CORRELATION BETWEEN ANTHROPOMETRIC DETERMINATION OF THE RETROGRADE FIN NAIL LENGTH AND INTRAOPERATIVE FIN NAIL LENGTH MEASUREMENT AMONG ADULT PATIENTS WITH FEMUR SHAFT FRACTURE TREATED AT MUHIMBILI ORTHOPEDIC INSTITUTE.

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

Muhimbili University of Health and Allied Sciences

Department of Orthopaedics and Traumatology

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By

Ogutu Meshack Owidi

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

Muhimbili University of Health and Allied Sciences

October, 2024

CERTIFICATION

The undersigned certifies that they have read and hereby recommends for acceptance by the Muhimbili University of Health and Allied Sciences a dissertation entitled **"Correlation between anthropometric determination of the retrograde fin nail length and intraoperative fin nail length measurement among adult patients with femur shaft fracture treated at Muhimbili Orthopedic Institute."** in partial fulfilment of the requirements for the degree of Master of Medicine (Orthopedics and Traumatology) of Muhimbili University of Health and Allied Sciences.

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DECLARATION AND COPYRIGHT

I, **Ogutu Meshack Owidi** declare that this dissertation entitled **"Correlation between anthropometric determination of the retrograde fin nail length and intraoperative fin nail length measurement among adult patients with femur shaft fracture treated at Muhimbili Orthopedic Institute."** is my original work and it has not been presented and will not be presented to any other University for a similar or any other degree award.

Signature……. Date……

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ACKNOWLEDGEMENT

To Dr. Violet Lupondo: You are more than just a supervisor, you are a teacher, mentor, and beacon of inspiration with your unwavering passion, and commitment to your students.

Thank you for instilling knowledge in your gift for breaking down complex concepts and presenting them in a way that is both comprehensive and accessible. Thank you for your patience and willingness to go the extra mile to ensure understanding are qualities that set you apart as an exceptional educator. Your genuine care and concern for the personal and professional development of your students are truly remarkable. You take the time to understand our strengths, weaknesses, and aspirations, and provide guidance and support every step of the way. Your encouragement, constructive feedback, and belief in our abilities have instilled within us the confidence to overcome challenges and strive for greatness.

I would like also to express my deepest gratitude and appreciation to Dr. Adam Hussein, my co-supervisor, for his invaluable guidance and support throughout the journey of writing my dissertation. Dr. Adam's expertise, insightful feedback, and unwavering dedication have been instrumental in shaping the quality and direction of my research. His patience, encouragement, and willingness to share his knowledge have significantly contributed to my personal and academic growth. I am truly grateful for the opportunity to work with such a remarkable mentor

With utmost admiration and respect,

Dr. Ogutu Meshack Owidi.

DEDICATIONS

I dedicate this research dissertation with boundless love and gratitude to the most important people in my life. To my beloved wife, Hannah Mbingu Ogutu , this dissertation stands as a testament to your unwavering love, support, and encouragement throughout this academic journey. Your presence in my life has been a constant source of strength, inspiration, and motivation.

To my precious child, Eunier Tsemedi Namitsentse Ogutu, you are my inspiration and the driving force behind my pursuit of knowledge. Your smiles, laughter, and unwavering love have provided me with endless motivation to overcome obstacles and strive for excellence.

To my beloved late mother, Eunice Awuor Owidi, your unwavering love, sacrifices, and unwavering belief in my potential have shaped me into the person I am today. Your resilience, wisdom, and strength have been a guiding light throughout my life. I am forever grateful for your presence in my life.

Lastly, I dedicate this research dissertation to my father, Christopher Ogutu Owidi, Your values instill in me inspiration and continue to guide me. Your unwavering support and belief in my abilities are always cherished.

With all my love and gratitude,

Ogutu Meshack Owidi.

ABSTRACT

Background: The sign FIN nail is an intramedullary nail that is used in the treatment of femur shaft fractures. Preoperative measurements of accurate fin nail size for insertion are paramount as it saves operation time and prevents unnecessary unwrapping of nails during surgery. Anthropometric techniques used in preoperative determination of fin nail length include measuring the distance between the lateral knee joint line and greater trochanters most prominent portion, measurement of the most prominent part of greater trochanter and the superior pole of the patella and also measurement of the distance from the tip of the little finger to the olecranon. The gold standard for obtaining fin length is intraoperative fin nail estimation via use of marked reamer, nonetheless some literatures have shown that anthropometric preoperative determination of fin nail length is as well effective. This study aimed at assessing the accuracy of anthropometric determination of fin nail length among adult patients with femur shaft fracture treated at Muhimbili Orthopedic Institute (MOI).

Objective: To determine the correlation of preoperative anthropometric determination of retrograde fin nail length and intraoperative fin nail length measurement among adult patients with femur shaft fracture treated at MOI.

Materials and methods: A cross-sectional descriptive hospital-based study was carried out at Muhimbili orthopedic Institute from March 2023 to December 2023. A consecutive sampling technique was employed to obtain 44 patients after they had met inclusion criteria. These forty-four patients with femur shaft fracture that were intended for flexible intramedullary nail (FIN IMN) insertion whether as an elective case or emergency case and satisfied the inclusion requirements and gave their consent to participate in the study. The preoperative measurement result as per the operating surgeon and two randomly selected residents was documented for each patient, the principal investigator also did the following anthropometric measurements: the distance between greater trochanter to “superior” pole of patella (GT-SP), greater trochanter to the lateral knee joint line (GT-LKJ) and olecranon to the tip of little finger (O-TF). Accuracy was determined by measuring intraoperative fin nil length using a marked reamer and compared to preoperative anthropometric fin nail length measurement.

For categorical data, descriptive statistics like means and standard deviations was employed. These were entered into password-protected Excel spread sheet tables and then analyzed using Stata 14 software. The P value of <0.05 was considered statistically significant based on the two-sided t test.

Result: A total of 44 patients were enrolled to the study. The mean age was 33, more than 60% were above 25 years and 86.36% were males. 81.82% were motor cycle accidents. The correlation between the intraoperative nail size and the pre operative measurements were significant and linear, with the highest correlation being between intraoperative nail size and olecranon to tip of little finger less 10cm. (spearman's rho 0.87, p <0.01)

Conclusion and recommendation: There was linear and positive correlation between the intraoperative nail size and all the pre operative measurements, and was also statistically significant. The study recommends the use of olecranon to tip of little finger less 10cm as first priority pre operative measurement, followed by olecranon to tip of little finger less 8cm as they were more accurate.

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ABBREVIATIONS

A/E	-	Accidents and Emergency
AO	-	Association for Osteosynthesis
D 1/3	–	Distal one third
DIP	–	Distal interphalangeal
FIN IMN	-	Flexible intramedullary nail
GT-LKJ	-	Greater trochanter to the lateral knee joint line
GT-SP	-	Greater trochanter to “superior” pole of patella
IMN	-	Intramedullary Nail
M 1/3	–	Median one third
MCA	-	Motor cycle accident
MH	-	Metacarpal Head
MOI	-	Muhimbili Orthopedic Institute
MUHAS	–	Muhimbili University of Health and Allied Sciences
MVA	-	Motor vehicle accident
O-LF	-	Olecranon tip to tip of Little Finger
O-MH	-	Olecranon tip to Metacarpal Head
ORIF	-	Open Reduction and Internal Fixation
O-TF	-	Olecranon to the tip of little finger
RUST	-	Radiologic union scale for Tibia
RTA	-	Road Traffic Accident
SD	–	Standard deviation

DEFINITION OF TERMS

Adult- anyone who is older than 18 years.

Femur shaft fracture- is a break in diaphysis or metaphysis of femur

Outcomes- In concrete, observable terms, this reflects the outcome of the treatment of femur shaft fractures.

Classification system - The hierarchy of fracture categories and its definition of the key fracture diagnosis. The patterns of fractures in the context of this study are based on the AO Classification system and the type of fracture, whether open or closed.

Closed fracture- when a bone "fractures," but the hematoma from the fracture is not in contact with the outside world.

Open fracture- when bone fractures and the fracture hematoma is in contact with the outside world.

Anthropometric determination- the art of physical noninvasive measurement of body part, in context of this study, the length of femur corresponding to the inserted nail.

Accuracy- in the context of this study, the degree of closeness between anthropometric determined length of fin nail to isthmus and intraoperative measured length of isthmus.

