

**EARLY FUNCTIONAL OUTCOME OF
DISTAL FEMORAL FRACTURES
TREATED OPERATIVELY AT
KENYATTA NATIONAL HOSPITAL AND
P.C.E.A KIKUYU MISSION HOSPITAL**

**A DISSERTATION SUBMITTED IN PART FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF MASTER OF MEDICINE IN
ORTHOPAEDIC SURGERY UNIVERSITY OF NAIROBI.**

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DECLARATION

I, Dr Agunda Moses, hereby declare that this dissertation is my original work and has not been submitted in whole or part in any institution of learning for award of a degree

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DEDICATION

I dedicate this book to my family especially to my wife Evaline, my daughters Jacinta and Joy, and to my son Jeremy. Without their love, support, understanding, and encouragement, completion of this work would not have been possible.

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LIST OF ABBREVIATIONS

- AP = Anteroposterior
- AO = Arbeitsgemeinschaft für Osteosynthesefragen (German for Association for the Study of Internal Fixation),
- A.S.A. = American society of Anaesthesiologists
- BCP = Buttress condylar plate
- CBP = Condylar blade plate
- CT scan = Computerized tomogram scan
- DCS = Dynamic condylar screw
- DVT = Deep venous thrombosis
- FWBAT = Full weight bearing as tolerated
- HSS = Hospital for special surgery
- K.M.H. = Kikuyu Mission Hospital
- K.N.H. = Kenyatta National Hospital
- KROM = knee range of motion
- LISS = Less invasive stabilization system
- LLC = Long leg cast
- MIPPO = Minimally invasive percutaneous plate osteosynthesis
- MOI = Mechanism of injury
- MRI = Magnetic resonance imaging
- ORIF = Open reduction and internal fixation
- O.T.A. = Orthopaedic Trauma Association
- P.C.E.A. = Presbyterian Church Of East Africa
- PMM = polymethyle methacrylate
- RCT = Randomized controlled trial
- R.T.A. = Road traffic accident
- RIMN = Retrograde intramedullary nailing
- Rx = Treatment
- SLR = Straight leg raising
- TARPO = Transarticular approach and retrograde plate osteosynthesis

ABSTRACT

Background: Distal femoral fractures account for 4% to 7% of all femoral fractures^{1, 20, 21}. They cause considerable morbidity and mortality, especially in the elderly. Locally they occur mainly in the young socio-economically active age group; with the majority caused by automobile accidents¹⁹. With increasing high energy lifestyles and increasing longevity, the incidence is projected to rise. Functional outcome of treatment of these injuries has however not been critically studied at KNH and PCEA Kikuyu Mission Hospital setup.

Objective: To determine early functional outcome of operative treatment of distal femoral fractures at KNH and P.C.E.A. Kikuyu mission Hospital

Design and setting: This was a prospective cohort study conducted at the orthopedics and trauma wards and fracture clinics at Kenyatta National Hospital and PCEA Kikuyu mission Hospital.

Patients and methods: 46 patients were recruited by consecutive sampling after they underwent open reduction and internal fixation. They were followed up for a period of three months during which any complications were noted. At three months they were assessed for knee range of motion, pain, knee ligament stability, ability to walk and climb stairs and muscle strength. Femoro-tibial alignment was determined from a review of the AP and lateral radiographs of the knee. The Hospital for specialized surgery knee score was then determined.

Results: There were 18 females and 28 males all totalling to 46. Majority were in the age bracket 25-45 years (70.6%). The leading cause of injury was RTA, followed by falls from a height. Thirty (65%) patients were treated using DCS, 11 (23.9%) with retrograde intramedullary nailing and 5 (10.9) with 95°-angle plate. 89% had good to excellent functional outcome 12 weeks after surgery. 1 patient suffered periprosthetic fracture and poor function at 3 months. There was 1 patient who suffered superficial wound infection. 78% had knee range of motion above 90° and 8.8% had below 60° of motion. 1 patient had no radiological union at 12 weeks.

Conclusions:

- Male: female ratio was 1.6:1. There was a slight male preponderance.
- Young socio-economically active individuals formed the majority of those with these injuries
- High energy trauma was the leading cause: RTA.
- Following operative fixation, functional outcome was predominantly good or excellent
- Knee stiffness was the leading complication.

INTRODUCTION

Distal femoral fractures cause considerable morbidity and mortality, especially in the elderly¹. In Kenya in a study carried out by Oduor at KNH, the incidence was found to be higher in the younger, socio-economically active age group. The leading cause in this study was motor vehicle accidents¹⁹.

