ANTEGRADE VERSUS RETROGRADE REAMED INTERLOCKING FEMORAL NAILING: A COMPERATIVE PROSPECTIVE STUDY AT MUHIMBILI ORTHOPAEDIC INSTITUTE (MOI)

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CERTIFICATION

The undersigned certifies that he has read this dissertation and hereby recommend for acceptance by the Muhimbili University of Health and Allied Sciences a dissertation entitled **Antegrade Versus Retrograde Reamed Interlocking Femoral Nailing: A Comperative Prospective Study at Muhimbili Orthopaedic Institute (MOI)**. In partial fulfillment of the requirements for the degree of Master of Medicine (Orthopaedics and Trauma) of the Muhimbili University of Health and Allied Sciences.

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DECLARATION AND COPYRIGHT

I, **Dr. Kubhoja Alex Bitta** do declare that this dissertation titled **Antegrade Versus Retrograde Reamed Interlocking Femoral Nailing: A Comperative Prospective Study at Muhimbili Orthopaedic Institute (MOI) FROM MARCH TO DECEMBER 2009** is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references. In addition I also declare that this work has not been submitted elsewhere for a similar or any other educational or non educational award and will not be presented in any other University or academic institution for a similar or any other academic award.

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DEDICATION

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ABSTRACT

Background:

Locked intramedullary nailing or interlocking nailing (ILN) is a proven mode of treatment for femoral shaft fractures in our hospital. It can be inserted via the antegrade or retrograde approach. Retrograde approach is technically less demanding especially if the patient is overweight. But there are concerns with regard to the violation of the knee and its effect on subsequent knee function.

Methods:

80 cases of femoral shaft fractures treated with locked intramedullary Nailing (SIGN NAILS) at the Muhimbili Orthopaedic Institute (MOI), March to December 2009 were enrolled in this study; 63 were males and 17 were females with a male to female ratio of 3.7:1.

I looked at radiological and clinical fracture union rates, alignment of the operated limb, knee function using the Thoresen scoring system, Implant failure rate, wound infection rate.

Results:

There were a total of 80 cases of femoral interlocking nails during the study period. Forty-two cases were antegrade nails and 38 cases were retrograde nails. 77(96.25%) patients achieved union,3 patients had non union(both were hypertrophic).

There was no significant difference between both groups, in regards to average time of fracture union, knee pain or swelling, extension deficit, and range of motion as well as post nailing femoral alignment($p>0.05$),wound infection and implant failure rate.

However patients treated through antegrade femoral nail fixation had better knee flexion compared to those of the retrograde with a p value >0.05

Conclusions:

Both methods of nailing achieved excellent union rates with good alignment of the limb. Contrary to popular belief, It was found that retrograde nailing does not give rise to a higher rate of knee complications. Therefore, retrograde femoral nailing approach is strongly recommended.

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ABBREVIATIONS

AO	-	Association of Osteosynthesis
ASIF	-	Association for the study of internal fixation
MOI	-	Muhimbili Orthopaedic Institute
RN	-	Retrograde nailing
AN	-	Antegrade nailing
SIGN	-	Surgical Generation Network Nail
UFN	-	Universal Femoral Nail
SPSS	-	Statistical Package for Social Scientists

1.0 INTRODUCTION AND BACKGROUND

Femoral shaft fractures are the major cause of prolonged hospitalization and with high morbidity rates encountered in Orthopaedic and trauma wards in Tanzania [1]. According to Muhimbili Orthopaedic Institute (MOI) records of year 2008 its trauma wards admit an average of 9 cases of closed femoral shaft fractures each week. This makes it 3rd commonest type of fracture encountered with a prevalence of about 430 per year [1] Males are more affected than females and a pilot study done at MOI Records shows a ratio of 6:1 [1]

Femoral shaft fractures are observed across all age groups but affect mainly the productive age group of the society (i.e.20-40 years) since this is the most active age group which is mainly involved in road traffic accidents as well as getting industrial injuries. There tends to be an age and gender-related bimodal distribution of femoral fractures with injuries occurring most frequently in young males after high-energy trauma and in elderly females after simple falls. The causes in young patients tend to be motor vehicle crashes, motorcycle crashes, pedestrians struck by vehicles, or falls from a height.

In a review of 515 patients with 551 femoral shaft fractures in a typical urban United States City [4], the average age was 27.2 years and 70% were males. The mechanisms of injury were motor vehicle crashes in 78%, motorcycle crashes in 9%, pedestrians struck in 4%, falls from a height in 3%, gunshot wounds in 2%, and other miscellaneous mechanisms in 3%. The fracture patterns[3] could be identified as oblique in 51%, transverse in 29%, comminuted in 14%, and spiral in 6% [3]

Road traffic accidents continue to be a problem of immense in many places worldwide [10]. It constitute a major but neglected public health problem and have a significant adverse effect on economy and health services of many countries. The WHO found that 1.2 million people are killed each year and 50 million are injured over the world [10].

In Tanzania, just is the case in many other Sub-Saharan African Countries, injuries and deaths resulting from road traffic accidents are on rise and it is the leading cause of death from trauma and one of the most common causes of disability [11]. In a study done at MOI [49] showed the relative distribution as follows: Road traffic crashes 80%, sports and falls 15%, industrial injuries 5%.

Salminen[5] did a study in Finland and found that there was a bimodal distribution of femoral shaft fractures i.e. young males (between the ages of 15 and 25 years) and elderly females (âbove75 years). Most of these fractures (75%) were attributable to high-energy mechanisms, with the majority being road traffic accidents.

Fractures secondary to low-energy trauma tend to occur more commonly in older female patients and in a review of 50 femoral shaft fractures caused by low-energy mechanisms, Salminen [3] identified only 13 patients who were younger than 60 years of age. All fractures were closed, and none were associated with significant other injuries. The fracture pattern was spiral in 29 patients, oblique in 11 patients, and transverse in 10 patients. Chronic disease and osteopenia were commonly identified as contributing factors [3].

Associated injuries can occur in conjunction with fractures of the femoral shaft and are more commonly observed in young patients especially after high energy traumatic injuries[4]. Ipsilateral femoral fractures can occur at the femoral neck, intertrochanteric, and distal femoral articular locations.

Other associated musculoskeletal injuries commonly observed are patella fractures, tibia fractures, acetabular fractures, and pelvic ring injuries. Also they are associated with abdominal, thoracic, and/or head trauma

The management of patients with femoral shaft fractures continues to evolve on the basis of the improved understanding of the local anatomy, and biomechanics of fixation techniques. Femoral nailing has advanced continuously over the past 60 years. Starting with the introduction of intramedullary nailing by Kuntscher in 1937, patient survival and outcomes have continued to improve [2,3.] He developed and utilized the intramedullary nail, a method bearing his name todate.Many refinements have been made on this method; however the basic concept of procedure Kuntscher described remained unchanged.

This method was widely used and popularized in America and Europe during the 2nd world war [62]. This method has however its limitations and is ideal only for transverse and short oblique femoral shaft fractures [71]. It is also associated with malrotation of to about 30%. The major limitation of Kuntscher nailing system was poor results in comminuted midshaft 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 [49]. To overcome these shortcomings modern intramedullary nailing system 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 is envisaged [17].

Prevention and improved management of limb shortening, angulation, infection, and nonunion have made interlocking intramedullary nailing the primary treatment for most femoral shaft fractures. Patient mortality and morbidity from pulmonary dysfunction, open wounds, and the frequently associated multiple other injuries have continued to improve with a better understanding of nailing techniques.

The transition from open nailing techniques to closed techniques using a remote entry site at the proximal femur paralleled the availability of image intensification.

The introduction and increased popularity of interlocking nails allowed for improved rotational control, better maintenance of femoral length, early weight bearing, as well as use of smaller implants. Improvements in nail designs and instrumentation have further expanded the indications for nailing. Antegrade and retrograde nails have seen similar improvements in design and instrumentation, increasing the ease of insertion and further expanding the use of intramedullary nailing techniques for some particularly difficult fractures.

More recently, the use of alternative entry points such as the tip of the greater trochanter has been introduced

1.1 Surgical Anatomy

The femur is the longest and strongest weight bearing bone in the human body .It is tubular and has an anterior bow with a radius of curvature of approximately 120 mm. proximally; the relevant osseous structures include the femoral head, femoral neck, calcar femorale, lesser trochanter, and greater trochanter.

Distally, the femur widens into the metaphysis. The relevant distal osseous structures include the medial and lateral condyles, medial and lateral epicondyles, and distal femoral articulation.

The shaft of the femur is cylindrical anteriorly, medially, and laterally. The thickened posterior cortex of the femur coalesces into the linea aspera in the central diaphysis of the femur. The linea aspera divides proximally to the lesser and greater trochanters, and distally to the medial and lateral femoral condyles. The linea aspera serves as a muscle attachment site as well as a buttress along the concavity of the femoral diaphysis.
The femur is almost completely encased in muscles, most of which have attachments to the bone itself. Knowledge of these muscle attachments is important for performing traumatic surgical dissections and for understanding the commonly observed deformity patterns associated with fractures of the femur.

The proximal muscular attachments include the hip abductor and short external rotator insertions at the greater trochanter, gluteus maximus osseous insertion at the posterolateral proximal femur, and iliacus and psoas insertions on the lesser trochanter.

