THE USE OF INTERNAL ROTATION TRACTION RADIOGRAPHS IN IMPROVING RADIOGRAPHIC ASSESSMENT OF EXTRACAPSULAR FEMORAL FRACTURES AT MUHIMBILI ORTHOPEDIC INSTITUTE.

Christopher Alinikisa Paul, MD

MMed (Orthopedics and Traumatology) Dissertation
Muhimbili University of Health and Allied Sciences
October 2024.

Muhimbili University of Health and Allied Sciences

Department of Orthopedics and Traumatology

THE USE OF INTERNAL ROTATION TRACTION RADIOGRAPHS IN IMPROVING RADIOGRAPHIC ASSESSMENT OF EXTRACAPSULAR FEMORAL FRACTURES AT MUHIMBILI ORTHOPEDIC INSTITUTE.

By

Christopher Alinikisa Paul

A Dissertation Submitted in (Partial) Fulfillment of the Requirements for the Degree of Master of Medicine in (Orthopedics and Traumatology) at

Muhimbili University of Health and Allied Sciences

October 2024

CERTIFICATION

The undersigned certifies that, he has read and hereby recommends for examination by Muhimbili University of Health and Allied Sciences a dissertation titled; "**The use of internal rotation traction radiographs in improving radiographic assessment of extracapsular femoral fractures at Muhimbili Orthopedic Institute.**" in partial fulfillment of the requirements for the degree of Master of Medicine in Orthopedics and Traumatology of Muhimbili University of Health and Allied Sciences.

_____

Prof. Billy Thompson Haonga. MD, MMed, FCS (COSECSA)

(Supervisor)

Date: _____

_____

Dr Albert Paul Macha. MD, MMed, lecturer

(Co-Supervisor)

Date: _____

DECLARATION AND COPYRIGHT

I, **Christopher Alinikisa Paul** declare that this **dissertation** is my original work and that it has not been presented, and will not be presented, to any other university for a similar or any other degree award.

Signature…… Date…….....

This dissertation is copyright material protected under the Berne Convention, the Copyright Act 1999, and other international and national enactments, on behalf of intellectual property. It may not be reproduced by any means, in full or in part, except for short extracts in fair dealing, for research or private study, critical scholarly review, or discourse with an acknowledgment, without the written permission of the Director of postgraduate studies on behalf of both the author and the Muhimbili University of Health and Allied Sciences (MUHAS).

ACKNOWLEDGMENTS

Firstly, my sincere thanks go to Almighty God for His guidance, comfort, encouragement and strength to move on and enabling me to finish this work.

My Supervisor Professor Billy Thomson Haonga, for his tireless and patient guidance, commitment and constructive criticism in the whole process of preparing this work. The combination of his abundance of knowledge in the field of orthopedic and his invaluable dedication are very crucial to the development of this dissertation. He has been exceptionally helpful from proposal development to report writing, always encouraging me to strive for greatness. His astute advice and rigorous attention to detail have greatly aided in improving my research technique and bolstering the overall coherence of my findings.

Furthermore, I would like to thank my co-supervisor Dr Albert Paul Macha, for his outstanding commitment and upbeat attitude. He has frequently demonstrated a desire to answer my questions, concerns, and requests for advice in a timely manner. His promptness has been really helpful in making sure my research assignment proceeds along without hiccups. I am appreciative of his insightful comments and critiques of my work.

Moreover, I would like to thank Dr. Anthony Assey and Professor Abel Makubi from Muhimbili Orthopedic Institute leadership for their fast permission to perform my study and for ensuring the data collection procedure proceed successfully. The MUHAS faculty, under the direction of Dr. Mwanga, and all of the orthopedic surgeons at MOI deserve recognition as well for their helpful feedback from the proposal's inception. Their advice has been very helpful in determining the course of my research.

Finally, I would want to thank my classmates for being such helpful guides during this adventure. Their friendship and support have increased the satisfaction of this encounter.

DEDICATION

This research is dedicated to my beloved uncle Alinikisa Wilbert Mafwenga for his endless encouragement, prayers, understanding and financial support. My sincere thanks go to my beloved friends for their daily prayers, moral and material support during my studies which played natal role toward this culmination. God bless you.

ABSTRACT

Background: The incidence of complex extracapsular proximal femoral fractures is rising globally, necessitating prompt and accurate diagnosis. While internal rotation traction radiographs have demonstrated higher reliability in other settings, their effectiveness in the clinical environment at Muhimbili Orthopedic Institute has not yet been assessed. This study aimed at assessing this phenomenon.

Objective: This study aimed to assess the use of internal rotation traction radiographs in improving radiographic assessment of extracapsular femoral fractures at Muhimbili Orthopedics Institute.

Methods: A cross-sectional study was conducted at Muhimbili Orthopedics Institute, involving 46 participants with extracapsular proximal femoral fractures who were attended at the emergency department between July 2023 and December 2023. Data on fracture pattern, routine and traction internal rotation radiographs were taken from the participants. 5 senior residents who were randomly selected, evaluated the radiographs. Descriptive statistics was used to assess the pattern of extracapsular femoral fractures while Fleiss kappa statistics was used to analyze the interobserver reliability for the routine and traction internal rotation radiographs among senior residents.

Results: The mean age was 63.8 ± 17.6 years. The majority of participants were females (55%), and most fractures resulted from slipping on a slippery surface (34.8%). The fractures were predominantly intertrochanteric (58.7%) and occurred more frequently on the right side (69.6%). The overall interobserver reliability among senior residents using routine radiographs was moderate ($\kappa = 0.593$, SE = 0.03, Z = 203.608, $p < 0.001$). Individual evaluations showed substantial agreement for diagnosing intertrochanteric ($\kappa = 0.626$, SE = 0.013, Z = 48.386, $p = 0.015$) and pertrochanteric fractures ($\kappa = 0.611$, SE = 0.013, Z = 47.890, $p < 0.001$), and excellent agreement for subtrochanteric fractures ($\kappa = 1.00$, SE = 0.013, Z = 77.340, $p < 0.001$). There was fair agreement for diagnosing unstable fractures ($\kappa = 0.214$, SE = 0.013, Z = 16.529, $p < 0.001$) and substantial agreement for stable fractures ($\kappa = 0.630$, SE = 0.013, Z = 48.744, $p < 0.001$).

In contrast, the overall interobserver reliability using internal rotation traction radiographs was excellent ($\kappa = 0.943$, SE = 0.04, Z = 262.928, $p < 0.001$). Evaluations of individual variables indicated nearly excellent agreement on the evaluability of radiographs ($\kappa = 0.990$, SE = 0.013, Z = 76.587, $p < 0.001$), and for diagnosing intertrochanteric ($\kappa = 0.904$, SE = 0.013, Z = 69.871, $p < 0.001$), pertrochanteric ($\kappa = 0.995$, SE = 0.013, Z = 76.965, $p < 0.001$), and subtrochanteric fractures ($\kappa = 1.00$, SE = 0.013, Z = 77.330, $p < 0.001$). There was nearly perfect agreement for assessing unstable fractures ($\kappa = 0.995$, SE = 0.013, Z = 76.960, $p < 0.001$) and stable fractures ($\kappa = 0.950$, SE = 0.013, Z = 73.455, $p < 0.001$).

Conclusions: This study demonstrates that internal rotation traction radiographs significantly enhance the interobserver reliability of fracture assessment compared to routine radiographs, highlighting their potential utility in improving diagnostic accuracy and patient's outcome in clinical practice. It is recommended that clinical protocols be updated to include internal rotation traction radiographs for the assessment of extracapsular femoral fractures. Furthermore, preventive measures should be implemented to prevent falling among elderly individuals which would lead to extracapsular proximal femoral fractures.

TABLE OF CONTENTS

CERTIFICATION i
DECLARATION AND COPYRIGHT ii
ACKNOWLEDGMENTS iii
DEDICATION iv
ABSTRACT v
LIST OF TABLES x
LIST OF FIGURES x
LIST OF ABBREVIATIONS xi
EVANS CLASSIFICATION FOR INTERTROCHANTERIC/PERTROCHANERIC FRACTURES xii
RUSSEL-TAYLOR CLASSIFICATION FOR SUBTROCHANTERIC FRACTURES xii
DEFINITION OF TERMS xiii
CHAPTER ONE 1
1.0 INTRODUCTION 1
1.1 Background 1
1.2 Problem Statement 3
1.3 Conceptual framework 4
1.4 Rationale 5
1.5 Hypothesis 5
1.6 Research questions 5
1.6.1 Overall research question 5
1.6.2 Specific research questions 6
1.7 Objectives 6
1.7.1 Broad objective 6
1.7.2 Specific objective 6
1.8 Literature review 7
1.8.1 The pattern of extracapsular proximal femoral fracture. 7

1.8.2 Interobserver reliability in assessing extracapsular proximal femoral fractures using routine radiographs. 9
1.8.3 Interobserver reliability in assessing extracapsular proximal femoral fractures using internal rotation traction radiographs 10
CHAPTER TWO 12
2.0 MATERIALS AND METHODS 12
2.1 Study design 12
2.2 Study population 12
2.3 Study area 12
2.4 Sample size 12
2.5 Eligibility criteria 13
2.5.1 Inclusion criteria 13
2.5.2 Exclusion criteria 14
2.6 Sampling technique 14
2.7 Variables 14
2.7.1 Independent 14
2.7.2 Dependent 14
2.8 Data collection technique 15
2.9 Data collection tools 17
2.10 Data collection tool test 17
2.11 Data management and analysis 17
2.12 Ethical issues 18
CHAPTER THREE 19
3.0 RESULTS 19
CHAPTER FOUR 27
4.0 DISCUSSION 27
4.1 To determine the pattern of extracapsular proximal femoral fractures among patients treated at MOI 27

4.2 To determine interobserver reliability when assessing routine radiographs among patients with extracapsular proximal femoral fractures treated at MOI.....30
4.3 To determine interobserver reliability when assessing internal rotation traction radiographs among patients with extracapsular proximal femoral fractures treated at MOI 32
CHAPTER FIVE.....35
5.0 LIMITATIONS, MITIGATIONS, CONCLUSION And RECOMMENDATIONS 35
5.1 Conclusion.....35
5.2 Limitations and Mitigations 36
5.3 Recommendations 37
REFERENCES 38
APPENDICES.....44
Appendix 1: Research Questionnaire.....44
Appendix II: Consent Form (English Version).....47
Appendix III: Consent Form: Kiswahili 49
Appendix IV: Ethical Clearances Form.....51
Appendix IV: Introduction Letter 53
Appendix V: Permission Letter 54

LIST OF TABLES

Table 1: Pattern of extracapsular proximal femoral fractures 19

Table 2: Overall Interobserver reliability when assessing routine radiographs among patients with extracapsular proximal femoral fracture 23

Table 3: Interobserver reliability of individual observations when assessing routine radiographs among residents 23

Table 4: Overall Interobserver reliability when assessing internal rotation traction radiographs among patients with extracapsular proximal femoral fracture 25

Table 5: Interobserver reliability of individual observations when assessing internal rotation traction radiographs among residents 25

LIST OF FIGURES

Figure 1: Evans classification 2

Figure 2: Conceptual Framework 4

Figure 3: Classification of intertrochanteric/Pertrochanteric and Subtrochanteric fractures 20

Figure 4: Study population flow chart 21

Figure 5: The flow of observations (analysis of radiographs among senior residents) 22

LIST OF ABBREVIATIONS

AVN	Avascular Necrosis
AP	Anteroposterior
CT	Computerized Tomography
MNH	Muhimbili National Hospital
MOI	Muhimbili Orthopedic Institute
MUHAS	Muhimbili University of Health and Allied Science
PFF	Proximal Femoral Fracture
PFFs	Proximal Femoral Fractures
R&T	Russell and Tylor classification
MoHCDGEC	Ministry of Health, Community Development, Gender, Elderly and Children
MoH	Ministry of Health [Zanzibar]
NBS	National Bureau of Statistics
OCGS	Office of the Chief Government Statistician

EVANS CLASSIFICATION FOR INTERTROCHANTERIC/PERTROCHANERIC FRACTURES

Based on post-reduction stability

I. Stable fracture

- Posteromedial cortex intact or minimal comminution.
- Able to resist compressive loads.

II. Unstable fracture

- Greater comminution of posteromedial cortex
- Can be converted to a stable pattern if medial cortical opposition obtained

III. Reverse obliquity

- Unstable because of medial displacement of femoral shaft due to adductors

RUSSEL-TAYLOR CLASSIFICATION FOR SUBTROCHANTERIC FRACTURES

Type I

- No extension into piriformis fossa

Type II

- Extension into greater trochanter with involvement of piriformis fossa

  Look on lateral x-ray to identify piriformis fossa extension

DEFINITION OF TERMS

Elderly individual- An individual 60 years of age and above in Tanzania [1].

Extracapsular femoral fracture – is a break in continuity of the bone of proximal femur out of the capsule of the hip joint [2].

Internal rotation traction radiographs-is utilization of high energy radiation to take images of the hip when the lower limb is subjected to traction and internally rotated [3].