Surgical treatment of these difficult fractures has evolved over time³⁰. The goals of surgical treatment are anatomical reconstitution of the articular surface; reduction of the metaphyseal component of the fracture to the diaphysis and restoration of normal axial alignment, length and rotation; stable internal fixation and early motion and functional rehabilitation of the limb^{2, 3, 30, 44, 54}.

Surgical treatment with open reduction and internal fixation has been recommended since the 1960s and has been shown to be superior to non-operative treatment^{2, 4, 8, 9, 25, 30, 40, 45}. Wenzel and colleagues reported on 112 patients treated according to AO principles, 73.5% had good or excellent results. For open reduction, these results were far superior to the 52% satisfactory results reported by Neer and associates¹⁵. Several other studies that followed reported similar results, and recommended open reduction over non-operative treatment.

Problems associated with surgery include infection, mal-union, non-union, varus collapse, loss of fixation, diminished knee motion, difficult fixation in osteoporotic bone and short distal fragment^{3, 8, 9, 11, 13, 30, 31, 37, 38, 44, 52, 54}. In a systematic review of acute distal femur fracture treatment, Zlowodzki *et al.*, found overall, the average non-union rate of 6.0%, fixation failure

rate of 3.3%, deep infection rate of 2.7% and average secondary surgical procedure rate of 16.8%¹¹

These problems have been addressed sequentially with evolution of treatment devices¹¹. New, minimally invasive techniques including retrograde Intramedullary nailing (RIMN), minimally invasive percutaneous plate osteosynthesis (MIPPO), less invasive stabilization system (LISS), trans-articular approach and retrograde plate osteosynthesis (TARPO) avoids metaphyseal and diaphyseal stripping⁴². Studies elsewhere indicate that these techniques have lowered the rates of nonunion, deep infection and implant failure^{3, 7, 10, 11, 25, 26, 31, 34, 36, 37, 38}. However, the diminished knee motion component still persists and contributes to adverse functional outcome¹¹.

In a study by Oduor, the treatment modalities used at KNH were as follows:

66.7% used conservative methods; 27.8% combined conservative and operative methods; and 5.5% used operative methods only.

The conservative measures used included skeletal traction in 97% of the patients on conservative treatment, followed in 50% with long leg cast (LLC) and in 29% with operation. The remaining 21% were mobilised after a period of skeletal traction. Only 2.9% used LLC without traction (13, 14yrs.).

Operations done included: In 58.3%, plate and screw fixation, of which 50% were condylar blade plate (CBP), 8.3% buttress condylar plate (BCP); and 41.7% Retrograde intramedullary nailing. However, there is no data on functional outcomes for all these modalities in this setup, and the various contributing factors to the functional outcome have not been studied.

This study was designed to determine the functional outcome of operative treatment of these injuries at KNH and PCEA Kikuyu mission Hospital.

LITERATURE REVIEW

Incidence and prevalence

Distal femoral fractures account for 4% - 7% of all femoral fractures which in Sweden corresponds to an annual incidence of 51 per million inhabitants older than 16 years^{1, 20, 21}. US incidence is 31 per million.

Excluding hip fractures, 31% of femoral fractures involve the distal end. With the modern trends of high energy lifestyles with increased longevity, this incidence is probably increasing²¹.

They occur predominantly in two patient populations: young persons especially young men, after high energy trauma; and elderly persons, especially elderly women, after low energy injuries^{1, 9, 19, 20, 21, 29, 33, 44, 54}.

Martinet *et al.*, analyzed AO data on femoral fractures from 1980 to 1989. Distal femoral fractures were 6% of the total (2165 out of 34319).

M: F ratio was 1: 1 (1114:1051.)²⁰ They found a bimodal distribution with one maximum affecting young patient, particularly men about 20years, the other one affecting the elderly, particularly women about 70 years.

They concluded that there are two distinct groups as a function of age, the gender and etiology:

1. Elderly women, older than 50 (osteoporotic) with banal trauma, such as a fall at home.
2. Men between 15 and 50 years with high energy trauma, such as traffic or sport accident.

Type A₂ fracture was the most common pattern.

And Traffic accident was the most frequent cause (53%), but also suggested that it was dangerous to stay at home (33 %.)²⁰

In one series from Sweden, 84% of distal femur fractures occurred in patients older than 50 years¹. In a Minnesota study of patients aged 65 years or older, 84% of distal femoral fractures occurred in women. The conclusion was: 'the incidence of distal femoral fractures rise exponentially with age and are greater among elderly women than men'¹.