The adductors insert on the posterior and medial aspects of the femur along its length. The vastus lateralis origin is proximal, just distal to the gluteus medius insertion. The anterior and lateral femur serves as the origin for the vastus intermedius along the majority of the diaphysis.

On the medial and posteromedial portions of the femur is the origin of the vastus medialis. Distally, the gastrocnemius originates from the posterior aspect of the femoral condyles. 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 tronchanter. Gluteus medius and minimus (powerful hip abductors) are inserted into greater tronchanter.

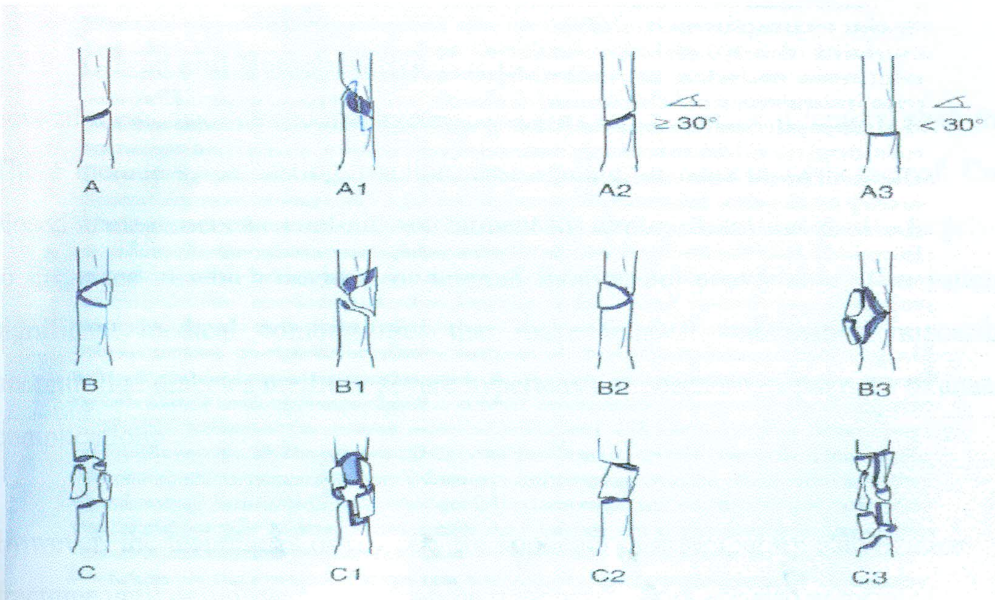
The adductors (longus, brevis and magnum) are inserted along the medial aspect of the shaft. The Gastrocnemius muscle origins are attached along to the posterior aspect of the lower end of the shaft. These muscles cause typical displacements of fragments in the fractures at the proximal, middle and distal 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 middle fragment medially and upwards. In the distal third fractures-the distal fragment is flexed by the origins of gastrocnemius muscles

1.2 *Classification of Femoral Shaft Fractures*

Femoral shaft is defined as stretching between 5 centimeters inferior to the lesser tronchanter 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 and the long bones are each divided into 3 segments.



Association for the Study of Internal Fixation classification of fractures of the shaft of the femur. Simple fractures (type A) are distinguished by the degree of obliquity of the fracture line. Wedge fractures (type B) are sub classified according to the anatomy of the wedge fracture. Complex fractures (type C) can be spiral, segmental, or irregular.

1.3 Principles of Treatment of Closed Femoral Shaft Fractures

Like any other fractures the primary goals 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 with minimal risk of complications.

There are mainly 2 types of management of femoral shaft fractures

1. Conservative or non operative treatment.
2. Surgical treatment which can be done using plates, intramedullary nails or external fixator.

1.3.1 Closed and Non-operative Treatment

Several methods of closed management exist for the treatment of femoral shaft fractures. These include spica casting, traction, cast bracing, or combinations thereof. Currently, closed management as a definitive treatment for femoral shaft fractures is largely limited to instances in which devices for internal fixation are unavailable or in patients with significant medical comorbidities that make femoral stabilization impossible e.g. uncontrolled diabetes mellitus, severe hypertension. , because of the risks of anaesthestic complications

However, the techniques of traction are applicable for temporary stabilization of femur fractures until definitive fixation can be performed. They are also associated with risk of pulmonary embolism, knee joint stiffness and this is shown by the study done at MOI [49] which showed that patients treated conservatively by skeletal traction at three month follow up 87% had joint stiffness of variable degrees.

Although the use of cast braces is abandoned in favour of surgery of modern techniques for femoral stabilization, these techniques may be useful in limited circumstances such as in patients who cannot tolerate anesthesia due to cormobid conditions or as an augmentative device in patients with distal or shaft fractures in which adequate internal fixation was not achieved and with doubtful stability.

1.3.2 Fixation with Intramedullary Nails

A variety of intramedullary devices are available. The most commonly used today are the following:

1. Standard intramedullary nails—Kuntscher, AO, Schneider, Sampson, and others—with which the objective is to insert the largest diameter nail possible to fill the medullary canal and rigidly control angulatory and rotary forces. Most are used with reaming, although some early solid nails were self-broaching.
2. Interlocking intramedullary nails—.

    - Modified first-generation interlocking nails, such as the Grosse-Kempf nail, have a proximal tubular portion for improved attachment and locking of the proximal screw.
    - The Russell-Taylor interlocking intramedullary nail is a second-generation nail.
    - Third-generation femoral nails including the cannulated AM femoral nail (Ace Medical), SIGN nail, the solid AO unreamed femoral nail and the Trigen nail (Smith & Nephew).

3. Flexible intramedullary nails—Ender, and the newer flexible Nancy nails and titanium elastic nail system—with which fracture fixation is achieved by three-point

pressure that is achieved when a prebent flexible nail is inserted into the medullary canal.

The fracture can be surgically exposed and reduction carried out under direct vision, or the intramedullary device can be inserted "closed" using fluoroscopic control.

Interlocking intramedullary nailing has been advocated as the treatment of choice for femoral shaft fractures by many international centers in reports by Wiss. [22]

1.3.3 Open Intramedullary Nailing

Open intramedullary nailing of the femur involves inserting the nail after exposing the fracture. The advantages of this method include the following:

- No special fracture or operating table is required.
- No period of preliminary traction is required to distract the fracture.
- Absolute anatomical reduction is easier to obtain than with closed techniques.
- Direct observation of the bone may identify undetected comminution not noted roentgenographically.
- Precise interdigitation of the fracture fragments improves rotational stability.
- In segmental fractures the middle segment can be stabilized, preventing the torquing and twisting associated with closed reduction and medullary reaming.
- In non-unions opening of the medullary canals of the sclerotic bone is easier.
- Rotational mal-alignment is rare after open reduction.

The disadvantages of the open method compared with closed intramedullary nailing include the following:

- Skin scars must be considered.
- Fracture hematoma, which is important in fracture healing, is evacuated.
- Bone shavings created by reaming the medullary canal often are lost.
- Infection rate is increased.
- Rate of union is decreased.
- If a locking nail is used, locking is sometimes difficult without image intensification.

1.3.4. Compression Plating

Historically, plating of femoral fractures has higher rates of infection and nonunion than closed intramedullary nailing. Ruedi in 1979 reported a 6% infection rate and a 14% nonunion rate with plating as compared with an infection rate of 0.5% and a nonunion rate of 0.8% reported for closed nailing by Winquist [15]

Disadvantages of plating include:

- Greater soft tissues and bony injury on its application.
- Stripping of periosteum.
- Splitting and scarring of muscles.

1.4 Literature Review

The management of femoral diaphyseal fractures was revolutionized by the development of the interlocking intramedullary nail, with antegrade insertion being the gold standard [77]. Interlocking nails can be inserted via two approaches antegrade or retrograde. The antegrade method involves insertion of the nail into the femoral canal through the greater tronchanter or piriformis fossa. Both approaches are associated with high union rates.

The antegrade technique has had tremendous success. Winquist [73] had a 99.1% union rate with postoperative knee range of motion averaging 130 degrees and a 0.9% infection rate in a series of 520 femur fractures. Antegrade nailing is associated with recognized complications such as the Trendelenburg gait due to injury to the hip abductors or its nerve supply and implant-related pain [77].

Furthermore, surgical insertion of the nail via the antegrade approach is often complicated by difficulty in finding the entry point at the piriformis fossa, especially in obese individuals. Since antegrade nailing has been so successful in treating femur fractures, there has been some resistance to accepting newer techniques

On the other hand, retrograde nailing involves insertion of the nail through the intercondylar notch of the femur, just anterior to the insertion of the anterior cruciate ligament. Retrograde approach by virtue of the fact that it involves an entry point through the knee , if precautions are not taken, the articular cartilage around the intercondylar notch as well as the articular surface of the patella is at risk of damage, giving to posttraumatic patellofemoral osteoarthritis [72] as a late complication

In 1950, Lezius introduced a form of retrograde femoral nailing to treat subtrochanteric and intertrochanteric femur fractures [76]. A curved nail was introduced through the medial femoral condyle and passed up through the fracture site.

In 1970, Küntscher described condylocephalic nailing utilizing a medial femoral condyle as a starting portal for the management of intertrochanteric hip fractures [75]. Since then, better methods for fixation of subtrochanteric and intertrochanteric femur fractures have been developed.

Later, Swiontkowski began treating ipsilateral femoral neck and shaft fractures by stabilizing the femoral neck with multiple cancellous screws, followed by retrograde rodding of the shaft fracture. In this series, the retrograde rods were inserted extra-articularly from a medial femoral condylar as a starting point [74].

