

OUTCOME OF SKELETAL TRACTION IN PATIENTS
WITH FEMORAL SHAFT FRACTURES AT KENYATTA
NATIONAL HOSPITAL

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A dissertation submitted in partial fulfilment of the requirements of the degree of Master of Medicine in Surgery of the University of Nairobi

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DECLARATION:-

I hereby certify that this dissertation is my original work and has not been submitted in any other university.

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DEDICATION

This dissertation is dedicated to my parents, my wife and children whose patience and encouragement has enabled me complete this study.

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LIST OF ABBREVIATIONS

KNH	KenyattaNationalHospital
SPSS	Statistical Package for Social Sciences
UON	University Of Nairobi
PTI	Pin Tract Infection
MOF	Multiple Organ Failure
ARDS	Acute Respiratory Distress Syndrome
RTA	Road Traffic Accidents
DVT	Deep Venous Thrombosis
PE	Pulmonary Embolism
RCT	Randomized control Trial
UTI	Urinary Tract Infection
VTE	Venous Thromboembolism
ORIF	Open Reduction Internal Fixation
ROM	Range of Movement
LOS	Length of Stay
MVA	Motor Vehicle Accidents
ORIF	Open reduction and internal fixation

DEFINITION OF TERMS AND TERMINOLOGIES/ KEY WORDS :-

1. Outcomes :- An event or something that follows from an action, situation, result or consequence and in the context of this study it refers to functional outcomes e.g. for range of knee motion following a period of skeletal traction, and also to determine what proportion of patients will develop complications related to the fracture healing (e.g. non union, mal-union), insertion of the steinmann pin or because of immobility.
2. Skeletal Traction:- one of the two basic kinds of traction used in orthopedics for the treatment of fractured bones and the correction of orthopedic abnormalities. Skeletal traction is applied to the affected structure by a metal pin or wire inserted into the structure and attached to traction ropes. Skeletal traction is often used when continuous traction is desired to immobilize, position, and align a fractured bone properly during the healing process.
3. For purposes of this study, the shaft of the femur will be defined as: the distance between 5 cm distal to the lesser trochanter and 6 cm proximal to the most distal point of the medial femoral condyle (dencker 1963).
4. Pin Tract Infection :- Infection of the pin tract is one of the complications that may develop with skeletal traction, and careful scrutiny of pin sites is an important precaution. Some common signs of infection of the pin tracts are erythema, drainage, noxious odor, pin slippage, temperature elevation, and pain

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ABSTRACT :-

Background: -

Road traffic accidents are a leading cause of trauma in Kenya (1). Many of the victims have multiple injuries with a significant proportion having femoral fractures (2).

While early fracture fixation is advocated to ease pressure on costs and morbidity associated with prolonged hospitalization, this is not possible for all patients who present at KNH due to a variety of factors. Majority have to be on prolonged periods of skeletal traction as they await internal fixation while in others, it is the definitive treatment.

While the spectrum of complications associated with skeletal traction is known, there are no studies to show the burden of these complications at KNH and hence justify continued use of skeletal traction for patients awaiting surgery.

Objective :

To determine the incidence of complications associated with skeletal traction in patients with femoral shaft fractures at KNH and analyse their occurrence in relation to the duration of traction.

Study Design and Setting:-

This was a prospective, descriptive study of convenience sampling method of patients admitted with femoral shaft fractures during a 3-month period in the orthopaedic wards at KNH.

Patients and methods:

Consecutive adult patients admitted with femoral shaft fractures of either sex on skeletal traction for more than two days as they awaited internal fixation were recruited.

Data collected included the patient demographics, duration of skeletal traction, other associated injuries, cause of the fracture, fracture geometry and occurrence and time of onset of complications directly related to skeletal traction. The outcome measure was the occurrence of one or more complications associated with skeletal traction. Significant variables measured included PTI; knee stiffness; quadriceps muscle atrophy and pneumonia.

Results:

Seventy five patients with femoral shaft fractures on skeletal traction were recruited. Transverse and comminuted fracture patterns were the most common accounting for 41.3% and 37.3% of the fractures

respectively. Ninety six percent of the patients were managed on Perkins mode of traction, whilst the mean duration on traction was 4.7 weeks. Prevalence of PTI was 24% occurring most commonly during the 5th and 6th week on traction, PTI was significantly associated with comminuted fractures with 42.9% of the patients with this fracture pattern developing PTI. Knee stiffness was the most common complication and 62.7% of the study population had stiffness by the 4th week on traction. Only 36% of the patients got reduction in their thigh circumference from the time of onset of traction.

PTI was significantly associated with prolonged durations of traction as patients who developed PTI were on traction for average of 6.7 weeks as compared to 4.25 weeks for those who did not develop any PTI. Patients who were on traction for an average of 2.7 weeks were at a lower risk of developing knee stiffness as compared to those on traction for 5.6 weeks.

Conclusion:

Knee stiffness and pin tract infection were the most common complications associated with skeletal traction with the latter associated more with comminuted fractures. The incidence of these two rose significantly from the fourth week of traction.

INTRODUCTION

Fracture management has evolved such that early fixation is now advocated due to a better understanding of the metabolic response to trauma and also to cut on costs of hospitalization. In a resource-poor setting such as Kenya, shortage of theatre space and cost of implants prevent early fixation of all trauma patients presenting to hospitals, hence the primary management modality is skeletal traction. In many developing countries conservative treatment of fractures is still a viable option. However teaching of conservative fracture methods is under – emphasized thus making it difficult for doctors and other health workers to learn the art of conservative fracture treatment (3). Results of conservative fracture treatment have been poor when compared to open reduction and internal fixation. Conservative fracture treatment is mostly left/assigned to the junior health care personnel available, and as such it has become synonymous with the application of plaster of Paris cast or Steinmann pin for traction then “forgetting” the patient for a designated period. This is despite the fact that more than 90% of patients with fractures in many developing countries will be treated by conservative methods (5).

In developing countries, shortage of surgeons, of appropriate, affordable equipment and implants, and reliable clean surgical environments increases the risks of surgical complications of orthopaedic procedures often to unacceptable levels. Conservative management of femur fractures with traction remains a viable option and often the only option for cost-sensitive developing countries (5). Extended lengths of skeletal traction are associated with several complications either as a result of traction or prolonged immobilization. When properly applied, conservative treatment gives good and acceptable results, and it is the “gold standard method” of care. It should always be remembered that operative results should be compared to those of conservative treatment, not the other way around [6].

LITERATURE REVIEW

The use of skeletal traction at KNH for management of femoral shaft fractures has continued despite adoption of newer techniques in the hospital in recent years, such as locked femoral nailing, in addition to the older techniques such as plating (51).

In a study by Saidi et al the average length of hospital stay was fourteen days, this is much longer than in reports from established trauma facilities. In a study at the Vancouver General and Teaching Hospital in Canada, the length of hospital stay in 1997 was 9.14 days despite caring for patients with more severe injuries (24% with ISS > 16) versus 13.4% with ISS > 15 in the KNH-based by Saidi et al(2,7).The prolonged length of hospital stay at KNH was caused by predominance of skeletal injuries. Long bone fracture fixation was performed late; which was occasioned by an initial period of non-operative care, that would last up to 4 weeks, delays were also caused by time spent to raise funds for desired implants (2).

Majority of the patients pay for the services out of their pockets [8]. If a policy of early fracture treatment incorporating a care reimbursement system that does not delay the operative intervention is introduced, the average length of stay may improve. Early fixation prevents pulmonary complications, alleviates pain, eases nursing care, reduces complications, and allows early rehabilitation and return to work[9].

Isotonic skeletal traction through a Steinman pin was popularized by Bohler and his students (10). Many centres worldwide employ skeletal or skin traction temporarily before surgery (11). Traction reduces pain at the fracture site, aligns and maintains tissue length and hence making operative reduction easier (11,12). It however has potential disadvantages, including making nursing of the patients more difficult, for instance use of a bed pan by the patient, pressure area care prior to surgery. Complications associated with skeletal traction are sepsis at the pin site, knee stiffness and pulmonary complications because of the prolonged immobilization(13).

In the last two decades there has been a major shift towards open and closed operative management of femoral fractures (14). Operative management gives better results than non-operative management in terms of anatomical; functional outcomes and complication rates (15,16). In developing nations there is an enormous trauma burden and lack of standard, affordable equipment and implants are a hindrance to operative management and hence skeletal traction remains a viable option (3).

Several studies have been done to determine the usefulness of pre-operative traction, in patients with proximal femoral fractures (13,18). Traction prior to surgery is standard practise in some hospitals, a survey of 78 hospitals in Sweden showed that a quarter of those, routinely applied skin traction to all patients with hip fractures (12), while another survey done by Brink et al found that pre-operative traction was standard practise in 20% of trauma departments in the Netherlands(11).

In these studies skin traction is used mainly and the patients were on traction for a maximum duration of 2.3 days(11), comparatively in our setting, patients are on skeletal traction for two to three weeks atleast prior to internal fixation (2). In this study only 4 patients were put on skeletal traction of the total patients put on traction, reasons for the difference are not given (11).

From the Cochrane review article on the pre-op benefits of traction, not many studies have looked at the complications of patients put on skeletal traction. The main outcome measures in these studies were degree of pain, analgesia use, length of surgery, ease of fracture reduction, and incidence of pressure sores and other complications were secondary objectives (19,20).

One of the earliest accounts of complications of skeletal traction is by Kirby & Fills (21). They mainly looked at complications associated with trans-fixation pins and wires in skeletal traction, from a series of 305 fractures of long bones, complications occurred in 12, of these only 3 were related with Steinman pin use; one of the patients had pin tract infection (PTI), and 2 had peroneal nerve palsy, however the author

clearly states many patients who had a little drainage from the pin but no signs of inflammation were not regarded as pin tract infection.

The definition and incidence of PTI in the literature is quite variable. Pin tract infection is defined as an abnormal condition associated with skeletal traction or external fixation devices and is characterized by infection of superficial or deeper soft tissues or by osteomyelitis. Some of the signs of pin tract infection are erythema at the pin sites, drainage, pin loosening, elevated skin temperature, and tenderness. Factors which predispose to pin tract infection are thermal necrosis and accumulation of fluid around the pin. Regular pin care prevents crusting around the pins, thus minimizing fluid accumulation and hence transmission of bacteria, within the underlying sterile tissues(22,23,24).

Patients who are put on skeletal traction are at risk of morbidities associated with prolonged bed rest. A feature peculiar to these patients is morbidities associated with pin tract infections, which results in pain, pin loosening and subsequently need for removal of the pin. Neglect in these cases can lead to abscess formation and osteomyelitis (22). The prevalence of pin tract infection varies dramatically in the literature from a 1% prevalence of major infections to an 80% prevalence of minor infections (26). Reported incidence in the world literature on pin tract infection is averaged to be 5-10% (25). Even in the study identified by the Cochrane review (27), the prevalence of pin tract infection varied, based on the treatment of pin sites, from 8-25% (28).

In most studies that have looked at pin tract infection it has been noted that there is no standard definition of a pin tract infection, hence the possible reason for the wide variation of PTI prevalence. PTI was reported as simply inflammation around the pin site in one series and it was noted that upto 41.6% of patients in that study had a PTI (29). It can be additionally defined as cellulitis around the pins or as sero-purulent discharge from the pin sites or as pin loosening. In 1962 Procter from South Africa reported his series of 41 patients who were on Perkin's traction for femoral shaft fractures; PTI was found in 15% of

the patients, while in a study by Usdin a few years later on 58 patients on Perkin's traction, only 8.6% developed pin tract infection (31). More recently, In Sierra Leone, Gosselin (32), in a series of 53 patients 42.6% of the patients had a pin tract infection at an average 29 days after being put on traction. Bezabeh and Wamisho (5) in Ethiopia from a total of 68 patients diagnosed pin tract infection in 11.8% of patients.

Other complications associated with skeletal traction are decubitus ulcers, venous thrombo-embolism, knee stiffness and pneumonia. There is sparse literature on the occurrence of these complications in association with skeletal traction.

Butt et al, (33) in a randomised control trial of operative versus non-operative treatment of distal femoral fractures found that in the non-operative arm, a total of 26 patients developed complications. Three of these patients had venous thrombo-embolism, 4 had chest infections, 4 had pressure sores, 4 had UTI's and 5 out of 26 patients developed pin tract infection.