In the older group, most injuries occur after moderate trauma - a fall on a flexed knee. Two thirds of fractures caused by moderate trauma were preceded by prior age-related fractures (hip, proximal humerus, distal forearm, pelvis, vertebrae) or with radiographic evidence of generalized osteopaenia¹.

In the younger age group, distal femoral fractures occur after high energy trauma, often are open, comminuted, and result of direct application of load to a flexed knee^{19, 44}. Most are caused by vehicular accidents, including motorcycle accidents, but also from industrial accidents or falls from heights. Most patients are younger than 35 years with a definite male preponderance¹⁹.

The degree of comminution in supracondylar region is often equivalent in both groups. However, younger patients with high energy trauma have a greater incidence of additional intra-articular disruption, or segmental or more proximal shaft comminution.

PATHOLOGY

Relevant anatomy

Bone

The supracondylar (metaphyseal) area is the transition zone between the distal diaphysis and the femoral articular condyles^{22, 24}. At the diaphyseal-metaphyseal junction, the metaphysis flares, especially on the medial side, providing a platform for broad condylar weight-bearing surface of the knee joint. Anteriorly between the two condyles is a smooth articular depression for the patella, the trochlear groove. Posteriorly is the intercondyloid notch. Medially is the adductor tubercle at the maximal point of flare of the metaphysis. Both condyles have epicondyles on their outer surfaces.

Surgically, the femoral shaft in sagittal view is aligned with the anterior half of the condyles, whereas the posterior half, both condyles lie behind the femoral shaft axis. The condyles are wider posteriorly than anteriorly. A transverse cut through the condyles show a trapezoid with a 25 degree posterior to anterior decrease in width on the medial side.

Muscle

Anteriorly, the extensor compartment contains quadriceps femoris with four heads. Lateral and medial intermuscular septa separate the extensor from adductor and posterior compartments. The partitions form important landmarks for both lateral and medial approaches to the knee.

Medially the superficial femoral artery run down the thigh between extensor and adductor compartments, and pass into the popliteal fossa about 10cm above the knee joint by passing

through the adductor hiatus. It should be identified and avoided in medial approaches to the distal femur^{22, 24}.

The muscles produce characteristic bony deformities with distal femur fractures.

The Quadriceps and hamstrings cause shortening.

The Gastrocnemius displaces and cause angulation of the condyles posteriorly.

In intercondylar fractures, the Gastrocnemius cause rotational mal-alignment of the condyles.

ALIGNMENT:

The Mechanical axis passes through the head of the femur and middle of the knee joint, and subtends an angle of 3 degrees from the vertical axis^{23, 24}

The Anatomical axis has a mean valgus angle of 6 degrees from vertical axis^{23, 24}

The knee joint line is parallel to the ground^{23, 24}

ANATOMIC AND FUNCTIONAL CONSEQUENCES OF THE INJURY

Supracondylar fractures characteristically deform with femoral shortening and posterior angulation and displacement of the distal fragment^{3, 26}.

Intercondylar involvement leads to rotational mal-alignment of the condyles relative to each other in the frontal plane.

Axial alignment can often be regained by traction, but is hard to maintain^{3, 26}.

Intercondylar involvement with mal-rotation makes reduction almost impossible by traction alone, and is often difficult even with surgery.

The aims of treatment are to restore length, rotation and axial alignment and anatomical reconstitution of articular surface to avoid long-term morbidity^{3, 10, 22, 26, 30}.

Axial alignment and restoration of articular surface require anatomic reduction by an operative procedure^{3, 26, 29, 30}.

CLASSIFICATION

Muller and colleagues, in an updated AO classification system for distal femoral fractures, separated these fractures into 3 main groups³.

Type A (extra-articular)

Type B (unicondylar)

Type C (bicondylar)

The 3 are each further separated into 3 subgroups.

Type A (extra-articular) are classified as simple two-part supracondylar fractures (type A₁),

Metaphyseal wedge fractures (type A₂) and comminuted supracondylar fractures (type A₃)

Type B (unicondylar) are classified as lateral condyle sagittal fractures (type B₁), medial condyle sagittal fractures (type B₂) and coronal fractures (type B₃, Hoffa fractures)

Type C (bicondylar) are classified as non-comminuted supracondylar (T or Y) (type C₁), fractures with supracondylar comminution (type C₂), comminuted supracondylar and intercondylar regions (type C₃)

In progressing from A to C, fracture severity increases, whereas prognosis for a good result decreases. This relationship is also true for the progression from 1 to 3 within each group.²

MANAGEMENT

DIAGNOSIS

History and physical examination:

Careful evaluation of the whole patient and involved lower extremity is mandatory, especially in a poly-traumatized patient.

