DETERMINATION OF THE DEMOGRAPHIC CHARACTERISTICS, PATTERN, MECHANISMS OF DIAPHYSEAL FEMORAL FRACTURES AND THE DEVICES EMPLOYED IN EARLY IMMOBILISATION AT KENYATTA NATIONAL HOSPITAL.

A dissertation submitted in part fulfillment of the requirements for the degree of Master of Medicine (M.MED) in Orthopedic Surgery of the University of Nairobi

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DECLARATION

I hereby declare that this study is my original work and has not been presented for award of a degree at any other university.

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SUPERVISORS' DECLARATION

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This is to certify that this thesis is the original work of the author.

This was carried out at Kenyatta National Hospital's Accident & Emergency department and the orthopaedic wards.

The KNH/UON-ERC number of approval is P465/07/2015

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Abbreviations

KNH	Kenyatta National Hospital
UON	University of Nairobi
ERC	Ethics & Research Committee
A&E	Accident and Emergency
EMS	Emergency Medical Services
WHO	World Health Organization
MV	Motorvehicle
MC	Motorcycle
BC	Bicycle
PD	Pedestrian
RTA	Road Traffic Accident
AO/OTA	Arbeitsgemeinschaftfu¨rOsteosynthesefragen/ Orthopaedic Trauma Association

ABSTRACT

Background: Fractures of the femur amongst adults are quite a common indication for admission to an orthopaedic ward. A majority are due to high energy trauma with the subsequent development of pain as a result of the fracture. A classic traction device developed by Hugh Owen Thomas in 1875 is still widely used and largely effective in stabilization of diaphyseal femoral fractures in the prehospital and early hospital setting. This is a very affordable traction device made from locally available materials. However, the proper application of the splint on the patient determines how effective the device is in terms of giving the patient pain relief and comfort whilst in transit and as they await definitive fixation. Maqungo, Roche et al in South Africa found that 37.5% of patients in a Level 1 trauma centre had the Thomas splint applied before any radiological procedure. Ayorinde in Nigeria found that no patient had received any form of first aid from the accident scene to the hospital.

Objective: To describe pre-admission diaphyseal fracture femur splintage at KNH.

Design: Cross sectional study.

Sampling method:convenience sampling.

Setting: Kenyatta National Hospital Accident & Emergency Department as well as the Orthopaedic wards.

Study population: All consenting patients 18 years and above presenting at KNH Casualty department and those admitted to the orthopaedic wards with diaphyseal fracture femur..

Study period: 1st June to 31st August 2018

Methodology: All patients 18 years and above with a diaphyseal femoral fracture were recruited into the study at the point of entry into the Accident & Emergency department, KNH and in the orthopaedic wards. The type of splint applied and how the splint was applied were all noted in the data collection tool. The data collection tool also included information on patients' biodata (coded for ethical reasons), time of injury, how injury was sustained, how the patient was transported to KNH and arrival time at KNH.

Results: The most common cause of diaphyseal fracture femur was RTAs at 65.35% followed by falls at 16.53%. Pedestrians were at highest risk of femoral fractures accounting for 47% of samples. For sex distribution, 74.8% of patients were male and 25.2% female. Majority of patients had comminuted fractures. Only 26% of patients had adequate immobilization with a Thomas splint.

Results: Young males were most likely victims of RTAs along highways sustaining comminuted fractures. Transport to hospital was mainly via ambulance with 26% having adequate immobilization with a Thomas splint done by a trained health worker.

Conclusion: Provision of Thomas splints of various sizes and training of the general public in first aid interventions will go a long way in alleviating patient suffering after sustaining a femoral fracture.

1.0 CHAPTER ONE: INTRODUCTION.

A splint is defined as material or a device used to protect and immobilize a body part such as a broken limb (1). Lower limb splint material includes:

- **a)** Planks of wood secured around the limb using cords or sheets,
- **b)** Securing the injured limb to the non-injured one using cords with soft padding material in between the limbs,
- **c)** Pneumatic splints utilised especially in air ambulances,
- **d)** Thomas splint which is both a splint and a traction device when properly applied (2), (34).

In the human body, the femur is the longest, strongest, largest and heaviest tubular bone and acts as one of the principal weight-bearing bones in the lower extremity (5). The femoral shaft is the region between 5 cm distal to the lesser trochanter and 6 cm proximal to the most distal point of the medial femoral condyle (32). Diaphyseal femoral fractures are among the most common major injuries treated by an orthopaedic surgeon (31). Demographic data of patients with this fracture has been analyzed in some epidemiologic studies but little emphasis has been laid on the characterization of the fracture patterns of the femoral diaphysis using morphologic classification systems (5).

Globally the annual diaphyseal femoral fracture incidence from RTAs ranges from 1.0 and 2.9 million. Notably these rates are higher in low and middle income nations compared with high income nations (36).

Diaphyseal femoral fractures are a major cause of morbidity in the local setting with the cause being mainly trauma from road traffic accidents. Femur fractures account for 23.3% of all long bone fractures presenting at KNH (37).

On the matter of emergency medical services, Nairobi was noted to have deficient service provision with some reasons for this being listed as lack of recognition of Emergency Medicine as a subspecialist course by the Medical Practitioners & Dentists Board (3). Saidi described the response to injury as slow and haphazard from the accident scene to the hospital (41). In a survey of private ambulance services in Nairobi, 100 vehicles were on the ground but only 62 were active at any one time thus not meeting the World Health Organization’s recommendation of 1 vehicle to 50,000 people which would necessitate 70 active ambulances. Furthermore, response time from call to delivery of the patient was recorded as 2 hours; far from the recommended 8 minutes (42).

In the past, research has placed emphasis on the etiology of femoral shaft fractures and the various modalities of management employed in the local setting. Little has been done to elucidate exact causes of the femoral fractures and the kind of first aid given to the victim, transportation mode & time to hospital as well as the early hospital care accorded once they arrive at a hospital.The purpose of this study is to obtain information on the local practice on pre-hospital and early hospital care given to patients with diaphyseal femoral fractures.

2.0 CHAPTER TWO: LITERATURE REVIEW

Early immobilization of diaphyseal femoral fractures be they open or closed, is an adjunct to the analgesics given to a patient and is important in order to give the limb some stability during transport thus reducing pain experienced by the patient (3),(34). The Thomas splint, when properly applied, is able to achieve this and avoid the known complications associated with the device including peroneal nerve palsy, pressure ulcers, compartment syndrome and soft tissue injuries (4).

Internationally, road traffic accidents (RTAs) account for 57-74% of all femoral fractures (5), a clear indication of the morbidity generated from accidents all over the world. In Helsinki, Finland Rokkanen et al found that 78% of femoral fractures were caused by RTAs followed by industrial accidents (25). Chaudhaery et al in Nepal, India found RTAs to be the most common cause of femoral fractures followed by fall from height (26).

In Africa, Nigeria, Anyaehie et al found that RTAs account for majority of femoral fractures seen at a tertiary trauma center (6).Okoro et al in their paper found that RTAs account for 72% of all fractures seen which was noted to be a change in the cause of fractures which previously was falls from height (7). In Ethiopia, about 50% of all fractures resulted from RTAs with 68% of these being femoral fractures as was reported by Adamasie et al (8). In Tanzania, Hollis & Ebbs reported 71% of femoral fractures resulting from RTAs with falls from a height coming in second as a causative factor (18).

On the local scene, the urban setting has data reflecting that injuries to limbs predominate all traffic associated trauma admissions (more than 50%) (9).These admissions are also higher amongst pedestrians and those involved in injuries over the weekend according to Atinga, Saidi et al (9). In The Kenyan rural setting, more than 50% of limb fractures are due to RTAs (10, 11, and 12).Olemo et al concluded that multiple factors come into play in causation of RTAs but speeding is the leading cause (24).Kibogong and Kisia noted an increase in motorcycle related road crashes from their study in Naivasha and Thika (22). Furthermore Matheka, Omar et al noted that a majority of these motorcycle accidents were due to negligence and lack of education on injury prevention (23).

In all these studies, little had been stated on the morphology of the diaphyseal femoral fractures nor was there information as concerns the early immobilization done for the patient .Information on exact nature of RTA and mode of transportation to a health facility was also deficient in a majority of these studies considered.

The Thomas splint is considered to be an essential and basic piece of equipment in emergency and orthopaedic units in hospitals worldwide. Its design has had little modification in the years since its description by Hugh Owen Thomas (13), (14).

