CONSERVATIVE MANAGEMENT OF CLOSED FEMORAL SHAFT FRACTURES – IS SKELETAL TRACTION STILL JUSTIFIED OR COST EFFECTIVE IN A DEVELOPING COUNTRY LIKE TANZANIA?

By

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A dissertation submitted in partial fulfillment of the requirements for the degree of Master of Medicine Orthopaedics and Traumatology of the University of Dar es Salaam.

October 2005

CERTIFICATION

The undersigned certifies that he has read and hereby recommend for acceptance by the University of Dar Es Salaam a dissertation entitled:

CONSERVATIVE MANAGEMENT OF CLOSED FEMORAL SHAFT FRACTURES-IS SKELETAL TRACTION STILL JUSTIFIED OR COST EFFECTIVE IN A DEVELOPING COUNTRY LIKE TANZANIA?

Submitted in partial fulfillment of the requirements for the degree of Master of medicine Orthopaedics and Traumatology of the University of Dar Es Salaam.

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DECLARATION

AND

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I, SAMUEL PETER MALLYA SWAI declare that this dissertation is my own original work and that it has not been presented to any other university for a similar or any degree award.

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DEDICATION

This dissertation is dedicated to my late father Peter Mallya Swai and my mother Apaisaria Peter Swai, thanks for bringing me into this world, teach me to stand upright and instill in me a sense of hard work.

ABSTRACT

TITLE: Conservative Management Of Closed Femoral Shaft Fractures – Is Skeletal Traction Still Justified or Cost Effective in A Developing Country Like Tanzania?

Closed femoral shaft fractures have always been a challenge to orthopaedic surgeons and traumatologists for many years. They account for high morbidity rates in trauma wards, prolonged hospitalization as well as affecting the productive age group of the society.

In the developed world surgery is now the first option of treatment rather than conservative treatment. In the developing world however, owing to lack of both qualified personnel and funds to purchase modern implants, conservative treatment still remains the mainstay of treatment.

The broad objective of this study was to determine medical and financial benefits of embarking on early surgery of femoral shaft fractures versus conservative treatment in the form of continuous skeletal traction. Specifically to determine lengths of hospitalization, early and late medical complications encountered as well as the cost incurred by both the patient and the hospital on both types of treatment.

The study included patients admitted at Muhimbili Orthopaedic Institute with closed femoral shaft fractures during the period of August 2003 to July 2004 and of ages 11 to 72 years.

There were 91 patients with closed femoral shaft fractures enrolled into the study, out of these 8 were lost to follow up and the remaining 83 were treated. 42 patients were managed by continuous skeletal traction and 41 by open reduction and internal fixation.

Results

The ages ranged from 11 to 72 years with median age 26 years. The age group 21-30 years accounted for 53 patients (63.8%) followed by age group 11-20 with 19 patients (22.9%) patients with age 40 years or above were least affected with 11 cases or (13.2%).

67(81%) were males and 16(19%) were females.

The majority of injuries occurred within Dar es Salaam region affecting 72 patients (86.7%).

The commonest mechanism of injury was Road Traffic Accidents being the cause of injury in 67 patients (80.7%) followed by industrial injuries 9(10.8%) least were sports injuries and assaults.

The commonest sustained fracture was Transverse fracture type $32A_3$ by AO classification with 31 cases (37.3%) and there was no complex fracture type $32C_3$ in the study group.

Of 42 cases treated by conservative method 9(18.8%) had union, 1(2.4%) malunion and 31(75.6%) non union. One patient from this group died following complications from HIV/AIDS.

Of 41 patients treated by open reduction and internal fixation 39(95.1%) had union. 1(2.4%) had non-union and 1(2.4%) had malunion following a loosened plate. There was no death in this group.

Of those treated conservatively at 3 months follow up 10(23.8%) had severe knee joint stiffness 25(59.5%) had moderate and 7 (16.7%) had mild, while those treated by ORIF the complication was found on 2(4.9%), 17(41%) and 22(53.1%) respectively.

At six months the joint function had improved for both groups with only 1case(2.4%) with severe residual knee stiffness from the conservatively treated and none from the ORIF group.

Those treated by skeletal traction had significant longer hospital stays with mean stay of 58.33 days against 25.90 days for those treated by open reduction and internal fixation. The difference between the two means is 32.43. Kruskal-Wallis H chi-square 59.19 and P-value 0.00000 which is highly significant.

Longer hospitalization meant more direct and indirect costs to the patient, longer sick leaves and more unproductive days for skeletal traction type of treatment.

For the health facility longer hospitalization though not directly costing more per se its impact is in inefficient use of funds and increased workload. The former is compounded by the fact that the patient bears but only a fraction of real cost of treatment as the larger part of treatment is subsidized.

Conclusions:

1. Road Traffic Accidents are the main cause of closed femoral shaft fractures.
2. Treatment by continuous skeletal traction is associated with more complications especially non-union and knee joint stiffness.
3. Treatment by skeletal traction leads to longer hospital stay and late ambulation of the patient.
4. Skeletal traction directly and indirectly costs more than surgical treatment.
5. Skeletal traction is inefficient in terms of utilization of funds by a health facility.

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LIST OF ABBREVIATIONS

ADL	-	Activities of Daily Living
AIDS	-	Acquired Immunodeficiency Syndrome
AO	-	Arbeitsgemeinschaft für Osteosynthesefragen
ASIF	-	Association for Internal Fixation
F/E	-	Flexion/Extension
FWB	-	Full Weight Bearing
GA	-	General Anaesthesia
Hb	-	Haemoglobin
HIV	-	Human Immunodeficiency Virus
I/V	-	Intra-venous
K-Nail	-	Küntscher Nail
LA	-	Local Anaesthesia
MOI	-	Muhimbili Orthopaedic Institute
MUCHS	-	Muhimbili University College of Health Sciences
NWB	-	Non – Weight Bearing
ORIF	-	Open Reduction and Internal Fixation
PWB	-	Partial Weight Bearing
ROM	-	Range of Movement
RTA	-	Road Traffic Accident
SA	-	Spinal Anaesthesia
TB	-	Tuberculosis
UFN	-	Universal Femoral Nail

1.0 INTRODUCTION AND LITERATURE REVIEW

1.1 Background

In Tanzania, as is in many other developing countries, conservative management of closed femoral shaft fractures remains the mainstay treatment option although since four decades it has become almost obsolete in many developed countries.

These fractures affect mainly the productive age group of the society (i.e. 20 – 40 years) since this group is the one mainly involved in road traffic accidents as well as industrial injuries.

Fractures of femur are the major cause of prolonged hospitalization and accounts for high morbidity rates encountered in orthopaedic and trauma wards in our environment [1].

Apart from long hospitalization, conservative treatment is also associated with complications like:

1. Delayed union.
2. Non-union.
3. Malunion with significant limb shortening.
4. Knee joint stiffness.
5. Pin tract infection.
6. Fat embolism.

In our set up, due to lack of both personnel and necessary materials, all these fractures are initially managed with skeletal traction for a varying period of time, majority are however finally managed surgically with the commonest indication for surgery being non-union.

Contemplation of non-union is unjustified though until there is clear evidence either clinical or radiological that healing has ceased and that union is highly improbable. For descriptive purposes back in 1986 an American Food and Drugs Administration panel defined non-union as established when a minimum of 9 months has elapsed since injury and fracture shows no visible signs of healing for 3 months.

Confining a patient to bed for such a long period was unacceptable even when conservative management was popular in developed countries and therefore alternative methods of treatment were devised to shorten this period to about 6 to 8 weeks.

Signs of non-union at 6 – 8 weeks remains a cut off point to date for preclusion of conservative treatment in Tanzania.

1.2 Epidemiology

According to Muhimbili Orthopaedic Institute (MOI) records of year 2002 & 2003 its trauma wards admits an average of 4 cases of closed femoral shaft fractures each week. This makes it 3rd commonest type of fractures encountered with a prevalence of about 200 cases per year[1].

Like the rest of fractures seen the main causes are: -

Motor traffic accidents.

Industrial injuries.

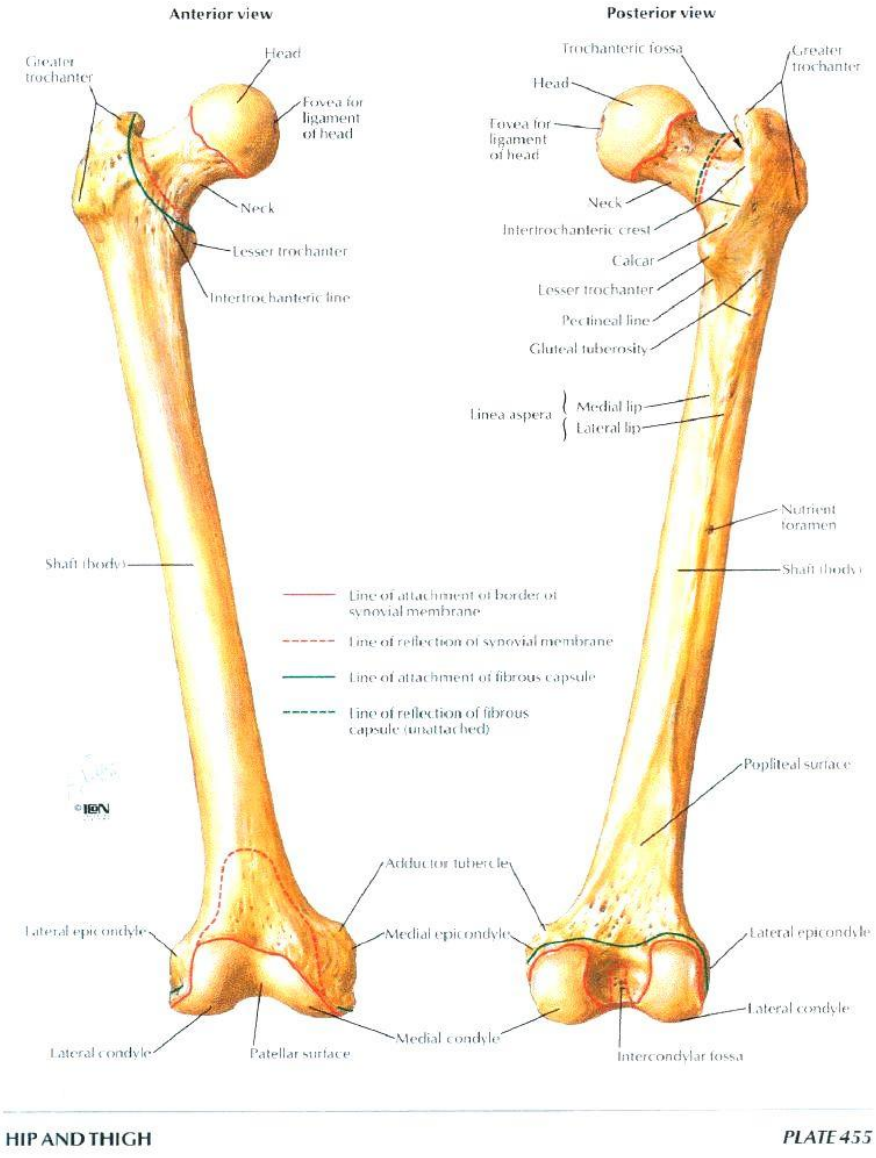
Sports injuries.

Fall from considerable heights.

The most commonly affected age group is 20 – 40 years since they are the main users of motorized vehicles, are the industrial workers and is the age group that is increasingly moving to urban areas for economic reasons.

Males are more affected than females and a pilot study of MOI records shows a ratio of 6:1[1].

Plate 1- Anatomy of Femur



Courtesy- Atlas of human anatomy-Frank Netter

The femur is the strongest and longest weight bearing bone in the body.

It is surrounded by powerful muscles that create problems in maintaining the fragments in position after fracture reduction.

Iliopsoas muscle (a powerful hip flexor) is inserted in the lesser trochanter.

Gluteus medius et minimus (powerful hip abductors) are inserted into greater trochanter.

The Adductors (longus, brevis et magnus) are inserted along the medial aspect of the shaft.The Gastrocnemius muscle origins are attached to the posterior aspect of the lower end of the shaft.

These muscles cause typical displacements of fragments in the fractures at the proximal, middle and distal thirds of the shaft of femur as such;

In the proximal fractures – The proximal fragment is drawn into a flexed position by the iliopsoas muscle and into abducted position by the Gluteus medius and minimus muscles.

In the middle third fractures – the adductors displace the distal fragment medially and upwards.

In the distal third fractures – the distal fragment is flexed by the origins of Gastrocnemius muscles.