The disadvantage of the medial condylar starting point was that it required the use of a flexible femoral nail or a reversed tibial nail. The tibial nail has no anterior bow and may cause varus malalignment in distal one-third femur fractures. Reversed tibial nails also tend to be smaller in diameter and weaker than larger diameter femoral nails.

Subsequently, an intercondylar starting point was developed for retrograde nailing of femoral shaft fractures in order to avoid the varus malalignment associated with the medial femoral condyle starting point [10] and Patterson was the first to report on this intercondylar approach after performing this procedure in 14 patients [37].

1.5 Indications for Retrograde femoral nailing

Retrograde femoral nailing may have an advantage over other techniques. Specific advantages include:

- No significant postoperative abductor weakness; no post-surgical heterotopic ossification in the region of the hip; simultaneous treatment of bilateral lower extremity injuries [56, 64-67].
- Effective treatment of ipsilateral femoral shaft and femoral neck fractures [56, 58, 71]; no risk of pudendal nerve palsy (which is as high as 17% in antegrade femoral rodding on a fracture table) [53, 54].
- Rapid access to the intended starting portal in patients with traumatic arthrotomies to the knee.
- The ability to treat thoracic and/or abdominal injuries and orthopaedic injuries simultaneously or sequentially without having to change operating tables.
- Several authors [56, 58, 64] have advocated retrograde femoral nailing to treat bilateral femur fractures. Both fractures can be rodded simultaneously, thus minimizing operative time and blood loss.

Obese patients can be operated on more efficiently and with greater ease using a retrograde technique [55].

Patients with poor skin quality in the region of antegrade starting points should also be considered candidates for retrograde femoral rodding [56, 67].

Ipsilateral femoral neck and shaft fractures can be stabilized using this technique [56, 58].

Since there is no direct radiation to the pelvic region during retrograde femoral nailing, pregnant patients may benefit from this technique [56, 66].

Patients with distorted proximal femoral anatomy, such as patients with Paget's disease or with previous proximal femoral fractures, can present a formidable challenge with an antegrade technique. Therefore, retrograde insertion of a femoral nail may be an attractive alternative [69]. Paget's disease tends to distort the proximal femoral anatomy much more than its distal anatomy.

Gregory have also demonstrated this technique's usefulness in cases with ipsilateral femoral and tibial fractures (floating knee) [81]

In addition, several authors [66, 67] have expanded its use to cases with ipsilateral pelvic or acetabular fractures. Specifically, incisions for antegrade femoral rodding can interfere with subsequent approaches to the acetabulum or pelvis. In addition, the use of a fracture table could potentially stress an unstable pelvis.

Since the reduction forces used in retrograde femoral nailing are less and usually more carefully controlled than the reduction forces used with a fracture table in antegrade femoral nailing, some authors [56] have recommended its use in delayed definitive fixation of the femur after external fixation and vascular repair for grade III open fractures.

There are situations in which the traumatic injuries to the patient may make one approach more attractive than another, such as in traumatic knee arthrotomies with femoral shaft fractures and traumatic amputations through the knee [67]. In these cases, the traumatic arthrotomy can provide access to the intercondylar notch.

In ipsilateral patella and femur fractures, one approach can allow the surgeon to deal with both injuries if a retrograde approach is chosen. A supracondylar femur fracture in a patient with a hip prosthesis can be managed with a retrograde rod [63]. However, there is the theoretical risk of a stress riser between the prosthesis and the nail [63].

Head-injured patients may also benefit from retrograde femoral nailing. An antegrade approach in a patient with a head injury can lead to significant heterotrophic ossification in the region of the hip joint [67].

Lonner described the use of a retrograde femoral nail in a patient with an ankylosed hip and stiff knee with a prior history of head injury. The patient had significant heterotopic ossification about the hip and sustained a femoral shaft fracture after a fall. The presence of heterotopic ossification in the hip region preoperatively made an antegrade starting portal almost impossible. The authors proceeded with retrograde femoral nailing and obtained good results [62].

1.6 Disadvantages of Retrograde nailing

Retrograde femoral nailing may also have some disadvantages. When the retrograde nail was introduced, concern for the development of post-traumatic arthritis with an intra-articular starting point caused the orthopaedic community to utilize an extra-articular starting point on the medial femoral condyle [61, 64].

This starting point, however, has been associated with varus malalignment [67]. An intercondylar notch starting portal was subsequently developed, again raising concerns about patellofemoral arthrosis [67]. Additional disadvantages may include the potential for knee stiffness, quadriceps atrophy, risk of intra-articular sepsis, risk of synovial metallosis [59], and the need for an arthrotomy if the hardware is removed [58, 67].

The proximal interlocking screw in retrograde femoral nail can be challenging because of the amount of soft tissue in the region of the proximal thigh. Loss of the screw in the thigh can be a technical nightmare.

The positive effect of reaming on fracture healing is thought to be from a combination of altered blood flow to the bone and the local muscles, and the deposition of marrow and cortical elements at the site of the fracture [28, 29, 30, 31, 32]. The impact of these factors has been studied in animal models in both the tibia and the femur.

The injury to the inner two thirds of the bone by reaming has been identified [35]. Animal studies in the tibia suggest that this process is reversed by 12 weeks after reamed nailing and by 6 weeks after unreamed nailing [31]. However, reaming has been shown to have a positive influence on the surrounding muscle perfusion, which may have implications for the extraosseous blood supply to the bone and the healing fracture [29].

In one study, periosteal blood flow was found to increase by a factor of six within 30 minutes of reaming [36]. Total blood flow and callus blood flow increases have been similarly demonstrated in animal models [34].

1.7 Comparison between Anterograde and Retrograde Nailing.

Antegrade femoral intramedullary nailing has been shown to have a high union rate [54]. The problems of Trendelenburg gait, difficult starting point, and post union implant-related pain have been reported [82].

However retrograde intramedullary nailing has now been shown in several series to have a high union rate without a deleterious effect on the knee joint or range of motion [80, 81]. Few studies have been done worldwide to functional outcomes between antegrade and retrograde reamed interlocking nailing.

Antegrade and retrograde nailing techniques have been directly compared and reported in one retrospective study and 3 prospective and randomized studies [41, 43, 44].

In a retrospective study comparing 134 femoral fractures treated with a retrograde technique and 147 fractures treated with an antegrade technique, Ricci [41] compared the rates of delayed union, nonunion, malunion, and complications at an average of 23 months. Union occurred after the initial procedure in 89% of the fractures treated with antegrade nails and 88% of those treated with retrograde nails. The final rate of union after additional interventions and the rate of malunions were the same between the two groups.

After excluding patients with ipsilateral hip or knee injuries, the authors [41] reported a significantly higher rate of pain at the associated entry site for each group. In patients treated with retrograde nails, 36% had knee pain compared with 9% of those treated with antegrade nails. Ipsilateral hip pain was reported in 10% of patients treated with antegrade nails compared with 4% of patients treated with retrograde nails. On the other hand there were seven delayed unions (7 percent) in retrograde group and 4 delayed unions (4 %) in anterograde group, six non-unions (6 percent) in each group [41].

It was also found that [41] in retrograde group, there were eleven malunions (11 percent), and in anterograde group, there were twelve malunions (13 percent). When patients with ipsilateral knee injuries were excluded, the incidence of knee pain was significantly greater for retrograde group patients (36 percent) than for anterograde group patients (9 percent). When patients with ipsilateral hip injuries were excluded, the incidence of hip pain was significantly greater for anterograde group patients (10 percent) than for retrograde group patients (4 percent)

Reliable outcomes have been reported with antegrade reamed and unreamed nailing techniques .Union rates have been reported to be between 70 and 99 percent, and the rate of malunion has been low [18, 23, 73] .

Ostrum [43] compared femoral fractures treated with antegrade and retrograde nails in a prospective and randomized study of 100 patients. Small-diameter (10 mm) nails were inserted after reaming in both groups. Knee pain was found to be equal in both groups, but thigh pain was observed to be associated with antegrade nails. Final healing after secondary procedures was similar between the two groups.

Ostrum [43] also showed that Knee motion was 120 degrees in all but one knee in each group and the antegrade nailed femurs healed faster than those treated retrograde (AN = 14.4 weeks vs RN = 18.1 weeks). Also more patients required dynamization for union in the retrograde insertion group (17 percent versus 5 percent) and retrograde nailing had an association with an increased time to union. All of the antegrade nailed femurs healed (100 percent), and 98 percent (one nonunion) of the retrograde femurs healed after secondary procedures.

In another prospective and randomized study comparing antegrade and retrograde femoral nailing for femoral shaft fractures, Tornetta and Tiburzi [44] found no difference in operating time, blood loss, technical complications, nail size, or the need for blood transfusions in 69 fractures. Reamed nails were used with both insertional techniques. The authors reported an increased rate of rotational and length discrepancies with the retrograde technique. In their study, the antegrade procedures were performed using a fracture table, whereas the retrograde procedures were accomplished with manual traction on a radiolucent table.

The time to union and the rate of union (100%) were the same for both surgical approaches. Because of the limited length of follow-up, no conclusions could be drawn regarding long-term knee function or complications. In a more recent follow-up presentation, Tornetta and coauthors reported similar results in knee range of motion, stair-climbing ability, pain medication requirements, and in patients prospectively randomized to treatment with either an antegrade or retrograde nail [45].