In Britain Rowlands and Clasper reviewed the use of the Thomas splint in stabilization of battlefield injuries and termed it as an indispensible tool (20). Wood, Vrahas and Wedel in Boston, USA reported that the Thomas splint was widely used as a traction device in the prehospital setting whereby physical examination led to suspicion of fracture femur later confirmed through imaging in the hospital (21). In Australia, Chu et al recorded 7.3% application of Thomas splint traction within 2 hours of arrival at the emergency department (38). In Iran, Alireza et al recommended that traction splints be used in preference to simple splints as they offered better pain relief, in keeping with wha tLockey had recommended earlier (28) (29). In South Africa, Maqungo et al found that only 37.5% of patients presenting with diaphyseal femoral fractures had immobilization with a Thomas splint prior to any radiological investigation (35).

According to the American college of surgeons' and the American College of Emergency Physicians' recommendations, a Thomas splint should be included in the ambulance equipment prior to conducting a road rescue of injured victims (15), (27).A pilot survey conducted at KNH Accident & Emergency department found less than five out of ten ambulances had a Thomas splint/ femoral immobilizer. Few in its stead had hardboard for full body immobilization whilst most relied upon the referring facility to have adequately applied a Thomas splint. Failure by the referring facility to immobilize the fractured limb adequately led to transfer of the patient in that state.

Ayorinde in Nigeria found that majority of the victims presenting with diaphyseal femoral fractures were transported by non-medical personnel (16). Despite the improvement in emergency medical services in Nairobi, Kenya, there is still demand for training of EMS personnel on adequate immobilization of patients as was found in the pilot study.

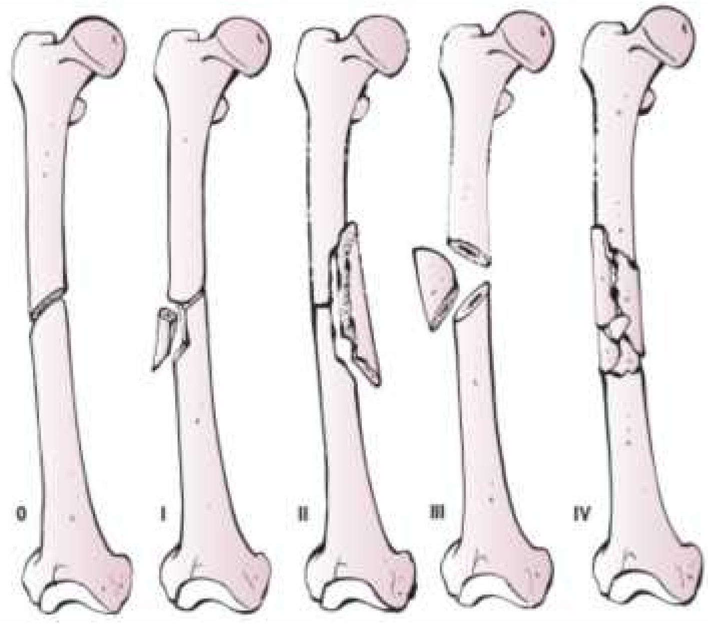
For purposes of planning the management for any diaphyseal femoral fracture, classification of the fracture is done. This facilitates decision making on type of implant required, need for a fracture table and/or fluoroscopy as well as the complexity anticipated. All this information is necessary so as to guide a facility on the equipment required in the management of these fractures as well as implants that should be stocked regularly.

Diaphyseal femoral fractures can be classified according to the level of comminution or according to the fracture morphology.In the present study, the Winquist and Hansen classification outlined below will be used in collaboration with the AO-Orthopaedic Trauma Association to give both aspects of diaphyseal femoral fractures (17). However, the AO/OTA method of classification will be documented through the data collection tool.

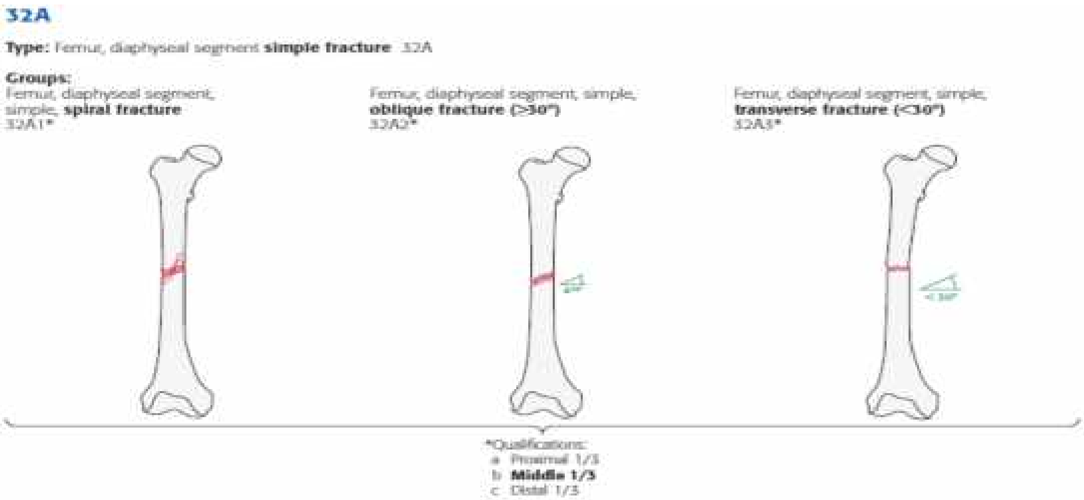
In Finland, Salminen et al found that young males involved in RTAs would sustain simple transverse or oblique fracture patterns whilst elderly females sustained spiral fragility fractures (5). Similar findings were recorded in Tanzania (18). In the United States, Wolinsky et al reported 51% oblique fracture, 29% transverse fracture, 14% comminuted and 6% spiral fracture patterns (39). In contrast Deepak et al in India reported a majority of diaphyseal femur fractures as comminuted followed by transverse (40).

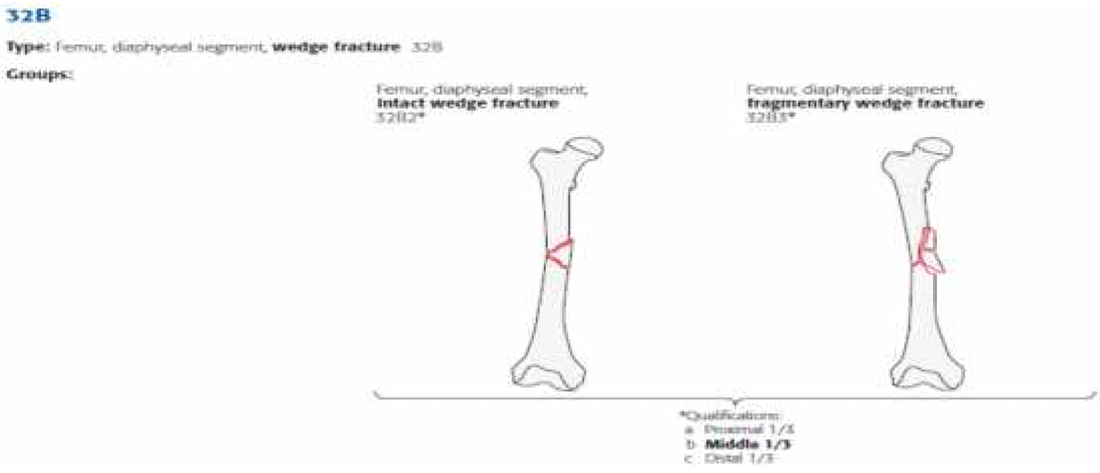
Winquist & Hansen Classification Of Fracture Comminution.(19)

