	3	4
13. ukukwela imitanto ishili ten.	0	1	2	3	4

14. ukwiminina 1 hour	0	1	2	3	4
15. ukwikala 1 hour.	0	1	2	3	4
16. ukubutuka pa umusebo uwaba bwino	0	1	2	3	4
17. ukubutuka pa umusebo ubutawaba bwino	0	1	2	3	4
18. uku pilibuka fast fast paku butuka	0	1	2	3	4
19. Hopping.	0	1	2	3	4
20. ukupilibuka mu bedi	0	1	2	3	4
Column Totals:	0	1	2	3	4

Interpretation: **Lower Extremity Functional Scale** is scored via summation of all responses

(one answer per section) and compared to a total possible score of 80.

Total Score: / 80

% of Disability: %

LEFS score = SUM (points for all 20 activities) Interpretation:

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sleep are also affected.

21-40% Crippled - Pain impinges on all aspects of life at home and at work

0-20% Bed bound - Careful observation should be made during the exam as these patients are

typically:

• Bed-bound or
• Exaggerating symptoms

Appendix 3

Research Timetable

April, 2014	Presentation at Postgraduate forum 2.seek approval from Research Ethics Committee
May, 2016	Beginning of Data Collection
September, 2016	End of Data Compilation
September,2016	Compilation of Research Findings
September, 2016	Presentation of Research Findings
January, 2017	Submit Final Copy

Appendix 4

Research Budget

Item	**Cost**
Stationery	K1,000
Research Assistants (training and data collection)	K5,000
Transport and Fuel	K2,500
Printing and Internet	K5,000
Measurement Tools	K5,000
Ethics	K 500
Contingency	K1,900
Total	**K20,900**

Appendix 5: Information sheet

Study Title: Functional outcomes of patients with closed femoral diaphyseal fractures at the University Teaching Hospital (UTH) in Lusaka, Zambia

Introduction

My name is Nova Nalondwa from the University of Zambia. Am carrying out a research on the functional outcomes of patients with closed femoral diaphyseal fractures at the University Teaching Hospital (UTH) in Lusaka, Zambia

Purpose of Study

The purpose of this study is to find out if there is a difference in functional outcomes between patients with femoral shaft fractures that are managed operatively in comparison to those that are managed conservatively at UTH.

The research involves assessment of functional outcomes after management of fracture femur and the tools to be used include a goniometer, measuring tape and a questionnaire. A full functional assessment of the patient post management will be done three times over a period of twelve weeks. The first assessment will be done on first contact with the patient, the second six weeks after the first assessment and the last assessment twelve weeks post fracture management.

Confidentiality

The results of your functional outcome measurements and your answers will be kept confidential and will only be used for research purposes.

Study Benefits

This study is aimed at assessing the functional outcomes of patients that have had diaphyseal femoral fractures. By assessing the functional outcomes, I hope to find out which of the two treatment methods produce better functional outcomes in patients with diaphyseal fractures. By assessing the outcomes I hope to find out what challenges patients face in function after fractures of the diaphysis of the femur.

The study also aims to provide data to aid in decision making which may aid in further management of patients.

Study Risks

The assessment of the patient adds no risk to the patient.

Voluntariness

Your participation in this study is completely voluntary. Should you choose not to participate, no penalty will be given and you will continue to receive the same care that you otherwise enjoy. You have the right to withdraw your participation any time you wish to do so.

If you have any doubts or you wish to seek clarification on the research, please feel free to contact the main researcher on the address below

Name: Nova Nalondwa

Address: Department of Physiotherapy,

School of medicine UNZA

Email: nnalondwa@gmail.com

Cell: 0968114092 or 0976832358

If you have any complaints about the study, please contact:

ERES CONVERGE IRB
33 Joseph Mwilwa Road
Rhodes Park
LUSAKA
Tel: 0955 155633/4

I understand the information given to me that my participation in this research is completely voluntary and its purpose has been fully explained to me. I also understand that my rights and privacy will be respected

Name of participant………………………………………………………………………

Signature or thumb print of participant…………………………………………………

Witness ……………………………………………………………………………………

Name and signature of the person obtaining consent………………………………….

Date …………………………………………………………………………………………

Appendix 5: Information sheet (Nyanja translation)

Zowelengeka: zofunikila kucitika pambuyo podwala matenda yotyoka myendo mucipatala ca University Teaching hospital (UTH) mu Lusaka, Zambia.

Ciyambi

Ine dzina langa ndine Nova Nalondwa. Ndi cokela pa sikulu lalikulu la University of Zambia. Pali pano ndikufunisisa ku dziba zomwe zimacitika pambuyo podwala matenda yotyoka myendo muchipatala cha UTH.

Cifukwa cobelengela

Cigawa cobengela ndi cofuna kuziwa zopambana zace zamatenda yotyoka myendo ndimomwe asungila zilonda zong'amba"mucipatala cha UTH.

Izowelenga zifuno ona pazi ncito zipezeka pambuyo paka sungidwe za uku ku tyoka kwa ziwalo nazosebenzela zake monga goniometre, measuring tape na questionnaire kapena pa cipepala camafunso monga ici. Aya mafunso yazacitika mundondonmenko yaka tatu muma sabata khumi na yabili.