Fracture pattern 32A-C

Treatment- is the management of femur fractures by surgical intramedullary nail insertion

32A - Simple	A1 - Spiral A2 - Oblique, angle > 30 degrees A3 - Transverse, angle < 30 degrees
32B - Wedge	B1 - Spiral wedge B2 - Bending wedge B3 - Fragmented wedge
32C - Complex	C1 - Spiral C2 - Segmental C3 - Irregula

CHAPTER ONE

1.0 INTRODUCTION

1.1 Background information

In the literature, various preoperative and intraoperative techniques are given for determining the right nail size. (1) Anthropometric measurements for determining the preoperative length of the femur nail are; measurements of the distance between the lateral knee joint line and the greater trochanter's most prominent portion, measurement of the distance between the most prominent part of greater trochanter and the superior pole of the patella and measurement of the distance from the tip of the little finger to the olecranon. (2) Preoperative measurement of accurate nail size prevents unnecessary unwrapping of inaccurate nails during the surgical process. (3) Changing a nail that is the wrong length lengthens the procedure and aggravates frustration of the operating surgeon. (4) Looking at the MOI fin Nail data, 25 out 166 FIN nails inserted in a period of six months were either above or below the isthmus on post-surgery control X-ray and was associated with intraoperative decision change from Fin nail insertion to standard nail insertion.

The techniques for measuring nail length intraoperative are ubiquitous, if the opposing femur is not also shattered, one can measure the length of the guide wire directly inside the femur using an intra-medullary ball-tip guide wire under intraoperative fluoroscopy, another way of intraoperative estimation of the femur nail length involves the use reamers that are designed with marks that show the reaming depth of the LAST reamer used for the corresponding nail. (2)(5) Making sure the intramedullary nail is the right length is crucial for the patient since an erroneous nail length can result in post-operative complications that range in severity from minor (soft tissue annoyance) to serious (peri-prosthetic fracture caused by a stress increase from a short nail) (6).

The SIGN Fin nail was created to significantly lessen the difficulties associated with nailing femoral fractures. (7) Retrograde installation of the Fin nail eliminates the need for proximal interlocking screws in contrast to the conventional SIGN nail. Instead, the interference fit of the nail within the proximal femoral canal allows for stability. (8)

Since the intramedullary FIN nail are also used to treat femur fractures, a trustworthy method for templating is yet to be developed. (9) It is challenging to accurately estimate preoperatively the isthmus length when performing retrograde nailing of the femur using the FIN nail with leg-length disparity and shortening being frequent complications. (10) To properly and completely restore patient anatomy, the proper measurement of femoral length and, subsequently, IMN implant length is crucial. To determine the precise nail size, several techniques have been reported. (11)

FIN nails theoretically have certain benefits over traditional SIGN nails. (12)(13) The FIN nail decreases surgical time since it eliminates the requirement for proximal interlocking screws when put retrogradely, and it provides appropriate distal fixation for stable fractures. (14)(15) However, according to the SIGN surgical online database, Fin nails are used to treat only 3.3% of all femur fractures (16), making them less common than the usual standard SIGN nail. Globally, preoperative nail size measurement is done, some centers use radiologic methods in estimating the right nail size, however in our set up, the anthropometric measurement of nail size is commonly used. Nevertheless, no studies in our setting have been performed to assess the accuracy of preoperative anthropometric measurement.

1.2 Problem Statement

Various methods have been referenced in writings to determine nail size preoperatively despite the fact that intraoperative measurement is the gold standard. Orthopedic centers across the globe have adopted different methods of preoperative nail size measurement with most centers using the preoperative radiological measurement technique. In “MOI” however, the anthropometric preoperative measurement is the most commonly used technique and different surgeons use different preoperative anthropometric measurement methods of which the correlation is yet to be established

1.3 Justification/ rationale of the study

Fin nail length measurement preoperatively reduces surgery time and thus accuracy of fin nail length is of paramount importance in avoiding time wastage identifying fin nail length size. Based on the results of this study, the most accurate modality can be picked and adopted in our center. The information acquired will increase orthopedic surgeons' awareness of the use of fin nails, but also serve as a benchmark for potential future research.

1.4 Research Question

In locating the isthmus for fin nail insertion, is anthropometric measurement accurate in determination of fin nail length among adult patients with femur fracture treated at MOI

What is the proportion of adult patients with distal femur fracture that get treated by fin nail insertion?

What is the preoperative measurement techniques for fin nail length determination used at MOI?

What is the accuracy between preoperative anthropometric measurement of fin nail length and intraoperative fin nail length measurement?

1.5 Objectives

1.5.1 Broad Objective:

To determine the correlation of anthropometric preoperative determination of retrograde fin nail length using intraoperative marked reamer measurement as a gold standard measurement among adult patients with femur shaft fracture treated at MOI

1.5.2 Specific Objectives:

1. To determine the proportion of adult patients with distal shaft femur fracture treated by sign fin nail insertion
2. To determine the preoperative measurement techniques for fin nail size determination used at MOI
3. To determine the accuracy between preoperative anthropometric measurement of fin nail length and intraoperative fin nail length

1.6 Conceptual framework.

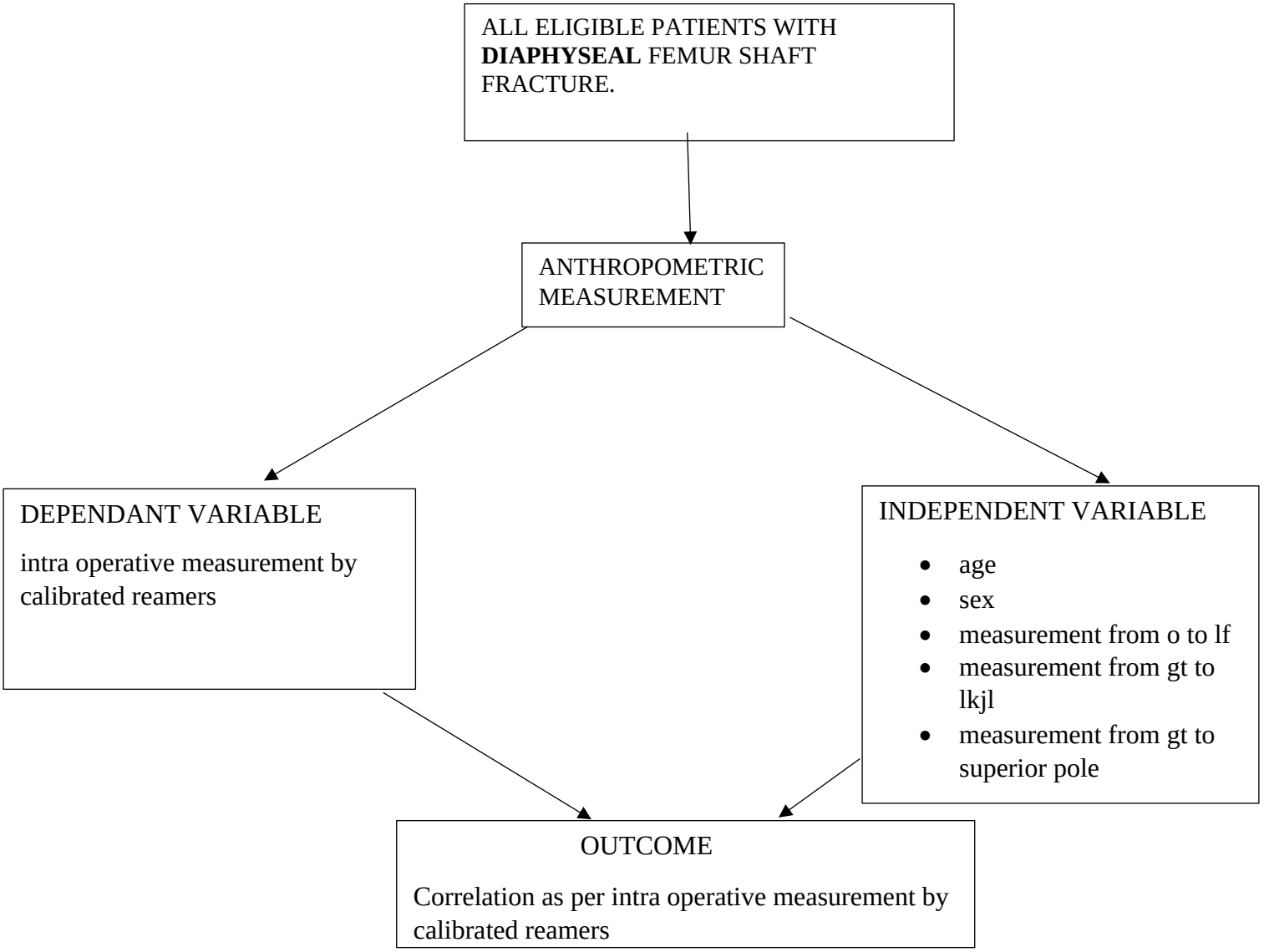


Figure 1: Conceptual framework

1.6.1 Description of conceptual framework

Correlation was measured by using the dependent variable intraoperative nail size against the independent variables such as the pre operative measurements, sociodemographic characteristics and other injury related characteristics. These variables were selected because they provide accurate predictions for the study objectives.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Proportion of femur shaft fractures