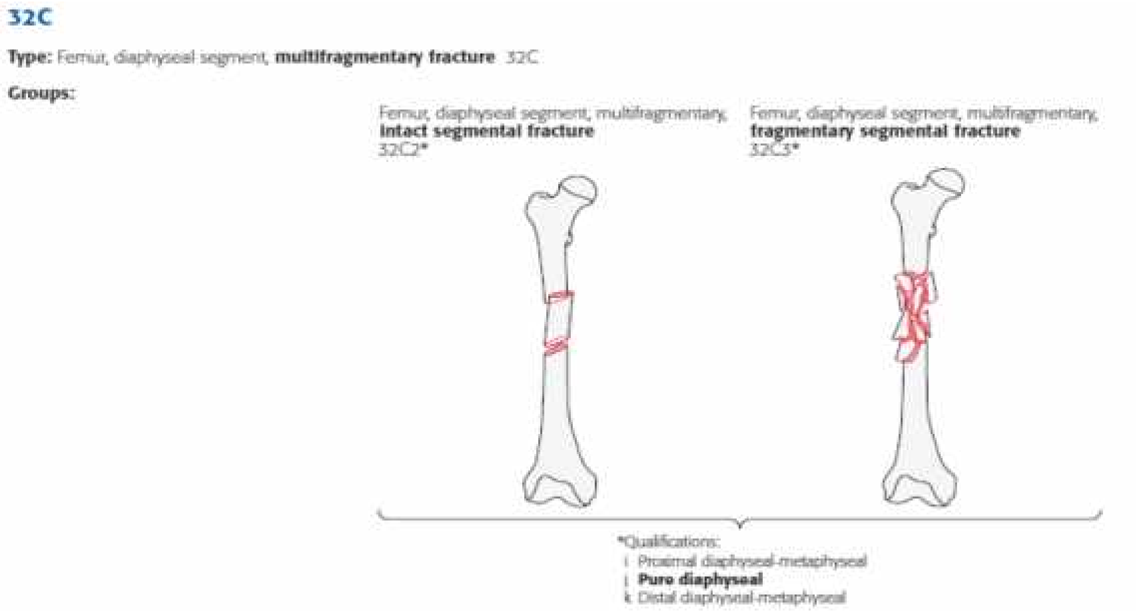
Grade	**Degree of Comminution**
0	None
I	Butterfly fragment <25% or minimally comminuted segment with at least 75% cortical contact remaining between the diaphyseal segments
II	Butterfly fragment or comminuted segment with (approximately 25–50%) with at least 50% cortical contact between the diaphyseal segments
III	Butterfly fragment or comminuted segment approximately 50–75% with minimal cortical contact between the diaphyseal segments
IV	Complete cortical comminution such that there is no cortical contact between the diaphyseal segments. Segmentally comminuted



AO-OTA Classification According to Morphology(30)







2.1 Conclusion

It is evident from literature that diaphyseal femoral fractures are a global problem that causes plenty of morbidity. The management of the diaphyseal femoral fracture from the time it occurs at the accident site to the orthopaedic ward prior to definitive management was an area not well defined in the KNH set up and required further consideration.

2.2 Study Justification

Diaphyseal femoral fractures present a major source of morbidity in the world over. In Kenya, lack of adequate resources leads to poor early management of patients hence increasing their morbidity. This study investigated the causes of diaphyseal femoral fractures and their early immobilization devices with an aim to coming up with recommendations on how to reduce the numbers of poorly immobilized limbs and improve patient service delivery by reducing the morbidity associated with poor immobilization.

2.3 Problem Statement

Proper immobilization of femoral shaft fractures facilitates pain management and avoids the complications of peroneal nerve palsy, pressure sores, compartment syndrome and further soft tissue injuries. Training on when and how to immobilize a femoral shaft fracture is necessary so as to improve patient service delivery.

The devices employed in immobilizing femoral shaft fractures at KNH and the personnel carrying out the immobilization were assessed in this study.

2.4 Primary Objective

To describe pre admission splintage of diaphyseal femoral fractures as seen at Kenyatta National Hospital.

Specific objectives:

a) To describe the demographics, mechanisms and sites of injury and means of transportation to hospital in diaphyseal femoral fractures.

b) To determine the splintage devices in diaphyseal femoral fracture immobilisation and the adequacy of splint application.

c) To determine the cadre of staff applying the splint and their training.

3.0 CHAPTER THREE: MATERIALS AND METHODS

3.1 Study Design

In order to achieve the objectives in this study, prospective convenient sampling study was carried out.

3.2 Study Setting

Kenyatta National Hospital's Accident & Emergency department was where the study was conducted. KNH is the national teaching and referral hospital based in Upperhill, Nairobi which is the capital city in Kenya. It is based along Hospital road, 5km from the city center. It has a 2000 bed capacity and is one of the two main referral hospitals in Kenya, also serving the greater East and Central Africa region.

3.3 Study Duration.

1^{st}June 2018 to 31^{st} August 2018.

3.4 Study Population

All patients 18 years and above presenting to KNH A&E with diaphyseal femoral fractures.

3.5 Inclusion Criteria

- **a)** Clients 18 years and above with midshaft femoral fractures.
- **b)** Clients who consented to the study.

3.6 Exclusion Criteria.

- **a)** Patients with associated ipsilateral leg fractures.
- **b)** Patients who declined to give consent.

3.7 Sample size

KNH medical statistics estimates that 508 femur fractures are admitted every year. The study was conducted over a period of three months. Assuming all the patients with diaphyseal femoral fractures were captured in the three month period, the target population representation was 127 patients.

3/12 x 508 = 127

Sample size determination was achieved using Cochran's formula

$$n = \frac{z^2 pq}{d^2}$$

Where,

n= the sample size if the target population is more than 10,000

z= the standard normal deviation at the required Confidence Interval (C.I). In this study it was 95% with a 5% margin of error.

p= the proportion in the population targeted estimated to have characteristics being measured. According to a study in Tanzania, a prevalence of 39% of diaphyseal femoral fractures was found.(18)

q= 1-p

d= the level of statistical significance set <0.05

For this study, the proportion of the target population wasn't known hence 50% was used i.e p=0.39, z=1.96, and a level of statistical significance of 0.05 was desired. Sample size was calculated as shown below:

$$n = \frac{1.96^2 x 0.39 x 0.61}{0.05^2} = 365.56 \approx 366\, patients$$

Since the target population is less than 10,000, the required sample size is smaller. A final population sample size estimate (n_f) was calculated using the Fisher et al formula:

$$nf = \left[\frac{n}{1 + (n-1)/N} \right]$$

Where:

n_f= the desire sample size (with a population that is less than 10,000)

n= the desired sample size (with a population that is more than 10,000)

N= estimate of the population size.

The target population (estimate of the population size) is 127. The above

$$n_f = \frac{366}{1 + \frac{366-1}{127}} = \frac{366}{3.874} = 94.4759 \approx 95\, patients$$

Therefore the sample size is 95.

3.8 Data Collection

Ethical approval was obtained from Kenyatta National Hospital – University of Nairobi ethics and research committee. All femoral shaft fractures were recruited into the study by the principal investigator or his assistant. They were classified according to the AO classification for femoral shaft fractures.

In addition to classification, the following information was obtained using a questionnaire:

- **a)** Date of birth
- **b)** Sex
- **c)** Time of accident
- **d)** Location of accident
- **e)** Arrival time in hospital
- **f)** Mechanism of injury
- **g)** Splintage applied
- **h)** For motor vehicle accidents use of seat belts
- **i)** Mode of transport to hospital

3.9 Data management

For confidentiality and to avoid data loss all questionnaires were stored in computer hard drives and backed up in flash discs and personal email accounts. Filled questionnaires were stored in lockable cabinets throughout the study and accessed only by investigators .Double entry of the same data was done for accuracy purposes after collection. Passwords were used to protect data. Raw data editing was done to detect any errors and omissions. Data coding was done using numerals and answers. Coding for key informants was also done. During data classification the coded data was arranged according to characteristics after which it was entered using Microsoft Access then exported to SPSS version 21 for analysis. Coding and verification of the data was done for easy manipulation, analysis and presentation.

3.10 Data analysis

Quantitative data was analyzed using SPSS version 21. Description statistics were analyzed using measures of central tendency such as median, mean and mode. Chi square was used to test the association between two variables which were categorical. The same was done for Splintage devices. Logistic regression models were used to analyze the relationship between demographics and patterns associated with diaphyseal femoral fractures. Measures of the dispersions were used to analyze the demographic data. P values and confidence intervals were utilized in determining the statistical significance of the results.

3.11 Limitations

- Severely injured patients who were obtund /blunted or unconscious, whom qualify for study recruitment but could not give consent.
- Patients who died from their injuries having presented into the A&E department with diaphyseal femoral fractures but died before consent for recruitment into the study.

3.12 Delimitation

- Consent was obtained from guardian or relative for those whom had impaired judgement e.g. unconscious, drunk or died after being reviewed in the A&E department.

3.13 Pretesting

Pretest of the questionnaire was done in the same A&E department on 13 patients with diaphyseal femoral fractures. The tool was utilized on the patients by the primary researcher before the actual study was conducted. The questionnaire was administered to 10% of the study's sample size. This assisted in making modifications to the questionnaire and gave the primary researcher chance to practice how to collect the data before the actual survey. Issues raised during the pretesting were corrected. It also aided in assessing the validity and reliability of the questionnaire and thus ensured that the data collection was done in a standardized way.