Immobility is associated with increased risk of VTE, decubitus ulcers and pulmonary complications. Bed rest is a highly un-physiologic form of therapy and can lead to a number of complications. Decreased respiratory excursion and stasis of secretions leads to atelectasis and pneumonia, lesser muscle contractions of the lower limbs results in reduced venous return, venous stasis and VTE. Pressure sores develop because of prolonged pressure on bony prominences. Sores occur in relation to the amount of time soft tissue is compressed against underlying bone and the amount of pressure exerted on the patients skin (34,35). After a femoral fracture, patient's cannot bear weight and are bedfast on their back; the same body sites are therefore continually subjected to pressure until after surgery, when the incidence of sores diminishes (36). Therefore patients who are on extended periods of skeletal traction are at an increased risk of developing pressure sores at the calcaneal, sacral, ischial sites.

Respiratory problems are common after long bone fractures, fat embolism syndrome is commonly seen in long bone fractures(37), followed by respiratory dysfunction and insufficiency (38).

Despite the development of medical and anesthetic management, evidence indicates that early treatment of the fractures in a multiply injured patient has a profound effect in reducing the risk of subsequent respiratory complications (38,39, 40).There are numerous studies showing that early fixation of femoral fractures can decrease the incidence of ARDS and multiple organ failure (MOF) (41,42,). Over the last decade the beneficial effects of early stabilization of femoral shaft fractures by intra-medullary nailing have been challenged. The association between early femoral fixation with reamed nailing and a higher risk of ARDS/MOF has been suggested (30,37,).

A prospective study showed that among 178 patients, the incidence of pulmonary complications was significantly higher in those with late stabilized fracture (42). In patients with a single fracture, the complication rate after late fixation was 22% in comparison with 4% after early stabilization. In patients with multiple fractures, the rates ranged between 100% and 32%, respectively (43, 44).Early fixation can lead to the prevention of thrombosis, subsequent bed ulcers, and decreases the need for analgesics (45, 46).Furthermore, early stabilization eliminates the need for supine position for skeletal traction, it improves pulmonary function and prevents atelectasis(41,46,47).

Severely restricted knee motion is a recognized complication of operative procedures or trauma around the knee. This is a significant problem in underdeveloped countries where the initial management of many of these injuries is suboptimal. The reported rate of significant knee stiffness after various injuries and procedures around the knee is as high as 11% in well established centers, but it may be much higher in underdeveloped countries, where trauma facilities are not adequate(48). A large percentage of these cases present with adhesions inside as well as outside the knee, and the management of these cases then becomes complex (49).

Reconditioning, loss of skeletal muscle mass and strength, is often seen because of immobilization, there is bone demineralization due to absence of weight bearing stress on the skeleton and joint contraction occurs because of muscle atrophy. Loss of extension is labeled more debilitating in western cultures, with small extension deficits impeding normal walking; restricted flexion however is a serious problem in the Asian countries, where social and religious morals make sitting on the ground a normal requirement of everyday life. Flexion loss is mostly due to intra-articular fibrosis and scarring in the quadriceps-femoral mechanism. Anterior adhesions involve the quadriceps expansion in the lateral and medial recesses, the supra-patellar bursa, muscle adhesions to the femur, patella, or even shortening of the rectus femoris (49).

Procter et al studied 41 patients on Perkins traction, all the patients had full knee ROM at a period of 10 weeks(30). A few years later Usdin reported his own series of 58 patients, managed by Perkins traction, and only 2 cases had residual knee stiffness (31). Moulton *et al.* reported their series of 45 consecutive patients with femoral shaft fractures treated by straight longitudinal traction, supplemented by functional bracing at around six weeks. All fractures healed, one with a varus mal-union and the average length of stay (LOS) was eight weeks, and at six months, the average knee flexion was 127° (50).

From the study done in Ethiopia at the Black Lion hospital it was found that at the end of traction; circumference of thigh was reduced only in 8 (11.8%) patients, knee range of motion was 40-60 degrees in ten patients and between 60-90 degrees in 50 patients. It was more than 90 degrees in 7 (10.3%) patients. At mean follow-up of eight months (range 4- 21 months). Only one patient ended up with non-union and there was also only one mal-union. Shortening of over 2 cm was noted in 11(16.2%) patients (5).

A number of studies have described the complications of traction however no study from our setting where patients are primarily managed on skeletal traction have looked at the complications due to extended periods of skeletal traction.

STUDY JUSTIFICATION:-

This study will provide clinicians with essential information on the pattern and frequency of the complications that occur with skeletal traction. It will aid policy makers; in that a time frame (safety zone) will be established within which a patient can be managed on skeletal traction without being at risk of developing complications.

In spite of these complications, majority of our patients are on skeletal traction for prolonged periods and to date no studies from our setup have reported on the occurrence of adverse events associated with extended durations of skeletal traction. Also the patient profile at KNH is different as most of our patients are of a younger age group.

While early internal fixation has been shown to be ultimately the standard in management of femoral shaft fractures, in the local setting this is not possible for all the patients hence the need for skeletal traction, therefore it is important to study the occurrence of complications associated with skeletal traction.

The purpose of this study is to document the utility of skeletal traction and describe related common morbidities.

BROAD OBJECTIVE:-

To determine the incidence of complications associated with skeletal traction in patients with femoral shaft fractures at KNH and analyse their occurrence in relation to the duration of traction.

SPECIFIC OBJECTIVE:-

1. To determine the average duration of skeletal traction in patients with femoral shaft fractures.
2. To determine the incidence of complications resulting from skeletal traction for femoral shaft fractures and relate these to the duration of traction.
3. To analyse the risk factors that predispose to development of complications (pin tract infection; knee stiffness; pneumonia; disuse atrophy; non-union and mal-union) associated with skeletal traction.
4. To determine the period within which patients with femoral shaft fractures can be managed on skeletal traction beyond which they are at risk of developing complications.

PATIENTS AND METHODS

STUDY DESIGN AND PERIOD

Prospective, descriptive study on patients with femoral shaft fractures, admitted in the orthopaedic wards at KNH between June 2012 and August 2012.

This was a study of convenience sampling of patients admitted with femoral shaft fractures during a 3-month period in the orthopaedic units. Patients included were those who were on skeletal traction for more than two days. They were followed up until discontinuation of skeletal traction either because the patient was taken for ORIF, or developed a pin tract infection or the fracture had healed.

UTILITY/ VALIDITY OF THE STUDY

Majority of the patients admitted at KNH with femoral shaft fractures are managed on skeletal traction from the onset, while awaiting ORIF. There are no protocols governing timing of operative intervention. Despite the complications associated with skeletal traction being known, no study has been conducted locally to document these complications. While preoperative skin traction would minimize morbidity, its effectiveness in reducing femoral fractures is questionable. Therefore it is hoped that the results of this study will assist to improve the management of femoral fractures and also it will aid in developing guidelines on how best we can avoid complications associated with pre-operative skeletal traction.

STUDY SETTING:-

The study was carried out at the KNH orthopaedic wards. KNH is the Largest referral and teaching hospital in Kenya. There are 3 orthopaedic firms each with its respective ward. Each firm is allocated 4 operating days. Despite this there are still a large number of patients awaiting operative fixation. Therefore skeletal traction for femoral fractures in this setting is still a viable option in management of femoral fractures either as a definitive form of treatment or while awaiting ORIF.

SELECTION CRITERIA:-

Consecutive patients with femoral shaft fractures of either sex on skeletal traction for more than two days were recruited.

INCLUSION CRITERIA:-

All skeletally-mature patients determined by age and imaging, with femoral shaft fractures put on skeletal traction as a definitive or temporary treatment option

Those who consented to be recruited in to the study.

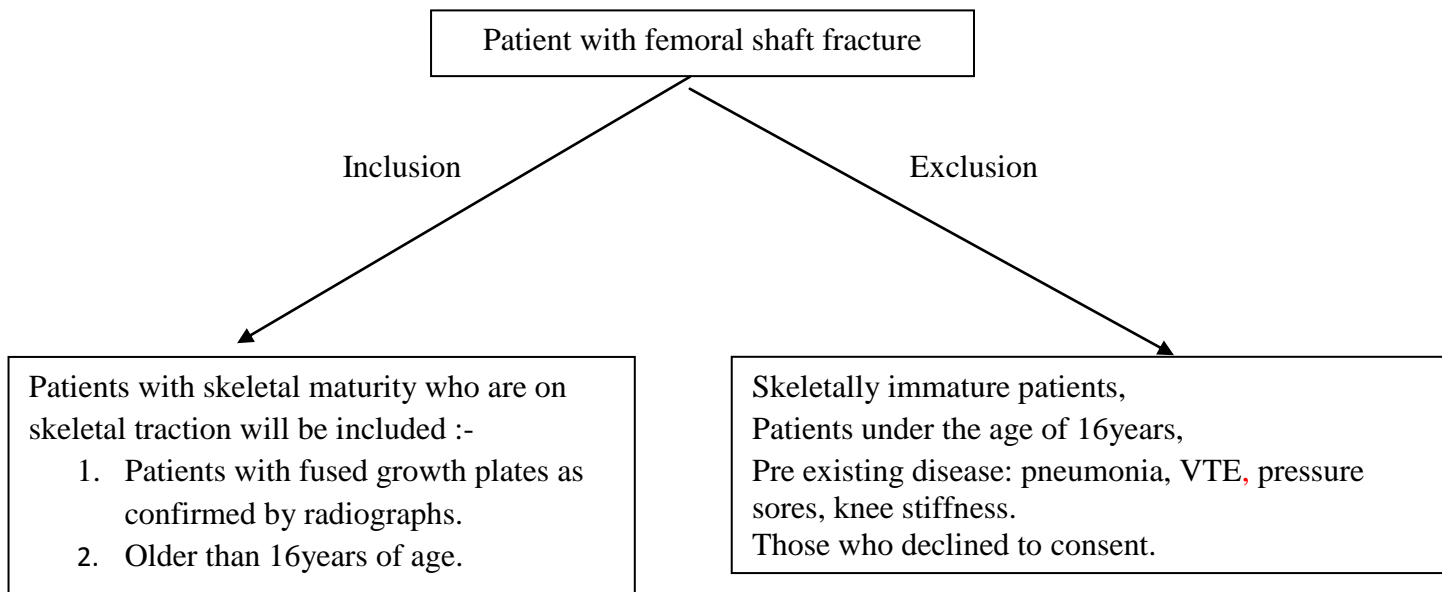
EXCLUSION CRITERIA:-

Skeletal immaturity determined radiologically.

Pre existing disease: pneumonia, VTE, pressure sores, knee stiffness

SAMPLING PROCEDURE:-

Consecutive Sampling method was used to recruit patients into the study. Patients with femoral shaft fractures were recruited into the study as they were admitted and put on skeletal traction until the sample size was achieved.



Once the patient was on skeletal traction – day 2 onwards, the patient was reviewed by the principal investigator, and recruited into the study if consented. The questionnaire was administered and the patient was examined for any signs and symptoms of chest infection, his range of motion at the knee was measured using a Grafco[®] orthopaedic goniometer, the pin site was examined for any signs of inflammation, the sites at risks of developing pressure sores were also examined for evidence of pressure sores. The size of both the thighs fifteen centimeters from the greater trochanter for both the fractured and un-fractured limb, were measured and recorded. This was done on a weekly basis for each of the patient's recruited up-to the point the patient was taken off skeletal traction. The patient's had an x-ray taken immediately after being put on traction and on the 6th – 8th week of the fracture site this was to ascertain correct reduction, assess the progress of healing and if there was mal-union.

In order to ensure that the procedural risks of developing a complication associated with skeletal traction were reduced, standardized aseptic pin insertion techniques were used this was ensured by placing of posters in each orthopaedic units guiding the pin insertion. The investigator made sure that the patients are given the necessary precautions and care that prevented them from developing traction associated complications.

SAMPLE SIZE CALCULATION:-

The sample size was determined by the use of the following formulae to achieve an adequate sample to accurately estimate the prevalence of complications in pin tract infection in the study population.

$$n = \frac{Z_{\alpha/2}^2 \times P(1-P)}{D^2}$$

Where n = required sample size

P = The proportion of patients admitted with femoral fractures at Kenyatta National Hospital in the year 2009/2010 is 24%¹ and 26%² respectively of all lower limb injuries

D = Precision with which to measure prevalence, set at plus or minus 0.05%.