Inter-observer reliability- The degree or extent of agreement between two independent observers who rate, code, or assess the same phenomenon [2].

Intra- observer reliability- An extent to which measurements, assessments or rates taken by the same observer are consistent [2].

Intertrochanteric fracture- Is a specific type of femoral fracture that occurs between the greater and lesser trochanters, which are located on the upper part of the femur [4]

Pertrochanteric fracture- Is a type of femoral fracture that involves both the greater and lesser trochanters of the femur [5]

Proximal femoral fracture – Is a break in the continuity of the bone of the femur from the articular surface of the hip joint up to 5 cm distal to the lesser trochanter [6].

Routine radiograph- Regular radiographs taken in order to diagnose a patient with trochanteric fracture. Includes AP pelvic, AP hip, lateral hip and full length femur radiographs [7]

Trochanteric fracture- Is a femoral fracture involving the trochanters, which are the bony prominences on the upper part of the femur. Trochanteric fractures are often categorized as intertrochanteric or pertrochanteric fractures depending on their location [8]

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background

Extracapsular femoral fractures constitute nearly 40% of proximal femoral fractures, with 90% being trochanteric and 10% subtrochanteric fractures [9]. The incidence of extracapsular femoral fractures have been escalating over the years with an annual projection of more than 3 million patients worldwide by 2050 [10]. The increment has been attributed to increase in life expectancy around the world in response to advancement in healthcare and subsequent incidence of osteoporosis amid the elderly individuals [11]. In contrast to young patients, extracapsular femoral fractures in geriatric individuals are due to low energy mechanism, and mostly a fall from standing position of less than 1 meter or ground level fall [12,13]. Additionally, muscle weakness, neurological gait disorders, confusion and self-medication are among the predispositions to extracapsular femoral fracture among the elderly [14].

In Sub Saharan Africa, Extracapsular femoral fractures are a growing problem which is usually accompanied with poor outcome mostly due to delay in treatment [15]. Similarly in Northern Tanzania, extracapsular femoral fractures dominated with a 54.5% of all proximal femoral fractures among patients who presented at a tertiary referral hospital [13,16]

Studies have shown presence of an escalation of complex fracture patterns with increasing age, coupled with high proportion of unstable fractures among patients with extracapsular femoral fractures. Unstable fractures have shown to project poor prognosis and higher complication rates compared to stable fractures [17]. Among extracapsular femoral fractures, Intertrochanteric fractures have more complex fracture patterns especially in the elderly individuals. Furthermore, determining the fracture's stability during radiographic assessment is crucial for the intertrochanteric fracture treatment protocol. [12,18]. In case of subtrochanteric fractures, in the past it was important to classify whether they extend to the piriformis fossa or the greater trochanter. This was attributed to the availability of implants at the time [10,19]. However, with the improvement of implants and presence of a variety of them, this is no longer a matter of concern.

Nevertheless, complexity of fracture patterns still warrants a clear radiological assessment of these fractures while planning for management [9].

Thus, radiographs play a critical role in making clinical decision, communication, research and following up prognosis[20]. Radiographically, Intertrochanteric fractures are usually classified using the Evans classification (based on post reduction stability). The two factors that dictate stability in extracapsular fractures are the integrity of the posteromedial cortex (calcar femorale), and the condition of the lateral femoral wall [21]. Evans organized extracapsular fractures to six different subtypes whilst highlighting the relevance of the medial and posterolateral support. In his classification, the final call regarding stability was taken depending on the displacement of medial cortex after reduction attempt [22].

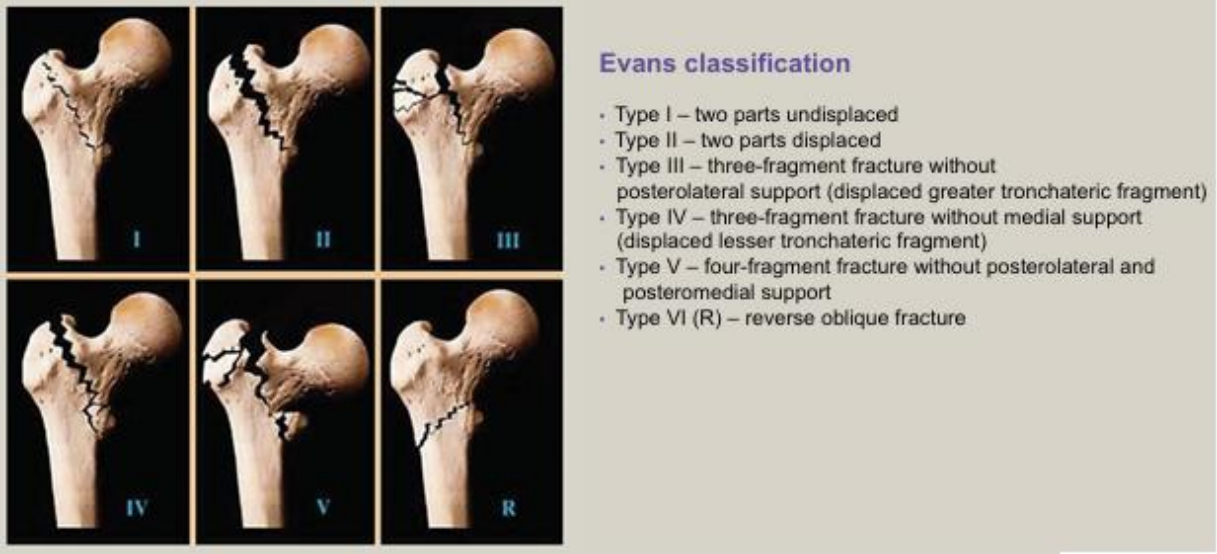


Figure 1: Evans classification

Posteromedial cortex and lateral wall integrity typically determine the method of treatment for these fractures and forecast the outcome [23]. The implant of choice for unstable fractures must be able to support additional weight in order to prevent loss of reduction due to collapse [24]. Hence, in treating unstable fractures cephalomedullary nails are usually highly recommended.

Meanwhile, stable fractures cephalomedullary nails, sliding hip screws, proximal femoral locking plate and fixed angle devices such as angled blade plate are recommended [25].

Intertrochanteric fractures are often evaluated using AP and lateral hip radiographs together with AP pelvic and femoral radiographs. [3]. However, the normal proximal femoral anatomy alignment involves the femur to lean forward and it's not straight forward as one would imagine [18]. Furthermore, in a state of injury of the proximal femur, deforming forces usually cause the limb to shorten and external rotate [26]. Therefore, under these circumstances, to assess routine radiographs and to produce an accurate diagnosis is usually a challenge [6]. Moreover, studies have elaborated decreased interobserver reliability in evaluation of trochanteric fractures using routine radiographs among physicians, necessitating expensive imaging modalities like CT scan which is sometimes difficult to obtain in our limited resources setup. Subsequently, there was a remarkable improvement in interobserver reliability when internal rotation traction radiographs were included in both groups [7,18,27]

In most trauma centers, for the cases involving complicated extracapsular fracture patterns, internal rotation traction radiographic view is usually requested [6]. However, studies examining the interobserver reliability of internal rotation traction radiographs in determining extracapsular proximal femoral fractures are lacking in our context.

1.2 Problem Statement

Internal rotation traction radiographs have been reported to generate more accurate assessment and construct a more reliable classification in extracapsular femoral fractures, which substantially contributes to the treatment of such fractures. Studies to assess internal rotation traction radiographs in improving radiographic assessment of extracapsular proximal femoral fracture have been conducted elsewhere.

However, there are no such studies in our setting. None of these research projects have been carried out at MOI. Therefore, the purpose of this study was to evaluate how effectively internal rotation traction radiographs can be used to better detect extracapsular femoral fractures in patients receiving care at the Muhimbili Orthopedic Institute.

1.3 Conceptual framework

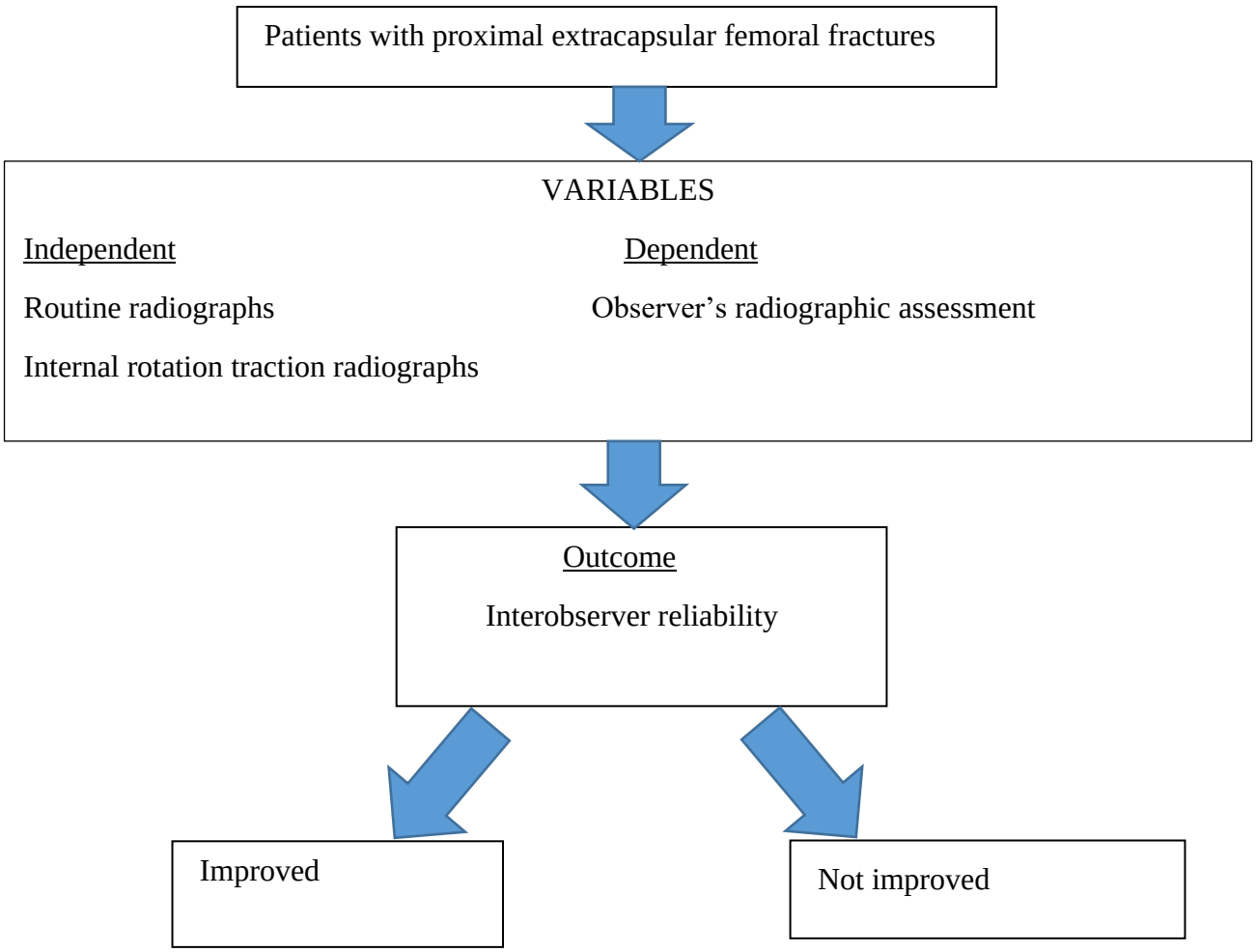


Figure 2: Conceptual Framework

The independent factors in this study include routine radiographs and internal rotation traction radiographs. The dependent variables in this study include radiographic assessment of extracapsular proximal femoral fractures by orthopedic senior residents. Eventually the outcome will be whether interobserver reliability has been positively improved or not when the assessment is made between the two types of radiographs of an individual patient.

1.4 Rationale

Extracapsular femoral fracture care is significantly improved by internal rotation traction radiographs, particularly in terms of early and precise diagnosis and planning of a suitable intervention. Furthermore, internal rotation traction radiographs utilize available resources and it's cheaper compared to other diagnostic modalities. However, no study has been conducted at our settings regarding its contribution in improving management of extracapsular femoral fractures. Therefore, scientific evidence is necessary to provide appropriate means of adopting ways to improve the treatment of these fractures.

The study has the potential to contribute to the body of currently known information, and the data can be utilized as a starting point for further investigation, the creation of management recommendations, and ultimately an increase in the caliber of patient care.

1.5 Hypothesis

Internal rotation traction radiographs are more reliable than routine radiographs when assessing proximal femoral extracapsular fractures among patients treated at Muhimbili Orthopedic Institute (MOI).

1.6 Research questions

1.6.1 Overall research question

Does the use of internal rotation traction radiographs improve radiographic assessment of extracapsular proximal femoral fractures at Muhimbili Orthopedic Institute from July 2023 to December 2023?

1.6.2 Specific research questions

1. What is the pattern of extracapsular proximal femoral fractures among patients treated at MOI from July 2023 to December 2023?
2. What is the interobserver reliability when assessing routine radiographs among patients with extracapsular proximal femoral fractures treated at MOI from July 2023 to December 2023?
3. What is the interobserver reliability when assessing internal rotation traction radiographs among patients with extracapsular proximal femoral fractures treated at MOI from July 2023 to December 2023?