In Nigeria, 1,034 cases of femur fractures were treated at tertiary center during a study period as from 2006 to 2011, 145 of those cases—or around 10.9% of all fractures—were treated using fin nails. All age categories among those who received fin nail treatment were impacted, with the age range (21 to 30) years seeing a large majority of instances (n = 411, 30.8%). Senior people, especially women (23, 1.7%), ground level fall was the most frequent cause (38, 2.8%), but among young people, road traffic crashes (970, 72.7%) were the most frequent cause. (17) In a study done in Kenya on satisfactory postoperative alignment following retrograde sign fin nailing for femoral shaft fractures, 28 fin nail cases were identified and treated during the study period. These cases were successfully matched to control cases of retrograde femoral shaft fixation with the standard SIGN nail. (8) At a single tertiary referral center in Tanzania, a prospective cohort research was carried out from 2012 to 2013. Patients with distal diaphyseal femur fractures who had skeletally mature bodies were treated with either retrograde SIGN Standard Nails or Fin Nails. During the course of this study, 85 patients with distal diaphyseal femur fractures had retrograde treatment with the SIGN Standard Nail (57) or SIGN Fin Nail (28) in total representing 33% of distal femur shaft fractures being treated by retrograde fin nail insertion. Among the patients treated via retrograde insertion 22(78%) were males while 6(21%) were females with the most affected age group being those within the age bracket of 18 to 29 (36%). (16)

2.2 Factors associated with femur shaft fractures

Road traffic incidents caused 93% of the injuries in the conventional SIGN nail group and 85% of the injuries in the Fin nail group. Only 25% of each group's fractures fell into the B- or C-type categories, with the majority of fracture patterns being A-type and length stable. Among the Fin nail cohort, 23(82%) were male while 5(17%) were female with the most affected age group being those within the age bracket of 20 to 29(32%). (8)

2.3 Preoperative measurement techniques

For preoperative nail length estimation, several approaches are available. Previous articles on this topic have attempted to locate a reference for external measurements made during physical experiments. Some of the methods of preoperative femur nail measurement include,

1. The distance between the proximal pole of the patella and the greater trochanter's most prominent point
2. The distance between the lateral knee joint line and the Greater Trochanter's most prominent point
3. The distance from the tip of the little finger to the olecranon (18)

Other methods to estimate nail measurements include radiograph imaging using a designated ruler or template (preoperatively or intraoperatively), radiograph imaging on a Kramer splint (19) and radiograph imaging of the suggested nail itself placed in its sealed box next to the patient's leg. Magnification must be considered because different models and manufacturers employ different estimations of magnification, which have also been shown to be erroneous. Although a preoperative CT scan exposes the patient to a significant radiation dosage, it is accurate for measuring the intramedullary canal's length and diameter. If CT is not performed for a different indication, for example, vascular insult, it is not recommended for routine use. (20) Using 100 femoral radiographs, C. Krettek et al. looked into how well intramedullary templates might anticipate the intramedullary nail. They came to the conclusion that templates are unreliable for determining implant length because radiological magnification has such a substantial impact on implant length. (21)

2.4 Correlation between preoperative anthropometric measurement of nail length and intraoperative nail length.

A study done in india looking at the relationship of anatomical length of forearm plus hand to the length of femur found that the mean forearm plus hand length and length of the femur were 42.85 (SD, ± 1.87) and 45.88 (SD, ± 2.95) cm, respectively with the mean difference between

these 2 measurements of -3.03 (95% CI, -3.83 to -2.22) cm, in males. The Pearson correlation co efficient between these 2 measurements was 0.575 with a p value of 0.0001 (Student's t test) which is extremely significant. (22)

Monappa A. Naik et al. used a measuring tape to determine the ipsilateral femoral length and forearm plus little finger length of 68 male and 32 females ranging in age from 19 to 55 (mean, 35.8) years. While the femoral length was measured from the point of the greater trochanter to the level of the proximal pole of the patella across the outside surface of the thigh, the forearm plus litter finger length was measured from the tip of the olecranon to the tip of the little finger. Compared to intraoperative measurement, the mean forearm plus little finger length and femoral length were 39.87 (SD, 2.73) and 39.85 (SD, 2.44) cm, respectively. The correlation between preoperative and intraoperative measurement for femoral length and forearm plus little finger length measurements was 0.861($p<0.001$), 0746($p<0.001$) respectively. Patient age, sex, and body mass index did not affect this correlation. (23) According to a study done by Fischmeister MF et al, they found the strength of correlation in descending order was Greater Trochanter to Proximal pole of Patella > Tip of Olecranon to tip of Little Finger > Greater Trochanter to lateral Knee Joint line are correlated with significant p-value ($p<0.001$). (24)

In determining the correlation between the forearm plus little finger length and the femoral length, Naik et al found the mean forearm plus little finger length and femoral length was 39.87 (SD, 2.73) and 39.85 (SD, 2.44) cm, respectively. The mean difference between these 2 measurements was 0.028 (95% CI, (–0.109 to 0.165) cm. The correlation between these 2 measurements was 0.861 ($p<0.001$). (18)

CHAPTER THREE

3.0 METHODOLOGY

3.1 Study site

The study was conducted at the Muhimbili orthopedic institute from March 2023 to December 2023. Muhimbili orthopedic institute is the national orthopedic referral center in Tanzania receiving patient even from outside the country for specialized care. The institute is involved in human “resource” development and also carries out research programs with a view of developing cheaper efficient ways of treating orthopedic and neurosurgery cases. The Muhimbili orthopedic institute currently boast of a bed capacity of 380 with approximately 10,000 surgeries performed per year in the 9 operating theatres available. The Accident and Emergency Department receives high number of cases of road traffic accidents and assaults in the neighbouring communities as well as the high number of patient check-ins and referrals from across the country. Patients presenting with femur shaft fractures are treated with standard intramedullary nail as well as retrograde fin nail insertion which has an approximated average of 10 fin nail insertions per month. MOI excellent services are provided by dedicated orthopedic surgeons, resident doctors, nurses and subordinate staff who all strive for good outcomes post-surgery.

3.2 Study design

A hospital-based cross-sectional design study was conducted at Muhimbili Orthopedics Institute.

3.3 Study population

The study population targeted adults 18 years of age and older with a stable femur fracture AO Classification 33A1 intended for FIN nail insertion.

3.4 Sample size determination

Sample size was calculated via Cochran's algorithm.

$$\text{Sample size (n)} = \frac{Z^2 p(1-p)}{e^2}$$

Where type one error was set at 0.05 and a 5% risk of a false-positive result is desired,

Hence we used z=1.96 p=0.283 (pilot study)

$$\text{Thus, Sample size} = \frac{1.96^2 \text{x} 0.283(1-0.283)}{0.05^2}$$

$$= 311$$

Considering the fact that few fin nails from this sample was adequate for this study, the sample size of infinite population was used to calculate the appropriate sample size.

For adjusted sample size

$$n_{adjusted} = \frac{no}{1+(no-1)/N}$$

N= patients who were treated with FIN Nail in six months which is 46 as per pilot study

no= cochrans sample size recommendation which is 311

$n_{adjusted} = 44$

Hence, the entire study consisted of a total sample size of 44 participants

3.5 Sampling Technique

Consecutive sampling technique was applied among patients who came to the casualty, the clinic or admitted for elective surgery and who meet the inclusion criteria.

3.6 Eligibility

3.6.1 Inclusion criteria

Patients who had stable distal Femur shaft fractures

3.6.2 Exclusion criteria

1. Patients with disproportionate congenital lower limb anomalies
2. Fracture patterns not indicated for Fin nail
3. Pathological fracture
4. Bilateral femur fractures
5. Previously treated femur fractures

3.7 Variables

3.7.1 Variables included

3.7.1.1 Independent

- Socio-demographic
- Preoperative measurements
- Injury related factors

3.7.1.2 Dependent

- Intraoperative fin nail length measurement

3.8 Data collection Technique

A pilot study had been carried out at MOI emergency department upon which the tool was pretested, looking at patients with femur shaft fracture pre-operation, intraoperation and post operation Fin nail insertion and their final control X-.ray on sign surgical Data base.