Mobisila

Zonse Zomwe tiza lankulana inu ndi ine ndiza mukabisila, zizangosobenzeseka muzowenlenga basi.

Kafunilo kopunzila

Aka kafunilo kafunika kuni tandizila kupeza kasungindwe kabwino kabantu bodwala aya matenda yotyoka myendo ndiponso kuthandizila bemene bofuna kupanga nzelu zabwino paku sunga aba bantu bama tenda aya

Zovutisa Kupunzila

odwala sapezapo vuto iliyonse ndizowelenga izi

Kuzipezeleka

Kuzipezekako kuwelengako uku ndikozipeleka. Ngati simufuna kupezekako zochitika izi palibe mulanda uli onse koma muzala mulupeza chitandizilo kumanso mulindi ufulu wokana ngati simufuna kupezekano muli ichi chigawo.

Ngati muli ododoma kapena muli ndi mafunso muli uphungu kufunsu. Kapena mungathe kufunse pama address aya:

Name: Nova Nalondwa

Address: Department of Physiotherapy,

School of medicine UNZA

Email: nnalondwa@gmail.com

Cell: 0968114092 or 0976832358

ERES CONVERGE IRB
33 Joseph Mwilwa Road
Rhodes Park
LUSAKA
Tel: 0955 155633/4

Eye ine namva kuti zonse zomwe zala nkulidwa mulichi chigawo ndipo

Zonse zomwe zala nkulidwa namva ndipo maganizo anga apelekedwa mwaufulu ndiponso namvaso phindulanga lizapatsidwa ulemu

Dzina………………………………………………………….

Signature…………………………………………………………

Dzina lanu………………………………………………………..

Dzina lanu(consent)……………………………………………….

Appendix 5: Information sheet (translation into Bemba)

Ifyatumbikemo: ifyatumbwikemo mubabwele aba amafupa ayakontoka pa chipatalala ica University Teaching Hospital (UTH) mu Lusaka mucalo ca Zambia

Pakwambako

Ine ninebo Nova Nalondwa ukufuma ku University of Zambia. Ndefwailikisha ukwishiba efyo mulekwanisha ukufuma lilya mwaicenene kumolu elyo bamyafwilisheko kuno ku University Teaching Hospital (UTH) muno Lusaka, muno caalo ca Zambia.

Icilefwaikwa muli ubu bufwailikisho

Icilefwaikwa muli ubu bufwailikisho ku sanga nga ifyo bapola abantu filapusana nga naabaya ku theatre ku operation nangula naba sendama pa busanshi ukutinta ikulu pano pa chipatala ca UTH kuli balya abaicena mukulu.

Muli Iyi iyifwailikisho tukabomfya utunu utwaka ku penda kwati uko beta at goniometer, measuring tape na imipusho uku penda efyo mwapola. Fyonse ifya ku ipusha fikachitika pa imyeshi yitatu. Imipusho ya kutampila ikachitita paly aba patient babamona. Iya ibila lilya papita 6 weeks elo iya pa last lila pa pita 12 weeks.

Nkama

Fyonse efo mukalanda muli uyu ubufwailisho fika sungwa ne nkama elo fika bonfeshekesha fye mu ubufwailisho umu.

Ubwafikilisho bwa bufwailikisho

Muli uyu ubufwailikisho ndefwaya ukwisha efyo ba pola abantu abakwatadiaphyseal femoral fractures. Elo nafuti ndefwaya ukwishiba nga niyisa treatment iyi bomba bwino ukuchila iyinangu. Elo ndefwaya ukwishiba ama problems abantu bakwata paku pola.

Ubwafya bwa ubufwailikisho

Ubufwailisho uyu tabwaka chene imwe nangu ukumipanga ati tamwakapole

Ukuipelesha

Ukuba umu mu ubafwailishi chili pali imwe ngamulefwaya. Nshilemi chinga kuli treatment elo fyonse efyo baleminona ba doctor ta fya kachinje. Nga mulefwaya ukuleka ukuba mu ubufwilisho ubu kuti mwaleka nshita ili yonse.

Nga namukwatako imipusho nangu pali efyo mulifwaya ni landepo kuti mwantumina phone nangu mwankonka pali address iyi imbikile panshi pachipapala ichi

Name: Nova Nalondwa

Address: Department of Physiotherapy,

School of medicine UNZA

Email: nnalondwa@gmail.com

Cell: 0968114092 or 0976832358

Nga namu kwatako ifyo mwamona ati fyashupa kuti mwatuma ama lamu aya:

ERES CONVERGE IRB
33 Joseph Mwilwa Road
Rhodes Park
LUSAKA
Tel: 0955 155633/4

Ningufwa fyonse efyo mwalanda elyo ine uku ba umu mu ubufwailikisho ninebo nasala nemwine, elyo ningufwa fyonse efyo filepilibula

Name of participant……………………………………………………………………

Signature or thumb print of participant…………………………………………………

Witness ……………………………………………………………………………………

Name and signature of the person obtaining consent………………………………….

Date …………………………………………………………………………………….