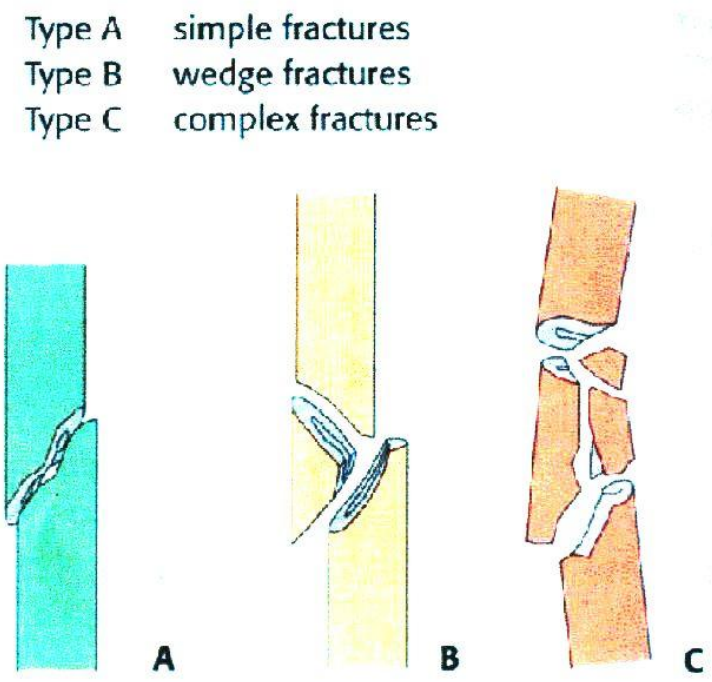
1.4 Classification of femoral shaft fractures

Femoral shaft is defined as, effect, stretching between 5 centimeters inferior to the lesser trochanter and the upper border of a square containing the distal condyles of the femur.

For descriptive purposes thus the shaft is divided equally into proximal, middle and distal thirds. And the fractures are likewise divided into proximal, middle and distal third fractures.

Commonly used, however, is AO/ASIF classification that represents an alphanumeric coding of each bone or bone region and the long bones are each divided into three segments.

Plate 2- Classification of femur shaft fractures – 1



Adopted from-AO principles of fracture management

31 – Proximal.

32 – Middle.

33 – Distal.

The type of fracture is then graded as;

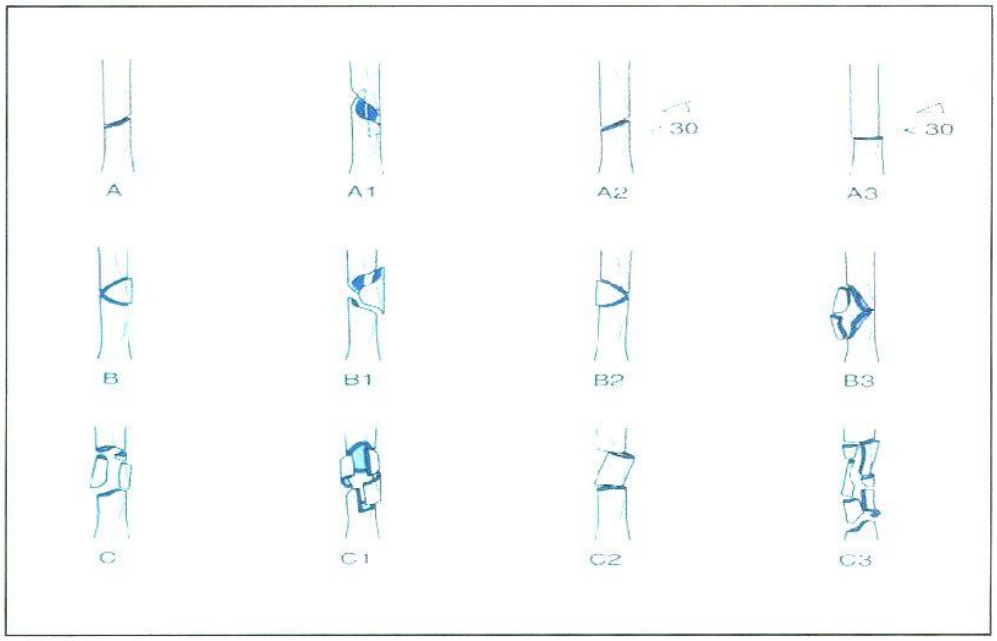
A- least severe with 2 fragments.

B- Wedge fractures 3 fragments.

C- most severe – complex > 3 fragments.

Plate 3- Classification of femur fractures – 2

Groups, which qualify the pattern: spiral, oblique or transverse.



Adopted from- Rockwood & Green fractures in adult Vol II.

32 A - Simple i.e. 2 fragments only fracture	32 A_1 – Spiral
	32 A_2 – Oblique
	32 A_3 – Transverse
32 B – Wedge fractures – 3 fragments	32 B_1 – spiral wedge
	32 B_2 – Bending wedge
	32 B_3 – Fragmented wedge
32 C – Complex fracture. - >3 fragments	32 C_1 – spiral wedge
	32 C_2 – Bending wedge
	32 C_3 – Fragmented wedge

1.5 Principles of treatment femoral shaft fractures

Like any other fractures the primary aims are:

Attainment of sound bony union without deformity

Restoration of function so that the patient is able to resume his/her former occupation and social activities and one might add as quick as possible and without risk of complications.

General measures

Priority of treatment is given in multiply injured patient. Huge force is usually required to fracture a normal femoral bone as such often these fractures are associated with other severe body injuries. Advanced Trauma Life Support protocol applies and immediate action must be taken to correct life threatening situations i.e.:

- Correction of respiratory obstruction and impairment.
- Control hemorrhage and treat shock.
- Immediate assessment and treatment of severe head injury whilst protecting the cervical spine.
- Immediate assessment and treatment on emergency basis ruptured viscera.
- Prevention of further soft tissue injuries around the fracture itself.

Treatment of fracture itself

The principles of fracture treatment are to:

- Prevent undue movement at the fracture site by temporary splintage until radiographic and any other examinations are complete.
- Prevent further soft tissue injuries
- Minimize the chances of a closed fracture becoming open one
- The fracture should be fully assessed clinically and radiologically to determine – site, pattern, displacement and angulation.
- Definitive treatment of fracture itself, after clinical and radiological examination is either conservative by continuous traction or open reduction and internal fixation.

1.6 Literature review on management of femoral shaft fractures

1.6.1 Traction history

Traction has been used since Hippocrates era i.e. 3AD. Hippocrates used it to reduce dislocations using his heel, ladder, poles and rack known then as scamnum of Hippocrates [2].

Shortly after Hippocrates more elaborate equipment with pulleys, longer levers and stronger ropes were used with aim of producing short, sharp pulls but soon proved unsuitable for prolonged traction due to skin damage and impaired circulation [3].

As a formal type of treatment traction is well described in the writings of Galen (130 – 200AD) and with the gained experience of its use the practice was to remove the traction once some form of splint had been applied. During the same time there was

much discussion on how and when the immobilized limb's joints should be exercised[3].

Continuous traction is of recent origin i.e. middle of 19th century and this was mainly achieved by applying traction to the shin [4].

Petit and Pott and thus the utilization of gravity in maintaining position used inclined planes.

In 1839 John Haddy James described continuous traction using a weight suspended over a pulley. He bandaged the leg to a wooden splint that rested on rollers, a string from the wooden splint was passed over a pulley to a weight and the patient was fixed to the headboard by a harness to prevent him being pulled out of bed.

1860 Gordon Buck introduced straight leg traction for treatment of femoral fractures that proved very popular during the American Civil war and came to be known as Buck's traction [5].

He used a roller bandage and adhesive tape as well as pulley and weight. A perineum band was fastened to the head of bedstead to prevent rotation and a sandbag employed maintained counter extension.

Dr. Buck described the 4 prerequisites for continuous traction namely:-

i. To maintain uninterrupted and efficient extension without producing intolerable pain, excoriations, sloughing or sores.

ii. To minimize the suffering of patient on long confinement as well as be convenient for evacuation of bowels.

iii. To be cheap and easy to apply.

iv. Not liable to become deranged.

Early 1900 Allesandro Codvilla tried to apply traction to a below knee plaster but was found to produce skin necrosis and thus at around this period in order to circumvent this problem skeletal traction was introduced[6].

1909 Martin Kirschner used thin wires above and below fracture line and applied a distraction apparatus to prevent over lapping.

1911 – Fritz Steinman introduced thicker pins (Steinman pin) and stirrups. He also described sites at which this type of traction was to be applied. This method is still used to date.

Properly applied skeletal traction has acceptable results with some literature reporting up to 97% union [7,8] such results are however obtained in the so called "balanced traction" whose main basic concept is that the extremity is suspended in some form of a frame which holds the entire extremity creating a "single unit".

A popularly used such unit today is traction in Böhler-Braun splint. Invented by Lorenz Böhler (Professor at University of Vienna 1936 – 1951). His main mode of treatment of femoral shaft fractures was conservative after seeing complications associated then by open reduction and internal fixation. He propagated the norm "as conservative as possible and as operative as necessary" in all fracture management after observation of higher morbidity and mortality associated with surgical management of fractures.

He also emphasized on active motion of all non-immobilized joints in this apparatus.

Apart from afore mentioned complications, skeletal traction is also associated with:

Malunion, limb shortening, osteoporosis, non-union, fat embolism, tethering of muscles, bedsores and hypostatic pneumonia [9,10].

Its major drawback is however, long confinement to bed 6 – 9 months. The latter can be costly to both the patient and the health service provider.

Although it is still a gold standard mode of treatment for treatment of closed femoral shaft fractures in children [11], recent studies have shown that even in this age group ORIF by intramedullary silastic nailing shortens both hospital stays and decreases over all hospital costs [12].

Alternative and complimentary methods to traction:

Other methods of treatment of femoral shaft fractures were introduced initially to complement continuous traction and later as alternatives.

First to be introduced as a complementary treatment was weight bearing spica cast. With this method, continuous traction was applied for about 6 weeks after which weight-bearing spica was applied and patient ambulated on crutches with progressive weight bearing.

This method however has its drawbacks as it leads to both hip and knee contractures. To circumvent this a cast brace an essentially external support device was introduced. The latter had several advantages namely:

- It permits progressive weight bearing
- It improves muscles and joint movements
- It allows increased skeletal stress that stimulates fracture healing.

Femur has been however, the least consistent bone to respond to functional bracing due to angulatory deformities of various type especially on its proximal ½ as a result

of inability to immobilize the hip joint, thus bracing became limited to the distal ½ fractures.

Bracing is also associated with higher incidence of significant limb shortening often requiring corrective measures.

Given the shortcomings of all other methods, the AO of Switzerland[13,14] started recommending back in early 50s the use of Küntscher nail or compression plates for almost all femoral shaft fractures citing the following advantages:

- Most accurate reduction.
- Early motion.
- Good functional outcome.

Compression plating:

Its popularity has declined since the introduction of modern intramedullary nailing techniques (i.e. mid 70s). There however are a number of relative indications for its use i.e. Shaft fractures with proximal or distal metaphysical extension

Ipslateral neck/shaft, supracondylar/shaft fractures

Non-availability of equipment for closed nailing.

Its main disadvantages:

- Greater soft tissues and bony injury on its application.
- Stripping of periosteum.
- Splitting and scarring of muscles.
- Open exposure of bone fragments with increased risk of infection.

Biomechanically, plates are inferior to intramedullary nailing [15].

Intramedullary nailing:

Intramedullary fixation of diaphyseal fractures of femur is associated with minimal morbidity and the surgical procedure can be performed in a minimally traumatic fashion that recovery is rapid and that the rate of union is very high (>95%)[16,17] infection rates as low as (0.5-1%). Based on this evidence, it is the treatment of choice for a high percentage of diaphyseal fractures of femur .

Intrameduallary nailing technique was pioneered by G. Küntcher in early 40^s. Many refinements have been made on this method however, the basic concept of the procedure Küntscher described remains unchanged. Most femoral nailing systems in use today allow placement of a cannulated and slotted nail across the fracture. The groove on the sides of the nail permits reconstitution of the endosteal vasculature. The longitudinal slot decreases its tensional rigidity and the nail tends to compress circumferentially as it is driven into the canal.

The major limitation of Küntscher nailing system was its poor results in comminuted midshaft fractures and in fractures at the proximal or distal aspect of the shaft where the intramedullary canal is very wide.

Axial and rotatory loads are not neutralized and hence malrotation and postoperative limb length discrepancy are troublesome complications.

To overcome these shortcomings modern intramedullary nailing systems are provided with interlocking screws for locking of the major fracture fragments. What is recommended is "Static" locking with screws in both proximal and distal fragments for fractures in which both shortening and malrotation are envisaged [17] .

The addition of interlocking screws to modern nailing systems has also expanded the indications for this procedure to include otherwise not amenable to plain Küntscher nailing i.e. severely comminuted, proximal and distal fractures of the femoral shaft [18,19].

Despite being phased out, skeletal traction still saves a limited function in the initial phase of management, mainly as a measure for alleviation of pain, maintaining fracture alignment during transport of patient or when there's contiguous soft tissue or bonny infection of which internal fixation is contraindicated.

In the developing countries like Tanzania, probably owing to shortage of both trained personnel and implants or due to scarce funds allocated to the health sector, conservative management of femoral shaft fractures remains the main modality of treatment.

Apart from clear surgical shortcomings the second part of this study will analyze if this method is cost effective, analyzing both direct costs to the caregiver as well as direct and indirect cost to the recipient.

In pediatric orthopaedic surgery whereby traction remains a gold standard there is also a growing tendency to early surgery mainly to cut the costs of prolonged hospitalization[19].