Patients with femur fracture that were intended for FIN IMN insertion whether as an elective “case”, or emergency case and that did meet the prerequisites and gave approval were included in the study and were enrolled.

3.8.1 Diagnosis

A patient was diagnosed to have femur shaft fracture based on both clinical and radiological findings. The clinical findings included an elaborate history of the mechanism of injury, swelling, pain and deformity of the limb. Femur radiograph was taken to confirm diagnosis. The radiograph included two views AP and Lateral view of femur exposing Hip and knee joint.

The principal investigator together with the operating surgeon interpreted the radiograph and classified the fracture as per AO classification. The patient file was reviewed for biodata information including;

a) Age
b) Sex
c) Telephone number

Injury characteristic

a) The Limb affected
b) The Site of fracture

3.8.2 Measurement of fin nail length

The principal investigator did the following measurements;

a) The distance between the patella's proximal pole to the great trochanter's most conspicuous point. To highlight the greater trochanter, the thigh was slightly flexed and adducted.
b) The distance from the lateral knee joint line to the greatest prominence of the greater trochanter. To make the greater trochanter more noticeable, the thigh was slightly flexed and adducted.
c) The distance between the tip of olecranon to tip of little the finger. The elbow was flexed to 90 degrees and the wrist and fingers was in a neutral position

Retrograde Fin nail insertion aimed at the isthmus as the proximal cortex nail contact

According to Dorr et al 1997 and Yeung et al, theoretically, the isthmus is thought to be 10 cm distal to the mid-point lesser trochanter. (25)

The estimated anthropometric measurement for the Fin nail was obtained by deducting 10 and 8 centimeters respectively from the measurement of;

a) Greater trochanter to the proximal pole of patella
b) Great trochanter to lateral knee joint line
c) Tip of olecranon to tip of little finger

A self-administered Questionnaire was given to two randomly selected residents and it captured data on the estimated fin nail length and the method used to obtain the estimate.
These Findings together with the operating surgeons preoperative fin nail length estimate and the principal investigator estimated measurements were recorded in an excel sheet.

The patient was then followed into the operating room and the operating surgeon was requested to do intraoperative measurement of the isthmus via a marked reamer so as to identify the right nail size for insertion. The findings were also recorded in an excel sheet.

3.9 Investigation tools

- Questionnaire was used to collect patient biodata, injury characteristics, injury mechanism, AO/OTA classification and estimated anthropometric measurement.

3.10 Data processing and analysis

The Stata 14 software program was used to conduct statistical analysis after the data collection process was complete. In order to get summaries for socio-demographic categorical variables like gender, descriptive data analyses were carried out.

The proportion of adult patients with distal shaft femur fracture treated by sign fin nail insertion was determined by considering the total number of patients with distal femur shaft fracture treated via fin nail as the numerator and divided by total number of patients with distal femur shaft fracture treated (standard nail plus fin nail).

The preoperative measurement techniques for fin nail size determination used at MOI and their accuracy in determining the isthmus was obtained as a percentage of correct preoperative measurement by looking at the values of preoperative measurements in millimeters and comparing with intraoperative marked reamer measurements in millimeters.

The correlation was computed by using a Spearman's correlation coefficient that assessed the linear relationship between preoperative measurement techniques for fin nail size and intraoperative fin nail size measurement by a marked reamer. When applicable, continuous data like age and nail length was summarized using the mean (standard deviation) and median (range). Results were presented using tables and graphs. To ascertain the link between categorical parameters like gender, the chi-square test was utilized. The association between continuous variables like age will be examined using the T-test. The P value of <0.05 was considered statistically significant based on the two-sided t test

Table 1: Data analysis strategies according to specific objectives

S/N	Specific Objectives	Variables	Statistical Analysis Measures
1	Socio-demographic characteristics	Sex, Age	Descriptive statistics
2.	Injury related characteristics	Limb affected, injury mechanism, location of fracture AO classification	Descriptive statistics
3.	assess link/ relationship between categorical parameters i.e. intraoperative nail size	Sex, age, Limb affected, injury mechanism, location of fracture AO classification	Chi-square
4.	Correlation between the dependent and independent variable Dependent: intraoperative nail size	Preoperative measurements	Spearman's correlation

3.11 Ethical clearance

The proposal was ethically cleared by IRB of MUHAS and permission to conduct the study sort from the executive director of MOI.

Informed consent was sort from the patient or next of kin for those who were not in a position to give consent by themselves. This was done after detailed explanation on the study objectives. Confidentiality assurance was provided. Patient management was not altered by refusal to participate in the study. The study participants underwent all the available standard management.

3.12 Dissemination plan

After completion, the documents and manuscripts of this research shall be submitted to the DPGS office at MUHAS for completing MMed Orthopedics and Traumatology requirements. The report's manuscript will be peer-reviewed, and abstracts will be presented at conferences.

CHAPTER FOUR

4.0 RESULTS

4.1 Presentation and analysis of the results

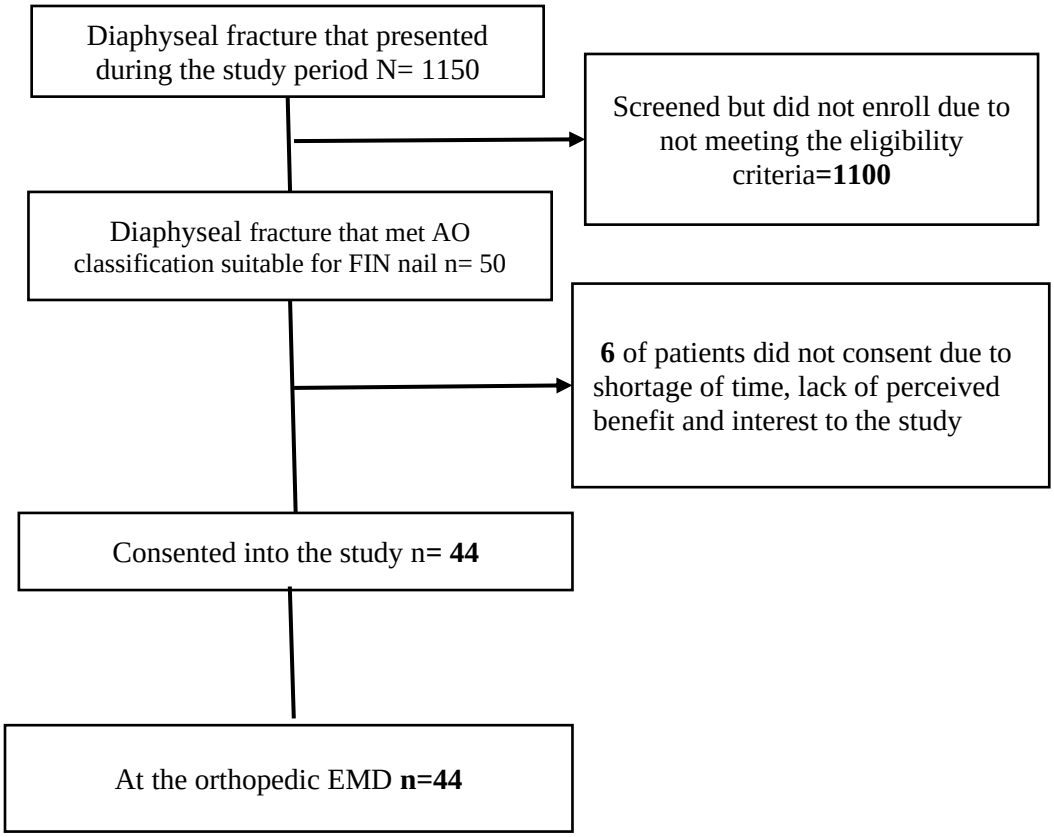


Figure 2: Represents a schematic flow of enrolled study participants and follow-up.

4.1.1 Research main findings

The study aimed to examine the correlation between anthropometric determination of the retrograde fin nail length and intraoperative fin nail length measurement among adult patients with femur shaft fracture treated at Muhimbili Orthopedic Institute. A highest level of correlation with the intraoperative fin nail length was olecranon to tip of little finger less 10cm. Moreover, there was no relation between interoperative nail size and socio-demographics or injury characteristics.