Study done by Acharya (48) showed that of the 27 knees available for evaluation, 26 achieved a flexion of >100° and one patient (with an associated fracture of the patella) only 90° of flexion. Mild anterior knee pain (not interfering with routine activities) recorded in 19 patients, was the most common complaint. Significant sagittal and coronal plane instability was noted in 10 of these knees. The overall status of the knee was assessed by the modified Knee Society Knee Score. At postoperative month 6, 63% had an excellent or good pain score, while only 37% had excellent or good functional scores. By the end of one year, excellent or good pain and functional scores were recorded in 77% and 73% of the patients respectively. Radiological angular malalignment (>5°) was present in 4 patients, 3 had valgus malunion and one had anterior angulation at the distal fracture. However, none were deemed to warrant a secondary procedure[48].

Acharya [48] also found that significant limb length discrepancy (>1 cm) was noted in 4 patients (mean, 2.25 cm). Four patients complained of pain around the distal interlocking screw and were managed with analgesics or single screw removal. Superficial wound infection was evident in 4 patients (3 had a traumatic arthrotomy), which resolved after antibiotic treatment and antiseptic dressings. No patient experienced a deep infection, fat embolism, heterotropic ossification, or implant failure. In this study, 93% of the operated knees achieved >100° of flexion (mean, 123°). The only patient whose range of knee flexion was more limited, had an associated ipsilateral patellar fracture [(48)] .

Although knee stiffness following RN has been a major concern, several studies have shown that the range of movement is not adversely affected [50, 51].

Comparative studies [51,52] have shown no difference in the incidence of knee pain between antegrade nailing and RN. Anterior knee pain has multiple causes (e.g. cartilage injury from initial trauma or quadriceps atrophy) and may not be due to the retrograde nail perse [51]. In this study [51], knee pain was the most common complaint (70%), noted even as late as one year postoperatively. In most patients it was not so severe as to interfere with activities of daily living, and only 3 (11%) required medication for pain relief. 53% of the patients with anterior knee pain had ligamentous instability of the knee, but there was no record of preoperative assessment for comparison.

As RN does not interfere with the anterior cruciate or collateral ligaments, the likely cause of such instability is the initial trauma itself. Indeed, the incidence of ligamentous injury following fractures of the femoral shaft range from 5 to 48% [7] but to what extent this ligamentous instability contributes to knee pain is unknown.

The reported incidence of malunion in patients treated by RN varies from 2.2 to 42% [50, 51, 52].Ricci found that 4 patients had angular malunion and 4 had limb length discrepancy; none of them received additional surgical procedures to correct these deformities.

The reported incidence of symptomatic distal interlocking screws varies from 9% 5 to 33% [52].

A Study done in Malaysia showed that All 35 cases (100%) of the retrograde nailing and 85.7% cases of antegrade nailing finally achieved union [77]. There was no statistical difference between both the groups of patients, in regards to union. In the antegrade group of patients, the delayed union and nonunion rate was 9.5% and 4.8% respectively. In analysis of the post nailing fracture alignment, it was found that in all the parameters of the Thoresen system for fracture alignment were similar in both groups (Table 1). However, it is important to note that the retrograde group of patients showed 100% excellent results in terms of valgus or varus, procurvatum or recurvatum, rotation and shortening. Excellent results for each of the parameters meant valgus or varus angulation less than 5^0, procurvatum or recurvatum less than 5^0, internal rotation less than 5^0, external rotation less than 5^0, and shortening of 1 cm and below.

1.8 Postoperative Care and Rehabilitation after Intramedullary Nailing

Operative stabilization of femoral shaft fractures with interlocking nail allows early patient mobilization, decreases pain, facilitates nursing care, minimizes joint stiffness, and allows early functional rehabilitation. Early mobilization avoids many of the complications associated with prolonged recumbency such as pulmonary compromise, pressure sores, and muscle deconditioning.

Patients usually experience significantly diminished pain after femoral stabilization. As a result, they should be encouraged to sit up and get out of bed immediately after fixation. Because of the strength of a femur treated with a statically locked intramedullary nail, there should be virtually no concern by the patient or the physician regarding the stability of the mechanical construct. This applies to femurs stabilized with both antegrade and retrograde nailing techniques. Quadriceps and hamstrings exercises can proceed according to the patient's comfort.
Unrestricted active and passive range-of-motion exercises of the knee and hip can similarly be instituted immediately after surgery. Restoration of motor strength is dependent on the traumatic injury to the muscles, any associated injuries, and the patient's motivation. In patients with isolated femoral shaft fractures, supervised outpatient physical therapy is frequently unnecessary.

Weight bearing on the extremity is guided by a number of factors including the patient's associated injuries, the soft tissue injury, and the location of the fracture. For fractures treated with the currently manufactured intramedullary nails, immediate weight bearing is safe from a mechanical standpoint. Brumback et al [46] reported the biomechanical and clinical results of simulated and actual early weight bearing using commonly available implants.

They found that immediate weight bearing of segmentally comminuted mid-isthmal fractures treated with a statically locked intramedullary nail using two distal interlocking screws was safe and allowed healing without shortening or nail fatigue failure. Similarly, Arazi et al [47] followed 24 patients with comminuted diaphyseal femur fractures for a minimum of 1 year. Unrestricted weight bearing was allowed, and most patients were able to bear weight between 2 and 4 weeks after surgery.

No nail-related mechanical failures occurred, and all fractures healed without complications. An interlocking screw in each of two patients demonstrated some bending, but this was without consequence. The experience reported in these two studies supports the contention that early weight bearing after reamed statically locked antegrade intramedullary nailing is safe.

Early weight bearing may encourage callus formation and should be encouraged in applicable patterns. Fractures with proximal or distal extension and associated ipsilateral femoral fractures require individual modification to the weight-bearing progression. If weight bearing is limited during the first 6 to 12 weeks, an ankle dorsiflexion splint or orthosis should be used to avoid an equinus contracture.

1.9 Rationale of the Study

The prevalence of closed femoral shaft fractures is known to be high in Tanzania and treating them is difficult due to lack of human resources and implants [49]. The intramedullary interlocking nails **(UFN, SIGN)**, is one of the main implants used for the management of femoral shaft fractures at MOI.

With SIGN Intrerlocking nails (Surgical Implant Generation Network), it is now feasible to achieve interlocking nail insertion without the aid of an intraopertive image intensifier, simply by the use an external jig and slot finder. Successful interlocking nailing using this method should not only improve the quality of fracture care, but should also lead to a reduction of exposure to intraoperative radiation [20]. Despite the fact that interlocking femoral shaft nailing is among the commonest surgical procedures done at MOI, published data are scarce /lacking in developing world including Tanzania.

As to date, few studies have been published worldwide comparing both retrograde and antegrade nailing for femoral shaft fractures. This study was carried out with the aim of comparing the two methods, looking at early clinical outcome, ensuing complications and in our center this was the first study.

1.10 Aim of the study

This study was carried out in order to compare antegrade versus retrograde reamed interlocking femoral nailing which are the common approaches used for fixation of femoral shaft fractures in adult patients at our hospital, but also to determine outcomes following open reduction and internal fixation with the use of SIGN NAILS and complications associated with nail insertion via the intecondylar notch versus greater tronchanter.

Information obtained from this study will help the Institute to improve standard of care and increase patient's satisfaction. This study was also being done as a partial fulfillment for the award of the degree of Master of Medicine in Orthopaedics and Trauma of the MUHAS

1.11 Research Question

What is the clinical outcome and complications following fixations of femoral shaft fractures using antegrade vs retrograde approaches? Is antegrade approach associated with early fracture healing than retrograde approach? What is the situation at MOI?

1.12 Objectives

1.13 Broad Objective

To compare antegrade versus retrograde reamed femoral interlocking nailing among patients treated at MOI, March to December 2009.

1.14 Specific Objectives

1. To determine the prevalence of closed femoral shaft fractures.
2. To determine the causes of closed femoral shaft fractures.
3. To determine the average time to union and correlate it with the approach of interlocking used.
4. To determine specific knee joint complications following retrograde vs antegrade interlocking nailing approach.
5. To determine other complications inherent with either procedure

2.0 METHODOLOGY

2.1 Study Area:

This study was conducted at MOI, with a bed capacity of 165 beds, It is the main referral center for patients with skeletal trauma serving both the city of Dar es Salaam and the country at large for patients with such complicated injuries

2.2. Study Period:

This study was from March 2009 to December 2009 at Muhimbili Orthopedic Institute, a referral and teaching institution in Dar es Salaam Tanzania.

2.3 Study Design:

This was a hospital based descriptive cross -sectional prospective study. Patients were managed as per standard hospital procedure on emergency and elective basis by open reduction and internal fixation with interlocking intramedullary nailing

2. 4. Study Population:

Patients aged 18 years and above admitted at Muhimbili Orthopaedic Institute with closed femoral shaft fractures treated by open reduction and internal fixation with interlocking nails.

2.5. Inclusion Criteria:

The study included patients admitted at MOI with closed femoral shaft fractures from March 2009 to December 2009 treated with interlocking nail

2.6 Exclusion Criteria

1. Patients below 18 years of age
2. Open fractures of the femoral shaft treated with surgical debridement and interlocking nailing.