1.7 Objectives

1.7.1 Broad objective

To investigate the use of internal rotation traction radiographs in improving radiographic assessment of extracapsular femoral fractures at Muhimbili Orthopedic Institute from July 2023 to December 2023

1.7.2 Specific objective

1. To determine the pattern of extracapsular proximal femoral fractures among patients treated at MOI from July 2023 to December 2023.
2. To determine interobserver reliability when assessing routine radiographs among patients with extracapsular proximal femoral fractures treated at MOI from July 2023 to December 2023.
3. To determine interobserver reliability when assessing internal rotation traction radiographs among patients with extracapsular proximal femoral fractures treated at MOI from July 2023 to December 2023.

1.8 Literature review

1.8.1 The pattern of extracapsular proximal femoral fracture.

Proximal femoral fractures have a mortality of 30% in the first-year post injury. Generally, these fractures have become more common across the world, especially among the elderly [18]. Similarly, in the United States approximately more than 250,000 proximal femoral fractures occur annually. While, the majority of the victims being the elderly with the estimated mortality between 14% and 36% one year post injury [21]. On the other hand, 50% of all proximal femoral fractures are extracapsular. A study done in China found that extracapsular proximal femoral fractures were responsible for 17.47% of deaths [28]. A similarly study carried out in Pakistan projected that a mortality rate of 36.9% is due to extracapsular proximal femoral fractures [29]. With the presence of progressive aging population in Sub Saharan Africa, proximal femoral fracture incidence have been rising and expected to grow exponentially in the coming decades [15]. In Northern Tanzania, literature has shown an increase of 2.34 % of fragility fractures among the elderly population. Nevertheless the majority of fragility fractures in the study were extracapsular proximal femoral fractures (55.8%) [16].

Among the extracapsular proximal femoral fractures, trochanteric fractures have been dominant. A metanalysis study have shown ascendency of searches of trochanteric fracture among scientists indicating the increase of such fractures in the society [30]. However, an epidemiological study has shown that the increase of intertrochanteric fractures is futuristic. While the global burden is expected to rise in the future, the Asian community is estimated to be most affected by trochanteric fractures in the next 40 years [31]. Similarly a study conducted in Tanzania, majority of fragility fractures are trochanteric fractures, and the trend of trochanteric fractures especially among the elderly population seems to be increasing with time [13,16].

Studies have elaborated the supremacy of proximal femoral fractures among the elderly population [16,21]. Similarly other studies have stressed further that elderly women are affected the most because of post-menopausal osteoporosis and among other factors [32,33]. However, some studies have projected about the contribution of muscle weakness, medication and loss of

balance which become inevitable with age [34,35]. In line with these studies, a study conducted in Tanzania have also shown that fragility fractures mostly occur in the elderly individuals, whereby women are more affected than men [16].

Nevertheless, these injuries are usually low energy injuries. Studies have shown that majority of the victims usually succumb mechanisms such as falling from standing height or slipping on a slippery surface [29,36]. Few cases are due to motor traffic crush or fall from height. The latter mechanisms are usually reserved for the younger patients [37]. A study conducted in India have shown that majority of the participants had slipped on a slippery surface [32]. Contrary to this study, a study conducted in Tanzania showed that the majority of participants had fallen from a standing height [16].

Radiological assessment of extracapsular proximal femoral fractures is of paramount importance in recognizing, classifying, and planning management [27]. However, studies have revealed that the natural anteversion of the femoral neck in conjunction with the fracture deformity may reduce the classification accuracy of fractures and subsequently affect treatment. [7,18].

Misclassification of extracapsular proximal femoral fractures will terminate to faults in surgical planning and implant option, eventually rendering a patient into complications [6]. Internal rotation traction radiographs have been complemented for their role in increasing inter and interobserver reliability in assessing extracapsular proximal femoral fractures [21]. Nevertheless, most trauma centers usually deal with routine radiographs in the course of management of patients with extracapsular proximal femoral fractures [6,18]

1.8.2 Interobserver reliability in assessing extracapsular proximal femoral fractures using routine radiographs.

The pattern of extracapsular proximal femoral fractures is dynamic in correlation with time. It seems to become more complex, unstable and more pronounced among the aged individuals [7]. These changes contributes to the adaption of investigation and treatment modalities which would produce high quality outcome while considering the cost implication to the patient [15]. Studies have shown that when encountered with a complex extracapsular proximal femoral fracture routine radiographs may not be sufficient enough to assess and produce an accurate diagnosis which usually aids in treatment [21,27].

A study conducted in Argentina regarding, evaluation of interobserver agreement among residents and specialists, have shown poor inter and intraobserver reliability when assessing extracapsular PFFs by utilizing routine radiographs compared to internal rotation traction radiographs analysis [6]. Similarly, another study has also shown low interobserver and intraobserver reliability in classifying extracapsular proximal femoral fractures among physicians. However, in contrast to a previous study, this study did not include traction internal rotation radiographs in its assessment [2].

The necessity of traction internal rotation radiographs relies on the urgency required in operative management of extracapsular proximal femoral fractures for early mobilization to avoid complications [38]. While some studies have projected that, preferably, patients presenting with extracapsular proximal femoral fractures are ought to be treated operatively within 24 to 48 hours. Moreover, patients operated within 48 hours have shown to have a 20% lower risk of mortality 1 year post surgery, especially those with comorbidities [9,26,39]. Other studies have reported that early treatment within 48 hours is analogous with various complications because clinicians are faced with lack of time to optimize the patient's comorbidities before operation [39,40].

In the developing countries there are numerous obstacles which cause delayed treatment of proximal femoral fractures [15]. However, regardless of the timing of the treatment, recognizing atypical fractures or unstable fracture patterns radiographically is pivotal to the course of management of elderly individuals, particularly from first responders clerking the patient [2].

1.8.3 Interobserver reliability in assessing extracapsular proximal femoral fractures using internal rotation traction radiographs

According to, Crijns *et al*, experienced doctors are more eligible to identify the fracture patterns of complex fractures with a higher index of accuracy using routine radiographs than inexperienced doctors**.** Nevertheless, with addition of traction internal rotation radiographs, this accuracy increases significantly [20]**.** In correlation with these findings , Fernando *et al*, established that, with internal rotation traction radiographs, clinicians are able to classify fractures accordingly, henceforth harmonizing the working environment by appropriately selecting suitable implants and simplifying the tasks ahead [6].

Additionally, studies conducted in developed nations have clarified the essence of additional investigative means in case of reasonable doubt in diagnosing extracapsular proximal femoral fractures, such as CT scans [3]. In the developing world, the most commonly available investigation to diagnose extracapsular proximal femoral fractures in most trauma centers is radiography. Furthermore CT scans are expensive to most patients, given the fact that health insurance covers only a small proportion of the population [15]. However, several studies have shown presence of inadequate intraobserver reliability in extracapsular proximal femoral fractures classification system from experienced physicians by using routine radiographs [41–43]. In contrast to these findings, studies conducted where physicians were presented with internal rotation traction radiographs, intraobserver reliability was adequately satisfactory [3,27].

Considering that radiographs are one of the main investigative tool that is readily available, affordable and effective in diagnosing PFFs at our settings, it is essential to make sure that improvements are made to achieve maximum evidence based utilization of this tool so as to obtain most favorable results [16].

The universality in classification systems is immensely critical in the scientific community in terms of communication, information transfer and management of cases in a generalized manner in the world [22,42]. Internal rotation traction radiographs increase diagnostic accuracy and therefore provides an assistance in classification of extracapsular proximal femoral fractures accordingly [7]. Studies conducted in the United States proposed that with the introduction of internal rotation traction radiographs, diagnostic reliability elevated significantly amid clinicians treating individuals with extracapsular proximal femoral fractures [3]. In congruency with this study another study conducted in Latin America reported increased diagnostic reliability among residents and specialists when traction internal rotation radiographs were introduced in patients with extracapsular proximal femoral fractures [44].

Furthermore, a study conducted in Argentina elaborated that, 82.4% of fracture classification by residents and specialist by using routine radiographs were wrongly classified. Moreover, agreement of the correct diagnosis and classification among residents and specialists increased from 68.9% with routine radiographs to 78.79% once internal rotation traction radiographs were introduced when attending patients with extracapsular proximal femoral fractures [6].

Inclusion of internal rotation traction radiographs, increases agreement among clinicians in diagnosing and classifying extracapsular proximal femoral fractures. Moreover, it has a low cost compared to other advanced investigations, it's readily available in our setting and is associated with minimal morbidity intervention [18,27].

CHAPTER TWO

2.0 MATERIALS AND METHODS

2.1 Study design

This was a cross-sectional study

2.2 Study population

All radiographs of patients who visited MOI emergency department with extracapsular proximal femoral fractures and who were 18 years of age or older, from July 2023 to December 2023.

2.3 Study area

The study was conducted at Muhimbili Orthopedic Institute (MOI), which is a part of the Muhimbili complex in Dar es Salaam, Tanzania. Although it is a tertiary hospital, it also acts as the national referral hospital for orthopedics, trauma, and neurosurgery. With a total bed capacity of 362 and 9 operating rooms, it serves as a teaching hospital for Muhimbili University of Health and Allied Sciences. Annually, about 10,000 procedures are conducted.
In average the hospital attends about 20 to 25 patients with extracapsular proximal femoral fracture per month.

2.4 Sample size

According to a prior unpublished study conducted at MOI that looked at the profile of trochanteric fractures, treatment, and short-term results, the proportion of trochanteric fractures was 49.4% [45]. Considering all of this and the projected 5% maximum margin of error.

The Kish and Lisle formula [46] was utilized to establish the minimum sample size required for this study.

$n= Z^2P (1-P)/e^2$

The 95% confidence interval corresponds to 1.96, with,

n=sample size,

Z=is standard normal variance (at 5% type 1 error (P<0.05) it is 1.96), and

P=proportion of adult patients who sustained proximal femoral fracture = 49.4%.

e=the study's accuracy is 5%

Consequently, $n= ((1.96)^2 0.494 (1-0.494))/ (0.05)^2$ n= 384.

Given that few radiographs from this sample were adequate enough in this study, therefore, sample size of infinite population was used to calculate the appropriate sample size.
It is possible to modify n for small populations by adjusting for finite population size as elaborated by Kozack [47].
For small populations n can be adjusted so that

n(adj) = (Nxn)/(N+n).
Patients with extracapsular proximal femoral fractures treated at MOI from September 2022 to November 2022 (3 months) were identified in a pilot study. 67 adult patients were identified as having extracapsular proximal femoral fracture. Whereby, 3 senior residents from the radiology department, who did not take part in the study were recruited to evaluate the radiographs from these patients in order to test the research tool.

Substituting,
n (ad j) = (384x 67)/ (384+67)
= 57
Consequently, a sample size for this study was estimated to be 57.

2.5 Eligibility criteria

2.5.1 Inclusion criteria

- All patients with extracapsular proximal femoral fractures (18 years of age and older) as determined by radiography attended at the emergency room at MOI.
- Acute extracapsular proximal femoral fractures (within 24 hours injuries)

2.5.2 Exclusion criteria

- Tumors or lesions as they interfere with the normal proximal femoral anatomy
- Patients with mental illness because of poor cooperation during internal rotation traction radiographs
- Polytrauma patients with severe head injury, chest or other extremity injuries, because in such patients saving life is usually a priority.
- Preexisting lower- limb deformity because the study protocol requires equal limb length for adequate traction justification.
- Fractures involving the contralateral limb.
- Ipsilateral femoral shaft fracture.

2.6 Sampling technique

Patients were registered using the consecutive sampling method as they arrived at MOI's emergency department during the study period.

2.7 Variables

Studied variables included;

2.7.1 Independent

- Routine radiographs
- Internal rotation traction radiographs

2.7.2 Dependent

- Observer’s (5 senior orthopedic residents) extracapsular proximal femoral fracture radiographic assessment

2.8 Data collection technique

The emergency room was used to recruit participants who met the inclusion requirements. After educating them about the study, their consent was requested. The patient's history was used to determine the demographic characteristics of participants and the nature of their injuries. Standard radiographs were taken, including AP views of the pelvis, hip, and lateral, as well as internal rotation traction radiographs. Therefore, the following radiographs were taken:

AP pelvic radiograph

With the patient lying on his or her back, with the beam 1 m from the cassette and perpendicular to the center of the symphysis pubis.

AP hip radiograph

The patient was placed in supine position with the beam stationed perpendicular to the center of the trochanteric region of the fractured side, 1m in distance from the cassette.

Lateral radiographs of the hip

The patient was tilted 15 degrees toward the uninjured side, and the cassette and magnifier was positioned on the lateral region of the fractured side in a line parallel to the floor and perpendicular to the axis of the beam.

Internal rotation traction radiograph

This straightforward internal rotation and traction maneuver was carried out without sedation, it was handled gradually and softly.