4.2 Socio-demographic characteristics of patient with an open tibia fracture.

A total of 44 patients with femur shaft fracture treated at MOI were included. The mean age of participants was 33.34 years with a standard deviation (SD) of 13.98827 years ranging between 15 to 84 years. Slightly more than half of the participants 25(56.82%) were between the age of 15 and 33 years. The majority of participants 38(86.36%) were male, more than half 26(60%) were affected on the right limb. The major cause of injury was motor cycle accident (MCA) 36(81.82%), and among these, the majority were the cycle riders 19(43.18%). Also, most fractures were located on the distal third 25 (56.82%), with AO classification of 32-A3 (54.55%).

Table 2: Demographic and Clinical characteristics **of the study participants**

Demographic variable	**Frequency**	**Percentage**
	N = 44	**100%**
Sex		
Female	6	13.64
Male	38	86.36
Age group (Years)		
Below 25 years	14	31.82
Above 25 years	30	68.18
Mean (S.D)	33.34 (13.98827)	
Limb affected		
Left	18	40
Right	26	60
Injury mechanism		
Motor cycle accident (MCA)	36	81.82
Motor vehicle accident (MVA)	8	18.18
Injury mechanism		
MCA passenger	13	29.55
MCA pedestrian	4	9.09
MCA rider	19	43.18
MVA passenger	4	9.09
MVA pedestrian	4	9.09
Location of fracture		
M 1/3	19	43.18
D 1/3	25	56.82
AO classification		
32-A2	20	45.55
32-A3	24	54.55

4.3 Association between intraoperative nail size with socio-demographic and injury characteristics.

The study identified that there is no statistically significant relationship between intraoperative nail size among patients with femur shaft fracture and their gender, age, limb affected, location of fracture, AO classification and injury mechanism.

Table 3: Relationship between intraoperative nail size with socio-demographic and fracture characteristics.

		Intraoperative nail size	
Variable	**Response**	**Chi2**	**p value**
Gender			
Male	38	3.1	0.54
Female	6		
Age			
Below 25	14	1.94	0.75
Above 25	30		
Limb affected			
Left	18	3.01	0.55
Right	26		
Location of fracture			
M 1/3	19	3.77	0.43
D 1/3	25		
AO classification			
32-A2	20	2.18	0.70
32-A3	24		
Injury mechanism			
MCA	36		
MVA	8	6.17	0.18

4.4 Correlation between intraoperative nail size and independent variables among patients with femur shaft fracture.

Several factors might contribute to the correlation between intraoperative nail size and the independent variables among patients with femur shaft fracture treated at MOI. These factors can be categorized into patient factors, clinical factors, tool factors, evaluator biases, lack of training and standardization.

The correlation coefficient tests showed that there is excellent agreement between the independent variables/ preoperative measurements and the dependent variable (intraoperative nail size). The correlation coefficients were as follows: for trochanter to proximal pole of patella less 10cm was r= 0.7623 ($p < 0.01$), for trochanter to proximal pole of patella less 8cm was 0.7855 ($p < 0.01$), for trochanter to lateral knee joint line less 10cm was r= 0.7385 ($p < 0.01$), trochanter to lateral knee joint line less 8cm was r= 0.7116 ($p < 0.01$), olecranon to tip of little finger less 10cm was r= 0.8731 ($p < 0.01$), olecranon to tip of little finger less 8cm was r= 0.8392 ($p<0.01$), preoperative resident no1 measurement was r= 0.4908 ($p = 0.0007$), and preoperative resident no2 measurement was r= 0.4418 ($p = 0.0027$). Table 4 and figure 3 – 10.

Table 4: Correlation between intraoperative nail size and independent variables among patients with femur shaft fracture.

Dependent Variable	Independent variable	Spearman's rho (r)	p-value
Intraoperative nail size	Trochanter to Proximal Pole of Patella Less 10cm	0.7623	<0.01
	Trochanter to Proximal Pole of Patella Less 8cm	0.7855	<0.01
	Trochanter to Lateral Knee Joint Line Less 10cm	0.7385	<0.01
	Trochanter to Lateral Knee Joint Line Less 8cm	0.7116	<0.01
	Olecranon to Tip of Little Finger Less 10cm	0.8731	<0.01
	Olecranon to Tip of Little Finger Less 8cm	0.8392	<0.01
	Preoperative resident no1 measurement	0.4908	0.0007
	Preoperative resident no2 measurement	0.4418	0.0027

Figure 3: Correlation between intraoperative nail size and trochanter to proximal pole of patella less 10cm

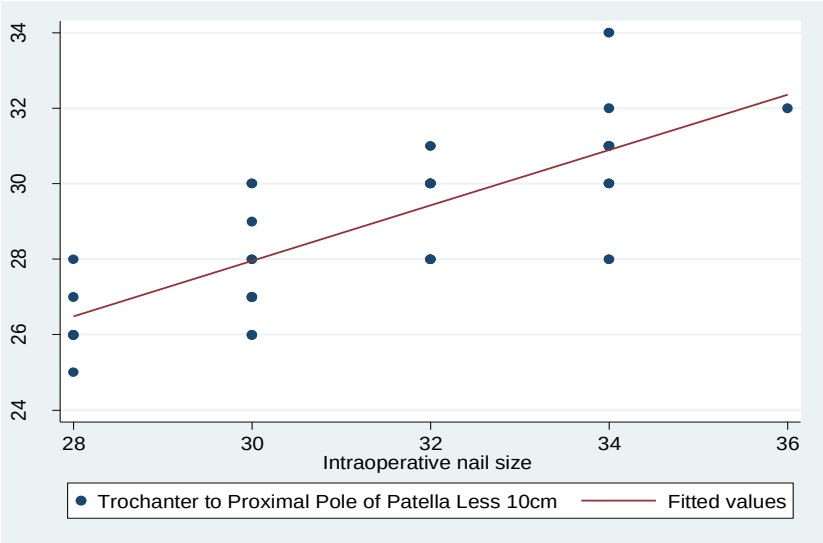


Figure 4: Correlation between intraoperative nail size and trochanter to proximal pole of patella less 8cm

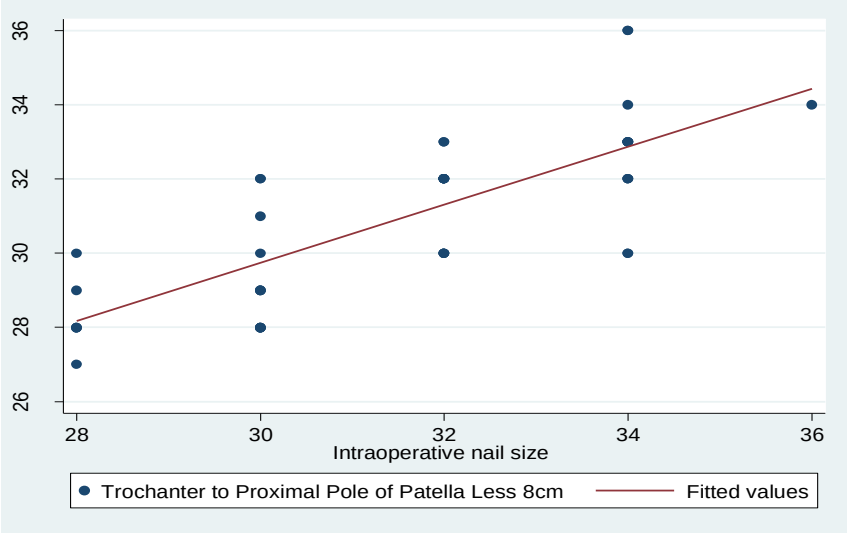


Figure 5: Correlation between intraoperative nail size and trochanter to lateral knee joint line less 10cm

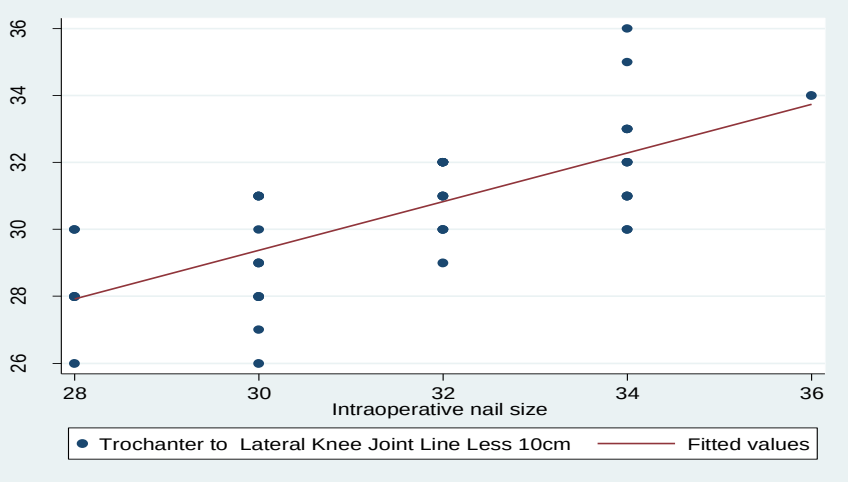


Figure 6: Correlation between intraoperative nail size and trochanter to lateral knee joint line less 8cm