2.0 RATIONALE OF THE STUDY:

2.1 In conservative treatment of closed femoral shaft fractures, the "Actual Cost" of subjecting a patient to an 8 week skeletal traction with its associated complications and poor results, finally managing the same patient surgically must be daunting to both the patient and the health service provider alike. Since most of our patients with femoral shaft fractures are initially managed conservatively it was found prudent to justify or discredit this mode of treatment objectively in the era of advanced technology.

2.2 No other study has been done in Tanzania to show merits and demerits medical, economic or otherwise of embarking on early surgical management over skeletal traction.

3.0 HYPOTHESIS

Surgical management of closed femoral shaft fractures is a modern and better way, which is also associated with lesser complications, shorter hospitalization and an overall improvement of patient's quality of life after trauma. It is probably more cost effective than skeletal traction mode of treatment.

Information generated from this study will be useful in rational use of meager resources allocated for management of trauma patients.

Greater beneficiaries though will be the patients themselves in terms of shorter hospital stays, early ambulation, early return to daily activities, early

return to wage earning activities and as such lessen their medical bills and improve their general economic welfare.

4.0 OBJECTIVES

4.1 Broad Objectives

To determine medical and financial benefits of early surgical management of closed femoral shaft fractures compared to conservative (skeletal traction) treatment as seen at Muhimbili Orthopaedic Institute.

4.2 Specific Objectives

i. To determine lengths of hospital stay between patients managed conservatively and those with early surgical intervention

ii.. To determine early and late medical complications in patients managed conservatively and those managed surgically.

iii. To determine total cost incurred by patient and by hospital (Institute) on the two modes of treatment.

iv. To determine patient's satisfaction in terms of pain alleviation, self-grooming etc. on both types of management.

5.0 METHODOLOGY

5.1 Study design: Randomized double blind clinical trial.

5.2 Study setting: Hospital based study in a referral and teaching Institution – Muhimbili Orthopaedic Institute.

5.3 Study population: Patients admitted at Muhimbili Orthopaedic Institute with closed femoral shaft fractures.

5.4 Duration of study: August 2003 – July 2004.

5.5 Sample size:

Sample size formula for comparison of two proportions

$$n = \frac{[Z_\beta \sqrt{p_1 (1-p_1) + P_2 (1-p_2)} + Zx\sqrt{2p (1-p)}]^2}{(P_2 - P_1)^2}$$

Where:

Z_β is the % point of normal distribution corresponding to 100% - the power, If power = 90% $\beta = 0.10 \Longrightarrow Z_\beta = 1.28$

Zx is the % point of normal distribution corresponding to the level of significance.

P_1 = % of patients treated by conservative (skeletal traction) treatment who had complications (taken to be 60%).

P_2 = % of patients treated by surgery (ORIF) who had complications (taken to be 10%).

$$P = \frac{p_1 - p_2}{2}$$

The minimum required sample is 35 patients per group. Due to non-response and loss to follow up the sample was increased to 40 per group.

5.6 Recruitment of Study Subjects

Patients were enrolled into the study as they were admitted.

Simple double blind randomization was used to assign patients into surgery or skeletal traction. Both the investigator and the patient were not aware into which group the patient will fall.

Only patients who consented were included in the trial.

Use of random number tables to do randomization whereby

Digits 0 – 4 were assigned to conservative (skeletal) treatment and

Digits 5 – 9 were assigned to surgical (ORIF) treatment.

The starting point was determined randomly.

The randomization list was prepared before the trial begun.

5.7 Exclusion Criteria

Patients with multiple fractures.

Pregnancy.

Mentally disturbed.

Presence of co–morbid conditions (Severe Hypertension, Diabetes, Epilepsy; TB)

5.8 Ethical Issues

Voluntary participation of patients with a written consent.

Guaranteed normal service if patient deny participation.

Ethical clearance to conduct study was obtained from Muhimbili Orthopaedic Institute and Muhimbili University College of Health Sciences Ethical Clearance Committee.

5.9 Data Collection

A structured questionnaire designed for the purpose of this study was used.

Information on demographic data that included name, sex, age, address, occupation were obtained from patient.

5.9.1 History

A detailed history of time, date, mechanism of injury as well as exclude co-morbid condition was taken on admission.

5.9.2 Physical Examination

Since to fracture femur requires enormous force both primary and secondary surveys as per advanced trauma protocol was conducted[20].

After ruling out multiple injuries a careful local examination of the affected limb to assess the extent of soft tissue injuries around the fracture and ascertain that the fracture was closed was conducted.

Special attention to skin around skeletal traction site to ensure no inflammation or infection was present was also taken before embarking on skeletal or surgical treatment.



5.9.3 X-Rays

Upon admission into trauma wards all patients come with X-Rays taken at the casualty. These were used to establish the diagnosis if found to be of good quality and satisfactory for the purpose.

Poor quality X-Rays were repeated, and these X-Rays together with history and physical findings were used to determine the type and pattern of fracture sustained and also to exclude open, pathologic, sub-trochanteric and physeal fractures from the study.

For patients on skeletal traction had X-Ray taken at 2 weeks to ascertain whether reduction has been maintained or adjust traction weight accordingly.

X-Rays were also taken at 4^{th} week for control of alignment and at 8^{th} and 12^{th} week for tracing of signs of fracture healing in terms of callus formation, bridging of the fracture fragments, diagnosis of malunion or signs of non-union.

For patients whom underwent surgery, post operative control X-Rays were taken within 2 – 3 days to assess the success of operation and at 2^{nd} – 3^{rd} month to diagnose implant failure (loose, broken, infected implant) and monitor fracture healing.

5.10 Limitation of the study

The lowest statistically accepted sample size was used due to investigation costs.

A short-term follow up was due to the fact that conservative or not one requires years to ascertain union or non-union.

This was a hospital-based study hence prone to selection bias.

5.11 Data analysis

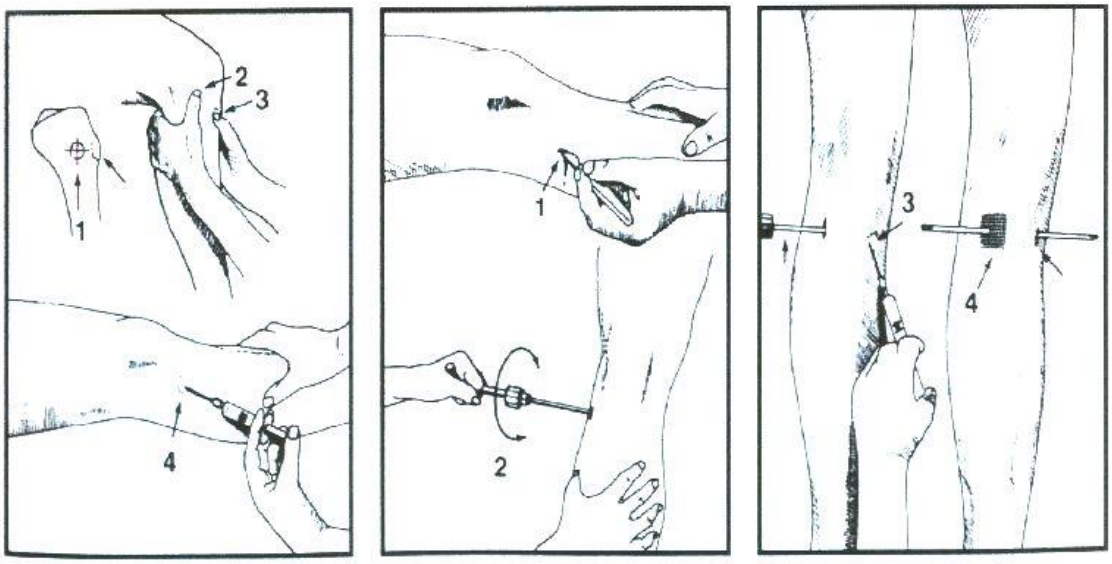
Data were entered in a computer using EPI-INFO Version 6.40 data program for analysis. Unpaired Student's t-test, Kruskal Wallis H, Wilcoxon and Bartlet's tests for comparison of two samples were used, P-values of less than 0.05 were considered significant.

5.12 Definition of terms

For the purpose of this study the following operative definitions were used:

Type I – Mode of treatment [Conservative]

Plate 4- Application of tibial skeletal traction.



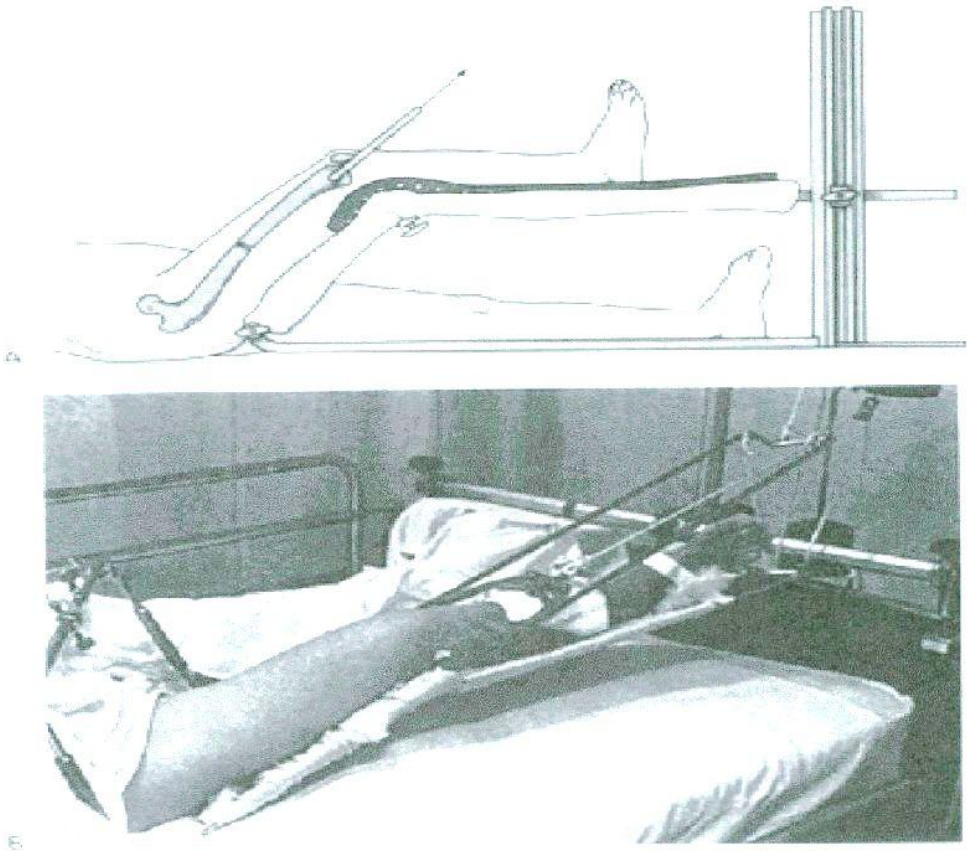
10. **Applying skeletal traction (1):** The preferred site is the upper tibia a little under 2 cm (1") posterior to the prominence of the tibial tuberosity (1). It is important to avoid the knee joint, and the growth plate in children; so begin by carefully identifying it by flexing the knee (2), noting its relationship to the tuberosity (3). If a general anaesthetic is not employed, infiltrate the skin and tissue down to periosteum with local anaesthetic (e.g. 2–3 ml of 1% Lignocaine) (4).

11. **Skeletal traction (2):** Now make a small incision in the skin (1) enough to take the traction pin only; inset it until the point strikes bone. Drive the pin through the lateral tibial cortex by applying firm pressure and twisting the chuck handle (2). You should feel it penetrate the outer cortex and pass quickly with little resistance until it meets the medial cortex. Stop at this stage.

12. **Skeletal traction (3):** Infiltrate the skin down to periosteum on the medial side, using the lie of the pin to guide you to the expected exit area (3). Drive the pin through the medial cortex, and make a small incision over the tenting skin to allow it to come through. Protect the openings with gauze strips soaked in Nobecutane® or a similar sealant (4). Try to inset the pin at right angles to the leg.

Adopted from- Practical fracture treatment by Ronald McRae Third Edition

Plate 5- Böhler Braun Splint.



Adopted from Rockwood & Green fractures in adults Vol II

In conservative type of treatment, a continuous skeletal traction was applied to reduce and maintain fracture reduction under the following protocol:

(a) General assessment of patient prior to application to rule out circulatory and co-morbid conditions i.e. Diabetes mellitus, thrombophlebitis, varices and skin problems.

(b) Preparation of skin aseptically using iodine and spirit and sterile draping of the site of application.

(c) Administering of a short acting general analgesia pethidine(50-100mg) and a benzodiazepin – Diazepam (5-10mg).

(d) Infiltration of both entry and exit site of the steinman pin with a local anaesthetic lignocaine 1%(2-5ml) each site.

(e) Small stab incision 2cm distal and 2 cm posterior to tibial tuberosity on the lateral aspect of the limb and insertion of a steinman pin from this point perpendicularly to the long axis of the tibia.