The patient was given an analgesic as a normal routine for trauma patients and placed supine with the beam positioned 1meter away from the cassette, perpendicular to the center of the symphysis pubis. The injured limb was then manipulated to undergo internal rotation such that the patella faces upward to allow femoral anteversion. The primary investigator then manually applied gradual longitudinal traction force to the affected limb, holding the ankle until the length is nearly equivalent to that of the normal limb.

After taking the radiograph, the strain was gently released to avoid any jarring movements and minimize discomfort.

Observers

Anonymously 5 orthopedic senior residents out of 14 were randomly selected to participate in the study, because more than 2 raters can bring about the desired outcome. However more than 5 raters do not add or decrease the degree of accuracy of the results obtained [43]. A senior resident was considered as any resident who is in their last year of studies at MUHAS taking orthopedic and traumatology. They are considered to be able to diagnose trochanteric and subtrochanteric fractures unsupervised. They were selected through simple random method, whereby their names were written in a piece of paper and mixed in a bowl. Then, five pieces of paper were selected from the mixture to increase the element of randomization in terms of evaluation of radiographs. To ensure blinding and to prevent confounders, images of participants were taken and presented to the selected senior residents 3 months later, while ensuring the resident has not taken part in the pathway of treatment of the participant. Through a structured questioner they assessed the routine radiographs and classified the fractures in the following manner:

- The adequacy of the radiograph to make an appropriate assessment
- Posteromedial involvement
- Lateral wall involvement
- Presence of an inverted intertrochanteric line
- Extension into the piriformis fossa/ greater trochanter
- Diaphyseal extension of the fracture
- Stability of the fracture
- Need for additional images

This simplified classification system is adopted from Evans instability criteria for intertrochanteric fractures (comminution, posteromedial wall compromise, subtrochanteric extension and verticality of fracture line) and the Russell-Taylor classification of subtrochanteric fractures [22,26]. Particularly, these fracture types, because they can potentially affect the treatment choice.

Each resident assessed the routine radiographs initially, then traction internal rotation radiographs was added in the series. These radiographs were presented anonymously and randomly to the residents.

2.9 Data collection tools

A self-administered structured questioner was used to collect data from orthopedic residents on their evaluation of extracapsular proximal femoral fracture radiographs.

2.10 Data collection tool test

The study tool was pre-tested to 30 adult patients with extracapsular proximal femoral fractures attended at MOI emergency department, who were not included in this study. The results were used to modify the tools through consultation with my supervisor to ensure that the tools covered the construct under the interest.

Furthermore, Cronbach's alpha test was utilized to test internal consistency of the questionnaire in which results from pretested participants were used to calculate correlation coefficient. The correlation coefficient (reliability test) from the Cronbach's alpha test results is a number between 0 and 1. An accurate and reliable score from the test was considered to be the one of 0.7 and higher [48].

2.11 Data management and analysis

All filled questioners were codded accordingly prior to data entry. Furthermore, SPSS (Statistical Package for Social Sciences) version 26.0 (SPSS, Inc, Chicago, IL USA) was used to code, and analyze the acquired data. Data cleaning was done by the lead investigator to ensure accuracy, consistency, and rationale.

There was a one-way analysis. Continuous variables with regularly distributed data were represented with means and standard deviation. Where appropriate, categorical variables were displayed as proportions or percentages. The data were presented in tables. Descriptive statistics was used to analyze the first objective.

To assess interobserver reliability in the second and third objective, Fleiss multirater kappa (κ) statistics was used to analyze the collected data. Results were interpreted as follows:

- A value of less or equal to 0 denotes a disagreement.
- 0.01-0.20 none to slight
- 0.21-0.40 reasonable
- 0.41-0.60 moderate
- 0.61-0.80 substantial
- 0.81-1.00 nearly excellent agreement

2.12 Ethical issues

This research received ethical clearance from the MUHAS IRB and approval letter to carry out data collection from the MOI executive director.

For patients who were not able to issue consent on their own, informed consent was obtained from the patient’s next of kin. This came following a thorough explanation of the study's goals. There was a guarantee of privacy, anonymity and that the management of the patient would not change if they had declined to take part in the study.

The study participants went through every type of standard management that is accessible.

CHAPTER THREE

4.0 RESULTS

Table 1:Pattern of extracapsular proximal femoral fractures

Variable	Frequency(n=46)	Percentage (%)
Age group		
18-38	6	13
39-59	11	23.9
60-80	17	37
Above 81	12	26.1
Mean age years (± SD)	63.8 (±17.6)	
Sex		
Male	22	47.8
Female	24	52.2
Mechanism of injury		
Ground level fall	13	28.3
Sipped on slippery surface	16	34.8
Motor Traffic Crash	12	26.1
Fall From height	5	10.9
Fracture type		
Intertrochanteric	27	58.7
Pertrochanteric	12	26.1
Subtrochanteric	7	15.2
Laterality		
Right	32	69.6
Left	14	30.4

This study included 46 participants with a mean age of 63.8 ±17.6 years, with the majority 29(63.1%) being more than 60 years of age.

Majority of the participants were females with a female-to-male ratio of 1.1:1 and slipping on a slippery surface accounted for 16 (34.8%) of the mechanism of injury among the participants.

The majority of the fractures were intertrochanteric 27 (58.7%). Furthermore, many occurred on the right side 32 (69.6%)

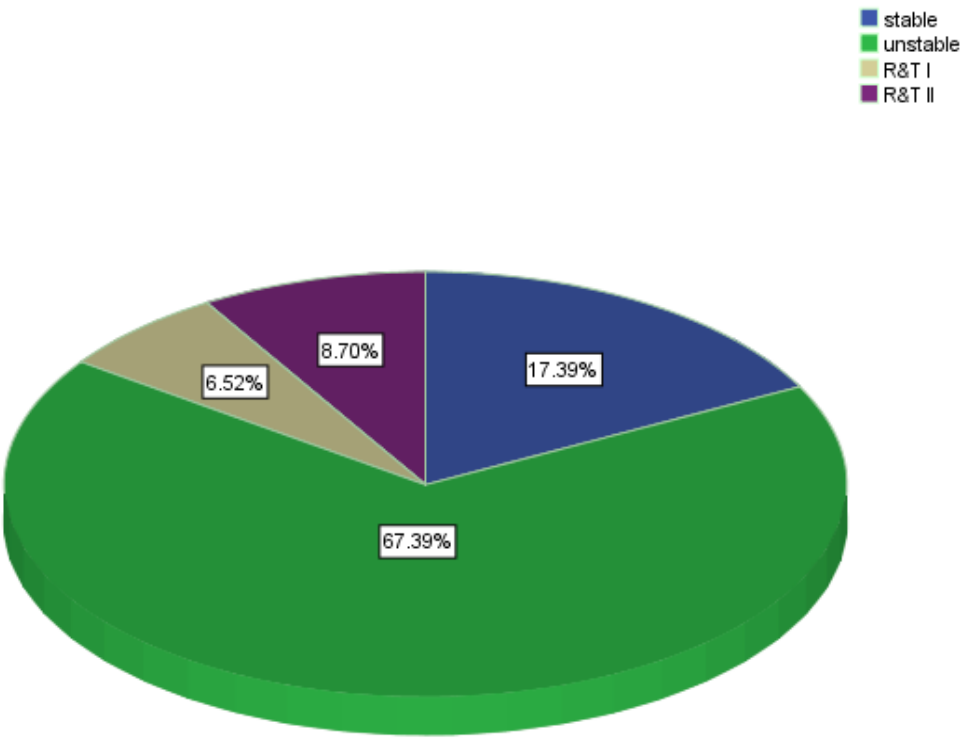
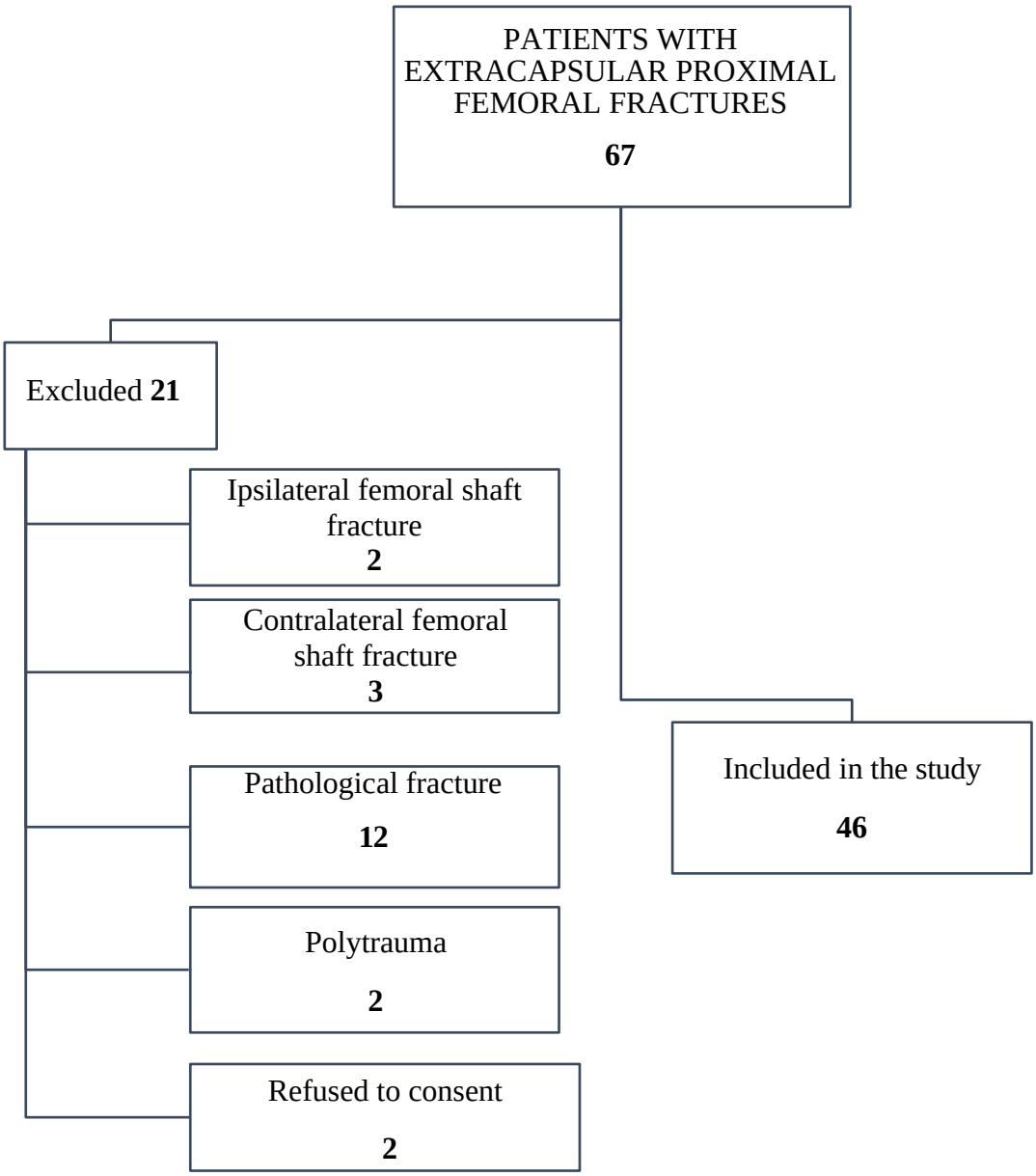


Figure 3: Classification of intertrochanteric/Pertrochanteric and Subtrochanteric fractures

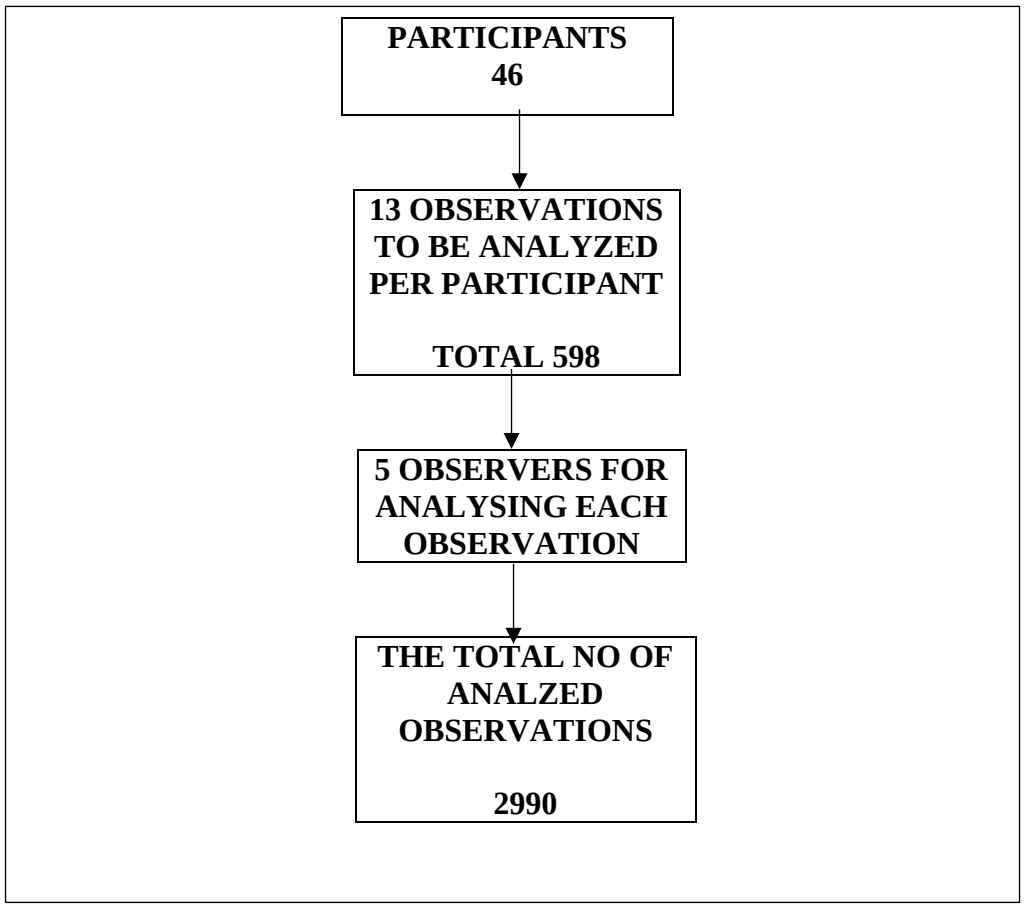
More than half of the study participants 31(67.4%) had an unstable intertrochanteric/pertrochanteric fracture, while Russell and Tylor I subtrochanteric fractures were found in 6.5 % of the participants.