Assess the hip joint above and knee and leg below the fracture. Check distal pulses — if not normal or deteriorate, prompt investigation is mandatory.

Rule out thigh compartment syndrome if tense swelling is noted — by examination and compartment pressure monitoring.

Identify grossly open and contaminated wounds.

Examination reveals swelling of the knee and supracondylar area, obvious deformity and marked tenderness.

Manipulation of the extremity demonstrates motion and crepitation at the fracture site; however, this is cruel and unnecessary if immediate radiographs are available.

Radiographic evaluation:

Routine AP and Lateral radiographs of the knee and supracondylar region are standard. If there is doubt about intra-articular involvement, CT scan is indicated and is more sensitive in coronal plane fractures, and also for identifying osteochondral lesions or impression fractures. MRI is helpful if chondral or ligamentous lesions are suspected.

An adequate AP view of the pelvis and AP and lateral views of the hip and the whole femur are indicated to identify ipsilateral additional injuries.

TREATMENT OPTIONS

Current Options for treatment of supracondylar and intercondylar femoral fractures include non-operative and operative treatment.^{2, 3, 26, 30}

Non-operative treatment is indicated in non- or minimally displaced fractures in low demand elderly patients. Modalities include:

- Skeletal traction or
- Initial splinting and mobilization with limited weight bearing, and eventual transition to a cast or functional brace³⁰.

Operative treatment is indicated in^{2, 3, 30, 44}

- Displaced fractures
- Open fractures
- Fractures associated with vascular injury.
- Fractures in a multiply injured patient
- Ipsilateral lower extremity fractures
- Pathological fractures
- Irreducible fractures.
- Elderly and morbidly obese.

Relative contra-indications to operative treatment include:²

- Infected fractures
- Fractures in haemodynamically unstable polytrauma patient
- Very osteopaenic bones
- Co-morbidities (medical)

The Treatment options for operative fixation include:^{2, 3, 26:}

- Fixed angle devices (blade plate, dynamic condylar screw)
- Anatomical plate and screw constructs
- Intramedullary nails
- External fixation.
- Locked plates
- Total knee arthroplasty

The selection is determined by the fracture pattern, bone quality, condition of the patient, the skill and experience of the surgeon^{2, 3}. David SM *et al.*, did not demonstrate in a cadaveric study a significant biomechanical difference between locked intramedullary nail and a 95-degree angled blade plate in absorbing torsional and axial stress^{41, 48}.

Angled blade allows excellent rotational, frontal plane and sagittal plane control of the distal fragment. The 95-degree blade plate was demonstrated in the laboratory cadaveric study to provide more rigidity and compression compared to antegrade or retrograde intramedullary

nails⁵⁰. When placed parallel to the joint surface, it can aid in re-establishing the normal alignment of the distal femur.

It can be used in fractures 2cm from the joint line²

However, its insertion is technically demanding.

DCS insertion is less technically demanding than for angle plate^{32, 33}.

However, a minimum of 4cm of intact bone is required in the distal fragment.^{2, 3}

DCS is not suitable in:

- Low trans-condylar fracture
- Coronal fracture
- Extensive intra-articular comminution.

Fixed angle devices prevent against varus collapse.

Each can be used in most type A and C fractures.

However, both may be difficult in fractures with small distal articular segment (2 -3 cm,) ^{2, 31} especially with distal lateral extension of the fracture line.

DCS is associated with sagittal plane rotation instability in this circumstance where additional distal screw fixation is not possible.

In multiplane intra-articular fractures, due to the fixed angle, the implants may interfere with or disrupt fixation of the articular segment¹⁰.

DCS also require more bone removal for its insertion¹⁰.

Anatomical, laterally based plate and screw constructs:

These are suitable for C2 -C3 fractures especially those with coronal plane components².

However, they have the following disadvantages:

- Lack a fixed angle screw fixation, instability (unreconstructed comminution) of the medial cortex will allow the screws to shift in the plate, which increase the possibility of varus collapse prior to union².
- Inadequate fixation in segmental bone loss and in very short distal condylar segment².
- In these instances, stability can be achieved with combined use of medial and lateral plates²
- condylar buttress plate is suitable for minimally displaced fractures and fractures with articular extension in the sagittal and coronal planes²

Newer plates by AO (locked plates) allow for multiple distal fixed angled screw positions and are adaptable to sub muscular plating techniques (**MIPPO, TARPO, and LISS**)^{34, 36, 37, 38}. They act as internal fixators providing angular stability to the construct⁴⁹. These techniques preserve the blood supply to bone by avoiding the traditional extensive soft tissues dissection^{42, 43} and improve fixation in osteoporotic bone⁵⁸.