(f) Mounting the traction stirrup to the pin and setting the limb in a pre-prepared Böhler-Braun splint ensuring that:

i. Traction cords were well aligned in each pulley.

ii. Cords were not stretched or frayed.

iii. Knots were secured.

iv. Cords and weights were hanging free of bed and floor.

v. Correct weight (10% of body weight) was applied.

vi. Foot plates and splints not touching end of bed.

vii. Bed-linen not interfering with line of traction.

(g) Maintaining correct body alignment and proper bed position for counter traction.

(h) Check weights after position changes.

(i) Assess patient for secondary complications of immobility i.e. thrombophlebitis, constipation, hypostatic pneumonia, urinary tract infection.

(j) Daily inspection of pin entry and exit sites for redness, swelling, odor, bleeding and discharge.

(k) Patient education on:

i. Purpose of traction

ii. Importance of body alignment

iii. Proper bed position

iv. Not to adjust traction

v. Report on pain, bleeding discharge from pin site

(l) X-ray follow up each fortnight and adjustment of weight accordingly.

Type II – Mode of treatment [Surgical]

Plate 6- UFN and plating of femur.

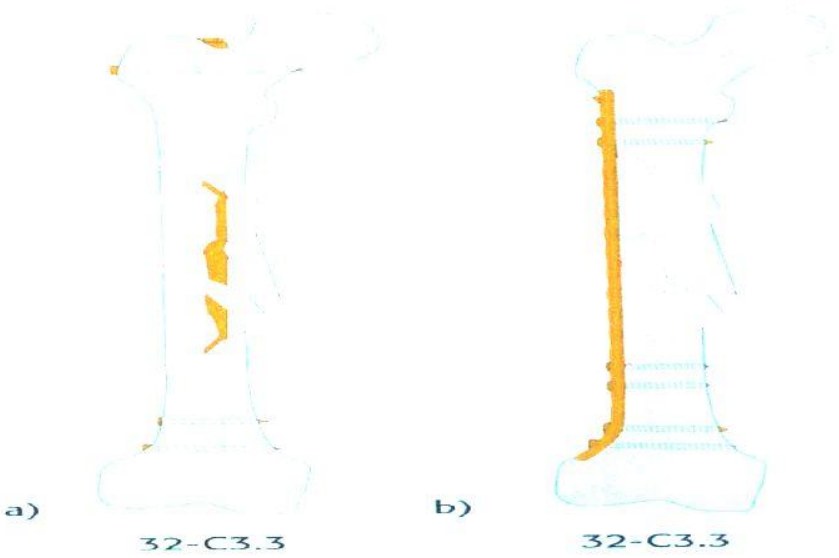
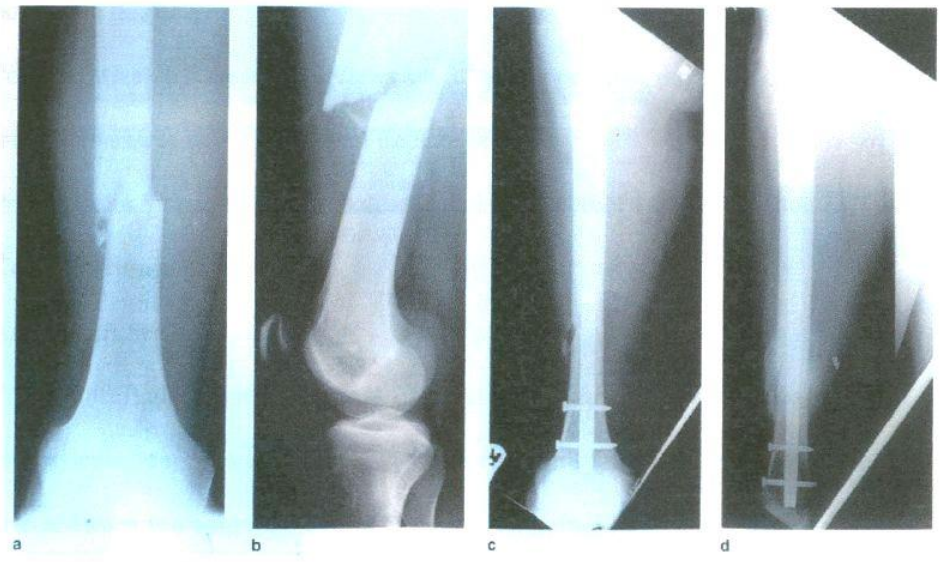


Fig. 4.6.2-7:
a) For complex, multifragmented diaphyseal fractures of the femur, the locked intramedullary nail reamed, unreamed, or cannulated is the implant of choice.
b) If for any reason nailing cannot be performed, a bridge plate (broad DCP 4.5 or broad LC-DCP 4.5) can be used—preferably after indirect reduction and using the tunneling technique.

Adopted from AO principles of fracture management

Plate 7- Universal interlocked femoral nailing.



In open reduction and internal fixation (ORIF) is a treatment whereby the fracture is opened and fixed internally either by intramedullary nailing or by plate and screws under general anaesthesia or spinal block.

Protocol for ORIF:

Protocol for ORIF is as for any major surgery performed in an operating theatre.

The type of implant to be used for rigid fixation of the fracture depended on age of the patient type and pattern of the fracture as well as availability of the implants.

For younger patients (adolescents) in order to safeguard the epiphyseal plate internal fixation was solely achieved by plates and screws.

Post operatively, surgical wounds were inspected daily for bleeding, dehiscence, odour and discharge.

Postoperative X-Rays in two views on 3rd post operative day at 3 months and at 6 months to assess union and detect implant failure.

Prophylactic 3rd generation cephalosporins I/V Powercef 1.0gm/24hrs for 72 hours.

Complications assessment:

Knee Joint Stiffness

This painful albeit temporary loss of function of knee joint due to periarticular or intraarticular causes culminating in loss or diminished range of movement of the affected knee is a common feature of prolonged immobilization.

It can be also due to quadriceps tethering whereby the quadriceps muscle becomes adherent to a femoral shaft fracture and are unable to glide over the smooth distal shaft in normal fashion.

Normal range of movement of knee is F/E 135-0-0.

The range of movements was measured with a long arm goniometer at 3rd and 6th month of each type of treatment

The values obtained were used to grade the severity[21].

Severe stiffness - ROM F/ E <90°/0/0.

Moderate - ROM F/ E 90° – 110°.

Mild - ROM F/ E >110°<135.

Pain alleviation assessment:

Pain is a complex and personal phenomenon, a harmful stimulus which signals current and impending tissue damage[22].

Pain associated with fractures is usually due to injury to the soft tissues by sharp edges of the fracture fragment and is proportional to degree of movement and deformity caused by the resultant abnormal movement.

With reduction and immobilization of fracture the pain greatly diminishes in any fractured bone. Only patients can accurately describe their own pain.

Adjective rating scale was used to describe the pattern of pain whether constant or intermittent and its character whether sharp, stinging or shooting.

Its intensity by patient's own rating:

- Whether mild, moderate or severe.
- Presence of any relieving or aggravating factors
- Whether it disturbed patient's sleep
- Need, duration and quantity of analgesics consumed.

3 grades of pain i.e. mild, moderate and severe were determined [23,24,25].

Activities of Daily Living [ADL] assessment:

These are basic tasks of everyday life.

Performing as many self care tasks as possible helps the patient develop independence and self esteem.

Feeling dependent on others can be defeating and certain satisfaction can be gained from setting objectives and accomplishing them.

Recovering from injury is certainly one of these accomplishments.

Using the Katz Index of independence in activities of daily living (Katz ADL) the patients were ranked in adequacy of performance in 6 functions of:

1. Bathing
2. Dressing
3. Using toilet
4. Transferring
5. Walking
6. Feeding

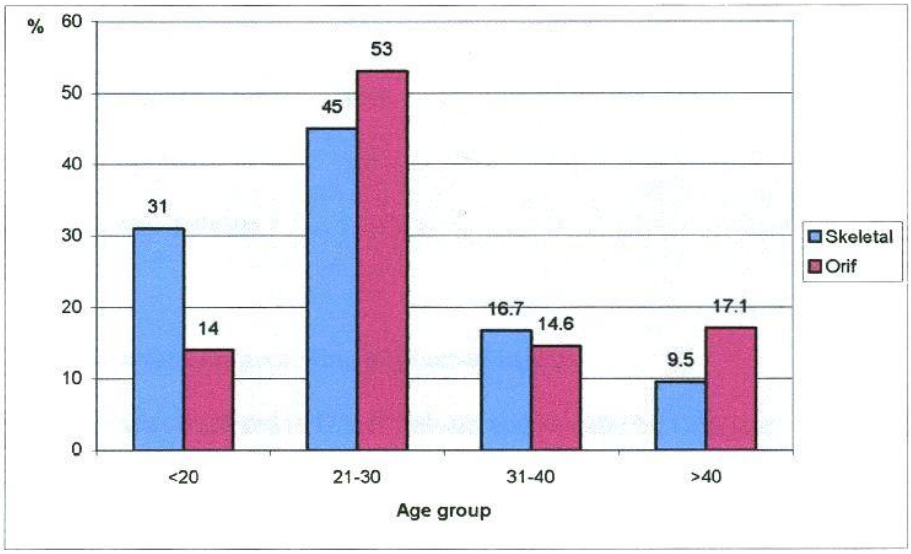
Patients were scored yes/no for independence in each and a score of

- 6 meant full function.
- 4 moderate or diminished ADL.
- 2 or less severe functional impairment, sedentary and highly dependent.

6.0 RESULTS

During the study period a total number of 108 patients with closed femoral shaft fractures were admitted into both male and female trauma wards of Muhimbili Orthopaedic Institute; out of these 103 where eligible but only 96 were randomly selected and recruited into the study, 5 patients did not consent and 8 patients were lost on follow up. Results of 83 patients studied are given and analyzed. Among these 42 (50.6%) were treated by skeletal traction and 41(49.4%) by open reduction and internal fixation.

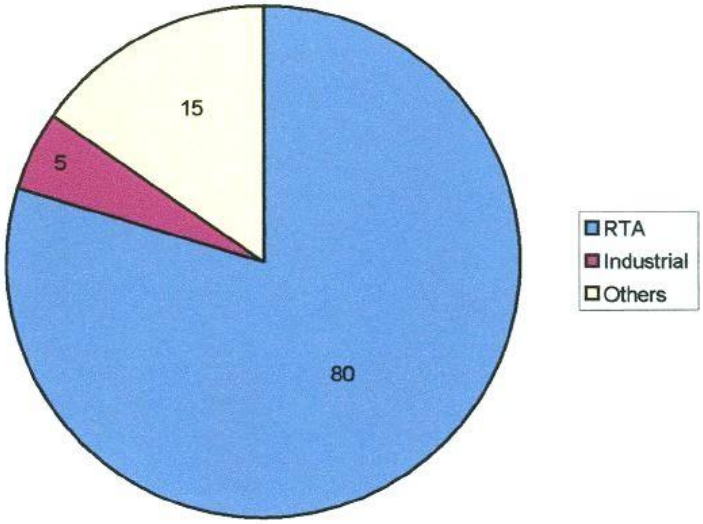
Fig. 1 Characteristic of study population according to age and type of management



Their ages ranged from 11 to 72 years, the mean age was 30 years.

Majority 48.2% were in the age group 21 – 30 years. There were 67 (81%) males and 16 (19%) females. Male to female ratio 4:1.

Fig. 2 Mechanism of injury



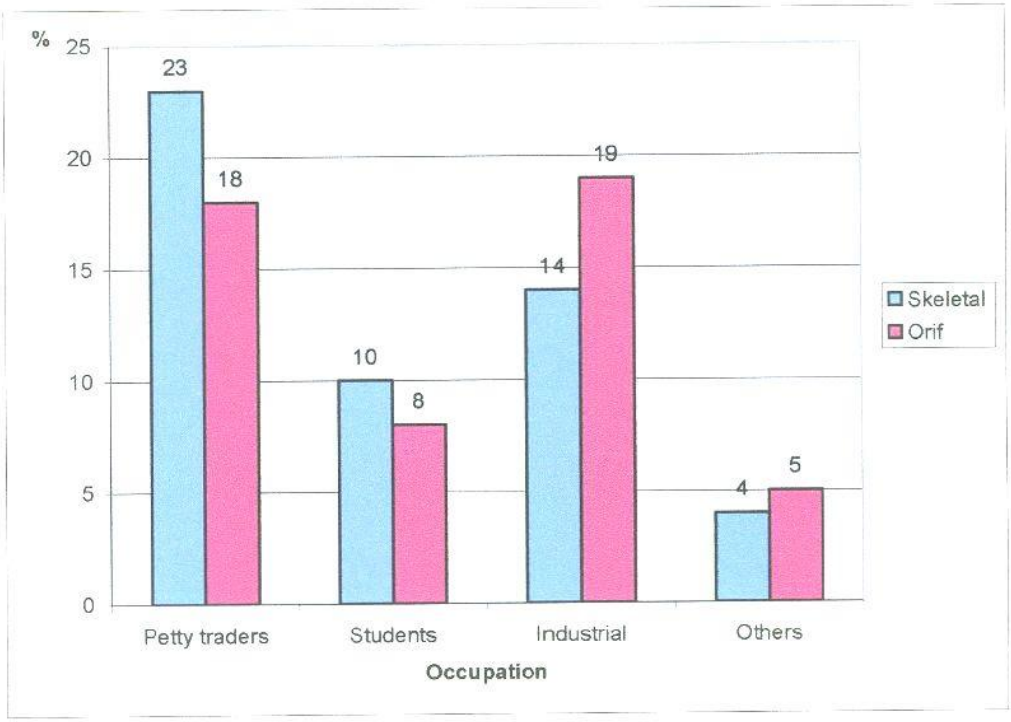
RTA constituted	80%
Industrial injuries	5%
Others (sports, falls etc.)	15%

6.3 Distribution according to place of injury

72% of injuries occurred in Dar es Salaam and its suburbs 12% cases in Ilala, 36% in Kinondoni and 24% in Temeke Municipalities respectively.