Figure 4: Study population flow chart



A total of 67 patients with extra-capsular proximal femoral fractures were attended. Among those, 55 had trochanteric fractures and 12 had subtrochanteric fractures. However, 21 patients were not included due to exclusion criteria, leaving 46 participants in the study. These participants covered more than 80 percent of the required sample size.

Figure 5: The flow of observations (analysis of radiographs among senior residents)



Thus, 46 participants with 13 observations each to be analyzed by senior residents. Therefore, there was 598 total observations per participant. Nonetheless, 5 observers (senior residents) were utilized for analysis. Hence, there were a total of 2990 observations.

Table 2: Overall Interobserver reliability when assessing routine radiographs among patients with extracapsular proximal femoral fracture

			Asymptotic		Asymptotic 95% Confidence Interval	
	Kappa	Standard Error	Z	Sig	Lower Bound	Upper Bound
Overall agreement	.593	0.03	203.608	.000	.592	.593

The overall interobserver reliability among senor residents when assessing proximal femoral extracapsular fractures by using routine radiographs was 0.593 (SE=0.03, Z=203.608, p<0.001).

Table 3: Interobserver reliability of individual observations when assessing routine radiographs among residents

Rating Category	Conditional Probability	kappa	Standard Error	Asymptotic		Asymptotic 95% Confidence Interval	
				Z	Sig	Lower Bound	Upper Bound
Evaluable	.067	.820	.013	63.449	.000	.820	.821
Intertrochanteric fracture	.051	.626	.013	48.386	.015	.625	.627
Pertrochanteric fracture	.050	.611	.013	47.890	.000	.609	.612
Subtrochanteric fracture	.078	1.000	.013	77.340	.000	.999	1.002
Unstable	.023	.214	.013	16.529	.000	.213	.215
Stable	.051	.630	.013	48.744	.000	.630	.631
Posteromedial comminution	.049	.471	.013	36.402	.000	.470	.472
Lateral wall	.040	.457	.013	35.369	.000	.457	.458
Reverse Oblique	.062	.894	.013	69.129	.000	.893	.895
Diaphysis extension	.055	.702	.013	54.264	.000	.701	.703
Piriformis extension	.028	.382	.013	29.575	.000	.382	.383
Additional image	.0.70	.961	.013	74.706	.000	.960	.962
Traction internal rotation image	.069	.945	.013	73.097	.000	.944	.946

Of the radiographs assessed by senior residents, the interobserver reliability on the evaluability of the radiographs provided was 0.82 (SE=0.013, Z = 63.449, P<0.001). Furthermore, concerning diagnosing intertrochanteric and pertrochanteric fractures using routine radiographs, the interobserver reliability was 0.626 (SE = 0.013, Z= 48.486, P = 0.015) and 0.611 (SE=0.013, Z=47.890, P<0.001) respectively.

However, the interobserver reliability on assessing subtrochanteric fracture was 1.00 (SE = 0.013, Z= 77.34, P< 0.001). Nonetheless, on diagnosing unstable pertrochanteric/intertrochanteric fractures among senor residents the interobserver reliability was 0.214 (SE 0.013, Z = 16.529, P<0.001), meanwhile for stable pertrochanteric/intertrochanteric fractures the interobserver reliability was 0.630 (SE 0.013, Z = 48.744, P<0.001).

Moreover, the interobserver reliability was 0.471 (SE 0.013, Z = 36.402, P<0.001) and 0.457 (SE 0.013, Z = 35.369, P<0.001) for detecting posteromedial comminution and lateral wall involvement in pertrochanteric/intertrochanteric fractures, respectively.

On evaluating reverse obliquity in trochanteric fractures using routine radiographs, the interobserver reliability was 0.894 (SE 0.013, Z = 69.129, P<0.001). Additionally, among subtrochanteric fractures when detecting if the fracture line had extended to the diaphysis or piriformis extension the interobserver reliability was 0.702 (SE 0.013, Z = 54.264, P<0.001) and 0.382 (SE 0.013, Z = 29.575, P<0.001) respectively.

Consequently, interobserver reliability for the necessity of additional radiographic image was 0.961 (SE 0.013, Z = 74.706, P<0.001). Meanwhile, suggesting that supplementary radiographic image should be traction internal rotation radiograph with an interobserver reliability of 0.945 (SE 0.013, Z = 73.097, P<0.001).

Table 4:Overall Interobserver reliability when assessing internal rotation traction radiographs among patients with extracapsular proximal femoral fracture

			Asymptotic		Asymptotic 95% Confidence Interval	
	Kappa	Standard Error	Z	Sig	Lower Bound	Upper Bound
Overall agreement	.943	0.04	262.928	.000	.943	.943

The overall interobserver reliability among senor residents when assessing proximal femoral extracapsular fractures by using internal rotation traction radiographs was 0.943 (SE=0.04, Z=262.928, P<0.001).

Table 5: Interobserver reliability of individual observations when assessing internal rotation traction radiographs among residents

Rating Category	**Conditional Probability**	**Kappa**	**Standard Error**	**Asymptotic**		**Asymptotic 95% Confidence Interval**	
				Z	**Sig**	**Lower Bound**	**Upper Bound**
Evaluable	.075	.990	.013	76.587	.000	.990	.991
Intertrochanteric fracture	.071	.904	.013	69.871	.000	.903	.904
Pertrochanteric fracture	.077	.995	.013	76.965	.000	.994	.996
Subtrochanteric fracture	.077	1.000	.013	77.330	.000	.999	1.001
Unstable	.076	.995	.013	76.960	.000	.994	.996
Stable	.072	.950	.013	73.455	.000	.949	.951
Posteromedial comminution	.071	.939	.013	72.599	.000	.938	.940
Lateral wall	.070	.943	.013	72.935	.000	.942	.944
Reverse Oblique	.078	.991	.013	76.608	.000	.990	.991
Diaphysis extension	.077	1.000	.013	77.330	.000	.999	1.001
Piriformis extension	.077	1.000	.013	77.330	.000	.999	1.001
Additional image	.003	.185	.013	14.331	.000	.185	.186

Of the internal rotation traction radiographs assessed by senior residents, the interobserver reliability on the evaluability of the radiographs provided was 0.990 (SE=0.013, Z = 76.587, P<0.001). Furthermore, concerning diagnosing intertrochanteric and pertrochanteric fractures using internal rotation traction radiographs, the interobserver reliability was 0.904 (SE = 0.013, Z= 69.871, P < 0.001) and 0.995 (SE=0.013, Z=76.965, P<0.001) respectively.

However, the interobserver reliability on assessing subtrochanteric fracture was 1.00 (SE = 0.013, Z= 77.33, P< 0.001). Nonetheless, on diagnosing unstable pertrochanteric/intertrochanteric fractures among senor residents the interobserver reliability was 0.995 (SE 0.013, Z = 76.96, P<0.001), similarly, for stable pertrochanteric/intertrochanteric fractures the interobserver reliability was 0.950 (SE 0.013, Z = 73.455, P<0.001).

Moreover, the interobserver reliability was 0.939 (SE 0.013, Z = 72.599, P<0.001) and 0.943 (SE 0.013, Z = 72.935, P<0.001) for detecting posteromedial comminution and lateral wall involvement in pertrochanteric/intertrochanteric fractures, respectively.

Furthermore, when identifying reverse obliquity in trochanteric fractures interobserver reliability was 0.991 (SE 0.013, Z = 76.608, P<0.001). Additionally, among subtrochanteric fractures when detecting if the fracture line had extended to the diaphysis or to the piriformis fossa the interobserver reliability was 1.00 (SE 0.013, Z = 77.33, P<0.001) in both scenarios.

The interobserver reliability for the necessity of additional radiographic image was 0.185 (SE 0.013, Z = 14.331, P<0.001).

CHAPTER FOUR

4.0 DISCUSSION

This study assessed the use of internal rotation traction radiographs in improving radiographic assessment of extracapsular proximal femoral fractures. Normal and internal rotation traction radiographs were assessed to see if there was a clinical difference in evaluating extracapsular proximal femoral fractures. Internal rotation traction radiographs are considered to be very effective in resource limited settings for the assessment of extracapsular proximal femoral fractures [18,49]. To our knowledge, there is dearth of published studies in this topic in our setting.

4.1 To determine the pattern of extracapsular proximal femoral fractures among patients treated at MOI

The study's participant demographics provide important insights into the epidemiology of extracapsular femoral fractures in our society. These results, which have a mean age of 63.8 years had a significant percentage of proximal femoral fractures in those aged over 60 years (63.1%), and shows similarity with other studies which revealed that these fractures become more common as people age[8,36,50]. A worldwide systematic review of hip fractures showed similar results to this study [51]. Additionally, another study conducted in Japan which showed extracapsular proximal femoral fractures are more prominent with increasing age [11]. Furthermore, a study conducted in Northern Tanzania revealed that majority of extracapsular femoral fractures are more pronounced in the elderly individuals with the average age of 65.4 years for those without fragility fracture as compared to 75 years for those with fragility fractures [16].

Nonetheless, with a female-to-male ratio of 1.1:1, the study's small female predominance is consistent with trends found in earlier research [4,52]. This finding might be explained by the fact that postmenopausal women have a higher incidence of osteoporosis, lower bone density and muscle wasting, which puts them at a higher risk of fragility fractures like the ones in this study. In concordance with these findings, a study conducted in the Czech studying the effects of sex and age on proximal femoral fractures showed that male to female ratio was 1:1.5 [53]. In line with

these findings, in sub-Saharan Africa a study has revealed that more than half of the population affected with proximal femoral fractures were female. In contrast, to these findings a study conducted in Quatar has elaborated that the majority of participants who had proximal femoral fractures were males. However, the population of that study constituted of younger patients below the age of 50 years [54]. Concomitantly, a study conducted in Tanzania agrees with the male domination over female in terms of proximal femoral fractures. This could have been explained by the sedentary lifestyle of males in the region [16].

Additionally slipping on a slippery surface was found to be a predominant mechanism of injury among participants in this study. This can be explained by the quality of tiles/marbles incorporated in our homes. To save cost, cheap floor coverage are more susceptible to cause slippage [55]. However, another reason could be loss of balance, tissue strengths and comorbidities as one ages [56]. These factors, induces one to easy falls. Nonetheless these findings are similar to other findings in Germany and Ethiopia, where by slipping on a slippery surface was a dominant mechanism of injury [33,52]. In contrast to these findings, a study conducted in Northern Tanzania revealed that the major mechanism of injury among participants was fall from a standing position (less than 1 meter height from the ground). Though, these findings are contrary to our findings, however in this study majority of participants with low energy mechanism of injury were female similar to our study [16].

Intertrochanteric fractures constituted the majority of fractures in our study, comprising 58.7% of cases. This is consistent with other literatures, as intertrochanteric fractures are known to be among the most prevalent types of extracapsular femoral fractures, especially in older adults [3,4,26]. Apart from osteoporosis, several other factors contribute to this dominance [3,57]. Anatomically the intertrochanteric region is subjected to more stress, plus it contains cancellous bone which is more susceptible to fractures [10,58]. Moreover, biomechanically the geometry of the proximal femur directs force lines to the intertrochanteric area. Thus, with age related changes including quality and strength of tissues and functional anatomy of the hip whereby a lot of muscles attaches to the intertrochanteric region, predisposes elderly individuals to succumb intertrochanteric fractures [8,59]

The high preponderance of fractures on the right side is a significant observation that can be further explored. Even though lateralization of the fractures has been observed in some studies, this phenomenon is not completely understood and must be tackled in the future studies. Nevertheless, two studies conducted in Senegal and Ethiopia in particular revealed similar results to findings of this study [5,33].