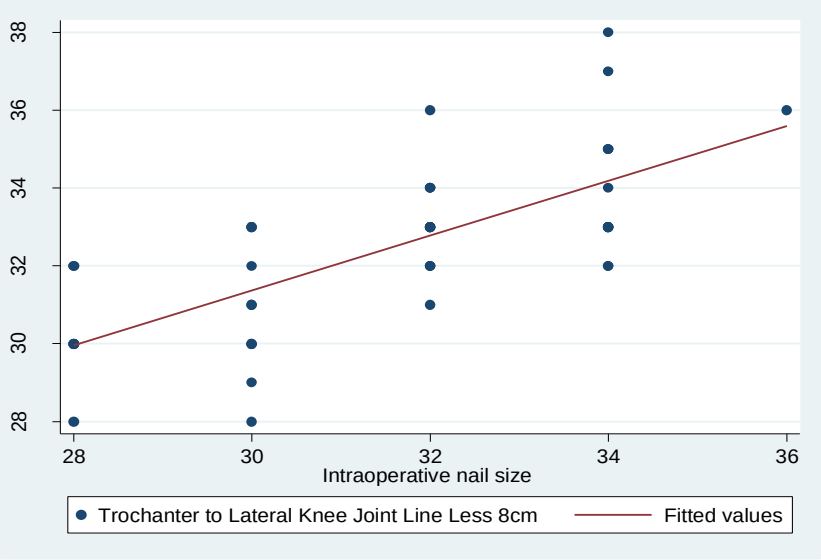


Figure 7: Correlation between intraoperative nail size and olecranon to tip of little finger less 10cm

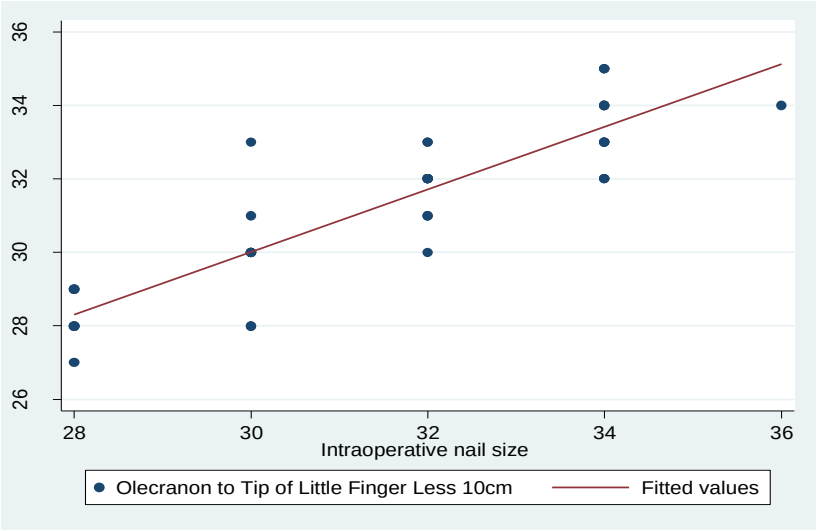


Figure 8: Correlation between intraoperative nail size and olecranon to tip of little finger less 8cm

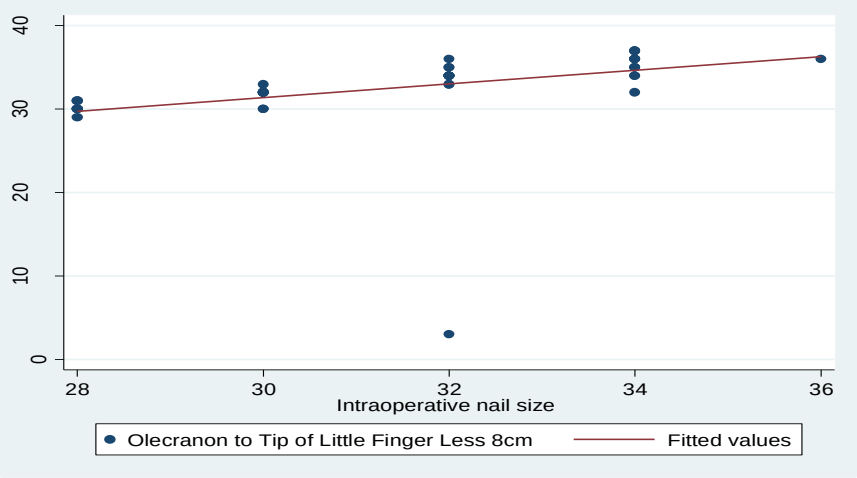


Figure 9: Correlation between intraoperative nail size and preoperative resident no 1 measurement

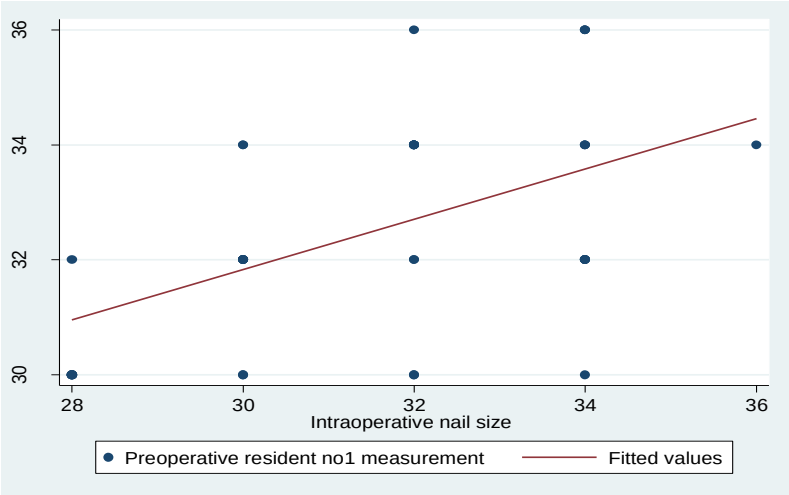
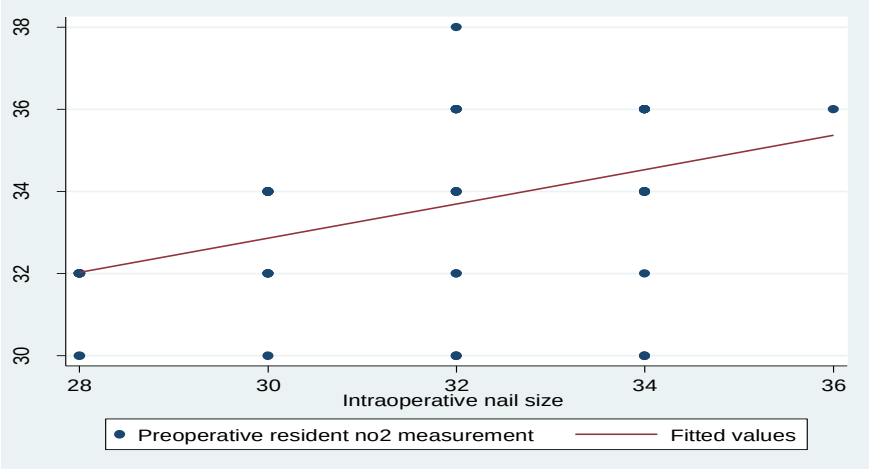


Figure 10: Correlation between intraoperative nail size and preoperative resident number 2 measurement.



CHAPTER FIVE

5.0 DISCUSSION

Intramedullary Nailing for distal femur shaft fractures is a common and effective treatment method. Preoperative planning of FIN nail length can ensure proper equipment preparation, prevent wastage of inaccurate nails, and reduce surgery time.

Intraoperative measurement with the aid of a marked reamer is regarded as the gold standard FIN nail length measurement

To our knowledge, there is no single published study that has assessed FIN nail length estimation preoperatively.