11 (28%) cases occurred outside Dar es Salaam.

Fig. 3 Characteristics of study population according to occupation and type of management



The study showed self employed – petty traders popularly known as "machinga" a domain of young males were mostly affected followed by students, industrial workers and farmers.

6.4 Marital status and type of management

51.9% single

Type I – 56%

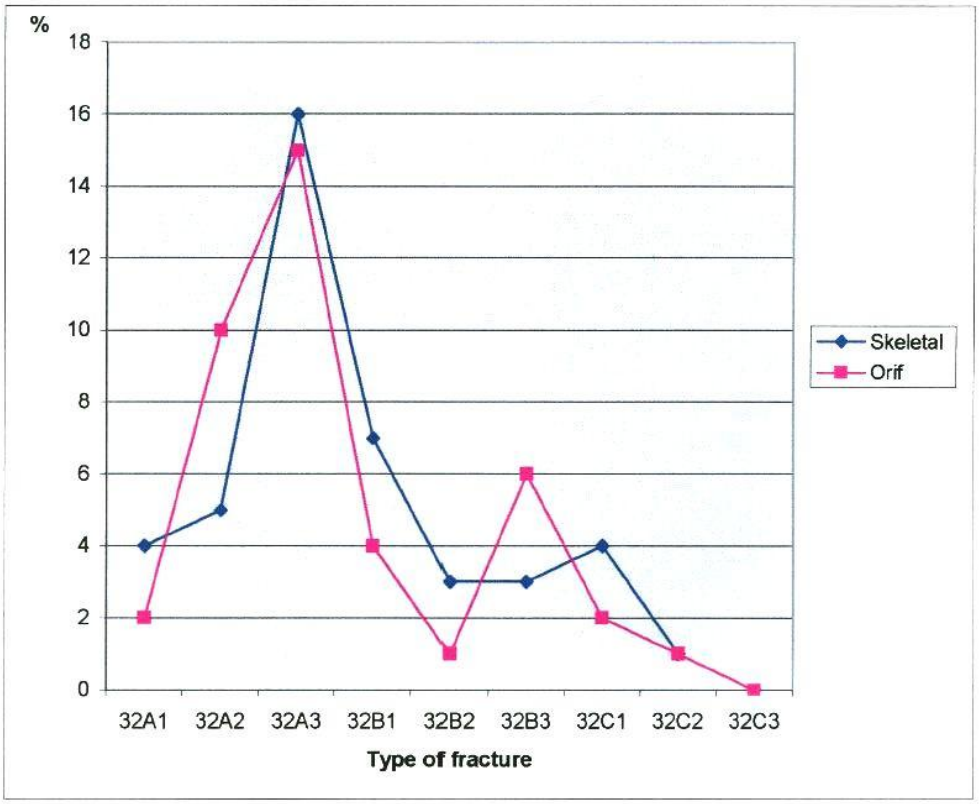
Type II – 44%

48.1%married

Type I – 50%

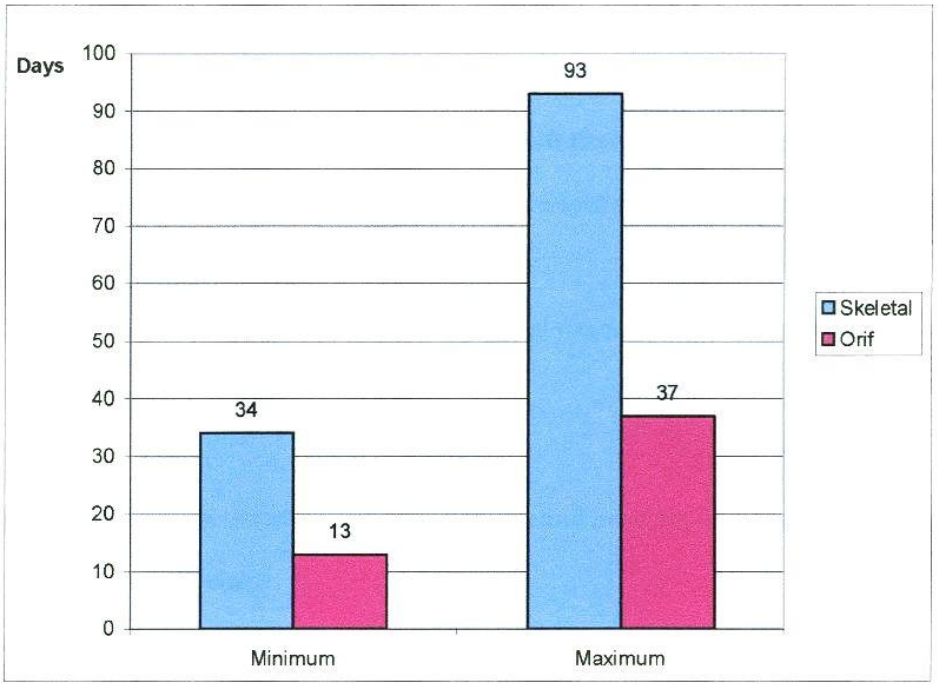
Type II – 50%

Fig. 4 Relationship of type of fracture sustained and type of treatment given



Majority of fractures sustained were type A fractures and type $32A_3$ – Transverse fracture being the commonest pattern with 31 case (37.%). There were no cases of the most complex type $32C_3$ fractures.

Fig. 5 Relationship between type of management and length of Hospitalization



Overall length of hospital stay for both modes of treatment ranged from 13 days to 93 days.

Type I minimum 34 maximum 93 mean 58.33

Type II minimum 13 maximum 37 mean 25.90

The difference between the means = 32.43

Comparison of the two groups y Kruskal – Wallis H test for two groups:

Chi-square 59 – 192

Degrees of freedom 1

P-value..... 0.00000

The difference between the two groups is highly significant and patients managed by Type I treatment had significant longer hospital stays.

6.5 Relationship of type of management and soft tissue complications

Those managed by skeletal traction 32(74%) developed mild pin tract infection and 11(26%) had severe pin tract infection.

Those who underwent open reduction and internal fixation none developed post surgical wound infection.

6.6 Relationship between type of management and bone healing complications:

Limb shortening.

Type I management – 31(72.6%) Had non-union

9(25% Union

1 (2.4%) Malunion

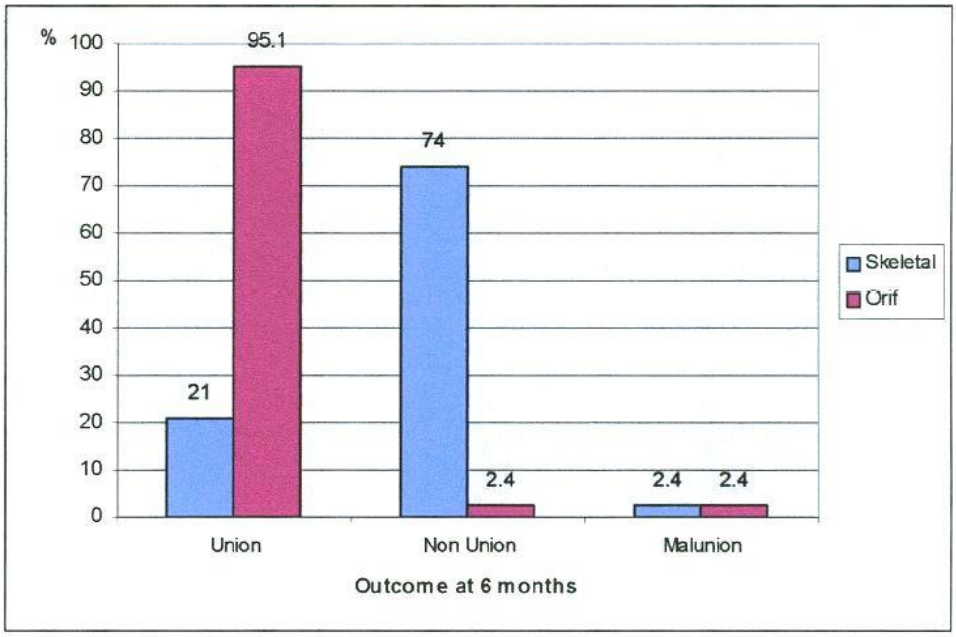
of the 10 cases who had union 1 had severe limb length discrepancy with shortening of 3.5 cm which required corrective osteotomy and plating, 3 had mild to moderate limb length discrepancy of 2 – 2.5 cm remedied by shoe elevation.

31 with non-union were treated by surgery and none developed limb length discrepancy post surgery.

Type II – 40(97.6%) cases had no limb length discrepancy post surgery

1(2.4%) had loosened plate, malunion with recurvatum and limb shortening of 3cm remedied by shoe elevation.

Fig. 6 Relationship between type of Management and signs of union at 6 months



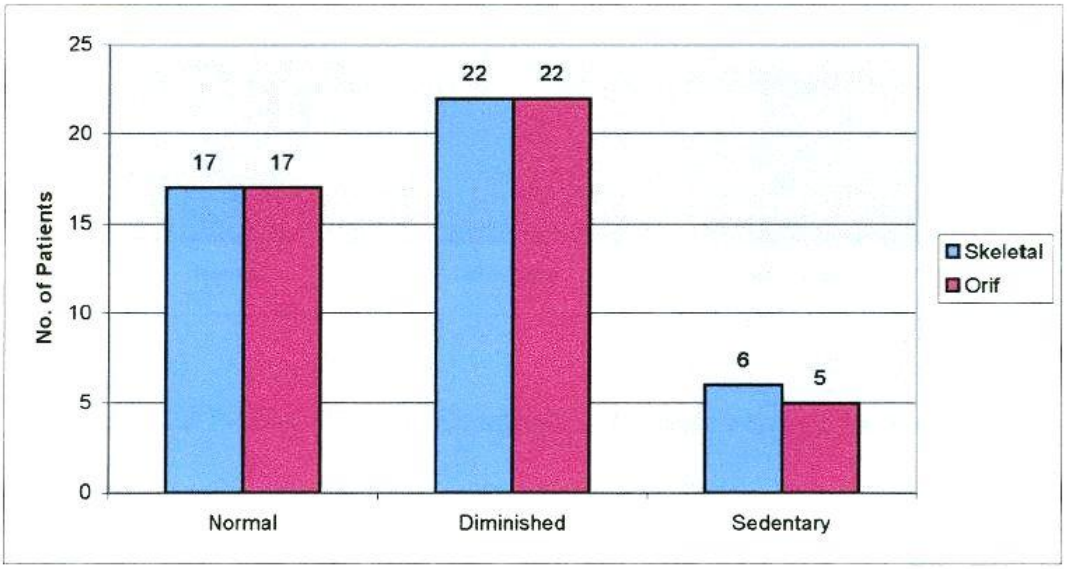
For those treated by skeletal traction 9(21%) had union,31(74%) non union and 1(2,4%) had malunion.

The group treated by open reduction 39(95.1%) had union,1(2.4%) non union and 1(2.4%) malunion. By Wilcoxon two sample test Chi-square 46.88 degree of freedom 2. P-value 0.0000 which is highly significant with open reduction and internal fixation having higher rate of union than skeletal traction.

Relationship between type of management and restoration of Activities of Daily Living – Katz Index

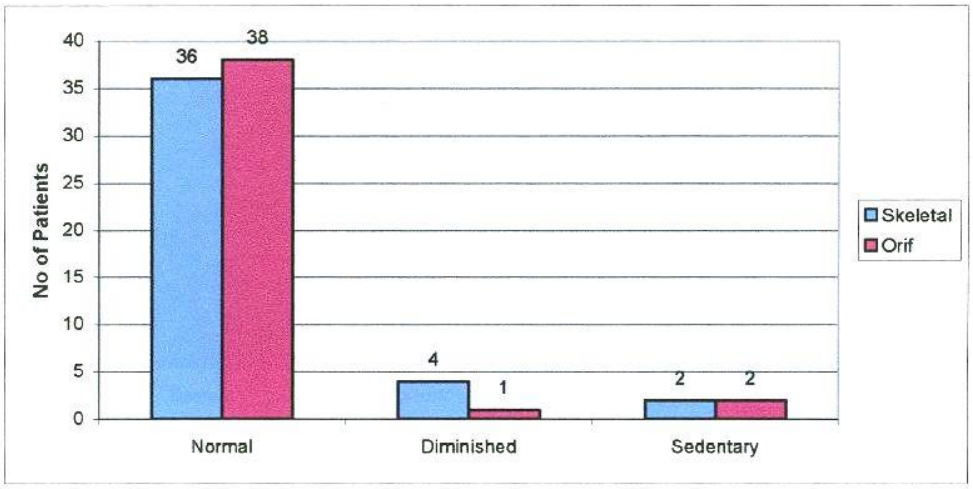
Score: 0 – 1 Normal ADL, 2– 4 Diminished AD L, 5- 6 Sedentary/highly ADL

Fig. 7 ADL at three months



Chi- square 2.28, P-value 0.32. No Significant difference between the two groups.