More than half of the study participants (67.4%) had an unstable intertrochanteric/pertrochanteric fracture, highlighting the severity and complexity of the fractures observed in our cohort. This can be explained by the fact that majority of our participants were elderly female, who are more prone to osteoporosis and hence fragility fractures. Similar to our findings, a study conducted in England have also reported the dominance of unstable pertrochanteric fractures among female participants [4]. Similar findings were also reported in other studies conducted in Senegal and Tanzania [5,16]

Additionally, Russell and Taylor I subtrochanteric fractures were found in 6.5% of the participants, indicating the presence of less common but clinically significant fracture patterns. These findings are similar to studies conducted in India and Tanzania, whereby subtrochanteric fractures were less prevalent, however, their clinical importance could not be neglected [13,19]

It is essential to comprehend the clinical and demographic traits of individuals suffering from extracapsular femoral fractures in order to improve treatment approaches and patient outcomes. Our research offers insightful information about the prevalence and trends of these fractures in our community, information that may be used to guide focused measures meant to lessen the impact of these injuries and improve patient care.

4.2 To determine interobserver reliability when assessing routine radiographs among patients with extracapsular proximal femoral fractures treated at MOI

The overall interobserver reliability among senior residents when assessing routine radiographs in evaluating proximal femoral extracapsular fractures showed moderate agreement beyond chance

These findings suggest that routine radiographs alone provide a moderate level of agreement among senior residents in identifying and classifying extracapsular proximal femoral fractures. However, variability in interpretation highlights the limitations of routine radiographs in certain cases, necessitating the use of additional imaging modalities to enhance diagnostic accuracy. These findings were consistent with another study conducted in Colombia [18]. Nonetheless, an interesting finding from this study was that with increased experience the variability decreases and thus, less need for additional imaging modalities [18]. Although, In contrast to these findings a study conducted in Argentina have shown that variability in analyzing extracapsular proximal femoral fractures using routine radiographs exists even in the experienced physicians [49].

Furthermore, excellent agreement among senior residents on the evaluability of routine radiographs have been demonstrated when individual observations were analyzed. This suggests a robust consensus among evaluators regarding the clarity and quality of the radiographic images provided for fracture assessment. These findings are similar to other studies [18,27]. However, In contrast to these studies, usually the best or evaluable radiographs are taken for most of these studies because there are retrospectively designed [3,27].

In diagnosing intertrochanteric and pertrochanteric fractures using routine radiographs, substantial agreement was observed among senior residents. These findings highlight the reliability of senior residents in identifying these common types of extracapsular femoral fractures based on routine radiographs. Similarly, other studies have shown the interobserver reliability to fall under the substantial category when routine radiographs are used among residents [18,49]. However, some other studies have shown the interobserver reliability to be moderate [3,60]

For diagnosing subtrochanteric fractures, excellent agreement was observed among senior residents when using routine radiographs. This indicates a high level of consensus and accuracy in identifying subtrochanteric fractures using routine radiographs, reflecting the distinct radiographic features associated with this type of fracture. These findings are identical to other studies, which signifies that, in cases of subtrochanteric routine radiographs seem to be adequate enough with no need for supplementary radiographic images [3,49].

In contrast, fair agreement was observed among senior residents in diagnosing unstable pertrochanteric/intertrochanteric fractures. However, substantial agreement was noted for stable pertrochanteric/intertrochanteric fractures, indicating greater consistency in diagnosing stable fractures compared to unstable ones. Similar observations were reported in a study conducted in India. Though this study used AO classification for evaluation, but the principle remained the same, observing the involvement of the lateral wall and posteromedial comminution [27]. Another study conducted in Argentina showed a substantial change in diagnosis from stable to unstable when additional imaging modalities were included [49]. Generally, these results warrant the use of additional images to increase diagnostic accuracy when treating pertrochanteric/intertrochanteric fractures as elaborated in another study conducted in the United States [21].

Moderate agreement was observed among senior residents in detecting posteromedial comminution and lateral wall involvement in pertrochanteric/intertrochanteric fractures. These findings suggest a moderate consensus among evaluators in identifying these specific fracture characteristics on routine radiographs. Similar to other studies, identifying lateral wall involvements and posteromedial comminution have been a challenge with routine radiographs among observers [27,49].

Nearly excellent agreement was observed among senior residents in identifying reverse obliquity in trochanteric fractures. Additionally, substantial agreement was noted for identifying diaphysis extension in subtrochanteric fractures, while fair agreement was observed for piriformis extension. Other studies have also shown similar findings for the reverse obliquity, signifying unstable fracture [18]. Nonetheless, in contrast to our findings, studies have shown an

excellent agreement in identifying diaphysis extension in subtrochanteric fractures and substantial agreement for piriformis extension [3]. The difference can be explained by the good quality of radiographs used in retrospective studies and compared to our prospective study.

Regarding the necessity of additional radiographic images, there was nearly excellent agreement among senior residents. Furthermore, there was strong consensus that the supplementary radiographic image should be a traction internal rotation radiograph. These findings are consistent to the findings of other studies where by observers had an excellent consensus that additional of traction internal rotation have proven beyond doubt to be necessary and crucial to the analysis of extracapsular proximal femoral fractures [3,27,49].

4.3 To determine interobserver reliability when assessing internal rotation traction radiographs among patients with extracapsular proximal femoral fractures treated at MOI

The overall interobserver reliability for proximal femoral extracapsular fracture assessment using internal rotation traction radiographs was excellent. This result suggests that senior residents have a strong consensus and a high degree of agreement when it comes to the interpretation of traction internal rotation radiographs for fracture assessment. These findings are in line with the findings of other studies [3,27,49]. Traction internal rotation tend to equate the deforming forces and thus, create a more favorable image for evaluation [18,60]. .
The study's excellent interobserver reliability emphasizes the usefulness and efficacy of traction internal rotation radiographs as a complementary imaging modality for evaluating fractures. Traction internal rotation radiographs gave senior residents broader perspectives and improved visibility of fracture features, which helps them diagnose patients more confidently and accurately, ultimately leading to better patient care.

Moreover, for individual observations, the interobserver reliability for the evaluability of traction internal rotation radiographs was nearly excellent. This highlights a strong consensus among senior residents regarding the clarity and quality of traction internal rotation radiographs provided for fracture assessment. Similar observations have been shown in studies done in India

and United states, where by observers agreed that the quality of internal rotation traction radiographs were adequately taken [21,27].

In diagnosing intertrochanteric and pertrochanteric fractures using internal rotation traction radiographs, there was nearly excellent agreement among senior residents. These findings underscore the reliability of senior residents in identifying these common types of fractures based on internal rotation traction radiographs as also elaborated by the findings of other studies [3,42,49].

Similarly, excellent agreement was observed among senior residents in diagnosing subtrochanteric fractures using traction internal rotation radiographs. This indicates a high level of consensus and accuracy in identifying subtrochanteric fractures based on this imaging modality. However, for subtrochanteric fractures, routine radiographs have shown to be competent enough to draw conclusion. Studies conducted in United States and Colombia have shown similar outcome [3,18]

For both unstable and stable pertrochanteric/intertrochanteric fractures, there was nearly perfect agreement among senior residents when assessed using internal rotation traction radiographs. These findings highlight the reliability of internal rotation traction radiographs in distinguishing between stable and unstable pertrochanteric/intertrochanteric fractures. Similarly a study conducted in the Netherlands have shown high degree of agreement in distinguishing between stable and unstable pertrochanteric/ intertrochanteric fractures when using internal rotation traction radiographs [60].

Additionally, there was nearly excellent agreement among senior residents in detecting posteromedial comminution and lateral wall involvement in pertrochanteric/intertrochanteric fractures using internal rotation traction radiographs. These findings are consistent to other studies, where the degree of agreement changed significantly when traction internal radiographs were introduced among observers, when lateral wall and posteromedial comminution were analyzed [3,49]

Furthermore, senior residents demonstrated nearly excellent agreement in identifying reverse obliquity in trochanteric fractures. Moreover, among subtrochanteric fractures, there was nearly excellent agreement in detecting both extension to the diaphysis and extension to the piriformis fossa. Similar to other studies, diagnosing reverse oblique, subtrochanteric fractures Russell and Tylor I and II had a perfect agreement among observers [18,27,49]. However, these findings demonstrates that in cases of reverse oblique and subtrochanteric fractures internal rotation traction radiographs are redundant as observes were capable to diagnose these injuries with routine radiographs with an excellent interobserver reliability [3].

However, there was none to slight agreement among senior residents regarding the necessity of additional radiographic images when assessed using internal rotation traction radiographs. This suggests a plethora of supplementary radiographic imaging beyond traction internal rotation radiographs in fracture assessment is futile. Similar to studies done elsewhere, traction internal rotation radiographs have shown to be sufficient for the evaluation of intertrochanteric/pertrochanteric fractures, especially in resource limited settings [18,27,49].

These findings, projects the reliability and effectiveness of internal rotation traction radiographs as an auxiliary imaging modality in fracture evaluation. By providing enhanced visualization and accurate characterization of fracture characteristics, internal rotation traction radiographs enable senior residents to make more confident and informed diagnoses, ultimately improving patient care.

CHAPTER FIVE

5.0 LIMITATIONS, MITIGATIONS, CONCLUSION And RECOMMENDATIONS

5.1 Conclusion

The study identified a significant pattern of extracapsular proximal femoral fractures predominantly affecting the elderly population, with a mean age of 63.8 years, and a higher prevalence among females. Intertrochanteric fractures were the most common type, constituting 58.7% of the cases

Furthermore, the study demonstrated a substantial interobserver reliability among senior residents when assessing routine radiographs for diagnosing intertrochanteric and pertrochanteric fractures. The reliability was excellent for assessing subtrochanteric fractures and substantial for stable pertrochanteric/intertrochanteric fractures. However, the agreement was only moderate to fair for detecting posteromedial comminution and lateral wall involvement. These results underscore the variability in diagnostic consistency using routine radiographs in assessing intertrochanteric and pertrochanteric fractures. Especially in an unstable fracture.

Nonetheless, the findings of this study have further revealed nearly excellent to excellent interobserver reliability when using traction internal rotation radiographs for diagnosing intertrochanteric, pertrochanteric, and subtrochanteric fractures. Similarly, in assessing posteromedial comminution and lateral wall involvement this study has shown excellent interobserver reliability. This indicates that traction internal rotation radiographs provide a more consistent and reliable method for diagnosing these fractures compared to routine radiographs, which is critical for accurate treatment planning and patient outcomes.

Overall, this study highlights the patterns and diagnostic reliability of extracapsular proximal femoral fractures at MOI, emphasizing the use of advanced radiographic techniques and the need for focused to improve diagnostic consistency and patient care.

5.2 Limitations and Mitigations

When evaluating the results, one must take into account the limitations of this study. The study's sample size was relatively small, which may limit the generalizability of the findings to broader populations. A larger sample size could provide more robust insights into the reliability of internal rotation traction radiographs in extracapsular proximal femoral fracture assessment.

Furthermore, this study was conducted at a single institution, which may introduce bias and limit the external validity of the results. Multi-center studies involving diverse patient populations could enhance the generalizability of the findings by providing a more comprehensive understanding of internal rotation traction radiograph reliability across different settings and patient populations.

However, the study focused on senior residents' interpretations of radiographs, which may vary based on individual experience and expertise. Incorporating assessments from a broader range of healthcare professionals, including specialists and radiologists, could provide a more comprehensive understanding of the reliability of internal rotation traction radiographs.

Nonetheless, the study did not standardize the imaging protocol for routine radiographs, which may have introduced variability in image quality and interpretation. Implementing standardized imaging protocols could minimize variability and improve the reliability of radiographic assessments.

Consequently, even though this study offers insightful information about how to use internal rotation traction radiographs to improve radiographic evaluation of extracapsular proximal femur fractures, it should be acknowledged that its design has limitations, that it may be biased due to being a single center study, that senior residents were used as primary observers, and that other important factors need to be taken into account.

5.3 Recommendations

The study's conclusions lead to the following recommendations:

1. To improve patient outcomes and reduce extracapsular proximal femoral fractures, a comprehensive approach is essential. This includes implementing community and healthcare initiatives focused on fall prevention, such as balance training, home safety evaluations, and public awareness campaigns. Additionally, strengthening osteoporosis screening and treatment, particularly for postmenopausal women, is crucial. Promoting calcium and vitamin D supplements, along with medications to enhance bone density, will help mitigate fragility fractures and enhance patient care.
2. Internal rotation traction radiographs should be requested to all patients whose traction radiographs are inadequate to achieve the appropriate diagnosis.
3. Further research is needed to explore the clinical utility and cost-effectiveness of internal rotation traction radiographs in fracture assessment. Comparative studies evaluating the diagnostic performance of internal rotation traction radiographs versus other imaging modalities can provide valuable insights into their role in clinical practice.

   Furthermore, future studies should aim to recruit a larger and more diverse sample to enhance the generalizability of findings and improve statistical power.