The $Z_{\alpha/2}$ is the cut off points along the x-axis of the standard normal probability distribution that represents probability matching the 95% confidence interval (1.96).

Substituting the above in the formulae we get;

$$N = \frac{(1.96)^2 \times 0.25(1-0.25)}{[(0.25+0.05) - (0.25-0.05)]^2}$$

$$\begin{aligned} n &\approx 72.03 \\ &= 72 \text{ patients} \end{aligned}$$

1,2 – KNH PREVALENCE OF FEMORAL SHAFT FRACTURES IN 2009/2011

STUDY DEFINITIONS

- Shaft of the femur :-For purposes of this study, the shaft of the femur will be defined as: the distance between 5 cm distal to the lesser trochanter and 6 cm proximal to the most distal point of the medial femoral condyle (dencker 1963).
- Pin Tract Infection :- will be defined by signs of hyperemia, tenderness, crusts, sero-purulent discharge around the pin site or pin loosening. A diagnosis of PTI was made in patients when any three of the signs of PTI occurred concurrently.
- Pressure sores : Trochanteric, sacral, calcaneal regions of the body were examined and the use of the pressure sore grading system was used to record presence of pressure sores :-
 - Grade 1 :- non blanchable erythema of intact skin
 - Grade 2:- Partial thickness skin loss involving epidermis, dermis or both
 - Grade 3:- Full thickness skin loss involving damage or necrosis of subcutaneous tissues that may extend down to but not through underlying fascia
 - Grade 4 :- Full thickness skin loss with extensive destruction, tissue necrosis or damage to muscle or bone.
- Knee Stiffness :- Patients who have a reduced range of motion of the knee of the injured limb this will be determined by using a Grafco[®] orthopaedic goniometer, to check the degree of ROM of less than 30 degrees, 30 to 90 degrees or more than 90 degrees.
- Pneumonia :- Patients who have recorded temperatures of 38 degrees centigrade or more taken using a mercury thermometer, respiratory distress, cough, chest pain and a positive chest radiograph with features of pneumonia will be used to make a diagnosis of pneumonia.
- Mal-union:-Healing with more than 10° of varus or valgus in the frontal plane, or 15° of anterior/posterior angulation in the sagittal plane will be considered a mal-union.
- Non union:- At six weeks, clinical healing was assessed by palpation of the callus and with the other hand, moving the lower end of the broken bone from side to side. The fracture was united if there was no motion and pain between the fracture fragments, and by determining if the patient is capable of straight leg raising as one. A non-union will be diagnosed if there is still motion at the fracture site after 8 weeks of traction in absence of local tenderness and notable to raise his/her leg.
- Quadriceps Muscle Atrophy :- Mid-Thigh circumference measurements of both legs in centimeters will be taken (fifteen centimeters from the greater trochanter will be used as the reference point) from the time the patient is put on traction and recorded up-to the time the patient is taken off traction

ETHICAL CONSIDERATIONS

Permission to conduct the study was sought from the KNH and University of Nairobi, Research and ethics committee.

Informed voluntary consent from patients or relatives was obtained where the patient was not able to consent for oneself.

Confidentiality was guaranteed to each patient from the data obtained.

Patients were allowed to withdraw at any point of the study should they choose to do so.

DATA COLLECTION:-

- A pretested, structured and coded questionnaire was used. The data gathered included: patient demographics, cause and pattern of fracture, traction type, time of commencement with the end point being removal of the traction either for surgery or because of a complication.
- Data were collected as pertains to the date of commencement of traction up to the date patient underwent operative management or was taken off traction.
- The patients were put on skeletal traction by a trained and qualified orthopaedic technicians assigned in each of the orthopaedic wards. Steinman pins were inserted with aseptic technique. There was risk of injuring the peroneal nerve during insertion of the Steinman pin, however there were no incidences reported
- Patients were recruited into the study two days after they were put on traction, and were followed upto the time they were taken off traction.
- Radiographs of the fracture site were taken immediately after the patient was put on traction to assess the alignment and reduction and subsequently at 6-8 weeks if the patient was still on traction to assess healing of the fracture site.
- The risk factors studied were age of the patient, cause of the fracture, fracture geometry and other associated injuries.

DATA ANALYSIS:-

After cross checking the questionnaires for any missing entries a data base was designed in MS Access which allowed the setting of controls and validation of the variables. On completion of the data entry, the data was exported to the Statistical Package (SPSS – Version 15.0 Chicago, Illinois) for analysis.

Descriptive statistics were applied to the data collected and continuous data were summarized using mean, standard deviation, median, mode and percentages were used for categorical or nominal data, a p value of <0.05 was considered significant in determining the associations between the risk factors and complications.

Data are presented in tables and figures where applicable. The t-test was used to compare duration of traction versus the development of complications to determine any significant association between the

continuous variables e.g. age and duration on skeletal traction, while chi-square was used to establish the significant associations between the fracture geometry, aetiology of fracture. Inferential statistics will be used to analyse relative risks of developing complications as compared to the duration patients are on traction. The incidence of complications related to period of skeletal traction will be evaluated and related to the duration of traction using the chi square test.

Ninety five percent Confidence interval (CI) will be calculated to identify the factors that are more likely to explain the explanatory variable (complication). P-value of less than 5% ($P < 0.05$) will be considered statistically significant.

LIMITATIONS TO THE STUDY:-

1. There were no clear guidelines ensuring aseptic techniques are followed during insertion of the Steinman pin for skeletal traction before our study. Therefore there may be an increased incidence of pin tract infections and in order to mitigate this we developed guidelines/ protocols that were put up in each orthopaedic ward giving procedural details of how the Steinman pin should be inserted under proper aseptic technique.
2. We did not have control over how patients were selected for ORIF, therefore one of the utilities of this study is to use the results in the development of guidelines / protocols where the fracture patterns, cause of the fracture, or presence of other associated injuries would determine which patient is given priority for ORIF.

RESULTS

During the three-month study period, 75 patients admitted with femoral fractures at KNH orthopaedic unit were recruited into the study. This study revealed femoral fracture frequently occurred in males with 70 (93.3%) male patients and 5 (6.7%) females yielding a male-to-female ratio of 14:1, Table 1.

The average age of the patients was 32.2 years (SD 10.24) and the ages ranged from 16 to 61 years. The female patients were on average slightly older than males with average ages of 40.2 years and 31.6 years, respectively ($p = 0.08$). All 18 patients below 25 years were males and only 12.3% of patients were aged 45 years and above (Table 1). The age distribution of female patients was similar in the various age groups above 25 years (two females were aged 25-34 years, two aged 35-44 years and one was over 45 years old).

Table 1: Basic demographic characteristics of patients with femoral fractures at KNH orthopaedic unit

	Frequency (n = 75)	Percent
Sex		
Male	70	93.3%
Female	5	6.7%
Age categories		
16-24 years	18	24.7%
25-34 years	27	37.0%
35-44 years	19	26.0%
45 years and above	7	12.3%
Occupation		
Casual labourer	23	30.6%
High fracture risk occupations	21	28.0%
Low fracture risk occupations	19	25.3%
Unemployed	12	16.0%

The most common occupation was casual laborer, and 12 (16.0%) of patients reported that they were unemployed. The occupations considered at high risk for femoral fractures and accounting for 28.0% of the sample were commercial or public service vehicle drivers, conductors on these vehicles, jobs in the building industry like masonry or carpentry and security guarding duties. Patients in the low fracture risk occupations were either in business, professional jobs or farming.

There were two types of skeletal traction that were applied in this study. Perkin's traction was used in management of 72 (96.0%) patients and Russell Hamilton's traction was applied in 3 (4.0%) cases. A total of 15 (20%) of the patients put on skeletal traction were changed to skin traction due to complications. Ten patients were taken off traction because they had healed. The remaining 57 (76.0%) patients underwent ORIF.

Overall, the mean duration on traction was 4.71 weeks (SD 2.55). Comparison of average duration of traction according to femoral fracture characteristics among the 57 patients who underwent ORIF are shown in table 2.

Table 2: Duration of skeletal traction and characteristics of femoral fractures

	Average duration (SD) in weeks	P value
Fracture classification		
Closed	4.74 (2.55)	0.914
Open	4.69 (2.68)	
Winqvist Hansen classification		
0	4.32 (2.46)	0.438
I	4.22 (2.22)	
II	6.00 (2.76)	
III	4.73 (3.10)	
IV	5.54 (2.11)	
Site		
Proximal shaft	5.00 (2.09)	0.876
Mid shaft	4.62 (2.76)	
Distal shaft	4.67 (2.61)	

Aetiology of femoral fractures

Motor vehicle accidents were the most common cause of femoral fractures accounting for 50 (66.7%) of the fractures (Figure 1). Among these, fractures resulting from motor vehicle accidents, the patient was commonly involved as a pedestrian (42% of 50 MVA cases) or passenger (38% of 50 cases). The other common aetiology of femoral fractures was fall from heights responsible for 14 (18.7%) out of the total 75 fractures. Five (6.7%) of fractures were stress fractures and 4 (5.3%) were pathological. One (1.3%) of fractures were assault, one (1.3%) were GSW, and one (1.3%) were osteoporosis/pathologic.

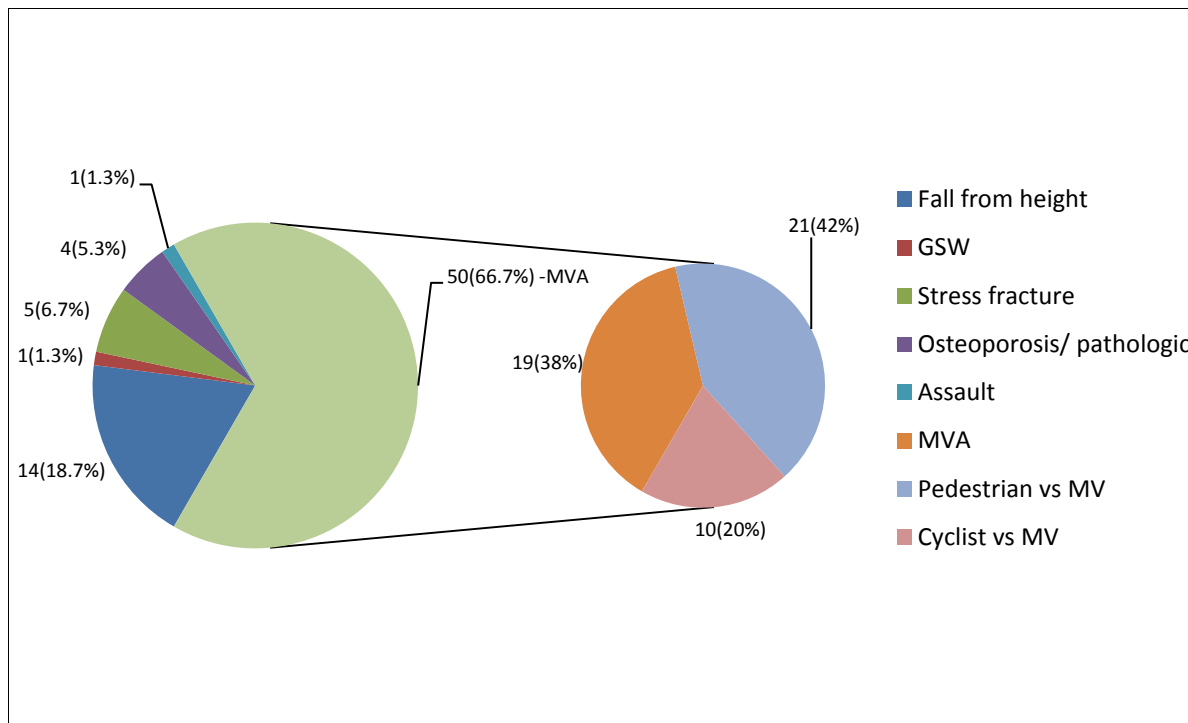


Figure 1: Aetiology of femoral injuries among patients admitted to KNH orthopaedic units

Femoral Fracture Characteristics

Among the 75 patients with femoral fractures in this study, 72 (96.0%) patients had fractures involving a single limb (Table 3). The right and left legs were almost similarly affected with 50.67% of fractures involving the right leg. The most common site of femoral fractures was the mid shaft which accounted for 45 (60%) fractures.