3.14 Recruitment and Training of Research Assistants

One assistant researcher working in the hospital was recruited .He has a Diploma in orthopaedic technology with experience of two years in KNH. He received training for two days on questionnaire administration, data collection techniques and recording. He also did a role play prior to pre-testing to familiarize himself with the questionnaire and on how to ask questions in a way that the client would understand.

3.15 Ethical Considerations

Approval to conduct the study was granted by the Department of Orthopaedic Surgery, University of Nairobi as well as Kenyatta National Hospital, Ethics and Research Committee (KNH/UON-ERC). Data collection commenced soon after approval was granted. Participants in this study or their next of kin gave a written informed consent. The consent given enabled the principal investigator to take the patient's bio-data and history related to the presenting injuries.

The investigator clarified to the participants the objective of this study .Participation in this study was on voluntary basis and as such, it was emphasized to the participants that they were free to participate or opt out of participation at any point during the study without any explanation to be made. Withdrawal of participation did not affect the participant's treatment or management in any which way.

Information obtained was treated with confidentiality. Participants were allocated a study serial number linking them to their bio-database accessible only to the principle investigator. Participants names were not used.

3.16 Dissemination of Findings

The findings of this study were presented at the Orthopedics Department, University of Nairobi, and copies to be deposited in the departmental library, college of health sciences library and to be published in a peer reviewed journal.

4.0 CHAPTER FOUR: RESULTS.

4.1Demographic data

Table 4.1 a: Age

Patients' age in years

N	Valid	127
	Missing	0
Mean		36.83
Std. Error of Mean		1.173
Median		33.00
Mode		28
Std. Deviation		13.222
Variance		174.822
Range		52
Minimum		18
Maximum		70

The mean of the patients' age was 36.83 years with a standard error of 1.173. The maximum age was 70 years and minimum was 18 years. The standard deviation was 13.222 and a variance of 174.822. The median age was 33 years and mode was 28 years. The majority of the patients were young people between the age of 18 and 38 years. The distribution was normal but with some outliers and that was why the range is quite high.

County of Residence

The majority of the people were from Nairobi county which can be explained by the location of the facility. The neighboring counties of Kiambu, Machakos and Kajiado also contributed to the number of patients by 25.2%, 20.47% and 14.96% respectively. Approximately 63% of the injuries were from outside Nairobi County.

Fig 4.1b County of Residence

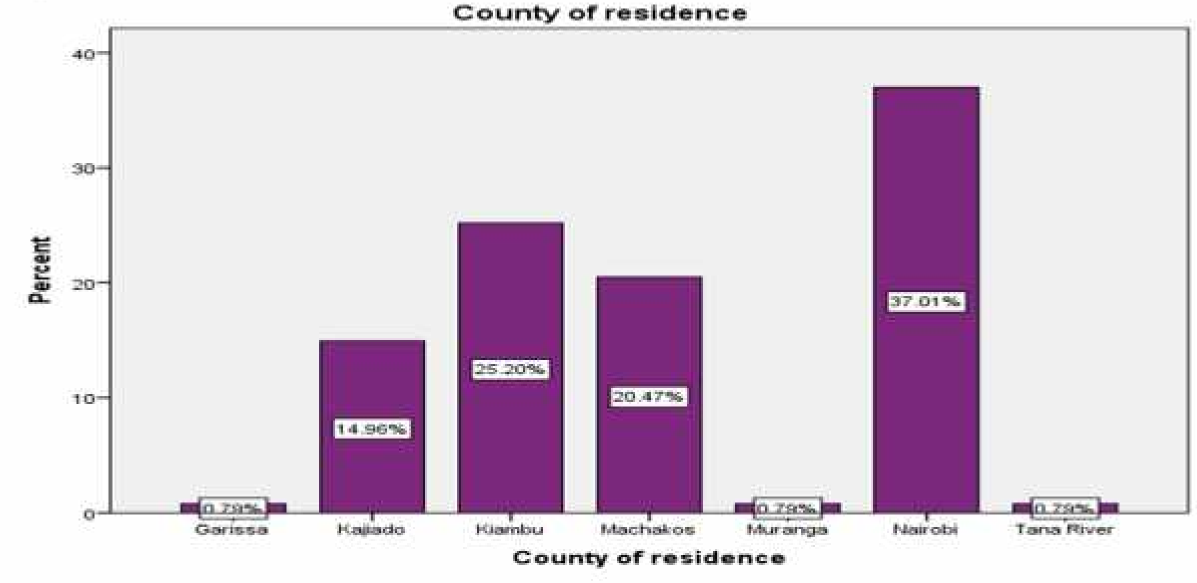


Table 4.1 c: Significance test for Gender and mechanism of injury.

One sample T- test

Test Value = 0					
				95% Confidence Interval of the Difference	
T	Df	Sig. (2-tailed)	Mean Difference	Lower	Upper
32.370	126	.000	1.252	1.18	1.33

The majority of the patients studied were males with 74.8% (95) while females were 25.2% (32). Majority of injuries on the patients were from RTA (83) followed by fall (21), gunshot (13) and assault (10). This shows that males are more exposed to injury than females. From table above we can see that the p-value is <0.001 which shows statistical significance. This confirms that males are more prone to diaphyseal femoral injury than females.

Majority of injuries were reported to be on road with 57.48% followed by residential areas with 37.8% while industrial areas were 4.72%. The one-sample t-test on table 4.2a below shows that numbers of injuries on road were higher than the other sites.

4.2 Injury details

Fig 4.2.a: Site of Injury

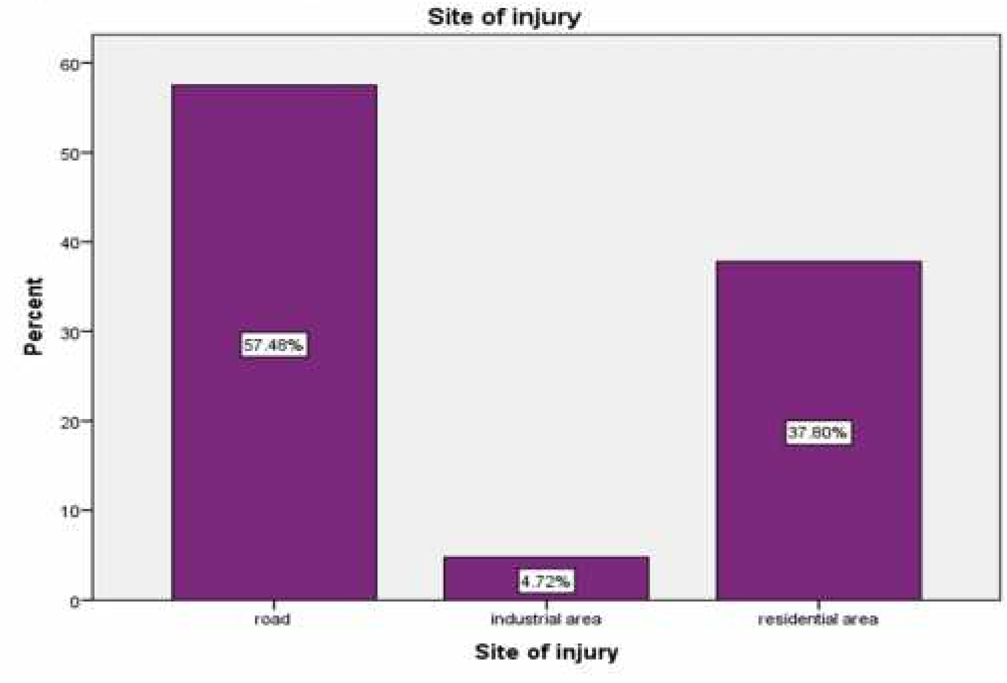


Table 4.2.b: Test of significance for injury site

One-Sample T-Test

	Test Value = 0					
					95% Confidence Interval of the Difference	
	T	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
Site of injury	21.171	126	.000	1.803	1.63	1.97

Table 4.2.c Chi square Test for Site of injury * Mechanism of injury Cross tabulation

Chi-Square Tests

	Value	Df	Asymptotic Significance (2-sided)
Pearson Chi-Square	88.699[a]	6	.000
Likelihood Ratio	98.801	6	.000
Linear-by-Linear Association	52.714	1	.000
N of Valid Cases	127		

Table 4.2.d: One-Sample T-Test

	Test Value = 0					
	T	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Type of road	26.135	126	.000	1.945	1.80	2.09

Despite the site of injury, road traffic accidents were the major cause of injuries with a total of 83 patients. Majority of injuries in the residential areas were due to fall. Gunshots were more prevalent in residential areas with 11 out of 13 cases (84.6%). 90% of the injuries were from the residential areas. The chi-square test results on table 4.2c above, shows that the results were statistically significant at a p-value of <0.001.