3. Patients with debilitating conditions like uncontrolled diabetes mellitus, malignancy, severe hypertension
4. Pathological femoral shaft facture
5. Patients who refuse to consent
6. Metaphyseal fractures e.g. supracondylar, pertronchateric and subtronchanteric.
7. Those with associated injuries around the knee e.g. patella fractures, tibia plateau fractures, femoral condylar fractures

2.7 Sample size estimation and sampling technique

Convenient sampling technique was used and all consenting patients who fulfilled the eligible criteria set in this study were included. The criteria of choosing which approach to be used to any patient (antegrade or retrograde), was entirely at the discretion of the operating surgeon.

Sample size estimation, using open Epi info software

Total admission of patients in a month at MOI, estimated to be 700 then for three months -2100.

Proportion of patients with femoral shaft fractures 5%

95% confidence interval =1.96

Error rate=5%

$$n = \frac{[N\,p\,(1-p)]}{d^2/Z^2_{1-\alpha/2.\ (N-1).p+px}{}^{(1-p)}}$$

n=71

Hence the minimum required sample was 35 per group.

Due to non response and loss to follow up the sample was increased to 40 per group. However 42 patients and 38 patients were recruited, and followed up.

2.8 Data Management and Analysis

Data was entered and cleaned into statistical software (SPSS version 13). Sample characteristics were explored using descriptive statistics. Mean and standard deviation was used for continuous variables and differences between means were examined using student t-test. For categorical variables, frequencies was run and differences in proportions of various attributes between the two antegrade and retrograde groups was examined using Chi-square test or Fishers exact test as appropriate. All the analysis was two tailed and significance level was set at 5% level.

2.9 Patient Enrollment and Follow-up

The 1st doctor who attends the patient classified the fracture using anatomical and AO classification systems; however the researcher later on reviewed the patient and preoperative x-rays to possibly affirm the diagnosis. Registrars, residents, specialists and consultants of varying experiences carried out the surgical operations.

Preoperatively 3rd generation intravenous cephalosporins - ceftriaxone sodium 1gm was given preoperatively and then post operatively once daily for 48 hrs (2 days). The SURGICAL IMPLANT GENERATION NETWORK NAILS (SIGN NAILS) were used in this study. A standard approach was used for both the antegrade and retrograde nailing. Retrograde nails were inserted through the knee via the intercondylar notch, with a soft tissue protection sleeve in order to protect the articular surface of the patella from damage by the guide reamers. In Antegrade approach, nails were inserted via the tip of greater tronchanter.

The criteria set for choosing the approach for the nailing was entirely at the discretion of the operating surgeon. The same kinds of nails were used in all the cases. Following ORIF, fracture was stabilized with at least 1 interlocking screw on either side of the fracture which was inserted from the lateral side.

Alignment and stability of the fracture was assessed clinically and radiologically and Post operative x rays were reviewed with respect to reduction, alignment of the fracture, which was taken within 2-3 days to assess the success of operation, at 2-3, months, and at 6 months to diagnose implant failure (loose, broken, infected implant) and monitor fracture healing.

After surgery, patients were enrolled on a gradual and graded physiotherapy programme; they were helped to getup into an upright position, stand and walk with a walker, thereafter crutches. Patients were encouraged to start partial weight bearing or at least stand up properly on the injured foot from day one after surgery.

The postoperative management of the two groups was the same and included toe-touch weight-bearing until there was formation of callus. Full weight-bearing was initiated when bridging callus was visible on two orthogonal radiographs. Follow-up was at 2 weeks for stitch removal and assessment of any signs of wound infections, then at four, eight and 12 weeks, and six months.

The range of movement of the knee and hip was measured each time. Pain in the knee was graded subjectively by the patients in both groups.

Radiological union was defined as the presence of bridging callus across three cortices and fractures were considered healed when the patients had radiological union, no tenderness to palpation and were able to bear weight without experiencing thigh pain [77]. Delayed union was defined as radiological union which took longer than 6 months while nonunion as not having any gross callus on radiographs 6 months after the surgery [77]

Angular deformity was evaluated on anteroposterior and lateral radiographs at the time of fracture union. Malunion was defined as more than 5 degrees of angular deformity in the sagittal or coronal planes, malrotation of at least 10 degrees, or more than one centimeter of limb length discrepancy as compared with the uninjured side. The Thoresen scoring system [78] was used to evaluate the eventual alignment of the fracture after the nailing, regards to the valgus or varus, procurvatum or recurvatum, shortening and rotational (internal or external) alignment, as shown in Table 1.

The former two were determined by examining the radiographs in both anterior-posterior and lateral views. While rotation was determined clinically by physical examination, observing the position of the patella and second toe in regards to the anterior superior spine on the same side. Shortening was determined by measuring the limb length and comparing with the sound limb.

This scoring system also enabled me to assess the patients' knee function clinically in terms of flexion, extension deficit, pain, and swelling. Patients' demographics and outcomes in terms of union/healing, alignment, and knee function were analyzed

Table 1. Thoresen scoring system.

Results

Variables	**Excellent**	**Good**	**Fair**	**Poor**
Malaligment				
Varus/valgus(degree)	5	5	10	10
Procuvatum/recurvatum(degree)	5	10	15	>15
Internal rotation (degree)	5	10	15	>15
External rotation (degree)	10	15	20	>20
Shortening (in cm)	1	2	3	>3
Range of motion (knee)				
Flexion (degree)	>120	120	90	<90
Extension deficit (degree)	5	10	15	>15
Pain or swelling	None	Sporadic	Minor significant	Severe

2.10 Data Collection Process

A structured questionnaire was used for data collection in English. Data was collected over a period of 6 months. Patients were evaluated on the day of admission and after surgery until they were discharged home, then were followed up at the clinic.

2.11 Recruitment of research assistant

Two research assistants with knowledge, ability and experience in research were recruited. The two day training covered description of the objectives of the study; oriented to the tools for data collection, emphasizing on making sure that each participant was asked to consent before starting the interview.

2.12 Pre- testing

Pre- test was conducted at MOI to test the data collection tool if would provide the depth, range and quality of information required and the likely response rate. Necessary amendments of the tool was done to obtain the required information

2.13 Ethical Considerations

Ethical clearance was sought from the ethical clearance committee of MUHAS. The aim of the study was fully explained to the patients and guardians who had freedom to ask questions about the study. Thereafter a written consent was sought for being included in the study or not.

2.14 Limitation of the study

1. Evaluation of the clinical outcome /morbidity of these patients in this follow up of 6 months was probably short
2. Preoperative and post operative knee stability test was not done ,as ligamentous injury could have been a cause of knee pain
3. This was a hospital- based hence prone to bias as femoral shaft fractures of other hospitals were not accounted for.
4. Laboratory and bacteriological studies were not done to confirm wound infection due to investigation costs

3.0 RESULTS

3.1 Characteristic of the study population according to sex and age

Table2. Sex distribution of the study population

SEX	Frequency	Percent
Males	63	78.8
Females	17	21.3
Total	80	100.0

A total of 80 patients aged 18 years and above agreed to participate in this study. There were 63 males (78.8%) and 17 females (21.2%) with a male to female ratio of 3.7:1

Table 3.Age distribution of the study population

Age group (years)	Frequency	Percent
18-35	54	67.5
36-53	19	23.75
54-71	7	8.75
Total	80	100

Their age ranged 18-71 with a mean age of 34 years .The majority of patients were in the age range of 18-35 years (76.5%)

Table 4 Frequency distribution according to occupation

Occupation	Frequency	Percent
Formal employment	31	38.8
Self employed	40	50.0
Unemployed	9	11.3
Total	80	100.0

Table 5.Duration of hospital stay

Days	Frequency	Percent
1- 10	50	62.5
11-20	17	21.25
21-30	10	12.5
31-40	3	3.75
Total	80	100

Most patients (62.5%) stayed between 1 to 10 days in the hospital 'mean time of stay was 10 days

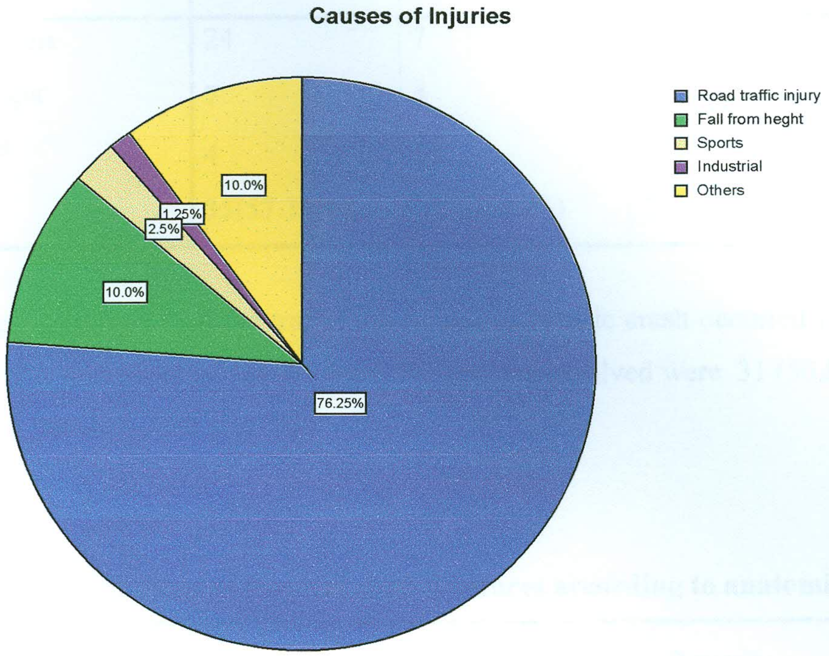


Figure 2 Distribution of the study population according to causes of injuries

Road traffic crash were the most cause of injury in 61(76.3%) ,followed by fall from height in 8 (10%) and others e.g. fall on a slippery surface in 8 (10%)