Table 3: Fracture pattern and distribution of femoral fractures at KNH

	Frequency	Percent
Lower limbs involved in fracture		
Single limb	72	96.00
Bilateral	3	4.00
Body side involvement in fracture		
Right leg	38	50.67
Left leg	34	45.33
Bilateral Fractures	3	4.00
Site of fracture		
Proximal shaft	17	22.67
Mid shaft	45	60
Distal shaft	12	16
Fracture classification		
Closed	59	78.7
Open	16	21.3
Fracture geometry		
Transverse	31	41.3
Comminuted	28	37.3
Oblique	12	16.0
Spiral	4	5.3
Winqvist Hansen classification		
0	34	45.3
I	9	12.0
II	6	8.0
III	15	20.0
IV	11	14.7

Fifty nine (78.7%) patients had closed femoral fractures (Table 3). Based on fracture geometry, transverse fractures and comminuted fractures were the most common type of fractures seen and these fracture types accounted for 31 (41.3%) and 28 (37.3%) fractures, respectively. Most femoral fractures were classified as grade 0, 34 (45.3%) using the Winqvist Hansen criteria and 15 (20.0%) were grade III fractures.

The association between age and femoral fracture characteristics is shown in Table 4. Only fracture classification showed a statistically significant association with patient age ($p = 0.008$). Most open fractures (10 out of 16, 62.5%) occurred in patients between the ages of 25 and 34 years.

Table 4: Characteristics of femoral fractures in patients at KNH orthopaedic unit and patient age

Age ranges	Limb fractured		Site of fracture			Fracture Classification		Fracture Geometry			
	Right	Left	Proximal	Middle	Distal	Closed	Open	Transverse	Oblique	Spiral	Comminuted
16-24 years	10	8	4	11	3	15	3	5	3	1	9
25-34 years	11	14	3	19	4	17	10	17	2	0	8
35-44 years	12	6	7	9	3	19	0	5	5	1	8
45 years and above	4	5	3	4	2	6	3	3	2	2	2
P value	0.500		0.465			0.008		0.068			

Types of associated injuries

Out of the 75 patients with femoral fractures 51 (68%) had other associated fractures. Figure 2 shows that the most common among the associated injuries was soft tissue injury present in 34 (45.33%) of the patients. This was followed by skeletal injuries 26 (34.67%) and head injuries in 12 (16.0%) patients.

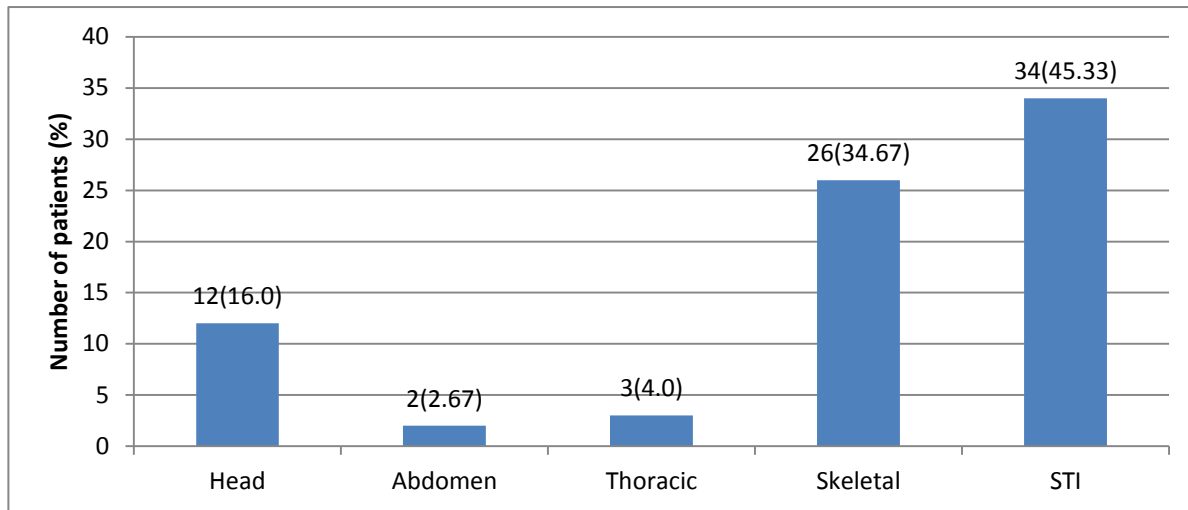


Figure 2:

Other injuries associated with femoral fractures among patients at KNH

Pin tract infection

The most common sign of PTI was crust formation around the pin site (Figure 3). The prevalence of this sign peaked at week 4 of traction with 53.33% of patient having the sign at this specific time. It was followed by tenderness around pin site and sero-purulent discharge which had peak prevalence of 18.67% and 17.33% occurring at week 3 and week 5, respectively.

The incidence of pin loosening was low and remained consistently low throughout the ten week period with a small peak (2.67%) occurring during week 6.

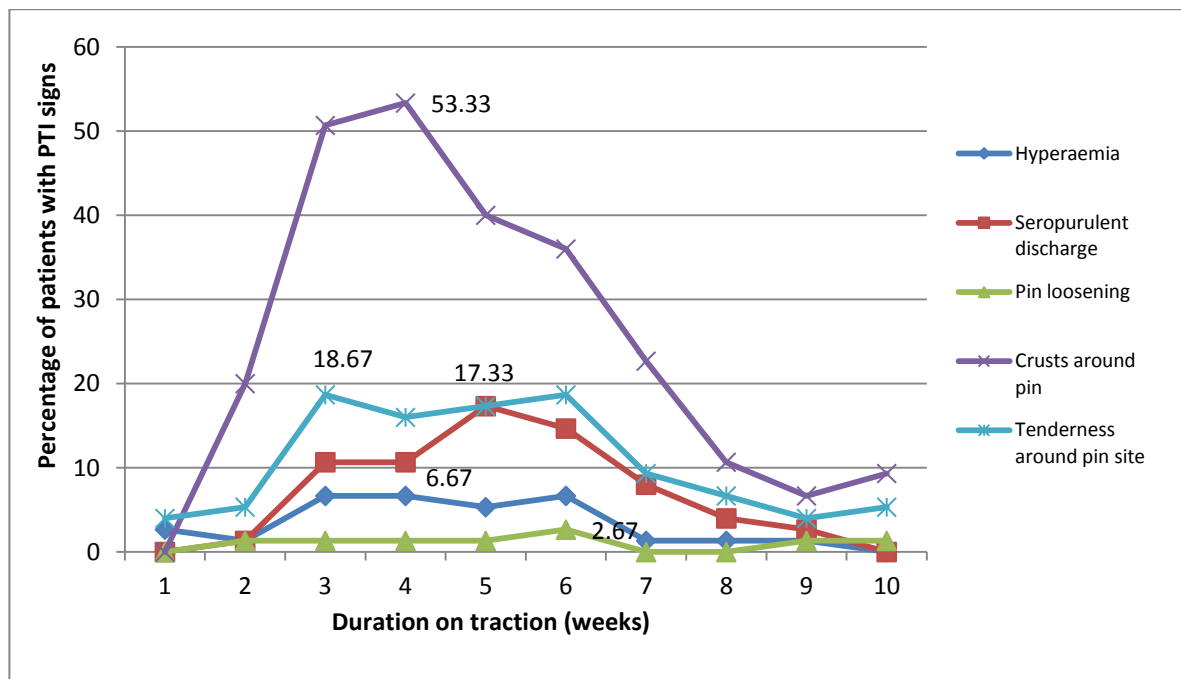


Figure 3: Prevalence of signs of PTI among patients on traction for femoral fractures

Overall, 18 patients had PTI during the 10-week study period representing a period prevalence of 24.0% for PTI among traction patients at KNH. Table 5 shows the proportion of PTI according to duration on traction. The prevalence of PTI peaked on week 5 and 6 with 10 (13.33%) of patients having PTI on both of these weeks.

Table 5: PTI prevalence according to duration on traction

Week	1	2	3	4	5	6	7	8	9	10	Period prevalence
Number of PTI	0	0	5	5	10	10	4	3	1	0	18/ 75
Prevalence (%)	0.00	0.00	6.67	6.67	13.33	13.33	5.33	4.00	1.33	0.00	24.0

PTI versus fracture characteristics

PTI infection was significantly associated with Winquist Hansen fracture classification ($p = 0.013$). The majority (91.2%) of patients with Winquist Hansen classification zero fractures did not have PTI. The odds of having a PTI infection in the patients with classification I to classification IV were between 1.37 and 5.2 fold higher compared to patients with classification 0. The prevalence of PTI infection in these higher classifications ranged from 20% to 54.6% compared to only 8.8% among patients with fracture classification 0.

Table 6: PTI and fracture characteristic (risk)

	PTI		OR(95% CI)	P value
	Yes (n = 18)	No (n = 57)		
Fracture classification				
Closed	14 (77.8%)	45 (78.9%)	1.00	0.916
Open	4 (22.2%)	12 (21.1%)	1.07(0.3-3.87)	
Winquist Hansen classification				
0	3 (8.8%)	31 (91.2%)	1.00	0.013
I	3 (33.3%)	6 (66.7%)	5.2(0.83-32)	
II	3 (50.0%)	3 (50.0%)	3.21(1.19-8.7)	
III	3 (20.0%)	12 (80.0%)	1.37(0.78-2.45)	
IV	6 (54.6%)	5 (45.5%)	1.88(1.23-2.85)	
Geometry				
Transverse	3(9.7%)	28(90.3%)	1.00	0.026
Communited	12(42.9%)	16(57.1%)	7.0(1.52-42.9)	
Oblique	2(16.7%)	10(83.3%)	1.87(0.14-18.6)	
Spiral	1(25%)	3(75%)	3.11(0.04-56.1)	

The majority of patients who developed PTI from week 3 to week 6 had sustained fractures in MVA (Figure 4). After week 7, falls were the most important fracture aetiology among patients with PTI.

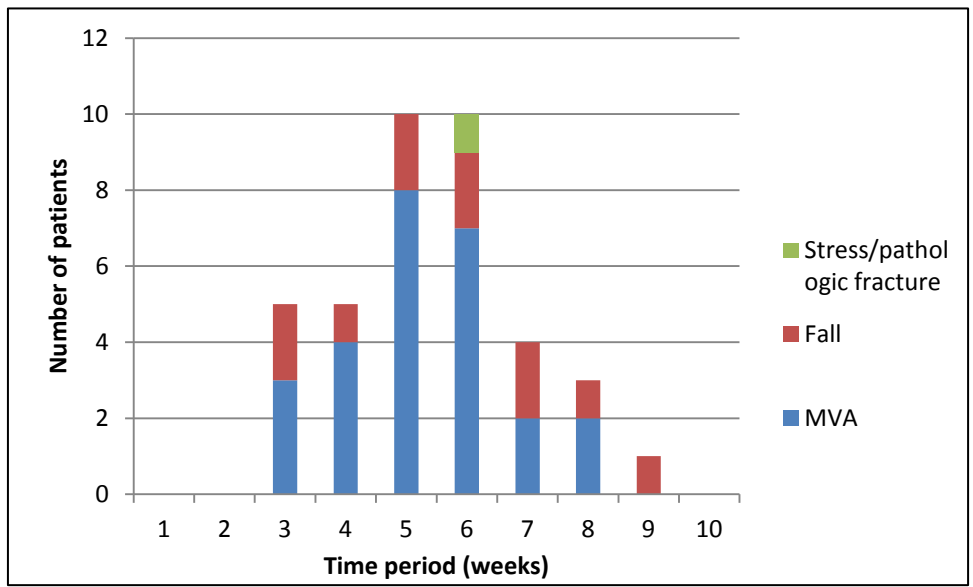


Figure 4: PTI complication in patients with different fracture aetiologies

Most of the patients with PTI had associated injuries (Figure 5). There was a proportionate increase in the number of patient without associated injuries who developed PTI between week 3 and week 6.