Table:4.2d: Type of Road

The majority of road accidents were from highway roads at 37.8% while other roads had 29.9%. The one-sample t-test on table 4.2.d, shows that the observation that the majority of accidents were from highways is statistically significant.

Means of Transport to Hospital

The majority of patients were transported to the hospitals by ambulances with 49.61% while good Samaritans vehicles had 37.8% and police vehicles accounted for 12.6%.

The majority of RTA injury patients (55) were transported by ambulances (66.3%) followed by Good Samaritans at 30.1% (25). The police transported 0.04% (3) from RTA. Majority of patients from fall injuries were transported by Good Samaritans at 71.4% (15 patients). The rest 6 (28.6%) were transported by ambulances. Majority of the gunshot injuries were transported by police vehicles with 84.6% (11 patients). The rest (2 of 13) patients were transported by good Samaritans (15.4%). It was found that 60% of the assaulted patients were transported by the good Samaritans while the ambulances and police transported 20% each. The results were statistically significant at a p-value of less than 0.001 with a chi square value of 87.258.

Time taken to arrive at triage in minutes

The average duration taken by the patients from the time of accident to triage was approximately 144$\pm$ 9 minutes (between 2hrs 15 mins and 2hrs 53mins). The variance was 10962 mins and a standard deviation of 105 mins. Meaning the duration was normally distributed.

4.3 Mechanism of injury

Fig. 4.3a Mechanism of injury

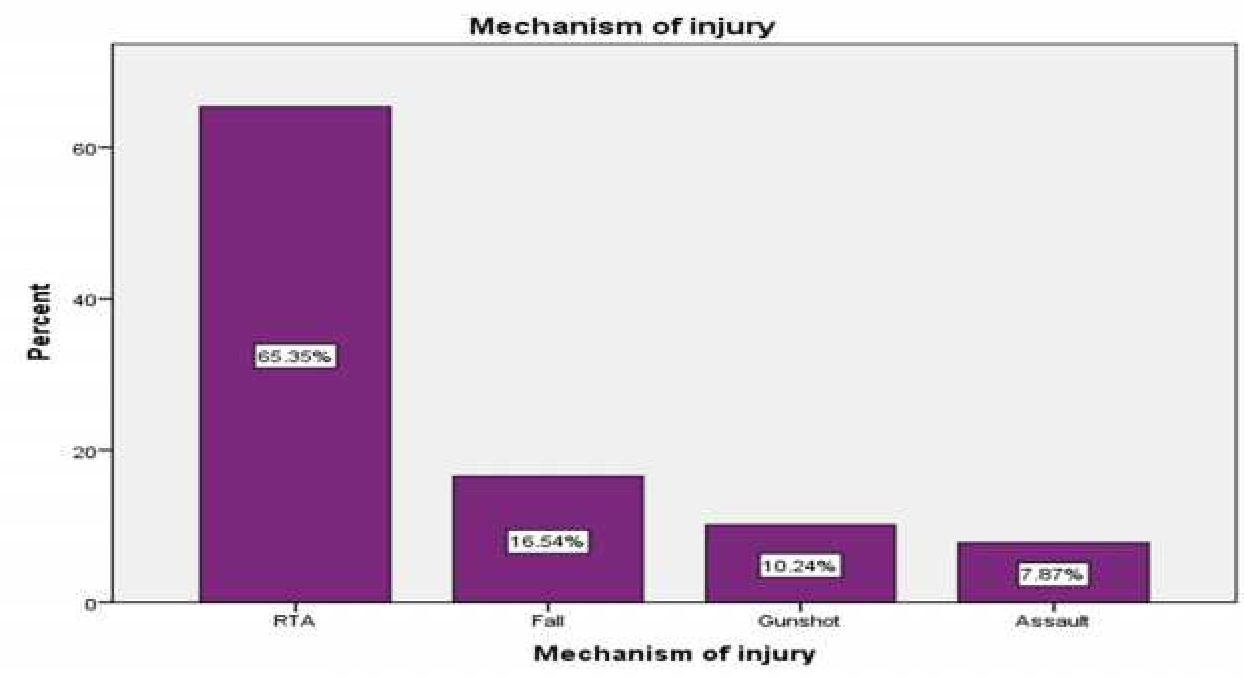


Table 4.3.b: one-sample test for significance for Mechanism of Injury

One-Sample T-Test

	Test Value = 0					
	T	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference Lower	95% Confidence Interval of the Difference Upper
Mechanism of injury	18.841	126	.000	1.606	1.44	1.78

Majority of the injuries were from road traffic accidents at 65.35% (83) followed by fall with 16.54% (21), gunshots with 10.24% (13) and assaults at 7.87% (10). The one-sample test indicates a p-value of less than 0.001. This means that the results are statistically significant.

Motor vehicle on motor vehicle and motor vehicle on motor cycle represented 15.7% each at 95% confidence interval. Motor vehicle on pedestrian accounts for 27.7% (23) which was the highest cause of RTA. This means there were many people suffering from injuries due to motor vehicles on pedestrians than any other. Motor cycle on pedestrian accounted for 19.3% (16) while motor vehicle alone accounted for 13.3% (11).

Table 4.3.c: Where the patient was for RTA victims only

		Frequency	Percent	Valid Percent	Cumulative Percent	Bootstrap for Percent[a] Bias	Std. Error	95% Confidence Interval Lower	95% Confidence Interval Upper
Valid	Pedestrian	39	47.0	47.0	47.0	.4	5.4	37.3	59.0
	Passenger	21	25.3	25.3	72.3	-.2	4.8	15.7	34.9
	Driver	22	26.5	26.5	98.8	-.2	4.9	16.9	36.1
	cyclist/rider	1	1.2	1.2	100.0	.0	1.2	.0	3.6
	Total	83	100.0	100.0		.0	.0	100.0	100.0

a. Unless otherwise noted, bootstrap results are based on 1000 bootstrap samples

The majority of RTA victims were pedestrians 47% (39) while drivers and passengers followed with 26.5% (22) and 25.3% (21) respectively.

Table 4.3.d: Whether the patient was wearing a seatbelt * Where the patient was Crosstabulation

Count

		Where the patient was				Total
		pedestrian	Passenger	Driver	cyclist/rider	
Whether the patient was wearing a seatbelt	Yes	0	8	11	0	19
	No	0	6	6	0	12
	NA	39	7	5	1	52
Total		39	21	22	1	83

Table 4.1.d above indicates that, 8 out of 21 (38%) passengers had seatbelts while 6 passengers (28.6%) had no seatbelts. It was found that 11 drivers out of 22 (50%) had seatbelts while 6 (27.3%) did not have them.

The results were statistically significant with a p-value less than 0.001 at 95% confidence interval.

Table 4.3.e: Fracture classification AO/OTA

		Frequency	Percent
Valid	32A1	9	7.1
	32A2	13	10.2
	32A3	24	18.9
	32B2	14	11.0
	32B3	28	22.0
	32C2	18	14.2
	32C3	20	15.7
	32A3, 32C2	1	.8
	Total	127	100.0

The most prevalent fracture classification was 32B3 with 22% (28) of the cases followed by 32A3 with 24 cases accounting for 18.9%. 32C3 had 20 cases accounting for 15.7% followed by 32C2 with 18 cases (14.2%). The prevalence of 32B2, 32A2 and 32A1 were at 14 (11%), 13 (10.2%) and 9 (7.1%) respectively. One person had two classifications, that is, 32A3 and 32C2 making 0.8% of the sample. These results were significant using one-sample t-test with a p-value of <0.001 at 95% confidence interval.

Table 4.3.f: Fracture type

		Frequency	Percent
Valid	Closed	85	66.9
	Open	41	32.3
	Closed, open	1	.8
	Total	127	100.0

Approximately 67% of the patients (85) had closed fractures while ~32% (41) presented with open fractures. One person (0.8%) had both open and closed fractures.

Table 4.3. g: Side involved

		Frequency	Percent
Valid	unilateral	126	99.2
	bilateral	1	0.8
	Total	127	100.0

Approximately 99% (126) of the cases were unilateral while 0.8% (1) was bilateral.