Fig. 8 ADL at six months



Chi- square, 2.28 P-value 0.32. No Significant difference between the two groups.

From this evaluation, the majority at 3 months had diminished ability to carry out activities of daily living but at 6 almost all 30/42 (71.4 %) type I and 38/41 (92.6%) type II had returned to normal activities of daily living.

6.7 Relationship between types of management with stiffness of ipsilateral knee joint

Range of movement of the knee. This was also assessed at 3 months and 6 months respectively for both types of treatments.

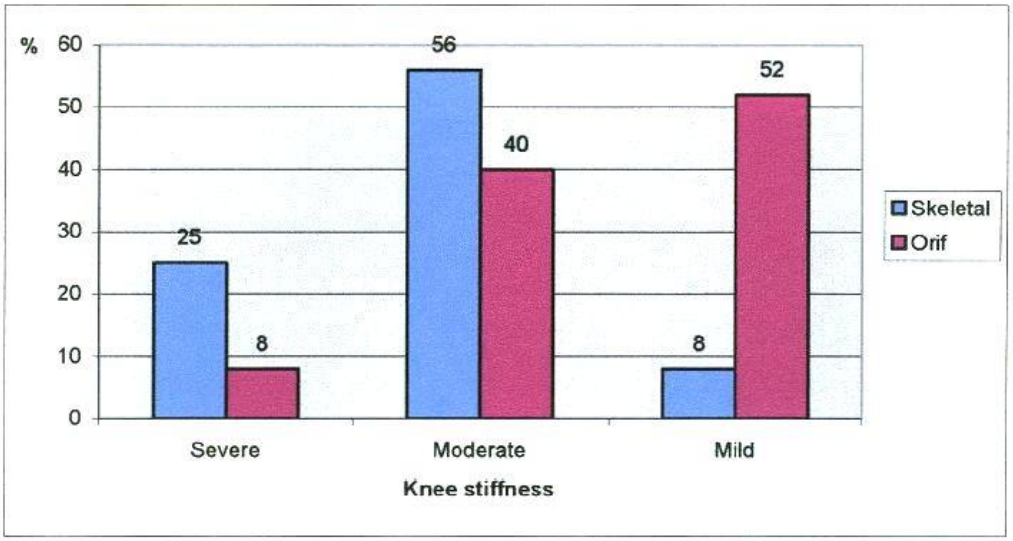
Range of movement grading

Severe limitation if F/E < 90^{O}

Moderate limitation F/E 90 – 110^{O}

Mild limitation F/E > 110^{O}

Fig. 9 Knee stiffness at 3 months

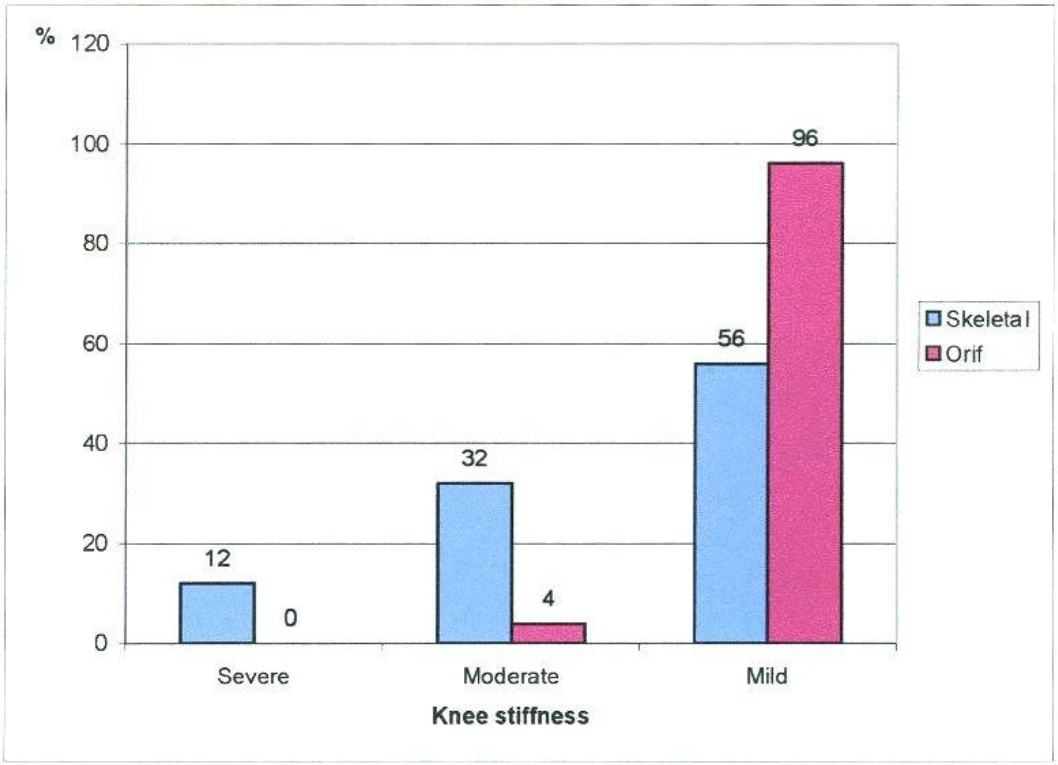


By student t-test Chi – square 16.61

Degree of freedom 2 P - value 0.00067 which is highly significant.

With skeletal traction having higher frequencies of knee stiffness than ORIF.

Fig. 10 Knee stiffness at 6 months



By student t-test Chi – square 16.61

Chi-square 9.6 Degree of freedom 2, P value 0.000821 highly significant.

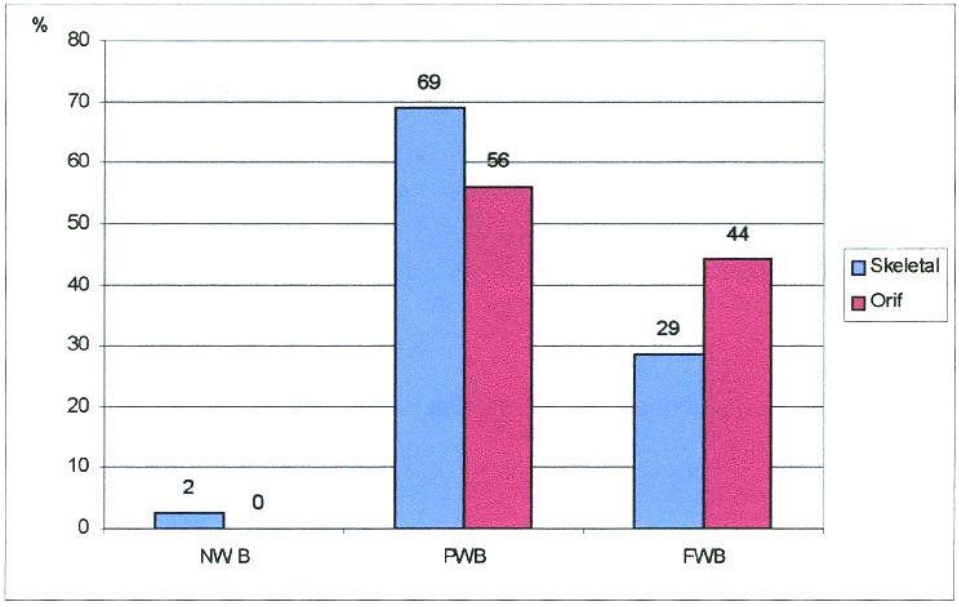
Type I having higher frequency of knee stiffness at 6 months than type II.

6.8 Relationship of ability to bear weight and type of management

Patients were assessed on their ability to bear weight at 3 and 6 months and graded: -

- Non weight bearing
- Partial weight bearing
- Full weight bearing

Fig. 11 Weight bearing at 3 months



Majority of patients on both groups were on partial weight bearing at end of 3 months

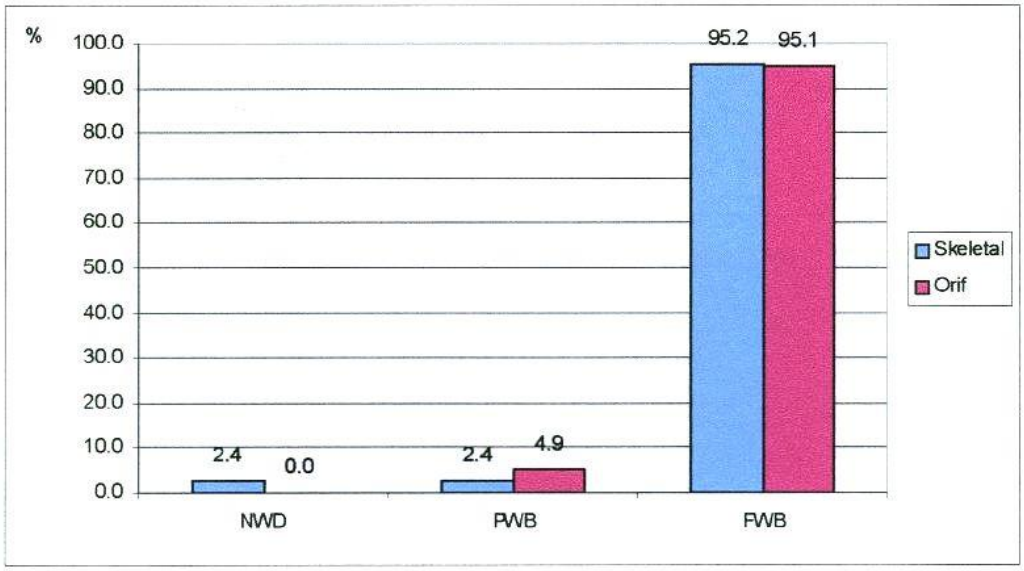
Chi-square 2.88

Degree of Freedom 2

P – value 0.236

No significant difference between the two groups.

Fig. 12 Weight bearing at 6months



Almost all patients 95.2% of type I and 95.1% of type II were on full weight bearing at 6 months follow up.

There was no significant difference between the two groups in terms of weight bearing at 6 months.

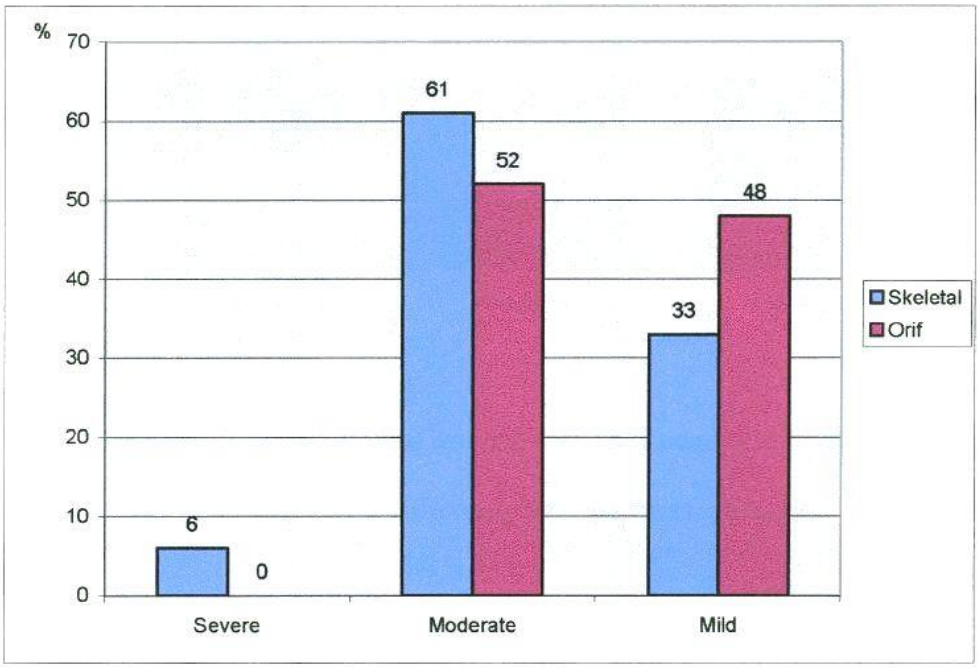
Chi-square 1.33

Degree of Freedom 2

P – value 0.513

6.9 Relationship between type of management and patients satisfaction in terms of pain alleviation

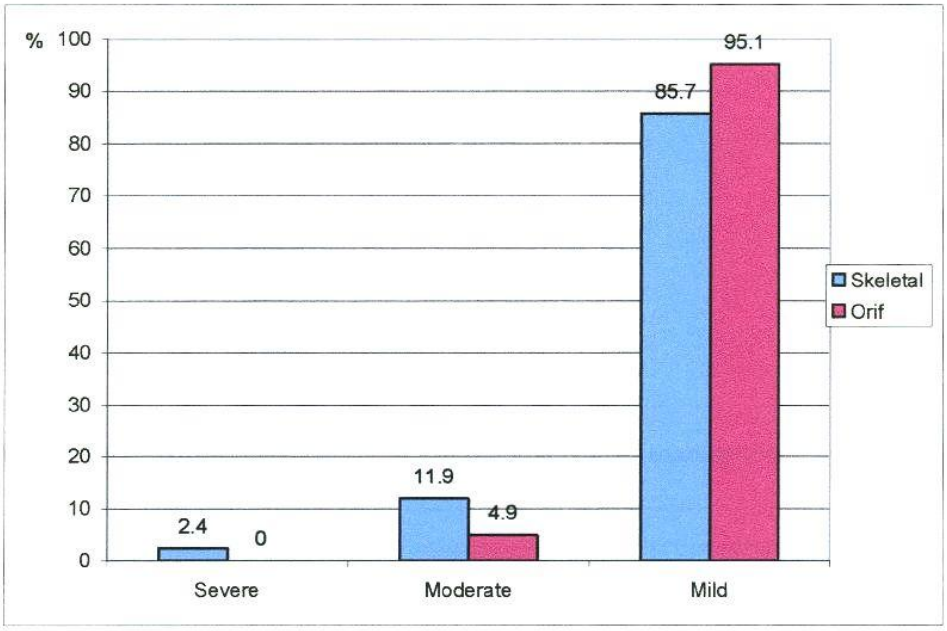
Fig. 13 Pain alleviation at 3 months



Only 6% of patients in group I had severe pain at 3 months follow up. The rest had either moderate, mild or no pain.