REFERENCES

1. MoHCDGEC, MoH, NBS, OCGS & ICF. *Tanzania 2015-16 Demographic Health Survey and Malaria Indicator Survey*. *Tanzania 2015-16 Demographic and Health Survey and Malaria Indicator Survey* (2016).
2. Mohamed, Z. *et al.* Evaluation of the Inter and Intra-Observer Reliability of the AO Classification of Intertrochanteric Fractures and the Device Choice (DHS , PFNA , and DCS) of Fixations. *Ethiop. J. Health Sci.* **30**, 755–760 (2020).
3. Khurana, B. *et al.* Internal Rotation Traction Radiograph Improves Proximal Femoral Fracture Classification Accuracy and Agreement. *Am. J. Roentgenol.* **211**, 409–415 (2018).
4. Lamb, J. N., Panteli, M., Pneumaticos, S. G. & Giannoudis, P. V. Epidemiology of pertrochanteric fractures : our institutional experience. *Eur. J. Trauma Emerg. Surg.* **40**, **page**, 225–232 (2014).
5. Mebouinz, F. N. *et al.* Fractures of the proximal femur in the elderly in a sub-Saharan country. *Int. J. Res. Orthop.* **7**, 19 (2020).
6. Bidolegui, F. M., Pereira, S. & Vindver, G. Implication of Internal Rotation Traction Radiography in Proximal Femoral Fracture Evaluation. *Rev. la Asoc. Argentina Ortop. y Traumatol.* **86**, 39–43 (2021).
7. Koval, K. J., Oh, C. K. & Egol, K. A. Help to Better Evaluate Fractures of the Proximal. *Bull. NYU Hosp. Jt. Dis.* **66**, 102–106 (2008).
8. Jeyaraman, M. Surgical Management of Proximal Femoral Fractures by Proximal Femoral Nailing-An Institutional Experience. *Orthop. Res. Online J.* **5**, (2019).
9. Sreekanta, A. *et al.* Surgical interventions for treating extracapsular hip fractures in adults : a network meta-analysis (Protocol). in *Cochrane Database ofSystematic Reviews 2019*, 7–12 (2019).
10. Jacob, J., Desai, A. & Trompeter, A. Decision Making in the Management of Extracapsular Fractures of the Proximal Femur – is the Dynamic Hip Screw the Prevailing Gold Standard? *Open Orthop. J.* **11**, 1213–1217 (2017).
11. Hagino, H. *et al.* Recent trends in the incidence and lifetime risk of hip fracture in

Tottori, Japan. *Osteoporos. Int.* **20**, 543–548 (2009).

12. Geiger, F., Zimmermann-Stenzel, M., Heisel, C., Burkhard, L. & Daecke, W. Trochanteric fractures in the elderly: the infuence of primary hip arthroplasty on 1-year mortality. *Arch Orthop Trauma Surg* **127**, 959–966 (2007).
13. Hollis, A. C., Ebbs, S. R. & Mandari, F. N. The epidemiology and treatment of femur fractures at a northern tanzanian referral centre. *Pan Afr. Med. J.* **22**, (2015).
14. Rubenstein, L. Z. Falls in older people : epidemiology , risk factors. *Age Ageing 2006;* **35**, 37–41 (2006).
15. Mebouinz, F. N. *et al.* Fractures of the proximal femur in the elderly in a sub-Saharan country. *Int. J. Res. Orthop.* **7**, 19–24 (2021).
16. Tsabasvi, M., Davey, S. & Temu, R. Hip fracture pattern at a major Tanzanian referral hospital: focus on fragility hip fractures. *Arch. Osteoporos.* **12**, (2017).
17. Lakstein, D., Hendel, D., Haimovich, Y. & Feldbrin, Z. Changes in the pattern of fractures of the hip in patients 60 years of age and older between 2001 and 2010. *Bone Joint J.* **95**, 1250–1254 (2013).
18. García-Serrano, M. C., García-Guerrero, L. F., Gómez-Gelvez, A. & Pinzón-Rendón, A. A. Diagnostic imaging concordance study: Are traction radiographs necessary in a hip fracture? *Injury* **52**, 1445–1449 (2021).
19. Mounasamy, V., Mallu, S., Khanna, V. & Sambandam, S. Subtrochanteric fractures after retrograde femoral nailing. *World J. Orthop.* **6**, 738–743 (2015).
20. Crijns, T. J. *et al.* Reliability of the classification of proximal femur fractures: Does clinical experience matter? *Injury* **49**, 819–823 (2018).
21. Sheehan, S. E., Shyu, J. Y., Weaver, M. J., Sodickson, A. D. & Khurana, B. Proximal femoral fractures: What the orthopedic surgeon wants to know. *Radiographics* **35**, 1563–1584 (2015).
22. Andersen, E., Jsrgensen, L. G. & Hededam, L. T. *Evans' Classification of Trochanteric Fractures: An Assessment of the Interobserver and Intraobserver Reliability*. *Injury* vol. 21 (1990).
23. Socci, A. R., Casemyr, N. E., Leslie, M. P. & Baumgaertner, M. R. Implant options for

the treatment of intertrochanteric fractures of the hip. *bone Jt. J.* **99**, 128–133 (2017).

24. Marmor, M., Liddle, K., Buckley, J. & Matityahu, A. Effect of varus and valgus alignment on implant loading after proximal femur fracture fixation. *Eur. J. Orthop. Surg. Traumatol.* **26**, 379–383 (2016).
25. Niu, E., Yang, A., Harris, A. H. S. & Bishop, J. Which Fixation Device is Preferred for Surgical Treatment of Intertrochanteric Hip Fractures in the United States? A Survey of Orthopaedic Surgeons. *Clin. Orthop. Relat. Res.* **473**, 3647–3655 (2015).
26. Fischer, H. *et al.* Management of proximal femur fractures in the elderly: current concepts and treatment options. *European Journal of Medical Research* vol. 26 at https://doi.org/10.1186/s40001-021-00556-0 (2021).
27. Jiamton, C., Sayan, P., Rungchamrussopa, P. & Kittithamvongs, P. Traction-Internal Rotation Radiograph Can Improve Agreement in AO/OTA Classification System for Intertrochanteric Fracture. *Indian J. Orthop.* **56**, 1998–2005 (2022).
28. Li, X. *et al.* All - cause mortality risk in aged femoral intertrochanteric fracture patients. *J. Orthop. Surg. Res.* **9**, 1–8 (2021).
29. Nasab, S. A. M. & Khorramdin, E. The assessment of mortality and quality of life after intertrochanteric fracture of femur in elderly patients. *Pakistan J. Med. Sci.* **33**, 895–898 (2017).
30. Zhang, Z. *et al.* Global Trends in Intertrochanteric Hip Fracture Research From 2001 to 2020: A Bibliometric and Visualized Study. *Front. Surg.* **8**, (2021).
31. Dhanwal, D. K., Dennison, E. M., Harvey, N. C. & Cooper, C. Epidemiology of hip fracture: Worldwide geographic variation. *Indian J. Orthop.* **45**, 15–22 (2011).
32. George, J. *et al.* Injury mechanisms of hip fractures in India. *Hip Pelvis* **33**, 62–70 (2021).
33. Bayray, A., Enqueselassie, F. & Gebreegziabher, Z. Magnitude and pattern of osteoporotic fractures among adults in Tigiray , Ethiopia ; a retrospective hospital based study MAGNITUDE AND PATTERN OF OSTEOPOROTIC FRACTURES AMONG. *Ethiop. Med. J.* **50**, (2012).
34. Sreekanta, A. *et al.* Surgical interventions for treating extracapsular hip fractures in

adults: a network meta-analysis. *Cochrane Database Syst. Rev. Surg.* **2019**, 7–12 (2019).

35. Lakstein, D., Hendel, D., Haimovich, Y. & Feldbrin, Z. Changes in the pattern of fractures of the hip in patients 60 years of age and older between 2001 and 2010. *Bone Jt. J* **95**, 1250–1254 (2013).
36. Machida, M. *et al.* Epidemiology of hip fractures. *IRYO - Japanese J. Natl. Med. Serv.* **65**, 432–439 (2011).
37. Socci, A. R., Casemyr, N. E., Leslie, M. P. & Baumgaertner, M. R. Implant options for the treatment of intertrochanteric fractures of the hip rationale, evidence, and recommendations. *Bone Jt. J.* **99-B**, 128–133 (2017).
38. Ravinath, T. *et al.* Surgical Management of Proximal Femoral Fractures by Proximal Femoral Nailing-An Institutional Experience. *Orthop. Res. Online J.* **5**, 474–484 (2019).
39. Klestil, T. *et al.* Impact of timing of surgery in elderly hip fracture patients : a systematic review and meta- analysis. *Sci Rep* **8**, 13933 (2018).
40. Orosz, G. M. *et al.* Association of Timing of Surgery for Hip Fracture and Patient Outcomes. *Am. Med. Assoc.* **291**, 1738–1743 (2004).
41. Thomsen, N. O. B., Jensen, C. M., Skovgaard, N., Pedersen, M. S. & Pallesen, P. Observer variation in the radiographic classification of fractures of the neck of the femur using Garden ' s system. *Int. Orthop.* **20**, 326–329 (1996).
42. Blundell, C. M., Parker, M. J., Pryor, G. A., Hopkinson-Woolley, J. & Bhonsle, S. S. *Assessment of the AO Classification of Intracapsular Fractures of the Proximal Femur*. *J Bone Joint Surg [Br]* vol. 80 (1998).
43. Jin, W. J. *et al.* Reliability of classification systems for intertrochanteric fractures of the proximal femur in experienced orthopaedic surgeons. *Injury* **36**, 858–861 (2005).
44. Garc´ıa, M. C., Luisa Fernanda Garc´ıa, Gomez, A. & Pinz´on, A. A. Diagnostic Imaging Concordance Study: Are Traction Radiographs Necessary in a Hip Fracture? *Injury* **52**, 1445–1449 (2021).
45. Kenyunko, K. M. PROFILE OF TROCHANTERIC FRACTURES AT MOI:

TREATMENT AND SHORT-TERM OUTCOME 2012. (2013).

46. Ajay, S. & Micah, B. SAMPLING TECHNIQUES & DETERMINATION OF SAMPLE SIZE IN APPLIED STATISTICS RESEARCH : AN OVERVIEW. *Int. J. Econ. Commer. Manag.* **II**, 1–22 (2014).
47. Kozak, M. Finite and Infinite Populations in Biological Statistics: Should We Distinguish Them? *J. Am. Sci.* **4**, 1545–1003 (2008).
48. Heale, R. & Twycross, A. Validity and reliability in quantitative studies. *Evid Based Nurs* **18**, 66–67 (2015).
49. Bidolegui, F. M., Pereira, S. & Vindver, G. Implication of Internal Rotation Traction Radiography in Proximal Femoral Fracture Evaluation Fernando. *Rev. la Asoc. Argentina Ortop. y Traumatol.* **86**, 39–43 (2021).
50. Klestil, T. *et al.* Impact of timing of surgery in elderly hip fracture patients: a systematic review and meta-analysis. *Sci. Rep.* **8**, 13933 (2018).
51. Kanis, J. A. *et al.* A systematic review of hip fracture incidence and probability of fracture worldwide. *Osteoporosis International* vol. 23 2239–2256 at https://doi.org/10.1007/s00198-012-1964-3 (2012).
52. B€acker, H. C. *et al.* Epidemiology of proximal femoral fractures. *J. Clin. Orthop. Trauma* **21**, 161–165 (2020).
53. Zelenka, L., Knížková, I., Kunc, P. & Lukešová, D. Study on the Effects of Sex and Age on Proximal Femoral Fractures in Two Culturally Diverse Countries. *Acta Chir Orthop Traumatol Cech* **85**, 40–45 (2019).
54. Hantouly, A. T. *et al.* Epidemiology of proximal femur fractures in the young population of Qatar. *Eur. J. Orthop. Surg. Traumatol.* **34**, 21–29 (2024).
55. Chen, C. C., Chen, Z. X., Chang, C. L. & Lin, F. L. The Slip-resistance Effect Evaluation of Floor Roughness Under Different Liquid Viscosity. *Procedia Manuf.* **3**, 5007–5013 (2015).
56. Xing, L. *et al.* Falls caused by balance disorders in the elderly with multiple systems involved: Pathogenic mechanisms and treatment strategies. *Front. Neurol.* **14**, (2023).
57. Li, X. ping *et al.* All-cause mortality risk in aged femoral intertrochanteric fracture

patients. *J. Orthop. Surg. Res.* **16**, 1–8 (2021).

58. Zuckerman, J. A. HIP FRACTURE J. *N. Engl. J. Med.* **334**, 1519–1525 (1996).
59. Curtis, M. J., Jinnah, R. H., Wilson, V. & Cunningham, B. W. Proximal femoral fractures : a biomechanical study to compare intramedullary and extramedullary fixation. *Inj. Int. J. Care Inj.* **25**, 99–104 (1994).
60. Schipper, I. B., Steyerberg, E. W., Castelein, R. M., Van Vugt, A. B. & Schipper, I. B. *Reliability of the AO/ASIF Classification for Pertrochanteric Femoral Fractures*. *Acta Orthop Scand* (2001).