4.4 Splintage Details

Table 4.4a: Type of splint applied

		Frequency	Percent
Valid	None	12	9.4
	Cardboard	10	7.9
	wooden planks	28	22.0
	Thomas splint	33	26.0
	backslab POP	4	3.1
	Hardboard	31	24.4
	opp. Limb	9	7.1
	Total	127	100.0

Thomas splint was the most applied type of splint at 26% (33) of the cases followed by hardboard at 24.4% (31). Wooden planks were applied to 22% (28) of the cases while 9.4% (12) did not have any splint applied. 7.9% (10) of the cases were splinted by use of cardboard while 7.1% (9) were splinted using the opposite limb. Back slab was applied to 3.1% of the population which was 4 people.

Restored limb length.

30 people (23%) had their limb lengths restored.

No deformity

30 people (23.6%) had no deformity.

Adequate splint size

Only 29 people (22.8%) had an adequate splint size. (AppendixIV).

Inadequate splint size

96 people (75.6%) had inadequate splintage.

Table 4.4b: Cadre of staff applying splint

		Frequency	Percent
Valid	nursing officer	20	15.7
	orthopaedic technician	12	9.4
	EMS staff	38	29.9
	Unknown	54	42.5
	Total	124	97.6
Missing	System	3	2.4
Total		127	100.0

Majority (54) of the persons applying splint were not known to the patients which accounted for 43.5%. The known persons accounted for 56.5% with EMS staff making 30.6% (38), nursing officers 16.1% (20) and orthopaedic technicians making 16.1% (20). None of the splints were applied by medical officers or subordinate staff.

Approximately 55% (67) of the staff applying the splint had no previous training on femoral immobilisation. However, 31% (38) had previous training on femoral immobilisation. 14% (17) of the population were unknown and hence their previous training could not be established.

Table 4.4c: Visual analogue scale of pain intensity.

		Frequency	Percent
Valid	mild, annoying pain	23	18.1
	nagging, uncomfortable, troublesome pain	9	7.1
	distressing, miserable pain	34	26.8
	intense, dreadful, horrible pain	50	39.4
	worst possible, unbearable,excruciating pain	11	8.7
	Total	127	100.0

Majority (50) of the sample making 39.4% reported to have intense, dreadful and horrible pain while 34 patients (26.8%) reported to have distressing, miserable pain. 18.1%(23) had mild and annoying pain while 8.7%(11) had worst possible, unbearable, excruciating pain. Only 7.1% (9) reported to have nagging, uncomfortable and troublesome pain.

4.5 ASSOCIATIONS

Table 4.5a: previous training and adequacy of the splint

Variables in the Equation

		B	S.E.	Wald	Df	Sig.	Exp(B)
Step 1	Prev training	3.433	.611	31.588	1	.000	30.972
	Constant	-4.091	.848	23.282	1	.000	.017

The health workers who had previous training were thirty-one (31) times more likely to put adequate splintage as compared to those with no previous training.

Table 4.5 b: relationship between carder and adequacy of splint

Variables in the Equation

		B	S.E.	Wald	Df	Sig.	Exp(B)
Step 1[a]	Nursing officer	21.822	5323.678	.000	1	.997	3000165343.783
	Ortho tech	22.812	5323.679	.000	1	.997	8077368233.261
	Ems staff	19.529	5323.678	.000	1	.997	302901308.747
	Constant	-107.123	26618.392	.000	1	.997	.000

a. Variable(s) entered on step 1: Nursing officer, Ortho Tech, Ems Staff

The results of cadre of staff against the previous training were not significant as shown in table 4.5b above.

Table 4.5 c: Relationship between splintage device and adequacy of splint

Variables in the Equation

		B	S.E.	Wald	Df	Sig.	Exp(B)
Step 1	Cardboard	-18.805	12710.151	.000	1	.999	.000
	Wooden planks	-.898	1.459	.379	1	.538	.407
	Thomas splint	3.710	1.128	10.819	1	.001	40.857
	Backslab POP	-18.805	20096.496	.000	1	.999	.000
	Opposite limb	-18.805	13397.623	.000	1	.999	.000
	Hardboard	-1.003	1.457	.474	1	.491	.367
	Constant	111.610	54586.167	.000	1	.998	2.963E+48

The results show Thomas splint was forty one times more likely to offer adequate Splintage as compared to no splint (p-value of <0.001) at 95% confidence interval. Other devises showed no statistically significant results.

Table 4.5d: Relationship between splintage devices and restoring limb length

Variables in the Equation

		B	S.E.	Wald	Df	Sig.	Exp(B)
Step 1[a]	Cardboard	-18.805	12710.107	.000	1	.999	.000
	Wooden planks	-18.805	7595.755	.000	1	.998	.000
	Thomas splint	3.710	1.128	10.819	1	.001	40.857
	Backslab POP	-18.805	20096.553	.000	1	.999	.000
	Opposite limb	-18.805	13397.683	.000	1	.999	.000
	Hardboard	.164	1.208	.018	1	.892	1.179
	Constant	145.089	56660.922	.000	1	.998	1.027E+63

a. Variable(s) entered on step 1: cardboard, wooden, thomassplint, backslabpop, opposite limb, hardboard.

The result shows that Thomas splint is forty one times more likely to restore limb length as compared to no application of any splint. It contributed positively on restoration of limb length (p-value <0.001). other splintage devices' contribution to restoration of limb length were not statistically significant.

5.0 CHAPTER FIVE: DISCUSSION

From the results analyzed, it was found that the median age of patients was 33 years and mode was 28 years. The majority of the patients were young people between the age of 18 and 38 years. This is in keeping with what is found internationally in Finland (25) and regionally in Nigeria, Ethiopia and Tanzania (6) (7) (8) (18).In this study 74.8% of patients were male with 25.2% being female. This too is in keeping with international and regional statistics (5) (6) (7) (8) (18).

The majority of the people were from Nairobi County which can be explained by the location of the facility. The neighbouring counties of Kiambu, Machakos and Kajiado also contributed to the number of patients by 25.2%, 20.47% and 14.96% respectively. Approximately 63% of the injuries were from outside Nairobi County. KNH being located in the capital city with an advanced roads network compared to other counties explains why majority of patients were from within the county when considering patient's county of origin. However, the surrounding counties in total contributed the majority of patients due to KNH being a tertiary referral center.

The most common cause of diaphyseal fracture femur for patients presenting at KNH was RTAs at 65.35% followed by falls at 16.53%.This is in keeping with the internationally recorded range of 57-74% (5). The aetiology of the fractures is similar to that found by Chaudhaery et al in Nepal, India where falls come second to RTAs (26). This differs from Finland where Rokkanen found industrial accidents to be second to RTAs (25). This can be explained by the higher mechanization of industry in Finland compared to Kenya. Enforcement of traffic rules and regulations is also very strict in Finland. Recklessness and lack of education on injury prevention can also lead to the local setting having more RTAs (23).

Regionally, the most common cause of femoral fractures was RTAs followed by falls from height as was seen in Nigeria, Ethiopia & Tanzania (6) (7) (8) (18). This was in keeping with the current study. Roads accounted for 57.48% of these fractures with majority occurring on highway roads (37.8%) as opposed to other roads (29.9%). This was statistically significant as per the one sample T-Test.

In this study, pedestrians were at highest risk of femoral fractures accounting for 47% of samples in keeping with a paper on admissions by Atinga, Saidi et al (9).

Majority had comminuted fractures with a AO/OTA classification of 32B3(22%) and 32C3(15.7%). This was similar to a study in India by Deepak listing majority of fractures as comminuted (40). The cause of majority of the fractures being RTAs indicates high energy transfer leading to these more comminuted fractures occurring. In the USA,Wolinsky reported 51% oblique and 29% transverse (39). With majority of the victims in this study being pedestrians, the high rate of comminution can be explained by the energy transfer from a vehicle.

Ayorinde in Nigeria noted that a majority of patients were transported to hospital by non-medical personnel (16) .In this study 49.6% of patients were transported via ambulance with 37.7% being brought by good Samaritans.The average duration taken by the patients from the time of accident to triage was approximately 144$\pm$ 9 minutes (between 2hrs 15 mins and 2hrs 53mins). The variance was 10962 mins and a standard deviation of 105 mins. Meaning the duration was normally distributed. With the increasing number of available ambulances as well as insurance cover for individuals, the situation here is bound to improve.

Thomas splint was the most applied type of splint at 26% (33) of the cases followed by hardboard at 24.4% (31). Wooden planks were applied to 22% (28) of the cases while 9.4% (12) did not have any splint applied. It was found that 7.9% (10) of the cases were splinted by use of cardboard while 7.1% (9) were splinted using the opposite limb. Back slab was applied to 3.1% of the population which was 4 people.In this study, 26% of patients had adequate application of a Thomas splint leading to good pain control as was confirmed with the Visual Analogue Scale.