P - value 0.167. No significant difference between the two groups.

Fig. 14 Pain alleviation at 6 months



Majority of patients in both groups had either mild or no pain at 6 months follow up.

P- value 0.302. No significant difference between the two groups.

6.9 Social Economic Assessment

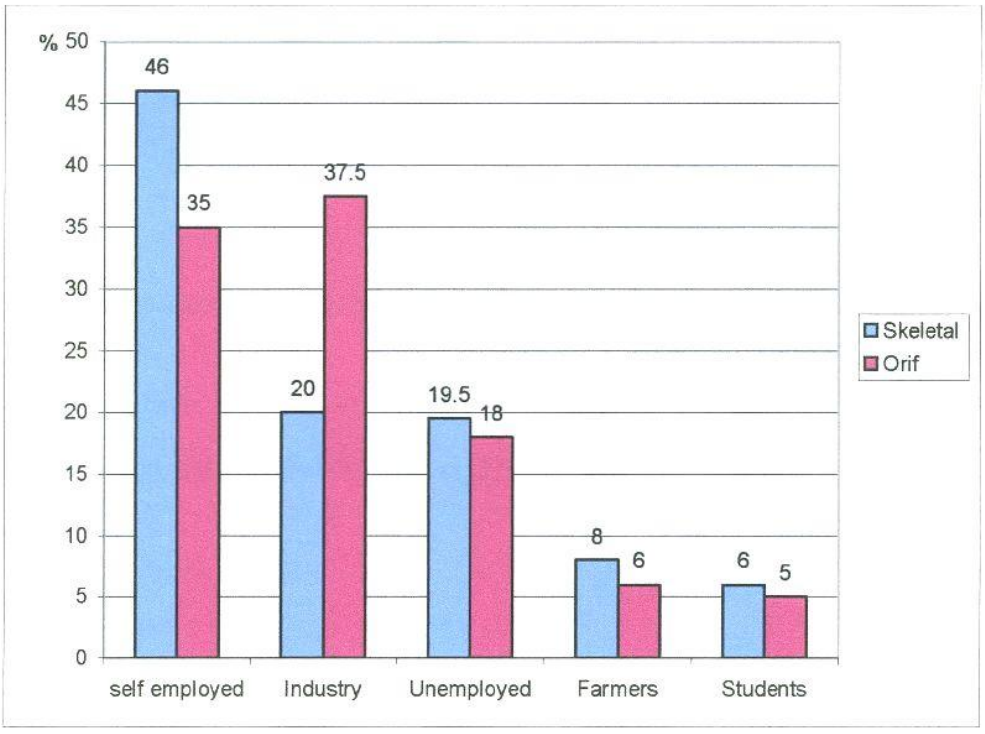
6.9.1 General characteristics

- Marital status: 56% single 44% married
- Number of children: Majority 40%, had no children and 25% had 1 – 2 children.
- Number of Dependants: Majority 39% had no dependants and 31% had 1 – 2 dependants.

6.10 Source of income

Self employed (petty traders) were the majority	33%
Followed by industrial worker (including drivers)	26%
Unemployed	20%
Farmers	11%
Students	10%

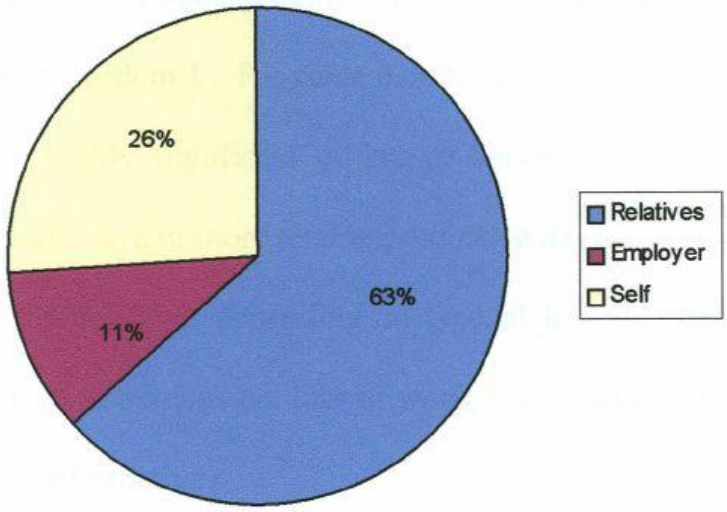
Fig. 15 Characteristics of source of income and type of management



The incomes were at par and no significant difference between both types of management.

6.11 Indirect cost to the patient

Fig. 16 Meeting Hospital costs



63% of cost of hospitalization was borne by a relative

Nutritional care

97.5% of food was provided by relatives. 2.5% by the Hospital.

Table 1. Length of sick-leave (total unproductive days) in relation to type of management

	Minimum	Maximum	Median	Mode
Type I	55 days	180 days	82	65
Type II	35 days	120 days	56	53

Bartlett's test for homogeneities of variance, Bartlett's Chi – square = 15.69.

Degree of freedom 1 P – value 0.000074

There is highly significant difference between the two groups with type I having longer sick leave or more total unproductive days.

Actual income loss; depending on type of job. The data was unreliable and other psychological burdens i.e. loss of work, loss of assets etc. were hard to quantify and were not informative.

20(48.6%) of type I run into debt while 18 (43.4%) of type II also run into debt

P - value 0.547 statistically no difference between the two groups.

6.12 Direct cost to the patient

Table 2. Characteristics of hospital stay cost and type of management

	Minimum TShs.	MaximumTShs.	Median	Mode
Type I	17,000.00	46,500.00	28,000.00	27,000.00
Type II	5,500.00	18,500.00	13,000.00	12,000.00

By Wilcoxon two sample test Chi-square - 59.86, P- value 0.0000, which is highly significant with, type I costing more in terms of admission fee.

6.13 Medicines

Commonly prescribed medications were analgesics in the first 10 days of treatment.

Later on haematenics and at least 25% of all patients were given antimalarials.

Total costs characteristics:

Type I – 4,800.0 – 42,000.00 Shs.

Type II – 3,800.0 – 56,000.00 Shs.

Bartlett's Chi – Square 6.78

P - value 0.376

No significant difference between the two groups in terms of medicines costs.

6.14 Investigations

All patients performed a minimum of 3 x-rays and an Hb level at least 3 times.

Other investigations were on demand as individual cases required.

All who underwent surgery had blood grouping and a cross match.

Characteristics of investigations to type of treatment had no significant difference between the two groups.

6.15 Wound dressing

Type I	min 0.00Shs.	max 15,000.00Shs.	medium 2,500.00Shs.
Type II	min 500.00Shs.	max 3,000.00Shs.	median 2,500.00Shs.

ANOVA - p – value 0.145. No significant difference between the two groups.

6.16 Crutches

All patients purchased a pair of crutches mode 15,000.00 Shs. Kruskal Wallis H

P - value 0.3 no significant difference between groups.

6.17 Physiotherapy

Table 3. Characteristics of cost of physiotherapy and type of treatment

	Frequency	Total cost	Mean
Type I	36	71,400.00Shs.	19,833.00Shs.
Type II	35	29,700.00Shs.	8,485.70Shs.

Kruskal – Wallis H test for two groups Chi-square 15.57 P – value 0.000079.

Which is highly significant and Patients on type I mode of treatment spent more on physiotherapy than those on type II.

6.18 Follow-up clinics

Patients from both modes of treatment had average of 3 visits after discharge with a visit costing 1,000.00 TShs.

Type I	min 1,000.00Shs.	max 15,000.00Shs.	mode 3,000.00Shs.
Type II	min 2,000.00Shs.	max 18,000.00Shs.	mode 3,000.00Shs.

P – value 0.18 No significant difference between the two groups

Table 4. Total Cost

	Minimum	Maximum	Median
Type I	52,507.50Shs.	808,075.00Shs.	24,7248.18Shs.
Type II	116,486.00Shs.	401,264.00Shs.	211,712.12Shs.

Difference between the two means 23,000.00Shs.

Kruskal – Wallis H Chi-square 11.7 Degree of freedom 1

P – value 0.000595 which is highly significant.

Type I is more costly compared to type II

Hospital Costs

Muhimbili Orthopaedic Institute is a recent established medical facility in existence for less than 10 years; It is in its third phase of development i.e. Capacity building phase and therefore both its fixed and recurrent costs are rapidly changing.

According to its financial summaries of July 2003-June 2004 it had following:

Fixed assets totaling	5,837,416,101.03Shs.
Operating costs totaling	1,298,452,948.68Shs.
Personal emoluments totaling	646,000,733.76Shs.

Table 5. Fixed and recurrent costs MOI 2002 to 2004 in TShs.

Items	July 2002 - June 2003		July 2003 - June 2004	
	Variable cost	**Fixed Cost**	**Variable cost**	**Fixed Cost**
Medicines	123,950,751.23		153,817,330.23	
Radiation			305,000.00	
Destitute	2,418,150.00		3,859,400.00	
Doctors honoraria	61,769,215.35		64,193,000.00	
Anesthetic allowance			2,010,000.00	
Implants	8,797,626.91		136,304,327.98	
Joint expenses	58,339,841.88		169,320,823.17	
Other P/Patient costs	56,495,951.00		55,610,230.00	
Other G/patient costs	50,953,024.95		43,113,732.46	
Physio honoraria	10,644,000.00		8,782,000.00	
	373,368,561.32	**0**	**637,315,843.84**	
Salaries		499,750,397.51		715,987,482.10
Night allowance		29,082,800.00		24,019,000.0 0
Uniform		92,945,000.00		4,807,000.00
Call allowance		36,664,720.00		847,458,637.10
Depreciation		15,300,312.65		139,090,980.00
		673,743,230.16		**01,731,363,099.20**
Number of patients				
-Inpatients	6,380		6,576	
-Outpatients	16,075		19,057	
Total	**22,455**		**25,633**	
Cost allocation per patient:				
Variable cost	22,455.00			25,633.00
Fixed cost per patient		30,004.00		67,544.00
Total unit cost per patient		**46,632.00**		**92,407.00**
Total cost for 83 patients		**3,870,420.00**		**7,669,814.00**

Total cost for the 83 patients on this study was 18,538,148.00Shs.

Cost borne by patients [operation fee, admission, medicines, x rays investigations, crutches, physiotherapy, dressing and follow up clinics] was 7,867,200.00Shs. i.e. 42% of the total cost.

Cost borne by MOI 10,670,948Shs. i.e. 58% of the total cost

Total cost per patient 128,565.64Shs. which is 39% above allocated cost per patient

Average costs: K-nailing 149,323.25Shs., UFN 155,458.00 Shs. and Plating 161,876.34Shs.

Treatment by skeletal traction only costs 730816.00Shs.

Treatment by ORIF only costs 868,197.00Shs.

Treatment by skeletal traction and surgery costs 9,127,135.00Shs.

From above quantification the Institute will save 87,752.40Shs. per patient if surgery is performed early.

7.0 DISCUSSION

Femoral shaft fractures are among the most common type of fractures that orthopaedic surgeons attend to in their daily practice.They affect mainly young males of productive age group (20-40 years) with male: female ratio of 6:1

The most common mechanism of injury is Road Traffic Accidents as this study has shown. The findings are comparable to previous studies on mechanisms of injury done at KCMC and Muhimbili [26,27].