Table 6 .Distribution of Patients involved and types of Road traffic injuries

Who in RTI	Types of RTI			Total
	Motor vehicle	motorcycle	Bicycle	
Pedestrians	24	7	0	31(50.8%)
passenger	7	4	1	12(19.7%)
drivers	4	13	1	18(29.5%)
Total	35(57.38%)	24 (39.34%)	2 (3.28%)	61(100%)

Among 61 victims of Road traffic injury, motor vehicle crash occurred in 35 (57.38%) and motorcycle crash in 24 (39.34%).Pedestrians involved were 31 (50.8%) ,drivers 18 (29.5%) ,passengers12 (19.7%)

Table 7. Distribution of femoral shaft fractures according to anatomical site

Anatomical location	Frequency	Percent
PROXIMAL 1/3	23	28.75
MIDDLE 1/3	38	47.50
DISTAL 1/3	19	23.75
Total	80	100.0

The most common anatomic site was middle 1/3 in 38 patients (47.50%) patients

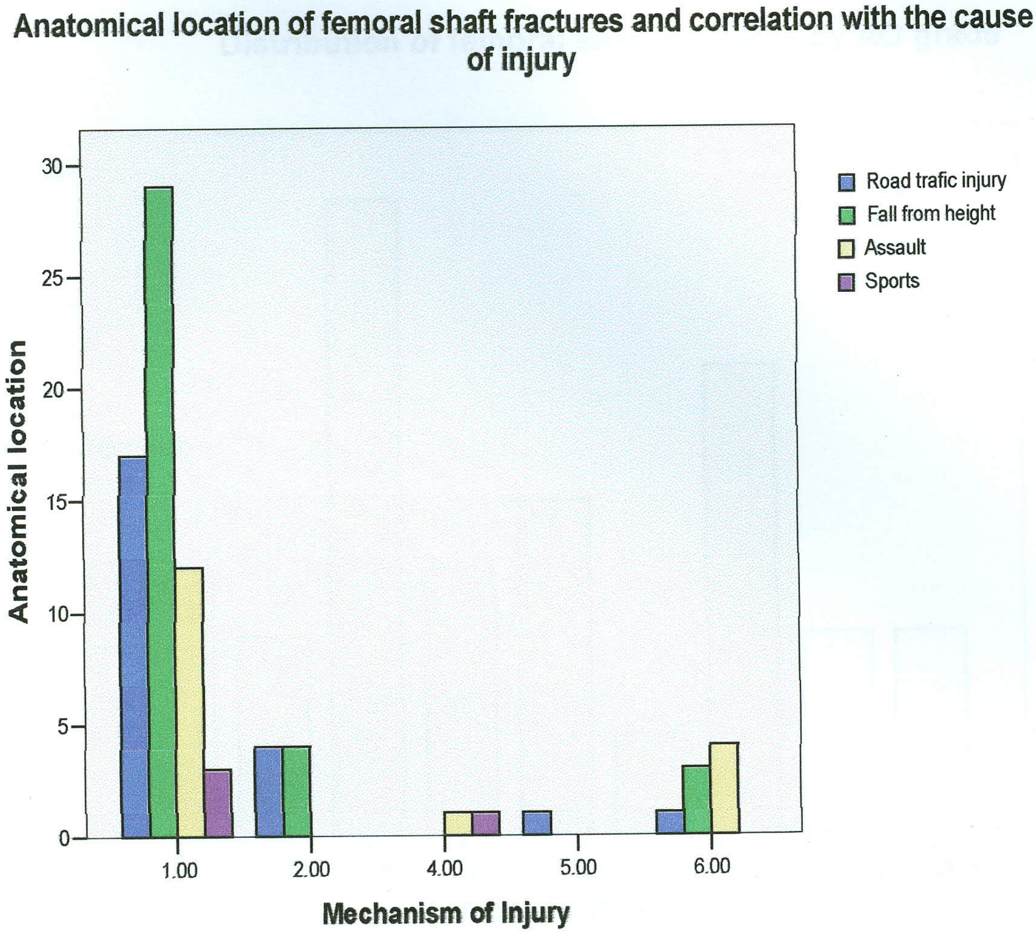


Figure3. **Anatomical location of femoral shaft fractures and correlation with the mechanism of the injury**

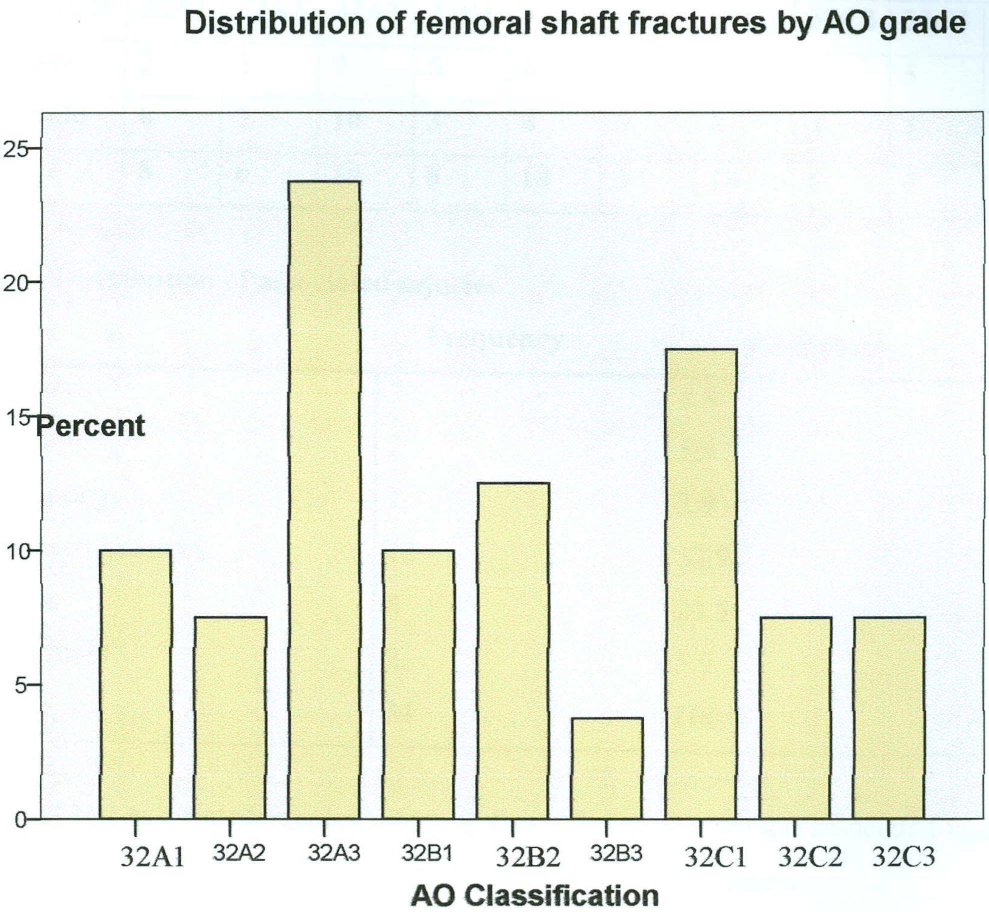


Figure 4. Distribution of femoral shaft fractures according to AO classification

The most common fracture was 32A3 (23.8%) fractures and the least was 32B3 (3.8%) fracture

Table 8. Distribution of femoral shaft fractures by AO grade and surgical approach

SURGICAL APPROACH	AO CLASSIFICATION OF FRACTURES									
	32A1	32A2	32A3	32B1	32B2	32B3	32C1	32C2	32C3	TOTAL
Antegrade	2	3	9	5	6	3	6	3	5	42
Retrograde	6	3	10	3	4	0	8	3	1	38
TOTAL	8	6	19	8	10	3	14	6	6	80

Table 9. Distribution of associated injuries

	Frequency	percentage
Head injury	3	8.8
chest injury	2	5.9
Visceral injury	1	2.9
Other Closed fractures	18	52.9
Soft tissue	8	23.5
Open fractures	2	5.9
Total	34	100.0

34 patients had associated injuries. Among them, the most common associated injury was other closed fractures 18 (52.9%) and the least was visceral injury.