5.1 Characteristics of patients with femur shaft fracture.

The finding of the study revealed there were more males with femur shaft fracture, and most of the patients were above 25 years old with a median of 33. Similar findings are seen in a study by Karapinar (26) where the prevalence was higher in males 92.1% and the median age was 29, in Alıç et al the mean age was 35 (27) and in Atif et al the mean age was 33. (28) A meta-analysis conducted also showed that the mean age of patients was 32. (29) In a study conducted in Africa, the prevalence of males was also high with the mean age of 38 (30), while in Nigeria a study recorded a mean of 64 years. (31) There are more males than females because of lifestyle where most drivers are men. But most patients are above 25 which could be due to increase in geriatric population worldwide. Since our findings are in line with most global results, the policies of prevention should target these populations.

Also, results from the study show that the most common mechanism of injury is motor cycle accident. These findings differ from the study by Karapinar where the most common mechanism of injury was motor vehicle accident (26), and also a study by Singh where 85% were caused by motor vehicle (32).

The difference could be attributed to the common means of transport in the regions as these studies were not carried out in Sub-Saharan Africa. Never the less, a study by Okwada et al from Uganda had motor cycle accidents as the most common cause of femur shaft fractures (33), but the majority of the victims were passengers in their case, while it was the riders in our study. Similarly, another study from Malawi had MCA as the common cause. (30) It is observed that most studies conducted in Sub-Saharan Africa have MCA and MTA as the common mechanism of injury. Hence, the highlights of the findings should be addressed by addressing the gaps in knowledge on the mechanisms of injury, but also formulate policies to enforce the implementation of necessary measures.

The limb most affected is the right, and in most cases, the fracture is located in the distal third. Chokothto et al also had 53% of injuries occurring on the right, but the most common location was the middle zone. (30)

According to AO classification, most common fractures are 32-A3. OTA classification A (simple) had a prevalence of 74% in a study done in Malawi. (30) In Pakistan, according to AO classification: 27 patients had 32A1 injury, 45 patients had 32A2 injury, 74 patients had 32A3 injury, 16 patients had 32B1 injury, 44 patients had 32B2 injury, 22 patients had 32B3 injury, 18 patients had 32C1 injury, 15 patients had 32C2 injury and 27 patients had 32C3 injury. (34) The results from the Pakistan study are in line with this study. It is important to verify adequate reduction before fixation and follow up patients until union is achieved.

5.2 Proportion of adult patients with femur shaft fracture treated by SIGN FIN nail insertion

The number of patients with diaphyseal femur shaft fractures that presented during the study period was 1150, patients that had femur fracture that met AO/OTA classification suitable for FIN nail was 50 hence the proportion adult patients with femur shaft fracture treated by SIGN FIN nail insertion at MOI during the study period was 4.3%. In Uganda, there was a prevalence of 5.2% of simple femur shaft fractures that were treated by standard intramedullary nailing (33). In Nigeria, the prevalence of simple femur shaft fractures that were treated by intra

medullary nailing was 10.9% of the total number of patients with femur fractures received in the facility during the period under review. Our study showed a smaller prevalence as compared to the studies done in Uganda and Nigeria. This difference in prevalence can be attributed to the fact that in those two studies, proximal simple femur shaft fractures were included while in our study, proximal simple femur shaft fractures were excluded.

5.3 Preoperative measurement techniques for fin nail size determination used at MOI

In our study, the correlation between the two surgeons' preoperative anthropometric measurement and intraoperative FIN nail measurement, was found to be 0.49 and 0.44 respectively, the most commonly used preoperative anthropometric measurement observed by both surgeons is trochanter to Lateral Knee Joint Line with a prevalence of 63% as compared to measurement of the greater trochanter to the proximal pole of patella (31%) and olecranon to tip of little finger (6%). There was no other study that looked into the prevalence of preoperative anthropometric measurement among surgeons.

5.4 Correlation between intraoperative FIN nail size and preoperative anthropometric FIN nail length measurement

There was a statistically significant correlation that was linear and positive between intraoperative nail size and the preoperative measurements. Although there is no consensus regarding the best parameter to be used for predicting femur nail length, the most predictive of the preoperative parameters in this study was olecranon to the tip of little finger less 10cm. Singh et al, Alao et al and Atif et al concluded that the length from the tip of the olecranon to the tip of the little finger correlated with the femoral length and is more convenient to perform and can also be used when the patient has sustained bilateral fractures of the femur (32). It can be readily performed with the use of a tape measure and can serve as a useful adjunct to determining the ideal length in cases where the contralateral femur cannot be used (37). Hence, it can be implemented in clinical practice to aid in preoperative planning and save on surgery time (28). In agreement with this study findings, the measurement of olecranon to tip of little finger requires less manipulation and the landmarks are easily located contrary to measurement of grater trochanter to lateral knee joint line or proximal pole of patella.

CHAPTER SIX

6.0 STUDY LIMITATION, MITIGATION, CONCLUSION AND RECOMMENDATION

6.1 Study limitation and mitigation

Obtaining marked reamers in every case for retrograde FIN nail insertion was a challenge Besides that, this was a cross-sectional study and the principal investigator was blinded to the intraoperative estimations. Generalizability was limited as this was a single Centre study, apart from that, there was lack of standardization of preoperative measurements. I believe that this is a representative sample and reproducible clinical method that is useful for pre-operative planning in patients with femur shaft fractures amenable to FIN nail insertion.

The available sets with marked reamers were identified and marked before sterilization and the sterilization team was requested to release the set with marked reamers only when there was a patient for fin nail insertion.

Another limitation is the gender bias (males 86%, Females 14%) this may exert a confounding factor on the final results. Separate quantification for Females only case study may throw better light on the preoperative anthropometry and ideal FIN nail length in the female population.

6.2 Conclusion

The most commonly used preoperative anthropometric measurement for FIN nail length measurement was greater trochanter to lateral knee joint line with a prevalence of 63%) compared to measurement of the greater trochanter to the proximal pole of the patella(31%) and olecranon to tip of the little finger(6%).

Although these three preoperative anthropometric measurements showed a statistically significant correlation between preoperative and intraoperative measurements, the olecranon to the tip of the little finger showed the most predictive linear correlation between pre-operation anthropometric measurements to intra-operative measurement in this study.

6.3 Recommendation

The study recommended the following to reduce femur shaft fractures:

- Policies of prevention should target the populations at high risk.
- Addressing the gaps in knowledge on the mechanisms of injury.

Intraoperatively:

- Increase the number of sets with marked reamers for patients who will require fin nail insertion.
- Use of olecranon to tip of little finger less 10cm as a preoperative measure.
- Procure and Avail more FIN nails of appropriate sizes

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APPENDICES

Appendix 1: Questionnaire

Preoperative determination of retrograde fin nail length among adult patients treated at MOI

FORM FOR PRIMARY DATA COLLECTION

A. BIODATA

i. Serial number …….

ii. D.O.B (Age)……

iii. Sex M ☐ F ☐

iv. Telephone number……

B. INJURY CHARACTERISTICS

i. Limb affected

a) Right ☐

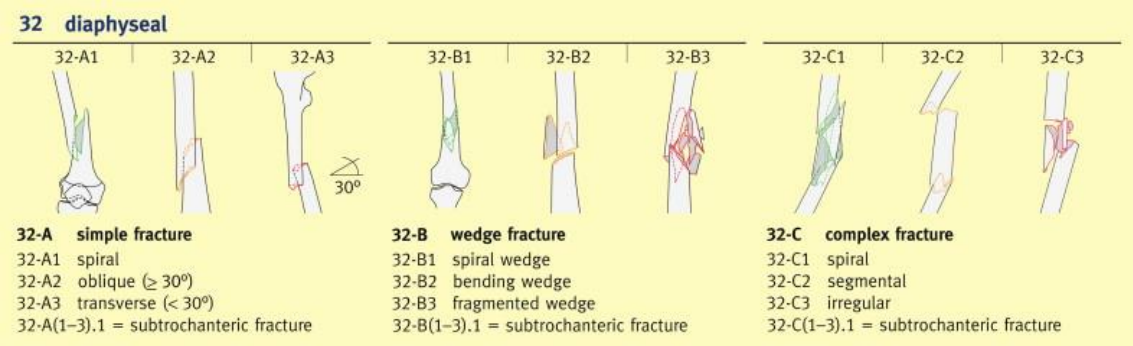
b) Left ☐

ii. Location of fracture(site)

a) M 1/3 ☐

b) D1/3 ☐

C. AO classification



D. INJURY MECHANISM

a) **Motor** vehicle accident

i. Driver ☐

ii. Passenger…….

iii. Pedestrian**……..**

b) Motor cycle accident

i. Rider……..

ii. Passenger…….

iii. Pedestrian…….

c) Fall from a height

i. Standing height……..

ii. Greater than standing height……..

d) Assault ……

e) Others ……

E. PREOPERATIVE ANTHROPOMETRIC MEASUREMENT

a) What is the estimated preoperative fin nail length …….cm

b) What method did you use in estimating the preoperative femur length (tick one)

- Greater trochanter to proximal pole of patella ( )
- Greater trochanter to lateral knee joint ( )
- Tip of olecranon to tip of little finger ( )

c) How many centimeters did you subtract from the preoperative femur nail length above inorder to arrive at the estimated fin nail length…….cm

Appendix II: Consent form (English)

Part A:

Introduction: I am Dr. Ogutu Meshack Owidi, a MUHAS student pursuing a Master of Medicine in Orthopedics and Traumatology. I am doing a study on "**CORRELATION OF ANTHROPOMETRIC DETERMINATION OF FIN NAIL LENGTH AND INTRAOPERATIVE MEASUREMENT BY A MARKED REAMER AMONG ADULT PATIENTS WITH FEMUR FRACTURE TREATED AT MUHIMBILI ORTHOPEDIC INSTITUTE**". Before consenting to participate in the study, please read this form carefully and make sure you understand it.