Majority (54) of the persons applying splint were not known to the patients which accounted for 43.5%. The known persons accounted for 56.5% with EMS staff making 30.6% (38), nursing officers 16.1% (20) and orthopaedic technicians making 16.1% (20). None of the splints were applied by medical officers or subordinate staff.

Approximately 55% (67) of the staff applying the splint had no previous training on femoral immobilization. 31% (38) had previous training on femoral immobilization. 14% (17) of the population were unknown and hence their previous training could not be established.

Health workers who had previous training were thirty one more times likely to apply adequate splintage compared to those with no previous training. A study done in Australia by Chu et al reported 7.3% application of the Thomas splint (38) whilst in South Africa Maqungo et al reported 37.5% application rate (35). With improving ambulance services and provision of a Thomas splint or femoral immobilizer, the rates of adequate immobilization should improve in the local setting.

6. Conclusion and recommendations.

Majority of the patients in the local setting are young males who were victims of RTAs along highways. Most fractures have a comminuted pattern and transport to hospital from the accident scene is mainly by ambulances.

Thomas splint is largely used to immobilize these fractures with the rate of adequate immobilisation of diaphyseal femoral fractures at Kenyatta National Hospital standing at 26%. This is low compared to international studies. Good Samaritans account for the majority of non-Thomas splints applied.

Recommendations

1. First aid and injury prevention training of the public.
2. Provision of Thomas splints or femoral immobilisers in ambulances to facilitate adequate splintage.
3. Public education on the need to call for an ambulance to the accident scene so as to transport victims to hospital in the recommended way.

Disclaimer

I, Dr Allan Ngugi, have not received any financial benefits or incentives from any party or individual that may benefit from this study.

7.0 CHAPTER SEVEN: REFERENCES

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TIME FRAME

	TIMELINE
BACKGROUND READING, LITERATURE REVIEW AND RESEARCH METHODS PLANNING	SEPT-DEC 2017, FEB 2018
STUDY PROPOSAL PRESENTATION	FEBRUARY 2018
SUBMISSION FOR ETHICAL APPROVAL	MARCH 2018
DATA COLLECTION AND ANALYSIS	JUNE 2018 TO AUGUST 2018
THESIS WRITING AND PRESENTATION	SEPTEMBER 2018

BUDGET

Stationery	Ksh 40 000
Statistician fee	Ksh 30 000
Assistants	Ksh 50 000
Miscellaneous	Ksh 20 000
Total-	Ksh 140 000

8.0 APPENDICES

Appendix I: Femoral Fractures Questionnaire

Biodata:

Study No:

X-ray No:

Please fill in the following details:

Patient's Details:

1) D.O.B
2) Sex ☐Male ☐ Female
3) Residence: County……………………………. Town/Village

Injury Details:*(Select one)*

4) Approximate time of injury:

   ……………………………………………..
5) Injury site:

   ☐ Road ☐ Industrial area ☐Residential area
6) In (5) above, if road:

   ☐ Highway ☐Others
7) Means of transport to hospital:

   ☐Ambulance☐Police ☐Good Samaritan vehicle
8) Time on arrival at triage.

   …………………………………….

Mechanism of Injury Details:

9) Mechanism of Injury:

   ☐RTA ☐Fall ☐Gunshot ☐Assault

10) In RTA above:

☐MV on MV ☐MV on MC ☐MV on PD ☐MV on BC

☐MV alone

☐MC on MC ☐MC on BC ☐MC on PD MC alone

☐BC alone

11) In RTA, was the patient a:

☐Pedestrian ☐Passenger ☐Driver

12) In RTA, was the patient wearing a seatbelt?

☐Yes ☐No

13) Fracture classification- AO/OTA

☐ 32A1 ☐ 32A2 ☐ 32A3

☐ 32B2 ☐ 32B3

☐ 32C2 ☐ 32C3

14) Fracture type ☐ Closed ☐ Open

15) Side involved ☐ Unilateral ☐ Bilateral

Splintage Details:

16) Splint applied:

☐None ☐Cardboard ☐Wooden planks

☐Thomas splint ☐ Backslab POP ☐ Hardboard

☐ Opp. Limb ☐ Femoral Immobiliser

17) Adequacy of Splint applied:

☐ Restored limb length ☐ No deformity ☐Adequate splint size

18) Cadre of staff applying splint:

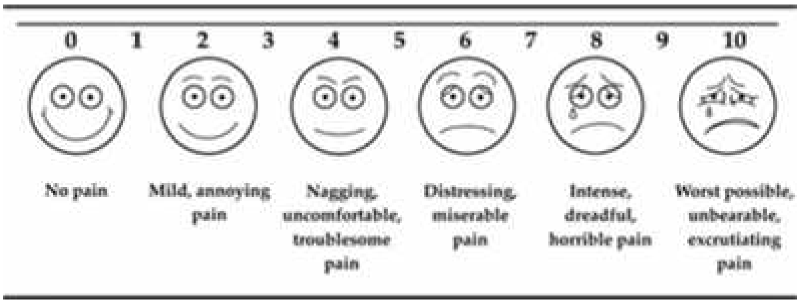
☐ Medical Officer ☐ Nursing officer ☐ Orthopaedic technician

☐ Subordinate staff ☐ EMS staff ☐ Unknown

19) Previous training on femoral immobilisation:

☐ Yes ☐ No

20) Visual Analogue Scale of pain intensity:



Appendix II: Consent Form (English)

STUDY ON EARLY IMMOBILISATION OF DIAPHYSEAL FEMORAL FRACTURES AT KNH

Dr Allan Ngugi, a post graduate student in orthopaedic surgery at the University of Nairobi, is conducting a study on early immobilization of diaphyseal femoral (thigh bone) fractures at KNH and would like to recruit you into the study. Your participation will involve you giving information concerning your age, circumstances surrounding your injury, transport to hospital and method employed in securing the broken bone.

Your participation in this study is on a voluntary basis and should you wish to withdraw from the study at any point then you will be at liberty to do so.

Your participation in this study will be kept in confidence and your actual name will not be used in the study. Confidentiality of information obtained from you will be protected through such processes as using code numbers for concealed identity and limiting the number of people with access to the information.

The benefits to you for being involved in the study include proper immobilization of your injured limb to the recommended standard.

There are no risks from you getting involved in this study. The study findings will not be used for any monetary gains.

Should you decide to withdraw from the study at any point, you will not be subjected to any discriminatory treatment. Should you require any further information or clarification then the main researcher may be contacted using the contacts on the consent certificate/form.

Consent Certificate

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

Participant's Signature (or thumbprint)………………………. Date……………

I confirm that I have clearly explained to the participant the nature of the study and the contents of this consent form in detail and the participant has decided to participate voluntarily without any coercion or undue pressure.

Investigator's Signature………………………………. Date ……………………

Witness Signature...Date................................

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Appendix III: Consent Form (Swahili)

UCHUNGUZI WA NAMNA TOFAUTI ZINAZOTUMIKA KUSITIRI MFUPA WA PAJA ULIOVUNJIKA KATIKA HOSPITALI KUU YA KENYATTA.

Daktari Allan Ngugi, anayesomea udaktari wa mifupa kwenye chuo kikuu cha Nairobi, anafuatilia upelelezi wa jinsia tofauti zinazotumika kusitiri mfupa wa paja uliovunjika katika hospitali kuu ya Kenyatta. Usaidizi wako utahusu wewe kutueleza mambo kadhaa kama vile, mwaka wako wa kuzaliwa na kutuelezea ulipopatana na ajali, namna ajali ilivyotokea, ulivyo safirishwa hadi hospitali na namna iliyotumika kuusitiri mfupa wa paja uliovunjika.

Kuhusika kwako katika upelelezi huu ni kulingana na mapendeleo yako na sio lazima, na isitoshe, unaweza kujiondoa kutoka upelelezi huu kwa wakati wowote.

Kuhusishwa kwako katika upelelezi huu ni jambo la siri baina yako na mpelelezi, na jina lako halitatumika kwenye upelelezi. Matokeo ya upelelezi huu yatakua ni ya siri kati yako na mpelelezi mkuu, na siri hii itawekwa kwa njia tofauti kama vile kutumia nambari za siri badala ya majina yako, pamoja na kuhusisha wasaidizi wachache katika upelelezi huu.

Fadhili utakayoipata ni kusitirishwa mfupa wa paja kwa njia inayofaa kama utapatikana kutositirishwa vyema.