Table 10. Anatomical location of fracture vs. surgical approach

Anatomical location of fracture	Antegrade	Retrograde	Total
P/3	18	5	23
M/3	19	19	28
D/3	5	14	19
Total	**42**	**38**	**80**

42 fractures (52.5%) were fixed through antegrade approach and 38 (47.5%) by retrograde approach

3.3. Outcome of treatment

Table 11.Fracture union vs surgical approach

		Antegrade	Retrograde	Total
Fracture YES	Union	40	37	77
	NO	2	1	3
Total		**42**	**38**	**80**

It was found that, among 80 fractures evaluated, 77(96.25%) had union and 3 had non union, of whom 2 were operated through antegrade approach and 1 by retrograde approach. The average time for union was 100.7821 days

Table 12.Correlation of average time to union with the surgical approach used

Days	antegrade	Retrograde	Total
50-100	22	19	41(53.2%)
101-150	16	18	34(44.2%)
151-200	2	0	2(2.6%)
Total	40	37	77(100.0%)

Most fractures had union in duration interval between 50-100 days (53.2%). No statistical difference between antegrade and retrograde group Chi square 2.211,df 2, p-value >0.05

Mean time of healing 100.78 days

3.4. COMPLICATIONS FOLLOWING TREATMENT

Table 13. Frequency distribution of non union

Non Union	antegrade	Retrograde	Total
YES	2	1	3 (3.75%)
NO	40	37	77 (96.25%)
Total	**42**	**38**	**80**

3 patients had hypertrophic non -union .Only one of them was reoperated

Table 14. Post Nailing Thoresen Scoring System

Varus/valgus	**Antegrade**	**Retrograde**	**p- value**
Excellent 5°	39	37	P > 0.05
Good >5°	0	0	
Fair 10°	1	0	
Poor >10°	2	1	
Provacatum /Recavartum			
Excellent 5°	41	38	P > 0.05
Good >5°	0	0	
Fair 10°	1	0	
Poor >10°	0	0	
Internal Rotation			
Excellent 5°	42	38	P > 0.05
Good >5°	0	0	
Fair 10°	0	0	
Poor >10°	0	0	
External Rotation			
Excellent 5°	42	38	P > 0.05
Good >5°	0	0	
Fair 10°	0	0	
Poor >10°	0	0	
Shortening			
Excellent 1cm	38	35	P > 0.05
Good 2cm	4	3	
Fair 3cm	0	0	
Poor >3cm	0	0	

Range of motion (knee)

Flexion	**Ante grade**	**Retrograde**	
Excellent >120°	36	32	
Good 120°	6	5	$P < 0.05$
Fair 90°	0	0	i.e. $0.001 > p > 0.005$
Poor < 90°	0	1	

About 85.71%of AN group and 84.21% of retrograde group shows excellent results, 14.28%- good results- ante grade, 13.16% good results – retrograde based on Thoresen scoring system

Extension deficit	**Ante grade**	**Retrograde**	
Excellent 5°	39	35	
Good 10°	3	2	$P > 0.05$
Fair 15°	0	1	
Poor >15°	0	0	

As for knee function, both groups did not differ significantly in regards to the presence of knee extension deficit ($p > 0.05$).

Knee pain	Ante grade	Retrograde	
None	31	21	
Sporadic, minor	10	10	$P > 0.05$
Significant	1	1	
Severe	0	0	

The proportions of patients in both groups who reported significant knee pain were small (2.38% in the antegrade group and 2.63% in the retrograde group)

Table 15. Implant failure

		AN	RN	Subtotal	Total
Screw breakage	Yes	0	1	1	80
	No	42	37	79	
Nail breakage/bending	Yes	1	0	1	80
	No	41	38	79	
Nail loosening	Yes	0	1	1	80
	No	42	37	79	

Implant failure rate in antegrade group was 1.25% and in retrograde group was 2.5%.

DISCUSSION

A total of 80 patients were included in the study(males 63,females 17)with a male to female ratio of 3.7:1,mean age of 34 years and the majority of patients were in the age group of 18-35.The prevalence of femoral shaft fractures was 81.83 per 1000 population.

This finding of male predominance and affecting the young productive age group is comparable to a previous study [49] in a similar age group. However it differs from another study which showed the average age being 27.2 years and 70% being males [4]. The male to female sex ratio has ranged from 4:1 in a study done in Rwanda [(8)] to 5:1 in Mozambique [80].

The male predominance could possibly be explained by a higher tendency of them being involved in risky activities which expose them easily to trauma. About 50% of the studied population was employed. Most patients (62.5%) stayed in the hospital between 1-10 days (from the day of admission, operation then discharge) with a mean hospital stay of 10 days and median of 8.5 days.

The most common mechanism of injury was Road traffic injury crash as shown in this study accounting for 76.3% of the studied population. These findings are comparable to previous studies on mechanisms of injury done at KCMC and Muhimbili (Tanzania) of 80% [26, 27] and in United States of America of 78% [4].

It was also found that among patients involved in road traffic crash; motor vehicle accidents were the leading cause accounting for 57.3% of all accidents ,followed by motor cycle 39.34% and bicycle 3.38%.However these results differ from earlier study [3] which showed that motor vehicle accidents accounted for 78% while motorcycle it was 9%.

In this study it was also found that pedestrian involved accidents dominated accounting for 50.8%, drivers 29.5% and passengers 19.7%

Fall from a height was the second leading cause of injuries after road traffic crash accounting for 10%.This differs from the study by Salminem et al [4] which found it to be 3%. It was also found that industrial accidents contributed the least with 3%.Previous study done at MOI [49] found it to contribute 5%. With regard to anatomical location of femoral shaft fractures, it was found that most fractures were in the middle third (47.50%) followed by proximal third (28.75%) and lastly distal third 23.75%.

In the present study the most common type and pattern of fracture sustained was transverse type 32A3 by AO classification (23.8%). This is consistent with fractures with fractures sustained under high tensile strain with a bending load of 250 Nm or more [30] and the least were type 32B3 (3.8%).

Shattered bone fracture type C fractures are usually caused by enormous force. They are associated with extensive degree of soft tissue injury even if skin around them appears normal. They result from compression, shearing or combined loading force . In the current study severely comminuted complex fractures type C3 was the second commonest fracture after type A3 and this differs from previous study done at MOI which showed that there was no type C3 fractures [(49)].

These fracture patterns also differs from previous study [4] which showed that the majority of fractures were oblique in 51% and transverse contributed for 29%. The difference between the two studies could be due to different mechanisms of injuries, 34 patients had associated injuries, among them the majority had other closed fractures (52.9%).One patient had visceral injury and he underwent Splenectomy on the day of admission then femoral shaft fracture was operated later .

Musculoskeletal injuries frequently occur in association with injuries in other parts of the body and therefore they must be managed with priorities of a polytrauma patient i.e. Advanced Trauma Life Support system developed by the America College of Surgeons. This study revealed a comparable favorable results interns of fracture union rate between the 2 studied groups, low non union rate, with average time of healing of 100.78 days. The overall union rate was 96.25% and this doesn't differ significantly with a study done by Winquest et al [73] which had a union rate of 99.1%. 95.23%, 97.36% of antegrade and retrograde nailing respectively finally achieved union.

There was no statistical difference in terms of union between the 2 groups of patients in regards to union (p>0.05.).These are comparable with other previous study results which showed a showed a union rate of 85.7% in antegrade group and 100% in the retrograde group but the differences were not statistically significant [77].

Also other studies done in the United States of America had a union rate of 100% for both surgical approaches [44], and 89% for antegrade and 88% for retrograde [41].

In the antegrade group of patients the non union rate was 4.76%, while in the retrograde group was 2.63%.This differs with another study [41] which showed a non union rate of 6% in each group and 4.8% in a study which was done in Malaysia [77]. The difference between these two studies could be explained by different surgical techniques.

In analysis of post nailing fracture alignment it was found that in all parameters of the Thoresen system for fracture alignment were similar in both groups with a p –value >0.05.However both groups (antegrade and retrograde) had excellent results in terms of internal and external rotation. Excellent results meant internal or external rotation of not more than 5 degrees.

Study which was done in Malaysia observed 100% excellent results in the retrograde group in terms of varus/valgus, provartum / recurvatum ,internal rotation, external rotation, and shortening [77].

As for knee function, both groups didn't differ significantly with regards to the presence of knee pain or swelling ($p>0.05$), knee extension deficit ($p>0.05$), however the antegrade group had more knee flexion compared to retrograde group ($p<0.05$). However other study [(77)] had showed that the two groups have similar knee function outcomes i.e. knee pain ($p=0.2379$ or swelling, knee extension deficit ($p=0.5100$) and knee flexion ($p=0.7215$).

11(13.75%) patients had malalignment; the antegrade group did infact yield a number of malunions, especially in procurvatum or recurvatum, varus or valgus angulation, but these numbers are not statistically significant.These results are almost similar to those obtained from previous study with malunion of 11% [77].

100 % of the patients in the Antegrade group and 97.3 % of the retrograde group showed good to excellent knee flexion based on Thoresen scoring system as opposed by 88.1 % and 91.4 % in antegrade and retrograde respectively [77].

The proportion of patients in both groups who reported significant knee pain in this study was also small (2.38% in the antegrade group and 2.63% in the retrograde group as compared to 9.5% and 2.9% in antegrade and retrograde respectively in previous studies [77]. May be it could be due to good surgical techniques for fractures fixation among surgeons at MOI.This also contravenes another study done in the United States of America [41] which retrospectively studied 293 femoral fractures, of which 140 were nailed retrograde while the other 153 were fixed with antegrade nails. They found that the incidence of knee pain was significantly higher in the retrograde group (36%)

compared to the antegrade group (9%). They also found that in the antegrade nail group of patients, 10% had hip pain and 26% had heterotrophic ossification.

In a prospective study of 100 consecutive femoral interlocking nails (54 retrograde and 46 antegrade), it was reported that knee pain was equally reported in both groups of patients. But hip and thigh pain predominated significantly in the antegrade group [(43)]. Knee flexion was not much different in both groups (98.1% of the retrograde group had knee flexion more than 120 degree compared to 97.8% in the antegrade group).This is consistent with my findings.