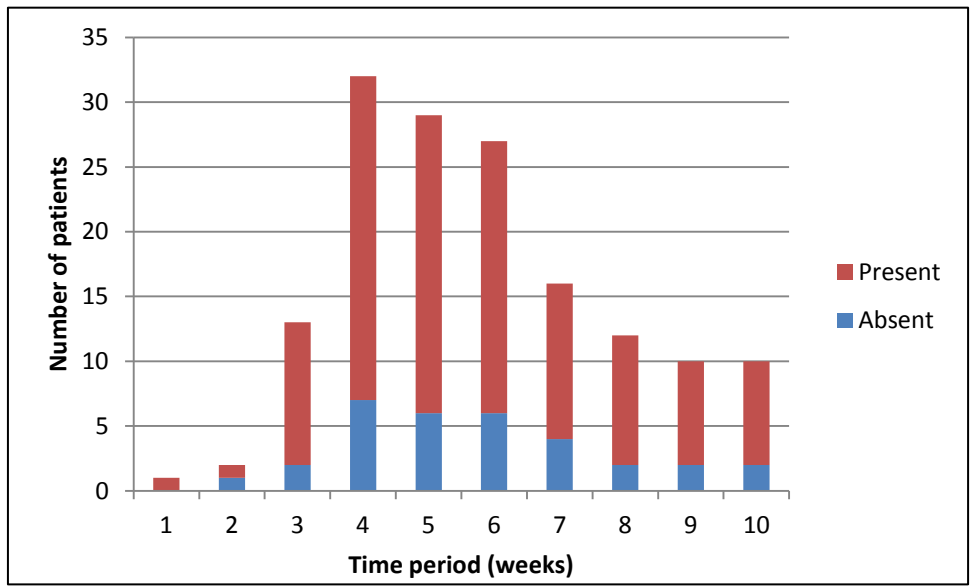


Figure 5: PTI complication in patients with and without associated injuries

Between week 3 and 4, most PTI were among patients aged 35-44 years. After this period PTIs occurred predominantly in younger age groups aged below 35 years (Table 7).

Table 7: PTI complication among patients in different age groups

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10
PTI										
16-24 y	0	0	0	1(25)	3(37.5)	4(50)	1(25)	1(33.3)	0	0
25-34 y	0	0	2(50)	1(25)	4(50)	3(37.5)	2(50)	1(33.3)	1(100)	0
35-44 y	0	0	2(50)	2(50)	1(12.5)	1(12.5)	0	0	0	0
45 y and above	0	0	0	0	2	2	1(25)	1(33.3)	0	0

Knee stiffness

Complications of traction related to knee stiffness were common. At admission 69.3% of patients had flexion greater than 90 degrees but this rapidly declined to less than 10% by the third week on traction (Figure 6).

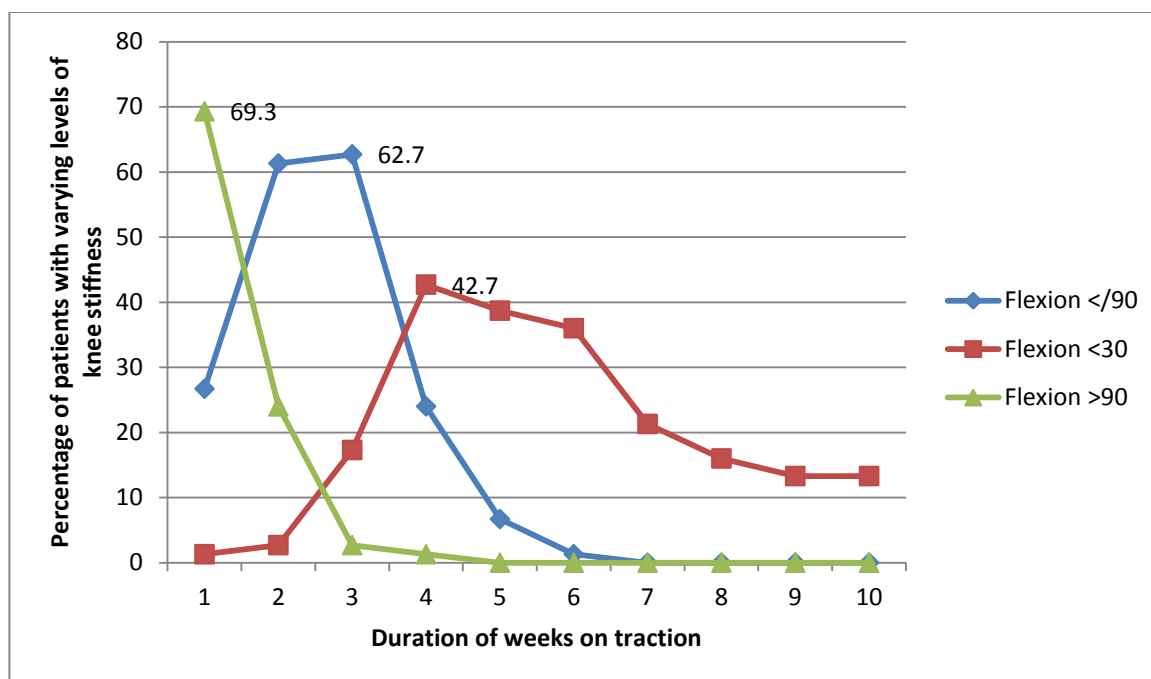


Figure 6: Prevalence of Knee stiffness among patients on traction for femoral fractures at KNH

Restricted movement represented by knee flexion less than 90 degrees was noted to have a peak prevalence of 62.7% and this occurred during week 4 (Figure 4). The prevalence of flexion less than 30 degrees rose steeply during the second and third weeks of traction with a peak prevalence of 42.7% occurring during the fourth week (Table 8).

Table 8: Prevalence of knee stiffness according to duration on traction

Week	1	2	3	4	5	6	7	8	9	10
Flexion <30	1(1.3)	2(2.7)	13(17.3)	32(42.7)	29(38.7)	27(36)	16(21.3)	12(16)	10(13.3)	10(13.3)
Flexion >90	52(69.3)	18(24)	2(2.7)	1(1.3)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)

Knee stiffness versus fracture aetiology

Throughout the 10-week traction period the aetiology of fractures in most patients with knee flexion less than 30 degrees was MVA. A significant number of the patients with stress or pathological fractures had knee stiffness (Figure 7). The single case of gunshot wound also developed knee stiffness during week 3.

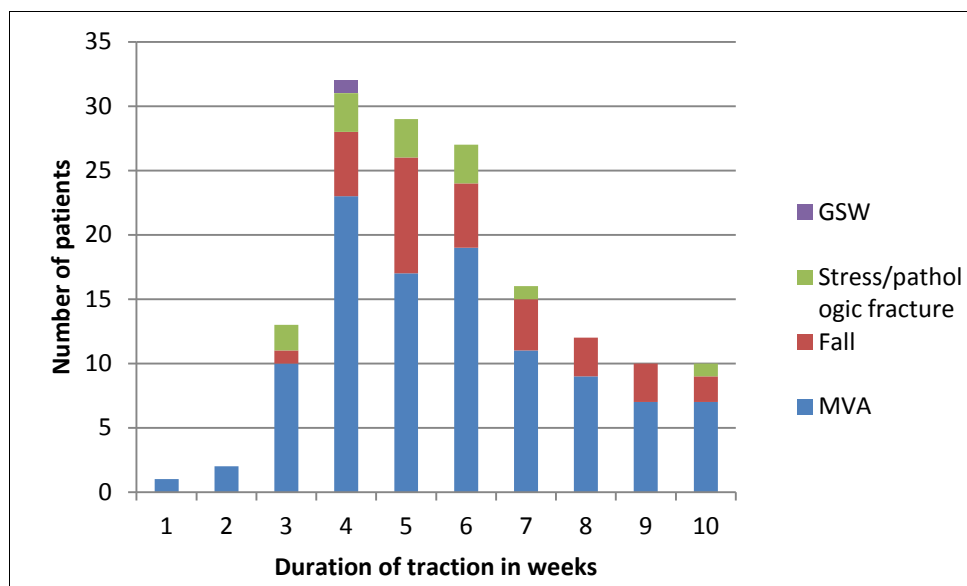


Figure 7: Fracture aetiology among patients on traction with flexion less than 30 degrees

Knee stiffness versus type of fracture

For patients with flexion less than 30 degrees comminuted fractures were the predominant fracture type (Table 9). However, during week 3 transverse fractures predominated among patients.

Table 9: Association between type of femoral fracture and development of knee stiffness

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10
Less than 30 degrees flexion										
Comminuted	1(100)	1(50)	5(38)	13(41)	13(45)	11(41)	8(50)	7(58)	5(50)	6(60)
Oblique	0	1(50)	1(8)	6(19)	4(14)	6(22)	3(19)	3(25)	3(30)	2(20)
Spiral	0	0	1(8)	1(3)	2(7)	2(7)	2(13)	1(8)	1(10)	1(10)
Transverse	0	0	6(46)	12(38)	10(34)	8(30)	3(19)	1(8)	1(10)	1(10)

Knee stiffness and patient age

During the first week knee stiffness occurred in a single patient aged 45 years and above. From the third week all age groups were affected by knee stiffness (Table 10). Most patients with knee stiffness were aged between 16 and 24 years or 25 and 34 years.

Table 10: Association between patient age and development of knee stiffness

	Week 1	Week 2	Week 3	Week 4	Week 5	Week 6	Week 7	Week 8	Week 9	Week 10
Flexion less than 30 degrees										
16-24 y	0	0	4(31)	9(28)	11(38)	10(38)	6(40)	3(25)	3(30)	3(30)
25-34 y	0	1(50)	6(46)	11(34)	10(34)	7(27)	5(33)	4(33)	4(40)	3(30)
35-44 y	0	0	2(15)	8(25)	5(17)	7(27)	3(20)	3(25)	2(20)	2(20)
45 y and above	1(100)	1(50)	1(8)	4(13)	3(10)	2(8)	1(7)	2(17)	1(10)	2(20)

Pneumonia

Pneumonia rarely occurred in the study and in cases where it was diagnosed it was noted that it occurred relatively early. It occurred in only 3(4.0%) patients on weeks 1, 2 and 4. One of the patients with pneumonia was changed to skin traction and a second patient with pneumonia eventually died during week 4. The single death that occurred in this study was in a patient with signs of pneumonia.

Pressure sores

Three patients developed pressure sores during traction. All the pressure sores seen in the study were grade I. Two patients had trochanteric or sacral region sores and the last patient developed calcaneal sores during week 3. One of the patients with trochanteric/ sacral sores also had PTI and pneumonia and this patient died during week 4.

Mid thigh circumference reductions

The mid thigh circumference measurement taken at the end of the traction period showed that in 27 (36%) patients there was a reduction in the circumference of the injured leg (Figure 8).

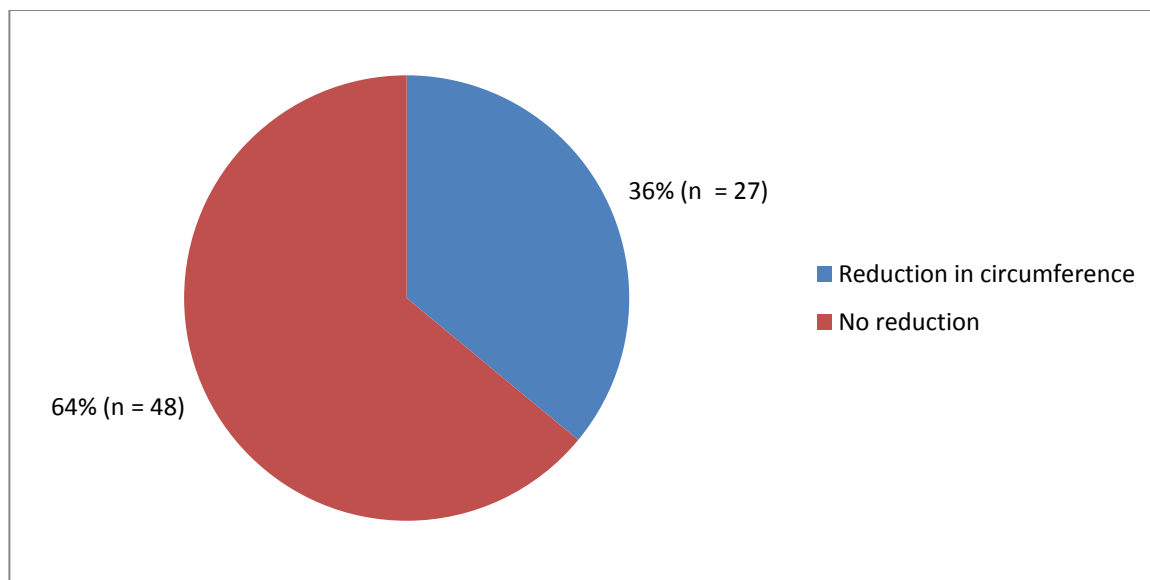


Figure 8: Prevalence of reduction in mid thigh circumference following traction

Reduction in mid thigh circumference versus fracture characteristics

Mid-thigh circumference reduction was more common in patients with PTI (61.1% versus 28.1%) and showed a statistically significant association with PTI ($p = 0.011$). Similarly, patients with knee stiffness were also more likely to have mid thigh circumference reduction ($p = 0.017$). Twenty three (45.1%) patients with knee stiffness (<30 degrees) had reductions in mid thigh circumference compared to 4(16.7%) of patients without knee stiffness.