Back in 1992-93 Singer [28] et al studied 15000 femoral shaft fractures of ages 15 to 94 and found a bimodal distribution on mechanism of injury with High Energy (RTA, sports, industrial injuries) in young adults and Low Energy (falls, minor trauma) in elderly population [29]. The findings in this study are also comparable for the affected age group.

In the present study the most common type and pattern of fracture sustained was transverse type 32A3 by AO classification. This is consistent with fractures sustained under high tensile strain with a bending load of 250 Nm or more [30].

Spiral and butterfly fractures were second and third common patterns. They result from indirect rotational forces and have large areas of contact but difficult to hold in place without fixation [31].

Shattered bone type C fractures were very rare and are usually caused by enormous force. They are associated with extensive degree of soft tissue injury even if the skin around them appears normal. They result from compression, shearing or combined loading force[31]. In the current study severely comminuted complex fractures type C1and 2 were rare (1-4%) and there was no any type C3 fractures.

Understanding fracture type and its displacement gives a surgeon a good insight and understanding of the extent of soft tissue damage ultimately guiding towards suitable methods of reduction and fixation.

Treatment of femoral shaft fractures has undergone significant evolution over the past century. Before the advent of skeletal radiology and aseptic techniques, conservative management was the main domain in treatment of these fractures. Empirical observations over centuries had however already shown differences in its outcomes prompting many modifications of treatment regimes over years as early as the Hippocratic era. The latest modification is that by Musa AA of the University of Sokoto –Nigeria of which he has modified the Böhler – Braun to be portable and user friendly for a developing country [32].

Museru LM and Mcharo CN have noted the fact that in majority of cases a fracture will heal whether it undergoes formal treatment or not owing to extraordinary powers of bone to heal spontaneously [33]. The question remains however what kind of healing or union is achieved. Orthopaedic surgeons have come to appreciate that bone union is not always the only goal to be achieved and that the limb function is infact the most important measure [34].

Prior to 1900s femoral shaft fractures were treated by various types of splinting. The discovery of radiology led to understanding of the forces acting on the fractured bones thus prompting the changes in the thinking and management of these fractures. Steinman and Kirschner respectively developed the first traction treatment modalities using pins or wires under tension. This technique though simple in its application, it is labour intensive for the ancillary staff requiring constant vigilance and careful

supervision in order to avoid associated complications i.e. over distraction, under distraction, pin tract infection, knee joint stiffness etc.

Literature on the prevalence of these complications is scarce, however with this study pin tract infection was found in mild form in 32(74%) and 11(26%) had severe pin tract infection. These were managed by daily cleaning with antiseptic solutions and a few severe cases by twice daily antiseptic cleaning, which brought the infection under control and no infection lead to loosening of the pin or discontinuation of the traction.

The knee joint stiffness found in this study at end of three months was severe in 11(25%), moderate in 26(56%) and only 6(8%) had mild knee stiffness. These are not comparable with a study done at Papua New Guinea where they had fewer rates and in mild or moderate forms and none in severe form. This is most probably due to the fact that they intimately engaged a physiotherapist in the management of patients on traction and isometric exercises were started as early as the in the first week of treatment. It is worthy noting though, that with rigorous physiotherapy even in this study only one patient (2.4%) had residual severe knee joint stiffness by the end of 6^{th} month.

The recommended protocol is traction for minimum of 6 weeks, isometric exercises at the end of first week, x-rays twice weekly for the first two weeks then once every fortnight, ambulation and light weight bearing on crutches 6-8 weeks [35].

Success in this method depends on proper application of the traction, dedicated and vigilant staff as well as understanding and a cooperative patient. In Papua New Guinea there are established units comprising of a clinical officer, a nurse, a

physiotherapist and an x-ray technician (with a portable x-ray machine) who monitor patients on traction regularly and have reported high success rate [36].

On the other hand in Malawi (pop 12 million) with only 4 orthopaedic surgeons a project by Mannion S and Whitney D at Central Hospital Malawi has shown very high non union on patients some of whom have been on traction for up to 4 months[37]. In this study no patient was treated by traction for such long periods.

In 1937 Küntscher introduced the principles of intramedullary technique. He developed and utilized the intramedullary nail a method bearing his name todate. This method was widely used and popularized in America and Europe during the 2nd World war [38]. This method however has its limitation and is ideal only for transverse and short oblique femoral shaft fractures [39]. Its also associated with malrotation of to about 3%.

The most modern type of treatment which has also supplanted all other methods is intramedullary locking rods. This method provides both the alignment and rotational stability enabling patient to be mobilized early and rapidly enough to be discharged from hospital after a week or so [40]. It has shown a very high success rate of union and early return to activities prior to injury including sports.Kempf et al reports union rate of 92.4%[41], Wiss et al 98.2%[42], Borner and Klem 98.5%[43]. These results are comparable to ones obtained in this study with the group managed with ORIF having 95.1% union.

There a few albeit rare drawbacks to this method especially if reamed interlocking nailing is used there is increased risk for infection and fat embolism. The rates for these complications are however very low, Christie et al reports 0% infection[44] and

O'Brien 4.8 % for interlocking nailing in open femoral shaft fractures[45]. The infection rate with this study for those who underwent ORIF was 0% and is comparable to those findings. No intramedullary nailing was however performed on an open fracture of femoral shaft in this study. Studies done by Geissler [46], et al on routine use of prophylactic antibiotics have shown to reduce infection to 0%-3%.In this study routine prophylactic antibiotics were used and results were 0% infection rate which are comparable to those findings.

Plate osteosynthesis is only advantageous and recommended where intramedullary nailing is not ideal i.e. fractures in proximal or distal shaft, in excessively narrow intramedullary canal and in non availability of equipment, implants and trained personnel for the procedure. It should be borne in mind that malunion,infection and mechanical failure of fixation, delayed union, nonunion, refracture and reoperation are all possible following plate fixation of femoral shaft fractures. With this study there were 2(9.6%) implant failures one broken plate which was re-plated and one loosened plate with fracture subsequently uniting in a malunion and shortening of 2.5 cm corrected by a shoe elevation.

In the developed countries having phased out conservative treatment of femoral shaft fractures its literature has become very scarce and the attention has since shifted towards it merit even to where it is currently regarded as the gold standard mode of treatment i.e. the paediatric patient. Studies by Fuchs et al and Braun et al for assessment of psychological and somatic aspects revealed a disturbance in the family environment, social and psychological problems due to prolonged period of

hospitalization as well as high cost of skeletal traction for children older than 3-4 years [47,48].

Surgery in form of retrograde intramedullary nailing in children and adolescents has shown to have fewer complications, better results allowing early weight bearing and shortened hospital stay [49,50].

In the United States where surgery is the mainstay treatment of femoral shaft fractures the average number of days lost from work or school has been found to be 30 days [51]. The average number of days lost from work in this study is 56 days, this is significantly higher comparatively and probably due to poorer choice of implants since interlocked nails provide better stability and allows earlier ambulation and weight bearing. In this study less than 50% of those treated by ORIF an interlocked nail was used.

The choice of treatment in a developing country however presents a challenge. The trend is a general increase of these types of injuries due to ever increasing usage of motorized vehicles and urbanization without reciprocal investment in health delivery resources. There is shortage of both trained personnel and materiel and a few trained surgeons get western oriented training with de-emphasis and belittling of conservative treatment as a credible and effective alternative to surgery. Due to under funding and over dependence on foreign aid skeletal traction is still widely being used in developing countries [52,53,54].

Skeletal traction if successful it is cheaper than surgery but if it fails then its cost is astronomical to the patient and relatively high to the hospital and society as a whole. The Papua New Guinea example should be applauded and emulated in order to

increase its success rate lest if facilities and personnel are available interlocked femoral nailing has more medical and economic benefits than other methods[55,56].

This study has shown that conservative treatment is associated with more complications, has longer hospital stays and is more costly to both the patient and the health facilities catering for them. It is as well outmoded. Early surgery has more benefits with less complications and shorter hospitalization[57,58]. The earlier it is performed the better for all parties concerned.

8.0 CONCLUSIONS

1. Road traffic accidents are the main cause of femoral shaft fractures.
2. The most affected in the society are males of young productive age.
3. Treatment by continuous skeletal traction as it is done in our set up today is associated with more complications in terms of nonunion and knee stiffness.
4. Treatment by skeletal traction leads to longer hospital stay, late ambulation, and late return to activities prior to injury.
5. Skeletal traction leads to overcrowding of trauma wards.
6. Treatment by continuous skeletal traction is inefficient in terms of utilization of meager resources allocated to health facilities and health sector in general.
7. Early surgery for closed femoral shaft fractures is associated with fewer complications.
8. Early surgery leads to shorter hospital stays, which is beneficial to the patient and the health facility alike.

9.0 RECOMMENDATIONS

1. Early surgery, preferably interlocked femoral nailing where facilities allow as in tertiary level centres like MOI is highly recommended. Should facilities not be available then Küntscher nailing or plate and screw fixation are better option than skeletal traction.
2. Training of more personnel and introduction of early surgery for the management of closed femoral shaft fractures to secondary (Regional hospital) level of health care system.
3. Donor funding propagation.

Q U E S T I O N A I R E

PARTICULARS:

Name……Age……Sex……Address……District……
Occupation……Date admit……Date disc……Hospital stay……days.
Diagnosis : (1) Transverse fracture
(2) Oblique fracture
(3) Spiral fracture
(4) Comminuted fracture
Date of injury……
Mechanism of injury: 1 RTA 2 Industrial 3 Other

TYPE OF MANAGEMENT:

Skeletal Traction (1) ORIF (2)

IF (1)
-Time and date of application…
-Site of application……
-Type of analgesia……
-Wt of patient……kg
-Wt applied……kg
-X-ray findings:2/52……1/12……2/12……
Complications:
(a) Pin tract infection: superficial (1) deep (2) measures taken……
(b) Non union ; Yes (1) No (2) measures taken……
(c) Limb shortening at 2/12 <2cm mild (1)
2 – 3 cm moderate (2)
>2 cm severe (3)
Measures taken……
Knee joint stiffness: (-) 10 full range mild
(-) 20 moderate
(-) 30 or more. Severe.
Measures taken……
Date of ambulation with NWB……PWB……

IF (2)
-Time and date of operation……
-Type of surgery: K nailing (1) Plate/screws (2)
- Type of Anesthesia: Spinal blockage (1) GA (2)
- X rays findings after surgery: a/ acceptable results…b/ unacceptable results…
-Revision of surgery/ re-operation No (1) Yes (2)
Reason for re-operation……
-Complications following surgery:

(a) Wound infection : Superficial (1) Deep (2) Measures.....
(b) Limb shortening; Mild (1) Moderate (2) Severe (3) Measures.....
(c) Knee joint stiffness: Mild (1) Moderate (2) Severe (3) Measures.....
(d) Implant failure: Loose implant (1) Broken Nail/plate (2) Measures...
-Date of ambulation with Non wt Bearing.....With partial wt bearing.....

OUTCOME OF MANAGEMENT:

(a) Union (1) non-union (2) malunion (3) limb shortening (4)

(b) Restoration of function:
-Normal ADL ( ) Diminished ADL ( ) Sedentary work ( ) Total disability ( )

(c) Patient satisfaction from treatment:
Pain control after traction or surgery: Severe pain(1) Moderate pain (2)
Willingness to undergo similar treatment in future: Yes (1) No (2)

SOCIO ECONOMIC ASSESSMENT:

-Marital status: S/M/D Number of children...Number of dependants.....
-Source of income: Self employed (1) Office worker (2) Ind.worker (3) Farmer (4)
-Meeting hospital costs: Self (1) Relative (2) Employer (3) Soc.welfare(4) Insurance (5
-Nutritional care: Food supplied relative (1) Hospital (2)

DIRECT COSTS (MOI rates 2003)

1/ Admission: Tshs per day x no of days admitted.....
2/Medications: ..... total cost
3/ Investigations: X rays.....FBP..... Hb.....Gr&X-mtch.....
4/ Wound dressing: Cost per dressing X total no of dressing.....
5/ Crutches.....

Skeletal traction:

Personnel:	Number	Time/hr	Rate/hr	Cost
Medical officer				
Nurse				

Supplies:
Analgesia (pethidine/morphine).....
Sedation (diazepam).....
Local anaesthetic.....
Antiseptic solutions.....
Dressing materials.....

7/ O R I F :

Personnel	Number	Time/hr	Rate/hr	Cost
Consultant .				
Specialist				
Medical officer				
Anaesthetist				
Asist.Anaesthetist				
Scr. Nurse				
Asist. Nurse				

Supplies:

Anesthetics.....
Infusions.....
Latex gloves.....
Scalpels.....
Sutures.....
Antiseptic solutions.....
Dressing materials.....
Implants : K-nail.....
Plate.....
Screws.....

8/ Other direct costs:

Physiotherapy: cost per session X no of sessions.....
Hospital visits after treatment.....

INDIRECT COSTS:

1-Loss of wages/income : Daily income X no of days lost.....
2-Length of sick leave.....days
3-Psychological burden:
a/ Loss of work b/Loss of assets (house,shamba,bicycle etc) c/Moving to cheaper accommodation or schools d/Divorce e/Destitution f/Running into debt

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