As for knee extension, 92.85% of the patients in the antegrade group and 92.10% of the patients in the retrograde group had excellent results (less than 5 degree extension deficit).

None of the patients in either group had any hip pain or impairment of hip motion. None of the antegrade nail patients showed any radiographic evidence of heterotrophic ossification.

This study revealed 5% infection rate of which, 3.75% occurred in the retrograde and 1.25% in the antegrade group. Both were superficial wound infection and were treated with debridement, antibiotics and cleared. Though it was superficial infections, the rates for this complication was high as compared to 0% in a study done by Christie [24], but it is comparable to a study which was done in Nigeria among patients treated with SIGN Nails [20] which had an infection rate of 5% (both were superficial infections)

There were 3 patients with implant failure,1 patient in the Retrograde group had screw breakage, also 1 patient in the retrograde group had nail loosening and in the antegrade group there was only 1 patient who had nail bending .All of these patients had fracture union. None of them had implant removal by the end of this study.

3 patients had non union (hypertrophy), 2 of them were on the retrograde and 1 in the antegrade group. Revision surgery plus bone grafting was done in only 1 patient (Revision nailing). The remaining 2 patients refused revision surgery

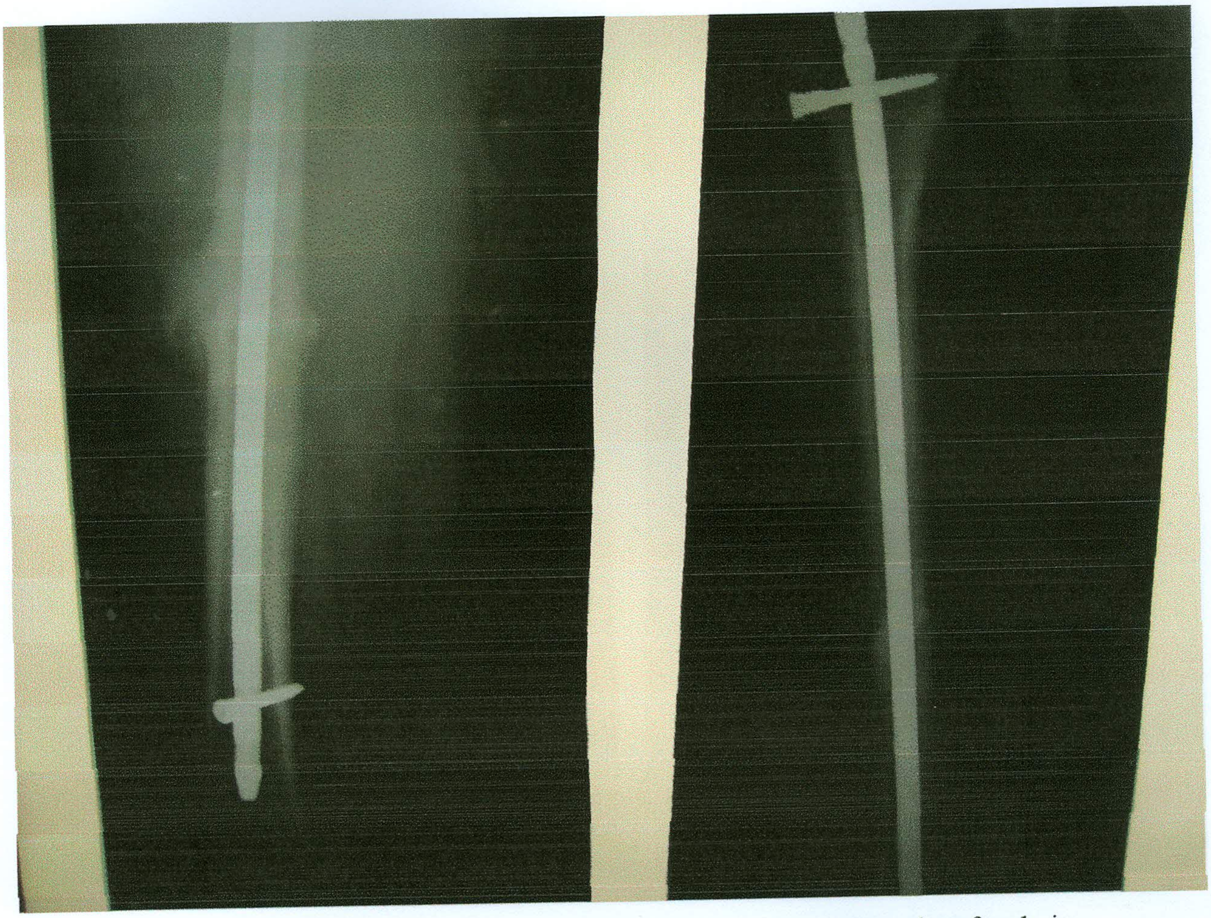


Figure 4: X-ray showing fracture healing of the Right femur at 2 months after being fixed by the SIGN NAIL through the Antegrade approach

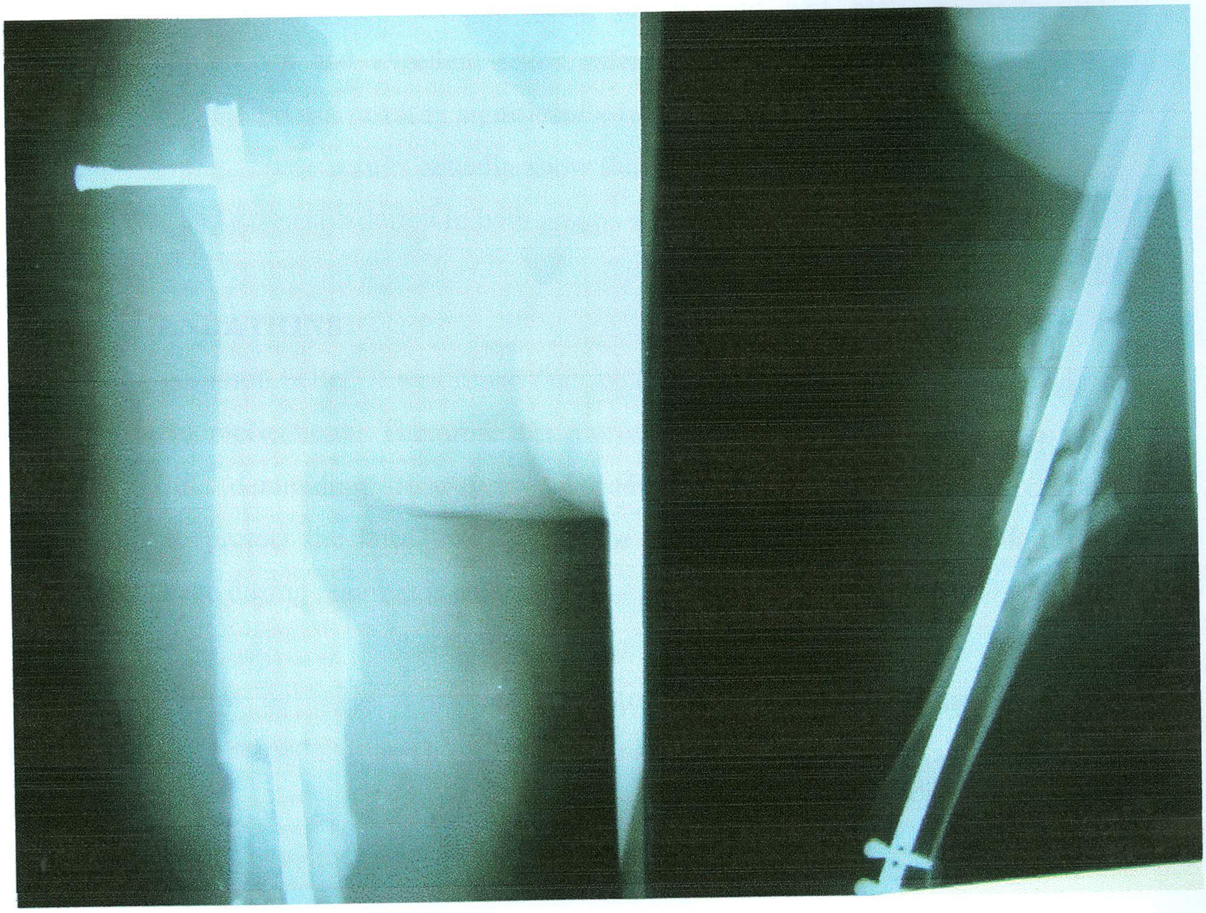


Figure 5: X-ray showing fracture healing at 4 months but with proximal screw loosening

CONCLUSIONS

Open reduction and internal fixation using interlocking nail both antegrade and retrograde approaches had excellent union rates with good alignment of the limb. Retrograde nailing did not result in significantly higher knee complications compared to antegrade nailing. These results actually show that the outcome of knee pain, swelling, knee flexion, and extension deficit in both groups are comparable

RECOMMENDATIONS

Contrary to common belief, it was found that retrograde nailing did not result in higher rates of knee complications. Therefore this approach of nailing is recommended as it is technically less demanding. However, it is adviced that one should take certain precautions to protect the knee joint during the procedure. The use of a soft tissue protection sleeve during reaming is essential.

Long term follow up study is recommended to determine knee complications like patellofemoral Osteoarthritis and hip complications like Heterotrophic Osssifications.

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