Table 11: Factors associated with reduction in mid thigh circumference of fractured leg

	Mid thigh circumference reduction		P value
	Yes	No	
PTI			
Yes	11(61.1)	7(38.9)	0.011
No	16(28.1)	41(71.9)	
Fracture geometry			
Comminuted	13(46.4)	15(53.6)	0.344
Transverse	8(25.8)	23(74.2)	
Oblique	4(33.3)	8(66.7)	
Spiral	2(50)	2(50)	
Less than 30 degrees flexion			
Yes	23(45.1)	28(54.9)	0.017
No	4(16.7)	20(83.3)	

Non-Union/ Mal-union

This outcome of fracture healing following traction was reported for 26 patients who were managed using traction for a period of ten weeks. Sixteen (21.3%) patients who had non-union at ten weeks were eventually taken off traction and taken for ORIF (Figure 9). Six (8%) healed in mal-union and 4 (5.3%) patients healed in union.

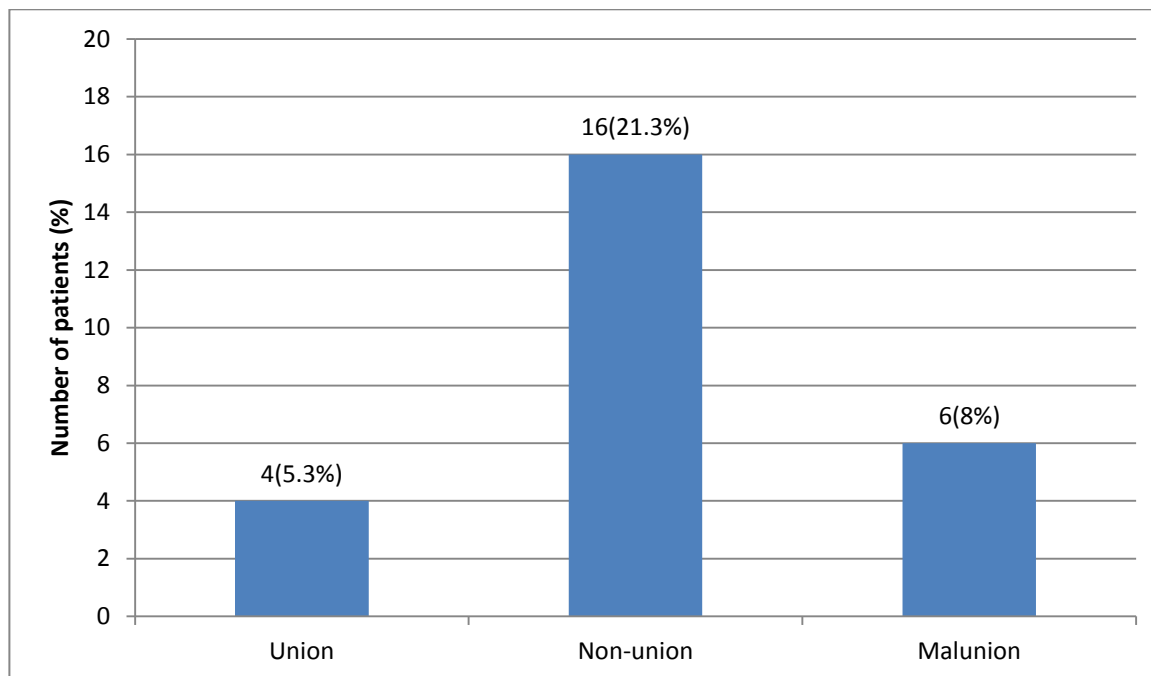


Figure 9: Fracture healing among patients maintained managed on traction

Complications and duration of traction

PTI infection was significantly associated with longer duration of traction ($p = 0.005$). The average duration of traction for patients who got PTI was 6.17 weeks (SD 2.72) compared to 4.25 (SD 2.33) for patients who did not get PTI.

Limited range of knee movement (flexion < 30 degrees) also showed a statistically significant association with duration of traction, $p < 0.001$. (Means 2.67 [1.43] versus 5.67 [2.4] weeks)

There was evidence of a weak association with flexion ≤ 90 degrees and duration of traction, $p = 0.062$
(Means = 4.61[2.66] versus 4.75 [2.53] weeks)

Table 12: Duration of traction versus development of complications

	Average duration (SD) in weeks	P value
Pin tract infection		
Yes	6.17 (2.72)	0.005
No	4.25 (2.33)	
Flexion < 30 degrees		
Yes	5.66 (2.39)	<0.001
No	2.66 (1.43)	
Flexion < 90 degrees		
Yes	3.22 (3.73)	0.062
No	4.91 (2.31)	
Flexion > 90 degrees		
Yes	4.61 (2.66)	0.827
No	4.75 (2.53)	

DISCUSSION

Skeletal traction continues to play a major role in the management of femoral shaft fractures at Kenyatta National Hospital and even further in the lower level hospitals in Kenya. This is despite evidence that early operative intervention has better outcome and is cost effective. Its use locally is however, occasioned by shortage of facilities, implants and surgeons; poverty and strain on government's health budget are the other (3). This study embarked on determining the incidence of complications associated with skeletal traction at Kenyatta National Hospital and investigate risk factors predisposing these patients to these treatment related morbidities.

The average age of the patients was 32.2 years, majority of the patients were in the age bracket of 25 – 34 years (Table 1). This uni-modal age distribution has been seen in other studies done from the region (5, 51). People of predominantly male gender in self employment or casual labour were mainly involved (Table 1) as has been shown in previous studies (5,51). It has been suggested that this age category of patients are the most economically productive and on the move in public transport as they fend for their families (5,51,52). Most injuries were caused by road traffic accidents hence presence of associated injuries in 68% of the patients. Developing countries are experiencing a general increase of all types of injuries as they undergo socio-economic changes characterised by urbanisation and an increased dependence on motor vehicles as a means of transport (3). This results in a significant increase of complex extremity fractures (53, 54).

Both femurs were involved equally (Table 3), with majority (60%) of the fractures in the midshaft region of the femur in a relatively similar pattern to that of Gosselin in Sierra Leone and Dim et al in Nigeria (32, 55). Transverse and comminuted pattern of fractures were the most common type as has been reported by Bezabeh and Hansen (5, 56). These fractures are a result of direct impact to the bone or indirect forces

transmitted through the knee subjecting the femur to high bending loads hence motor vehicle accidents are associated with a high rate of femoral shaft fractures (51).

The mean duration of skeletal traction was 33 days in this study. Studies in settings similar to ours have revealed varying durations of traction, for example Bezabeh's study in Ethiopia the average duration patients were on traction was 35 days (5), while Gosselin's study, revealed time in traction to be averaging between 23-66 days with mean duration of 45 days (32). These varying durations on traction are possibly due to differences in when the patients were taken off traction either for ORIF as was the case in our study, or the fractures healed by being solely managed by conservative method, like in Gosselin's Sierra Leone study.

Complications associated with skeletal traction from this study are more in line with data reported from other studies from the region. The most common sign of PTI was crust formation around the pin site. Overall, 18 patients had PTI at any point during the study period representing a period prevalence of 24.0% for PTI among traction patients at KNH. The prevalence of PTI peaked on week 5 and 6 of traction with 13.33% of patients having PTI on both of these weeks. The PTI rate in this study is slightly higher when compared to the study done by Bezabeh, where the PTI rate was 11.8% (5). It is comparable to other studies and was found to be: slightly lower than 36%(57) and 42.6% (32), and higher than 8.6% and 15% in studies done by Usdin (31) and Procter(30) respectively from South Africa. The high rate could possibly be due to technical considerations: re-using many times the same smooth, blunt Steinmann pins. Although we had put up guidelines in each orthopaedic unit and the orthopaedic technicians were advised to adhere to the recommendations on the insertion of the Steinman pin, whether utmost sterility was maintained during insertion of the pin with a hand drill is not known. It was noticed that many patients did not have the traction bow properly applied, this leads to frequent re-adjustments of the traction apparatus and this could possibly be another factor in increasing the risk of developing PTI. Host factors

such as chronic undernourishment or decreased immunity could have also contributed to the increased rates of PTI. Other host factors like the pin tract site itself could be in itself a risk for developing PTI and it has been shown that daily pin tract site care both by the patient and nursing staff could decrease the incidence of PTI (66). A more rigorously sterile technique, the systematic use of a hand drill to avoid thermal necrosis, and the use of sharp, centrally threaded pins (Denham) could help to decrease this complication to acceptable levels (32).

In this study PTI was significantly associated with prolonged durations of traction and was common in patients with comminuted fractures (Tables 5,6). The other studies done from the region have not described the occurrence of PTI in relation to the duration of traction or fracture patterns (5,64). We could probably attribute the increased incidence of PTI in comminuted fractures to the prolonged lengths of traction. These fractures are of a complex nature and they usually require internal fixation. The implants are expensive and unavailable hence they are on prolonged periods of skeletal traction predisposing them to PTI.

Knee stiffness was the most commonly occurring complication; at admission 69.3% of patients had flexion greater than 90 degrees but this rapidly declined to less than 10% by the third week on traction. Restricted movement represented by knee flexion less than 90 degrees was noted to have a peak prevalence of 62.7% and this occurred during week 4. The frequency of flexion less than 30 degrees rose steeply during the second and third weeks of traction to 42.7% in the fourth week. The rates of knee stiffness in this study may be higher when compared to other studies. This could be due to patients having some restriction / reluctance in flexing/extending their knees during the immediate post fracture period. This was due to pain caused at the fracture site aggravated by movements of the knee. Oduor et al (58) in a study at KNH had similar knee stiffness rates of 47.2%.

The data from Bezabeh's study on knee stiffness is not clearly reported as they have not stated at what point in time in respect to traction the patients develop knee stiffness they simply state that knee range of motion was 40-60 degrees in ten patients and between 60-90 degrees in 50 patients(5). It was more than 90 degrees in 7 (10.3%) patients, similarly in the study by Gosselin, knee range of motion was recorded in 34 patients (64.2%) and reported as full in 23 and good in 11(32).This data on knee motion, although apparently showing good results in the Perkins group, are too poor to lend themselves to critical analysis as they are not specific as to how they categorized full knee ROM and Good knee ROM. Usdin in his series of 58 patients from south Africa reported only 2 cases of residual knee stiffness (31), Bewes published his series of 15 patients from Tanzania in 1974 [59], all had at least 75% of knee flexion at the time of discharge.

Results from this study prove that knee stiffness is a significant problem even though majority of the patients are on Perkins traction which results to minimal knee stiffness. The development of knee stiffness was significantly associated with duration of traction (p value of < 0.001) (Table 12). However fracture geometry, age or cause of the fracture, are not significant risks as all the patients on traction are equally predisposed to develop knee stiffness and this is probably attributed to immobilization.

Reports on the use of the Perkins technique come mostly from developing countries.Similar results as this study have been reported from Malawi where measurement of complications such as knee movement restriction was only done at the time of discharge and does not reflect the true long-term outcome, they all had knee flexion of < 90 degrees upon discharge (60).

It is important to note that despite the patients in our series being on the Perkin's mode of traction the beds were not broken at the foot to allow for flexion exercise. It was also observed that the only form of physiotherapy they received was to perform isometric contraction exercises of the quadriceps and range of motion exercises of the ankle of the injured limb this could probably explain the high incidence of knee stiffness in the current study.