Purpose of the study: The purpose of this study is to obtain data regarding the correlation of preoperative anthropometric determination of retrograde fin nail length and intraoperative measurement via a marked reamer among adult patients with femur shaft fracture treated at MOI. Data obtained from this study will be used in possible protocol and approach change in treatment of femur fractures moreso via Fin nail.

Despite that, it is a partial fulfillment of my Master's degree in Orthopaedics and Traumatology.

Study procedures: Your socio-demographics, a brief medical history, injury characteristics and injury mechanism are the major pieces of information that are needed from you and will be documented on data-collecting sheets. Preoperative measurement of your femur is going to be done using a tape measure inorder to estimate the length of Fin nail to be used in treating your fracture. Intraoperatively another measurement is going to be done using a marked reamer so as to obtain the exact size of the fin nail to be used.

Risks and benefits: Since you won't receive any interventions other than the treatment being offered, there are no risks directly associated with the study. However, there may be advantages, such as the possibility of being followed up post-surgery by the lead investigator and assist in addressing any emerging issues before discharge.

Confidentiality: The data will be entered in a collection sheet that will not display your name but will use codes for research purposes and is strictly confidential.

Participant information: Your voluntary involvement in this study will not have any impact on your management at any point if you decide not to participate or withdraw from the study.

Contacts and Questions: If you have any questions at any moment, please do not hesitate to contact the principal investigator Dr. Ogutu Meshack Owidi, Muhimbili University of Health and Allied Sciences, P.O.Box 65001, Dar es Salaam) Mob 0766399535. You can get in touch with the Senate Research and Publications Committee's chairman if you ever have concerns concerning your participation rights through P.O. Box 65001, Dar es Salaam. Tel: 215 0302 - 6.

Part B

Participant consent: I willingly agree to participate because I have read, understood, and agree to all the investigator has just completely stated to me as evidenced by writings hereunder.

Signature……

Or participant's thumbprint (indicate right or left).

Witness signature……..……

Date……

Appendix III: Consent form Kiswahili

Utangulizi: Mimi ni Dkt. Ogutu Meshack Owidi, mwanafunzi wa MUHAS ninayesomea Shahada ya Uzamili ya Tiba ya Mifupa na Traumatology. Ninafanya utafiti kwa wagonjwa wenye Mivunjiko ya fupa la paja na kutibiwa kwa upasuaji na kuwekewa chuma cha ndani katika taasisi ya Tiba ya Mifupa Muhimbili (MOI).

Kabla ya kukubali kushiriki katika utafiti, tafadhali soma fomu hii kwa makini na uhakikishe kuwa umeielewa.

Madhumuni ya utafiti: Madhumuni ya utafiti huu ni kupata data kuhusu uwiano wa uamuzi wa kianthropometri wa kabla ya upasuaji katika kukadiri urefu wa msumari na kipimo kinachopimwa ndani ya upasuaji kupitia kirekebishaji chenye alama

Data itakayopatikana kutoka kwa utafiti huu itatumika katika itifaki inayowezekana na mabadiliko ya mbinu katika matibabu ya kuvunjika kwa fupa la paja haswa kupitia msumari wa Fin.

Licha ya hayo, ni utimilifu wa sehemu ya shahada yangu ya Uzamili katika Mifupa na Traumatology.

Nini kitafanyika katika kushiriki utafiti huu; Demografia yako ya kijamii, historia fupi ya matibabu, sifa za majeraha na utaratibu wa majeraha ndio sehemu kuu za maelezo ambayo yanahitajika kutoka kwako na yatarekodiwa kwenye laha za kukusanya data. Kipimo cha kabla ya upasuaji cha fupa la paja lako kitafanywa kwa kutumia kipimo cha mkanda ili kukadiria urefu wa msumari wa Fin utakaotumika kutibu kuvunjika kwako. Ndani ya upasuaji kipimo kingine kitafanywa kwa kutumia kifaa chenye alama tena ili kupata saizi kamili ya msumari wa Fin utakaotumika.

Hatari na manufaa: Kwa kuwa hutapokea hatua zozote isipokuwa matibabu yanayotolewa, hakuna hatari zinazohusiana moja kwa moja na utafiti. Hata hivyo, kunaweza kuwa na faida, kama vile uwezekano wa kufuatiliwa baada ya upasuaji na mpelelezi mkuu na kusaidia katika kushughulikia masuala yoyote yanayojitokeza kabla ya kuondolewa.

Usiri: Data itawekwa katika laha ya mkusanyo ambayo haitaonyesha jina lako lakini itatumia misimbo kwa madhumuni ya utafiti na ni ya siri kabisa.

Maelezo ya mshiriki: Kujihusisha kwako kwa hiari katika utafiti huu hakutakuwa na athari yoyote kwa usimamizi wako wakati wowote ikiwa utaamua kutoshiriki au kujiondoa kwenye utafiti.

Mawasiliano na Maswali: Ikiwa una maswali wakati wowote, tafadhali usisite kuwasiliana na mpelelezi mkuu Dk. Ogutu Meshack Owidi, Chuo Kikuu cha Afya na Sayansi Shirikishi Muhimbili, P.O.Box 65001, Dar es Salaam) Mob 0766399535. Unaweza kupata wasiliana na mwenyekiti wa Kamati ya Seneti ya Utafiti na Machapisho ikiwa utawahi kuwa na wasiwasi kuhusu haki zako za ushiriki kupitia P.O. Box 65001, Dar es Salaam. Simu: 215 0302 - 6.

Sehemu ya B

Idhini ya mshiriki: Ninakubali kwa hiari kushiriki kwa sababu nimesoma, nimeelewa, na ninakubali kwamba mpelelezi wote ameniambia kabisa kama inavyothibitishwa na maandishi hapa chini.

Sahihi……

Au alama ya kidole gumba ya mshiriki (onyesha kulia au kushoto).

Sahihi ya shahidi

…….

Tarehe……

Appendix IV: Ethical clearance

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/1869 Date: 20/08/2023

MUHAS-REC-08-2023-1869
OGUTU MESHACK OWIDI
SCHOOL OF MEDICINE
MUHAS

RE: APPROVAL FOR ETHICAL CLEARANCE FOR A STUDY TITLED: ACCURACY OF ANTHROPOMETRIC DETERMINATION OF THE RETROGRADE FIN NAIL LENGTH AMONG ADULT PATIENTS WITH FEMUR SHAFT FRACTURE TREATED 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: 20/08/2023
EXPIRATION DATE OF APPROVAL: 20/08/2024

STUDY DESCRIPTION:
Purpose:
The purpose of this cross-sectional study is to determine the correlation of preoperative anthropometric determination of retrograde FIN nail length among adult patients with femur shaft fracture treated at Muhimbili Orthopaedic Institute.

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-%2014844.pdf and in the MUHAS archives.

Appendix V: 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/K.157/2021

04th September, 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 **Ogutu Meshack Owidi** with **Reg. No. HD/MUH/K.157/2021** 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: **"Accuracy of Anthropometric Determination of the Retrograde Fin Nail Length Among Patients with Femur Shaft Fracture Treated at Muhimbili Orthopedic Institute."** he is being supervised by Dr. Adam Hussein from MUHAS and Violet Lupondo 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 Mwanima
For: DIRECTOR, POSTGRADUATE STUDIES

c.c **Ogutu Meshack Owidi**

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