Intramedullary nails: Nailing technique can be antegrade or retrograde nailing.

Antegrade nailing requires at least 5-7cm of distal bone for fixation, and therefore limited to type A fractures^{2, 14, 26}. It is particularly useful in supracondylar fractures with diaphyseal

extension². However, both Antegrade and retrograde nailing has been used successfully in management of C1-C2 fractures.

Contraindications to Antegrade nailing include: pre-existing proximal prosthesis/ hardware, femoral deformity, obliteration of intramedullary canal and insufficient distal bone stock.

Retrograde nailing is performed more frequently than antegrade in distal femoral fractures.

Retrograde intramedullary nailing: Indirect fracture reduction and minimally invasive nailing techniques have evolved for retrograde nailing. It has been used successfully in elderly osteopaenic patients and in polytrauma patients with comminution, and revision of failed internal fixation^{35, 40, 51}.

Other uses: fractures proximal to total knee arthroplasty, fractures distal to proximal femoral implants^{2, 46, 47}. Locking allows control of even comminuted fractures and avoids shortening and rotation at fracture site.³¹

Implant breakage is a concern for very distal fractures.

Disadvantages: use of intra-articular insertion can lead to knee sepsis, stiffness, and patellofemoral pain². Use in multiplane fractures interferes with articular fixation and distal fixation options may be limited.

External fixation is invaluable as a temporary measure in open fractures with associated bone loss; fractures associated with popliteal artery injury, associated significant soft tissue injury, extensive comminution, unstable polytrauma patient, and distal fragment less than 2cm²

The Benefits of external fixation are:

- Reduced surgical time and blood loss.
- Less disruption of blood supply to fracture fragments.

Complications: pin tract and joint space infection, joint contractures, arthrofibrosis and malunion².

Total knee replacement: In patients with arthritic knee, distal femoral replacement arthroplasty is indicated.

FUNCTIONAL OUTCOME

The main functional outcome parameters of the distal femoral injuries, both in the Schatzker and Lambert score and modified hospital for special surgery knee score are pain, function, range of motion, muscle strength and deformity. Pain is categorized as none, mild, moderate and severe. Severe pain is associated with negative impact on the patient's activities of daily living and therefore poor quality of life. Mild to moderate pain may also bear negatively to the patient's quality of life both physically and psychosocially; one has to remember to take analgesics. Function is assessed as patient's ability to walk, with or without support; and ability to climb stairs. Knee range of motion, muscle strength and residual deformity also impact on patient's quality of life.

Functional outcome determinants: Age, sex and fracture pattern are the main patient dependent factors affecting outcome. Fractures in elderly porotic females are more difficult to fix during open reduction and internal fixation (ORIF), yet the elderly are on the other hand prone to

develop complications associated with prolonged immobilization with conservative management^{6, 29}.

Comminuted, compound fractures are associated with more adverse outcome than simple, non comminuted fractures^{13, 26, 54}.

The presence of perioperative disease states such as arterial hypertension, previous myocardial infarction, smoking and severe bronchopulmonary disease also play a role in operative functional outcome⁵⁵.

Numerous studies indicate that operative treatment yields better functional outcome results than non operative methods^{25, 29, 30, 31, 32, 33, 45}. Butt MS et al (1996)⁶ carried out a prospective RCT of operative versus non-operative treatment of 42 displaced fractures of distal femur in the elderly; with mean ages of 77.6 years and 80.5 years for operative and non-operative group respectively. By criteria of Schatzker et al (1974), they reported excellent or good results in 53% of the operative group and in 31% of the non-operative group. Complication rates were three times more common in the non- operative group. The mean hospital stay for patients in operative group and non-operative group was 39 days (20 to 79 days) and 62 days (40 to 120 days) respectively.

Earlier results had favoured non operative treatment: Stewart MJ et al reviewed a total of 442 fractures. They found the highest incidence between the ages 6-65 years. The leading causes were motor vehicle accidents, falls and miscellaneous accidents¹⁶.

Two hundred and thirteen (213) fractures were followed for 1 year or longer.