Purported benefits of Perkins traction over other methods is that healing rates are the same or better while causing very little if any residual knee stiffness, thus reducing the overall recovery time [61,62]. It is recommended within 3 or 4 days from admission and almost always before the 7th day, active range of motion exercises of the knee should be started. Pain medication may be necessary for the first few days, but pain levels become tolerable with surprising rapidity. To be successful, the Perkins technique requires “enthusiastic persistence” from both patient and surgeon.

Pneumonia rarely occurred in the study and in cases where it was diagnosed, it occurred relatively early. This is possibly due to multiple injuries in these patients causing them to be lying supine most of the time which predisposed them to develop hypostatic pneumonia. One of the patients who developed pneumonia had suffered from chest injuries hence putting him at an increased risk. Pneumonia was diagnosed in only 4.0% of the patients on weeks 1, 2 and 4. One of the patients with pneumonia, also developed PTI and was changed to skin traction while a second patient with pneumonia eventually died during week 4. Most of the patients in this study were from a young age bracket and did not have multiple injuries therefore they were not completely immobilized; they are able to sit themselves up and are more active despite being on traction hence this could be the reason for the low incidence of pneumonia in this study. The patients who developed pneumonia were either in elderly age group or had multiple injuries, this proves that elderly age and multiple injuries are a significant risk factor in the development of chest infections.

However results from this study are not in keeping with other studies, Charash et al [65] reviewed early versus delayed femoral shaft fracture stabilization in polytrauma patients with thoracic injuries. The overall incidence of pulmonary complications (ARDS, pneumonia, fat embolism, or pulmonary embolism) was 56% in the delayed fixation group compared with 16% in the early fixation group. The authors noted that 48% of patients in the delayed fixation cohort (N = 25) went on to develop pneumonia compared with 14% in the early fixation cohort (N = 56). The low incidence of chest complications are

possibly because most of the patients in our series did not suffer from major/severe trauma, and are of a young age bracket.

Three patients developed pressure sores during traction. All the pressure sores seen in the study were grade I. Two patients had trochanteric or sacral region sores and the last patient developed calcaneal sores during week 3, one of the patients with trochanteric/ sacral sores also had PTI and pneumonia and this patient died during week 4, this patient also had severe head injury in addition to the femoral fracture this shows that there is an increased incidence of pressure sores with multiple injuries. The low rates of pressure sores are could be due to the comprehensive care given by the physiotherapists; all the patients once they were put on traction were given protective heel shoes made out of sheep hide to be worn over the heel of the fractured limb. Patients were also encouraged on mobilization from the onset, they were advised on turning and sitting up and this could explain why the low rates of pressure sores. An important factor is that most of the patients were of a younger age bracket (Table 1) and although they were bed bound they were not completely immobilized. The decreased incidence of pressure sores could also have been due to the fact that most of the patients did not have major associated injuries. None of the studies done from the region have looked at the occurrence of pressure sores, this is probably due to the fact that most of the patients in these series (5, 32) were in the age ranges of 25 – 35yrs and most of the patients were on Perkins traction and early mobilization was advised. In a study done by Versluysen it was found that the incidence of pressure sores among her series of patients Of 100 subjects, 66 developed sores of varying degrees of severity. The patients in this series were aged 70-94, of these 100 patients, 97 had confirmed fractures; 88 injuries were at the proximal femur and nine in the shaft (36). With increasing age the risks of developing pressure sores increases, if intense nursing care is not availed to the patient.

Fracture healing following traction was reported for 10 patients who were managed using traction only and did not have to undergo ORIF. Out of these 6 (8%) patients had fractures that healed in mal-union, four (5.3%) patients had fractures healing in radiological union, while 16 (21.3%) of the patients who were on traction for more than 8 weeks developed non union and were eventually taken for ORIF. Procter reported his series of 41 patients in South Africa [30], all the patients had achieved clinical union at 6 weeks. A few years later, Usdin followed up with his own series of 58 patients [31] and average LOS was 7 weeks amongst the 58 patients, 6 (10.4%) had delayed or non-unions requiring surgical treatment. Bewes published his series of 15 patients from Tanzania in 1974 [59], they had a 100% union rate at 12 weeks though his sample size was very small. In 1977, Pearson reported on a series of 100 Nigerian patients treated over an 18-year period with either skin (89) or skeletal (11) traction [63], mean time to clinical consolidation was 6 weeks, and to protected ambulation 7 weeks. Two-thirds of his cases were under 20 years of age. Buxton reported in 1981 his series of 50 consecutive patients from the UK mean time to clinical and radiological healing was 12 weeks (57).

Most of the patients in this study were eventually taken for ORIF, therefore it is difficult to draw conclusions about our rates of union from traction exclusively, the rates of non-union could possibly be due to over distraction of the fragments or there was soft tissue interposition between the fracture fragments.

Only 36% of the patients from this study developed reduction in thigh circumference, this shows that the rates of quadriceps atrophy are not high, however during the data collection it was noted that even though the thigh circumference was not reducing, the quadriceps muscle was significantly atrophied. Bezabeh in his series of patients from Ethiopia also found a similar occurrence where only 12% of patients were reported to have reductions in thigh circumference as compared to 55% who had no change (5).

Mid-thigh circumference reduction was more common in patients with PTI and showed a statistically significant association with PTI ($p = 0.011$). Similarly, patients with knee stiffness were also more likely

to have mid thigh circumference reduction ($p = 0.017$). Twenty three (45.1%) patients with knee stiffness (<30 degrees) had reductions in mid thigh circumference compared to 4(16.7%) of patients without knee stiffness. This could be due to decreased movements of the fractured limb, which leads to muscle atrophy and reconditioning, loss of skeletal muscle mass and strength. This is often seen because of immobilization. Joint contraction occurs because of muscle atrophy, flexion loss is mostly due to intra-articular fibrosis and scarring in the quadriceps-femoral mechanism. Anterior adhesions involve the quadriceps expansion in the lateral and medial recesses, the supra-patellar bursa, muscle adhesions to the femur, patella, or even shortening of the rectus femoris (49).

This study has revealed that patients can be managed on skeletal traction for up to 4 weeks (Table 12) beyond which it has been found that the incidence of developing PTI and knee stiffness increases. The other studies from the region have not revealed at what point on traction complications arose.

Developing countries are experiencing a general increase of all types of injuries as they undergo socio-economic changes, characterized by urbanization and an increased dependence on motor vehicles as a means of transport. This results in a significant increase of fractures of the extremities, incidence and complexity of injuries (53).

Conservative treatment remains an acceptable mode of treatment, even in the West, for complicated fractures it has produced favourable results in the past. Its main drawback is the prolonged hospital stay and reduction in knee range of movement (60).

In light of limited health care facilities and doctor expertise in many developing countries, it must be accepted that, for a long time to come, conservative methods of fracture treatment will remain not only the method of choice but also the only practical one.

Conclusions

The most common complications are knee stiffness followed by pin tract infection. The risk factors predisposing to development of these complications are, prolonged durations of traction, fractures that are comminuted and the presence of multiple injuries.

Most of the patients in the orthopaedic units at KNH are taken for ORIF, however they are on traction for at least four weeks prior to fixation. We conclude that patients can be safely managed on skeletal traction for up-to four weeks beyond which they are at an increased risk of developing complications.

Recommendations

1. In order to decrease the incidence of pin tract infection twice-daily pin site care by the patient with wool and alcohol (spirit) should be done.
2. Intensive physiotherapy from the beginning with focus on building quadriceps and knee range of motion exercises to decrease the rates of knee stiffness, most hospitals have physiotherapists whose help can be enlisted.
3. The use of a Perkin's bed is preferred in patients with femoral shaft fractures. This can be made by adapting the bed base so it can be split for knee flexion but also replaced when patient needs to sleep.
4. Patients with multiple injuries and comminuted fractures should be considered for early ORIF, in these patients skin traction can be considered as an initial temporary form of management as they await definitive care.

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APPENDIX 1

EXPLANATION OF INFORMED CONSENT FORM

Dear Participating Patient/ Guardian

Study No.....

HospitalNo.....

Title : Outcome of skeletal traction in patients with femoral shaft fractures at KenyattaNationalHospital.

My name is Dr Mustafa Musajee, a post graduate student in the department of surgery.I am going to be carrying out a research project as part of my course work for the program.

Skeletal traction is one of the modes of management for femoral shaft fractures, however there are newer modes of treatment where the fracture is operatively fixed using implants.

Purpose of the study

The purpose of this study is to document the utility of extended periods of skeletal traction and determine what are some of the morbidities which are associated with prolonged skeletal traction.

Risks and benefits

This study will provide clinicians with information on some of the complications that occur with skeletal traction and thus assist in policy making and developing protocols on how to prevent occurrence of these complications

Voluntary participation

Participation in this study is out of your own free will. Medical care will not be denied to you in case you decline to participate in the study. You may terminate participation at any time with no consequences whatsoever.

Confidentiality

All information will be treated with confidentiality.

I the undersigned have been explained to and understand the above and voluntarily accept to participate in the study.

Your participation in the study is highly appreciated and will help form future protocols in management of femoral fractures.

Please feel free to communicate with me if you have further questions on the study.

PRINCIPAL INVESTIGATOR :- DR MUSTAFA MUSAJEE TEL : - 0734 867251

SECRETARY, KNH/UON-ERC TEL :- (254-020) 2726300 Ext. 44355

I have read and understood the above information. I am satisfied with the information given by the person obtaining the consent. I have decided to participate in this study.

Signature/Thumb print:

Date :.....

(Parent/Guardian)

Telephone number (parent/ guardian):

I confirm I have adequately explained the requirements for the informed consent for the study. I have given the patient/guardian the details of the research in layman terms.

Signature of person obtaining consent:-

Date:.....

.....

SWAHILI CONSENT FORM

MAELEZO CHA KIBALI CHA RUHUSA

Nambari ya utafiti:.....

Nambari ya Hospitali:.....

Title :

MatokeoyaKuvutwamifupakwawagonjwaambayewamevunjikamifupayamiguukwenyeHospitaliKuuYa
Kenyatta.

Utafiti huu unafanywa na DrMustafa Musajee, mwanafunzi wa upasuaji katika Chuo Kikuu cha Nairobi. Kiini cha utafiti huu nikuchunguza matokeo za kuvutwa miguu kwa wagonjwa ambaye wamevunjika mifupa ya miguu. Utafiti huu itachunguza kama kunashida zozote zina husika na uvutaji wa miguu Kwenye matibabu ya kuvunjika mifupa ya miguu.

Sababu ya utafiti

Utafiti huu unafanywa kuchunguza matokeo ya uvutaji ya miguu kwa matibabu yaku vunjika mifupa.

Utafiti huu utafanyika katika hospitali kuu ya Kenyatta. Taarifa zitakazo kusanywa zita tumika kufahamisha wapasuaji na kuwapa ujuzi zaidi.

Hatari na manufaa

Utafiti huu utatoa taarifa muhimu kwa madaktari kuhusu matokeo ya Uvutaji ya miguu kwa matibabu ya kuvunjika mifupa. Huenda ikawa itatengeneza msingi wa masomo ya baadaye ambayo wagonjwa watakao faidika na upasuaji wa mifupa. Hakuna madhara au hatari yanayo tarajia kwa kushiriki katika utafiti huu.Hata hivyo, kama matatizo yata tokea, matibabu zinazofaa zitapewa.

Hakuna vipimo vya ziada isipokuwa yale yakawaida kwa matibabu yatakayofanika. Hakuna gharama za ziada zitakazostahitika na wanaoshiriki katika utafiti huu.

Uhusika Kwa hiari

Kuhusika kwa utafiti huu ni kwa hiari yako mwenyewe na hauwezi kushurutishwa. Utahudumiwa ata kama ukikataa kuhusika kwa huu utafiti. Una uhuru kutamatisha kuhusika wakati wowote bila madhara yoyote ile.

Usiri

Habari zozote utakazotoa zitawekwa kwa siri na jina lako halitachapishwa popote.

Kujiunga kwa utafiti huu ni kwa hiari yako mwenyewe na hutonyimwa matibabu yoyote usipokubali kujiunga nao. Historia na majibu yako yote yatawekwa vizuri wala hayata sikikwa au kutangazwa kwa mtu mwingine yeyote.

Mimi ninayeweka sahihi/kidole changu rasmi hapa chini nimeelezwa na kuelewa yaliyoandikwa hapa na nimekubali kwa hiari yangu kujiunga kwa utafiti huu.