APPENDICES

Appendix 1: Research Questionnaire

THE USE OF INTERNAL ROTATION TRACTION RADIOGRAPHS IN IMPROVING RADIOGRAPHIC ASSESSMENT OF EXTRACAPSULAR FEMORAL FRACTURES AT MUHIMBILI ORTHOPEDIC INSTITUTE.

No……

REG NUMBER: ….

SECTION A: DEMOGRAPHIC INFORMATION

1. Demographic information;

a) Age

i) 18-38

ii) 39-59

iii) 60-80

iv) Above 81

b) Gender,

(i) Male

(ii) Female

SECTION B: RADIOGRAPHIC ASSESSMENT

Instructions: tick where appropriate

1. Is the radiograph evaluable? (under exposed, over exposed, positioning)

a) Yes

b) No

If no,

i) Under exposed

ii) Over exposed

iii) Positioning

iv) Other……

2. Is there calcar, posteromedial cortical comminution associated with the fracture? (Lower trochanter avulsion is not relevant)

a) Yes

b) No

3. Does the fracture involve the lateral wall? (It's 3 cm distal from the innominate tubercle, and about 135° towards the fracture site)

    a) Yes

    b) No

4. Is there an inverted line in the fracture?

    a) Yes

    b) No

5. Does the fracture extend to the diaphysis?

    a) Yes

    b) No

6. Could the fracture be unstable?

    a) Yes

    b) No

7. Does the fracture extend to the piriformis fossa?

    a) Yes

    b) No

8. Does the piriformis fossa and greater trochanter are both affected by the fracture?

    a) Yes

    b) No

9. Diagnosis

    a) Intertrochanteric fracture (stable / unstable)

    b) Pertronchanteric fracture (stable/ unstable)

    c) Subtrochanteric fracture

10. i) Is an additional image required?

    a) Yes

    b) No

    ii) Which image…….

Appendix II: Consent Form (English Version)

THE USE OF INTERNAL ROTATION TRACTION RADIOGRAPHS IN IMPROVING RADIOGRAPHIC ASSESSMENT OF EXTRACAPSULAR FEMORAL FRACTURES AT MUHIMBILI ORTHOPEDIC INSTITUTE.

PART A:

Greetings: My name is Dr. Christopher A. Paul, and I am a postgraduate student at Muhimbili University of Health and Allied Sciences (MUHAS). I am conducting research on the use of internal rotation traction radiographs to improve radiographic assessment of extracapsular proximal femoral fractures among patients treated at Muhimbili Orthopedic Institute. Before filling out this form, please make sure you understand it completely. Any explanation can be requested.

Purpose of the Study

To analyze how well extracapsular proximal femoral fractures are diagnosed using internal rotation traction radiographs in patients treated at Muhimbili Orthopedic Institute.

Study procedures

If you accept to participate in this study, orthopedic residents will examine your hip radiographs and answer questions in order to collect data for this study.

Confidentiality

All details provided for this study will be kept completely private. The investigator will handle patient information and keep it confidential.

Risks and benefits to the participant

No dangers are anticipated from participating in the study.

Participation and withdrawal

You are free to leave the study at any time because participation is entirely voluntary. Your management will not be impacted in any way if you choose not to participate or drop out of the study, and you will still be eligible for all benefits.

Contacts and Questions

Directorate of Research, Publications and Innovation (DRPI)

P.O. Box 65001 Dar es Salaam

Tel: +255 22 2152489, Tel: +255 22 2150302-6 (Ext. 1016 Director, Ext. 1038 OMS)

Fax: +255-22-2152489

E-Mail: drp@muhas.ac.tz

Supervisor: prof. Billy Thompson Haonga

+255 754 583761

bhaonga@gmail.com

Researcher: Dr. Christopher A Paul

+255 692 337295

asajile77@hotmail.com

PART B:

I freely consent to/refuse to participate after having the above material properly given to me by the investigator; please omit any applicable information.

Signature of Participant…….

Signature of Investigator…….

Date of signed consent……

Appendix III: Consent Form: Kiswahili

Ridhaa ya kushiriki kwenye utafiti:

Sehemu A:

Utambulisho

Jina langu ni Dr. Christopher A Paul. mwanafunzi wa shahada ya udhamili katika Chuo Kikuu cha Afya na Sayansi Shirikishi Muhimbili (MUHAS). Nafanya utafiti juu ya kazi ya picha ya radiolojia ya kuvuta na kuzungushia mguu ndani ili kuongeza usahihi zaidi wa kugundua mvunjiko kwa watu waliovunjika mfupa wa paja katika taasisi ya Mifupa Muhimbili (MOI).

Unakaribishwa kushiriki kwenye utafiti huu. Tafadhali soma dodoso hili vizuri na kuelewa kabla hujashiriki. Unaweza kuuliza chochote ambacho hakijaeleweka au kuhitaji maelezo zaidi.

Shabaha ya Utafiti

Madhumuni ya utafiti huu ni kupata taarifa muhimu kuhusu kazi ya picha ya radiolojia ya kuvuta na kuzungushia mguu ndani ili kuongeza usahihi zaidi wa kugundua mvunjiko kwa watu waliovunjika mfupa wa paja katika taasisi ya Mifupa Muhimbili

Taratibu za Utafiti

Taarifa muhimu zinazohitajika zitaingizwa kwenye dodoso maalum la kukusanyia taarifa.

Usiri

Taarifa zote zitakazo kusanywa zitajazwa kwenye fomu maalum na zitakua siri. Habari yote iliyotolewa wakati wa utafiti huu itakuwa ya siri.

Faida na madhara kwa mshiriki

Tunategemea kwamba hapatakuwa na madhara yoyote yatokanayo na ushiriki.

Haki ya kujitoa kweye utafiti

Ushiriki wako katika utafiti huu ni wa hiari na kushindwa kushiriki au kujiondoa hakuathiri matibabu yako kwa njia yoyote katika hatua yoyote. Ikiwa utajitoa kwenye utafiti utaendelea kupata matibabu na huduma unazostahili kulingana na taratibu za Taasisi.

Mawasiliano.
Mkurugenzi wa utafiti, machapisho na ubunifu (DRPI)
S.L.P 65001 Dar es Salaam
Simu: +255 22 2152489, Simu: +255 22 2150302-6 (Ungani. 1016 Mkurugenzi, Ungani. 1038 OMS)
Faksi: +255-22-2152489
Barua pepe: drp@muhas.ac.tz
Msimamizi: prof. Billy Thompson Haonga
+255 754 583761
bhaonga@gmail.com
Mtafiti: Dr. Christopher A Paul
+255 692 337295

asajile77@hotmail.com

SEHEMU B:

Kiapo cha ridhaa ya kushiriki

Nimesoma na kuelewa taarifa zilizotolewa hapo juu na kufafanuliwa na mtafiti. Kwa ridhaa yangu nimeamua kushiriki/kutokushiriki (*kata lisilohusika*).

Sahihi ya mshiriki……...

Sahihi ya shahidi (mtafiti)…….

Tarehe ……

Appendix IV: Ethical Clearances Form

UNITED REPUBLIC OF TANZANIA

MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY

MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES

OFFICE OF THE DIRECTOR – RESEARCH, PUBLICATIONS AND INNOVATION

Ref. No.DA.282/298/01.C/1800 Date: 13/07/2023

MUHAS-REC-07-2023-1800
CHRISTOPHER ALINIKISA PAUL
SCHOOL OF MEDICINE
MUHAS

RE: APPROVAL FOR ETHICAL CLEARANCE FOR A STUDY TITLED: THE USE OF INTERNAL ROTATION TRACTION RADIOGRAPHS IN IMPROVING RADIOGRAPHIC ASSESSMENT OF EXTRACAPSULAR FEMORAL FRACTURES AT MUHIMBILI ORTHOPEDIC INSTITUTE.

Reference is made to the above heading,

I am pleased to inform you that the Chairman has on behalf of the University Senate, approved ethical clearance of the above-mentioned study, on recommendations of the Senate Research and Publications Committee meeting accordance with MUHAS research
policy and Tanzania regulations governing human and animal subjects research.

APPROVAL DATE: 13/07/2023
EXPIRATION DATE OF APPROVAL: 13/07/2024

STUDY DESCRIPTION:

Purpose:
The purpose of this observational cross-sectional study is to assess the use of internal rotation traction radiographs in improving radiographic assessment of extracapsular proximal femoral fractures among patients treated at Muhimbili Orthopedic Institute (MOI) from June 2023 to December 2023.
The approved protocol and procedures for this study is attached and stamped with this letter, and can be found in the link provided:
https://irb.muhas.ac.tz/storage/Certificates/Certificate%20-%2014818.pdf and in the MUHAS archives.

The PI is required to:

1. Submit bi-annual progress reports and final report upon completion of the study.
2. Report to the IRB any unanticipated problem involving risks to subjects or others including adverse events where applicable.
3. Apply for renewal of approval of ethical clearance one (1) month prior its expiration if the study is not completed at the end of this ethical approval. You may not continue with any research activity beyond the expiration date without the approval of the IRB. Failure to receive approval for continuation before the expiration date will result in automatic termination of the approval for this study on the expiration date.
4. Obtain IRB amendment (s) approval for any changes to any aspect of this study before they can be implemented.
5. Data security is ultimately the responsibility of the investigator.
6. Apply for and obtain data transfer agreement (DTA) from NIMR if data will be transferred to a foreign country.
7. Apply for and obtain material transfer agreement (MTA) from NIMR, if research materials (samples) will be shipped to a foreign country,
8. Any researcher, who contravenes or fail to comply with these conditions, shall be guilty of an offence and shall be liable on conviction to a fine as per NIMR Act No. 23 of 1979, PART III section 10 (2)
9. The PI is required to ensure that the findings of the study are disseminated to relevant stake holders.
10. PI is required to be versed with necessary laws and regulatory policies that govern research in Tanzania. Some guidance is available on our website https://drp.muhas.ac.tz/.

Dr. Nahya Salim Masoud,
Chairperson, MUHAS Research and Ethics Committee



Appendix IV: Introduction Letter

UNITED REPUBLIC OF TANZANIA
MINISTRY OF EDUCATION, SCIENCE AND TECHNOLOGY
MUHIMBILI UNIVERSITY OF HEALTH AND ALLIED SCIENCES
OFFICE OF THE DIRECTOR – POSTGRADUATE STUDIES

In reply quote:
Ref. No. HD/MUH/T.154/2021 18th July, 2023

The Executive Director,
Muhimbili Orthopaedics Institute,
P.O. Box 65474,
DAR ES SALAAM

Re: INTRODUCTION LETTER

We would like to inform you that the bearer of this letter is **Chritopher Alinikisa Paul** with **Reg. No. HD/MUH/T.154/2021** is a student at Muhimbili University of Health and Allied Sciences (MUHAS) "pursuing MMed. Orthopaedics/Traumatology.

As part of his studies, he will be doing an elective research titled: "**The Use of Internal Rotation Traction Radiographs in Improving Radiographic Assessment of Extracapsular Femoral Fractures at Muhimbili Orthopedc Institute.**" he is being supervised by Prof. B. Haonga from MUHAS and Dr. Albert Paul Macha from MOI.

The research has been approved by the Chairman of University Senate.

Kindly provide him the necessary assistance to facilitate the conduct of his research.

We thank you for your cooperation.

Victoria Mwanilwa
For: DIRECTOR, POSTGRADUATE STUDIES

c.c **Chritopher Alinikisa Paul**

9 United Nations Road, Upanga West, P.O. Box 65001, Dar Es Salaam. Tel. G/Line: +255-22-2150302/6; Ext. 1015; Direct Line:+255-22-2151378;Telefax +255-22-2150465;E-mail:dpgs@muhas.ac.tz;Web:https://www.muhas.ac.tz

Appendix V: Permission Letter

UNITED REPUBLIC OF TANZANIA
MINISTRY OF HEALTH

MUHIMBILI ORTHOPAEDIC INSTITUTE (MOI)

MOI
MUHIMBILI ORTHOPAEDIC INSTITUTE

Ref.PA. 290/338/01/63 **20th July, 2023**

Muhimbili University of Health and Allied Sciences

Dar -es Salaam

Tanzania.

RE: APPROVAL FOR CONDUCTING RESEARCH STUDY

Reference is made to your letter with reference number **HD/MUH/T.154/2021** dated on the 5thJuly, 2023 for conducting research study about. ***''The Use Of Internal Rotation Traction Radiographs In Improving Radiographic Assessment Of Extracapsular Femoral Fractures At Muhimbili Orthopaedic Institute MOI''***

On behalf of the Management I would like to officially inform you that, permission has been granted to your student **Christopher Alinikisa Paul** to conduct study at Muhimbili Orthopaedic Institute (MOI).

It's my hope that your stay at MOI will be fruitful. For any clarification contact CRTM +255713764522.

Dr. Joel J Bwemelo, CRTM

For: MOI Executive Director

Cc: Director of Post Graduate studies

Cc: Supervisor

Muhimbili Orthopaedic Institute (MOI), Upanga West Plot No. 1048/2, Kalenga Street, P. O. Box 65474 - Dar es Salaam; Telephone Number +255 -022-2151298/2152937/2152938 Fax: +255 -022-2151744
Website: www.moi.ac.tz, info@moi.ac.tz,