Hakuna hatari au mashaka yanayoweza kutokana na upelelezi huu. Hakuna faida ya pesa zozote ambazo zitapatikana kutokana na upelelezi huu.

Ukihitaji kujiondoa katika upelelezi huu uko na ruhusa kufanya hivyo kwa wakati wowote.

Ukihitaji maelezo zaidi unaweza kuwasiliana na mpelelezi mkuu kwa anwani, barua pepe au simu zilizoandikwa hapa chini.

Fomu ya Idhini

Nimekubali kwamba nimeelezwa kikamilifu kuhusu utafiti huu na nimekubali kushiriki.

Sahihi...Tarehe..

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

Sahihi ya mchunguzi………………………………Tarehe………………………

Sahihi ya shahidi…………………………………...Tarehe……………………..

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Appendix IV: Standardized Application of a Thomas Splint(33)

The present splint consists of a padded oval metal ring covered with soft leather, to which are attached inner & outer sidebars. These sidebars which exactly bisect the oval ring are of unequal length so that the padded ring is set at an angle of about 120 degrees to the inner sidebar.

At the distal end the two sidebars are joined together by a bar in form of a “W” to which the traction cords are secured to prevent slippage. The outer sidebar is often angled out 2 inches below the padded ring to clear the prominent greater trochanter.

Choosing a Thomas Splint

1. Measure the oblique circumference of the thigh immediately below the gluteal fold &ischial tuberosity. This measurement equals the internal circumference of the padded ring. To avoid causing pain, measure the oblique circumference of the normal thigh. Add 2 inches to this measurement if there’s much swelling of the injured thigh.
2. Measure the distance from the crotch to the heel and add 6-9 inches. This distance equals the length of the inner sidebar.

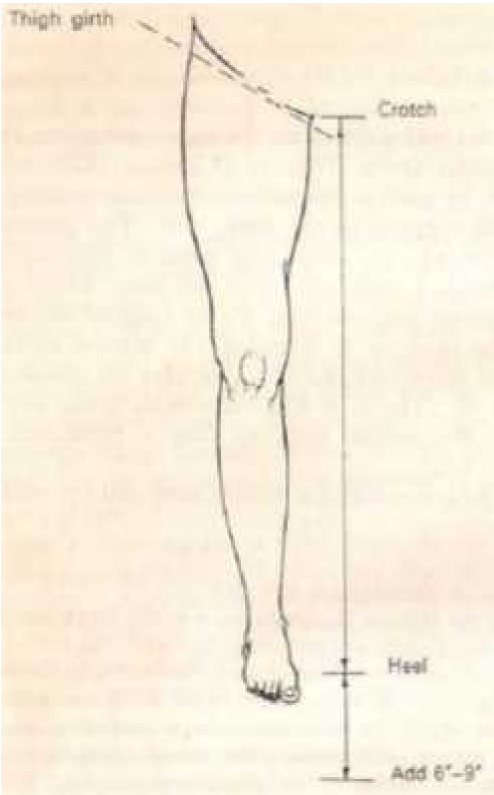

Fig 1(33)

Preparing a Thomas splint

1. Fashion the slings, between the sidebars, on which the limb can rest. Cut an adequate length of 6 inch wide gauze roll. Pass the length of gauze roll around the inner sidebar then pass both ends above the outer sidebar.

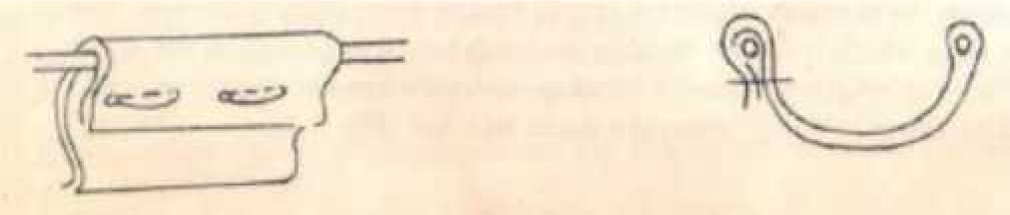

Fig 2(33)

Fasten the 2 ends to the sling so formed with 2 large safety pins or toothed clips. Ensure uniform support of the limb, and to avoid excess pressure in the region of the neck of the fibula and the tendocalcaneous.

The proximal sling leaves a triangular area thigh unsupported because of the obliquity of the ring of the splint with the sidebars. This triangular area can be supported by passing the length of gauze roll bandage around the ring of the splint as well as the sidebars.

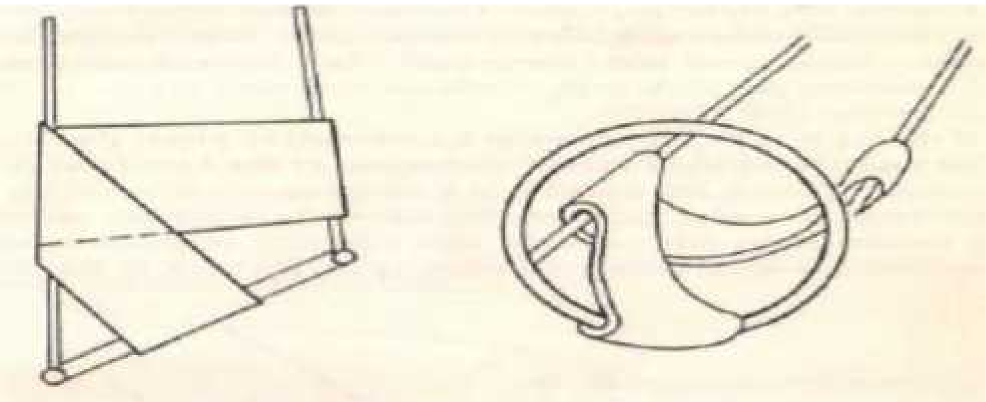

Fig 3(33)

The distal sling must end 2.5 inches above the heel to avoid pressure sores developing over the tendoarchilles.

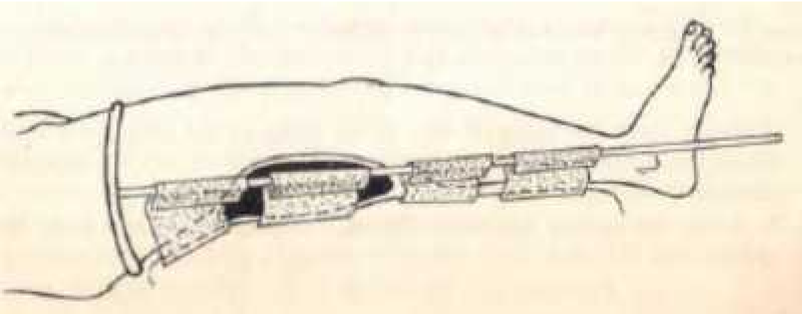

Fig 4(33)

The slings tend to slip distally on the sidebars of the Thomas splint. This can be prevented by pinning each sling to the one above or by binding the sidebars with zinc oxide strapping before applying the slings.

2. Line the slings with the orthoband.
3. Fashion one large pad from orthoband or cotton wool measuring about 6x9 inches and be about 2 inches thick when compressed. This pad is placed transversely under the lower part of the thigh to maintain the normal anterior bowing of the femoral shaft.
4. After the splint has been fitted, bandage the limb to the splint.
5. Using gauze roll, secure the limb at the ankle and tie the gauze to the distal end of the splint this applying traction to the limb. Alternatively, adhesive tape can be applied on the leg and the cords attached to it secured to the distal bar of the Thomas splint and traction applied.

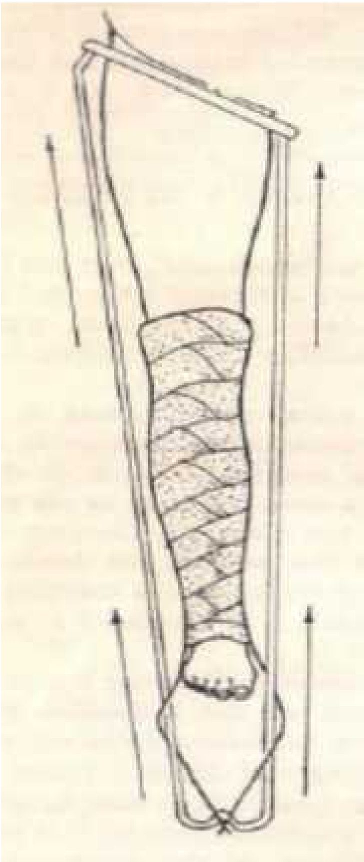

Fig 5(33)