Sahihi/Kidole:

Tarehe _____ (Mgonjwa/Uhusiano)

Nambari ya simu(Mgonjwa/Uhusiano)

Mimi Dr Mustafa nahakikisha kuwa nimeeleza mgonjwa sababu ya hi utafiti name kubali kujiunga kwenye hi utafiti.

Sahihi

Tarehe

Kwa Mswali yeyote tafadhali umpigie simu

1. Dk. Mustafa Musajee– *Mchunguzi mkuu*, SIMU: 0734867251

2. Secretary, KNH/UON-ERC - Simu :- (254-020) 2726300 Ext. 44355

APPENDIX 2

DATA COLLECTION SHEET:-

SOCIO DEMOGRAPHIC DATA:-

SERIAL NO.:-

1. NAME :-

2. AGE

3. SEX M F

4. OCCUPATION

5. AETIOLOGY

MVA	<input type="text"/>
Pedestrian v/s MV	<input type="text"/>
Cyclist v/s MV	<input type="text"/>
Fall from a height	<input type="text"/>
GSW	<input type="text"/>
Stress #	<input type="text"/>
Osteoporosis	<input type="text"/>
Metabolic bone dx	<input type="text"/>

1. SITE OF FRACTURE :-

RIGHT LEG LEFT LEG

PROXIMAL SHAFT	<input type="text"/>
DISTAL SHAFT	<input type="text"/>
MIDDLE SHAFT	<input type="text"/>

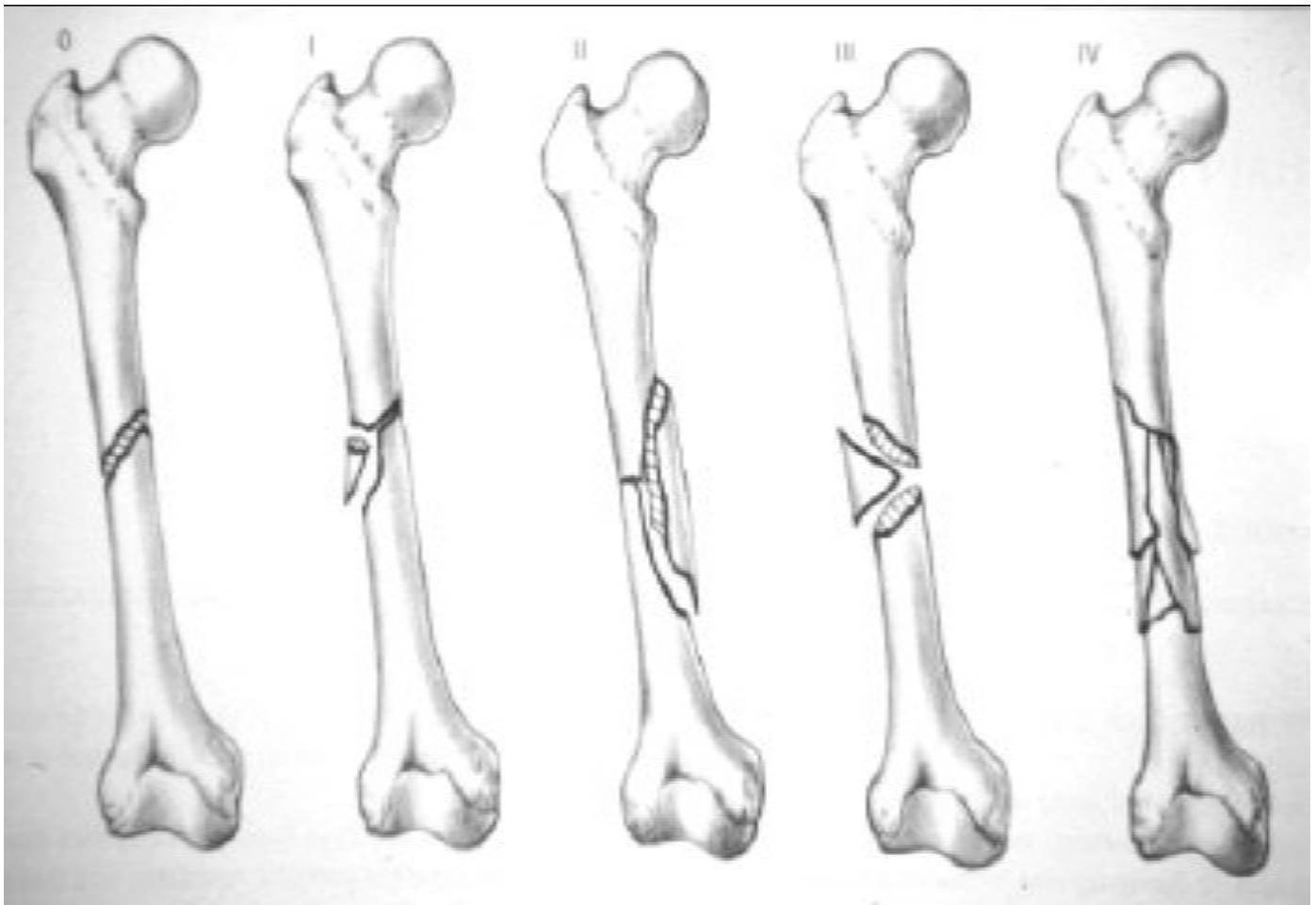
7. FRACTURE CLASSIFICATION

OPEN	<input type="text"/>
CLOSED	<input type="text"/>

8. FRACTURE GEOMETRY

- TRANSVERSE
- SPIRAL
- OBLIQUE
- COMMINUTED

9. Winquist Hansen Classification:-



10. Other associated injuries :-

- Head injury
- Abdominal injury
- GUT injury
- Thoracic injury
- Spinal injury
- Skeletal
- Other (specify)

MANAGEMENT PLAN:-

- Day of ORIF

- Date of Steinman pin insertion and put on traction :-

.....Type Of Traction :-.....

Complication Occurrence : -

Week/Duration on Traction	1	2	3	4	5	6	7	8	9	10
Pin Tract Site										
Hyperaemia										
Seropurulent Discharge										
Pin Loosening										
Crusts around the pin										
Pain around pin site										
Knee Stiffness										
Flexion <30 degree										
Flexion </=90 degree										

Flexion > 90 degree										
Signs Of Pneumonia please specify										
Pressure Sores (Grade and Site)										
Fracture Healing :- UNION or NON UNION										
MALUNION										
Thigh Circumfrence in Cm of Fractured limb and Unfractured Limb										

Total duration in weeks patient has been on traction :-

.....

APPENDIX 3



UNIVERSITY OF NAIROBI
COLLEGE OF HEALTH SCIENCES
P O BOX 19676 Code 00202
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Link: www.uonbi.ac.ke/activities/KNHUoN



KENYATTA NATIONAL HOSPITAL
P O BOX 20723 Code 00202
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Fax: 725272
Telegrams: MEDSUP, Nairobi
15th June 2012

Dr. Mustafa Musajee
Dept. of Surgery
School of Medicine
University of Nairobi

Dear Dr. Mustafa

Research proposal: "Outcome of Skeletal traction in patients with femoral shaft fractures at Kenyatta National Hospital" (P57/02/2012)

This is to inform you that the KNH/UoN-Ethics & Research Committee (ERC) has reviewed and **approved** your above revised research proposal. The approval periods are 15th June 2012 to 14th June 2013.

This approval is subject to compliance with the following requirements:

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

For more details consult the KNH/UoN ERC website www.uonbi.ac.ke/activities/KNHUoN

"Protect to Discover"

Yours sincerely

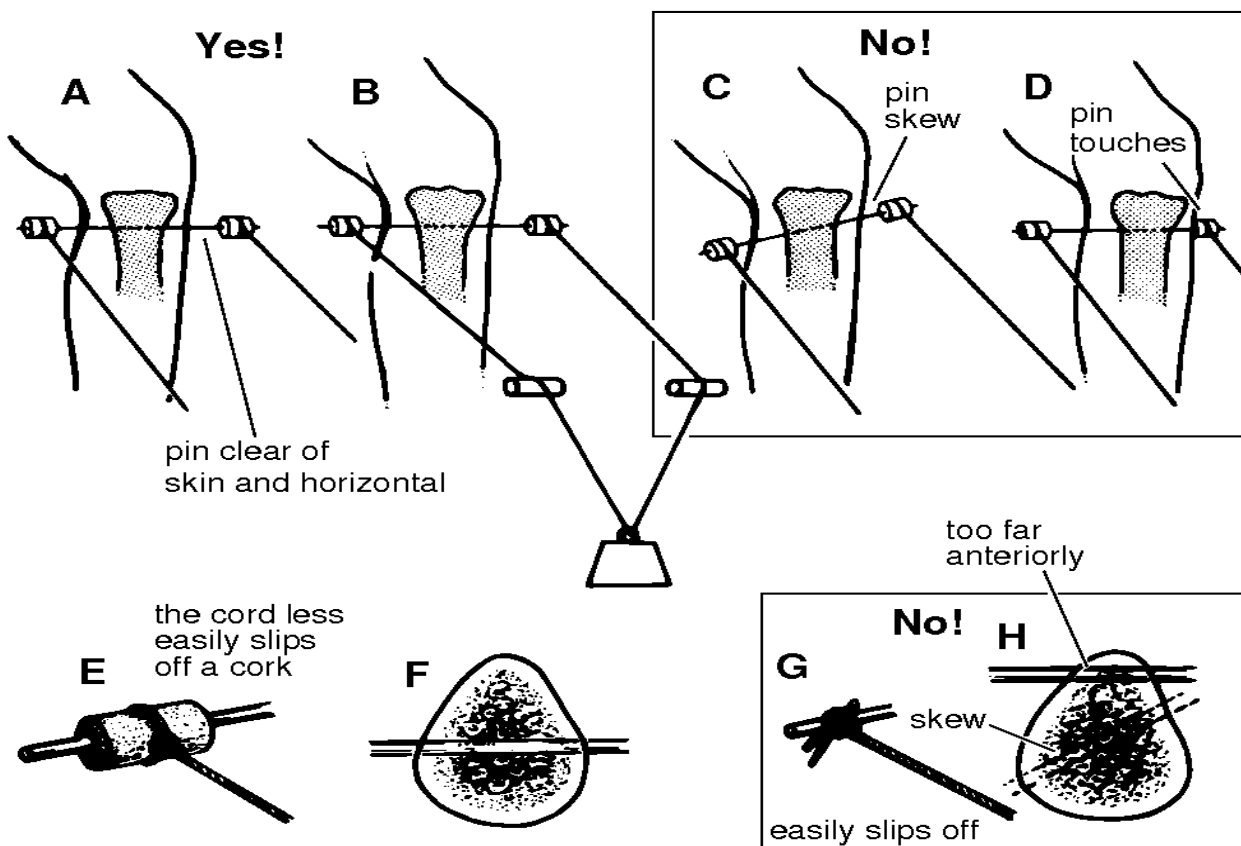
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SECRETARY, KNH/UON-ERC

c.c. The Deputy Director CS, KNH
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APPENDIX 4

Technique of Steinman Pin Insertion:- Reprinted with permission (Maurice K , Bewes P, Awori N. Primary Surgery Volume Two: Trauma. Low Priced Edition. Oxford; 1987; Chapter 70: 223)

TIBIAL TRACTION – RIGHT AND WRONG



If you are using local anaesthesia, sedate him or her, and apply povidone-iodine to the skin where the pin will be inserted and exit. Inject local anaesthetic into the skin, subcutaneous tissue, and periosteum of both sides, making sure it goes under the periosteum.

Make a small nick in the skin with the point of a sharp scalpel. Put the pin in the chuck, and push it through the skin into the bone, twisting it slightly from side to side as you do so. Ask one assistant to hold the patient's leg. Take great care to get the direction of the pin right. Ask your other assistant to check its direction by observing its alignment from the foot of the table. Putting it in is hard work!

As the pin comes out of the bone on the other side of the limb, its point will raise the skin, so nick this with a scalpel, and push the pin through it. When the threads of a Denham pin reach the bone, screw them in about six turns, so that some of them enter its cortex. The threads should lie in the cortex, not in the medulla. Finally, secure the pin in a Bohler's stirrup or, preferably, with Thomas pin mounts. If the sharp point might injure the patient's other leg, put a cork or a cap on it.