One hundred and fourteen (144) were treated by closed means: 67% of these had excellent or good results; 33% had fair or poor results.

Sixty-nine (69) fractures were treated by ORIF +/- bone graft: 54% of these had excellent/ good results; 46% had fair or poor results. They found ten (10) delayed union, 10 nonunion and 4 infections.

Poor results of ORIF resulted from infection, poor surgical technique, and homeopathic fixation, mechanically impossible to stabilize multiple fragments, adhesions about the knee and quadriceps mechanism.

They concluded that simple non operative methods produce good results in the majority of these fractures. 'Therefore it is our belief that conservatism should be taught and practiced more universally. Treat the patient, not the x-ray.'

They recommended 2 pin traction as the treatment of choice, and early active exercises of thigh muscles in traction to prevent adhesions and fibrosis¹⁶.

Neer et al followed up 77 fractures through lower 3 inches of femur for between 1-24 years. Twenty-nine (29) patients underwent ORIF: only 52% obtained satisfactory rating. Forty-eight (48) patients underwent closed treatment: 90% had satisfactory results; and 84% of those with displaced fractures.

No category of fractures at this level seemed well suited for internal fixation, and sufficient fixation to eliminate the need for external support or to shorten convalescence was rarely attained. The majority of serious local complications occurred after this form of treatment.

They again concluded in their series that early operative treatment should be limited to the debridement of open fractures and that internal fixation should be attempted only in the rare case of arterial injury or some other unusual problem in the management of associated injuries. It was thought that replacement of irreducible segments of closed fractures could better be performed in traction after the initial reaction to injury had subsided¹⁵.

On the other hand, good results have been reported after internal fixation by several authors: Schatzker et al (1974); Giles et al (1982)⁴⁴; Mize, Bucholz and Grogan (1982)³⁰; Healy and Brooker (1983)⁴⁵.

The mean ages in those four series were: 54.2, 55, 47 and 54 years respectively. Giles et al (1982) and Mize et al (1982) both reported the results of using AO blade plates, but did not have a conservatively treated group for comparison.

The other two series compared operative with non operative treatment, but were both retrospective and therefore nonrandomized.

Nevertheless, both reported a better outcome with internal fixation^{30, 44, 45}.

Butler MS et al reviewed data on 684 fractures of the femur that had been treated with Intramedullary nailing and identified 23 patients with fracture shaft femur with accompanying ipsilateral supracondylar fracture (12 patients, group 1) or a concomitant ipsilateral intercondylar fracture (11 patients, group 2).

Group 1 fractures were treated with interlocking nail without supplemental fixation. Group 2, 10 fractures were stabilized with interlocking nail and supplemental screw fixation and 1 with interlocking nail and a supplemental plate and screws.

Group 1: all united at a mean of 16 weeks (range 12-20). There was angulation of < 5 degrees in 10 patients. 1 patient had 25 degrees posterior angulation, and 1 had 10 degrees valgus angulation. No delayed union, non-union or infections were noted. No patient had fixation failure. At 28 months (range 9-59): 11 patients had no or only slight restriction in activity. 1 patient had severe restrictions and needed a wheelchair due to concomitant metabolic and cardiac disease. Ten patients had mild or no pain in the knee. One patient used a cane to assist in walking. The mean range of motion was 0-120 degrees flexion. No posttraumatic arthritis or clinical instability was noted¹³.

Wenzel et al reported on 112 fractures treated following AO principles, 73.5% had good or excellent results.

Schatzker and co-workers reported on 71 distal femoral fractures, 32 of which were treated by ORIF. They achieved good or excellent results in 75% of fractures treated with AO method as compared with only 32% in the conservatively treated group.

They concluded: 'if normal function or near normal function is to be achieved... then unquestionably, if correctly employed, ORIF ensures a very high rate of success.

Schatzker and Lambert (1979) reviewed 35 patients with supracondylar distal femoral fractures treated by ORIF; only 49% had good or excellent results. Among the 17 cases treated with AO method, 71% had good to excellent results⁶⁰.

Among the 18 cases treated by AO implants but not AO technique, only 21% had a good to excellent outcome

Critical review of these 18 patients revealed that most were elderly with severely comminuted fractures; however, surgical technical error was the common denominator contributing to the poor results. The most common errors included (1) incomplete reduction, (2) failure to achieve interfragmentary compression with lag screws, (3) failure to use autogenous cancellous bone graft to fill defects or comminution, (4) ineffective use of acrylic cement to supplement screw fixation in osteoporotic bone, and (5) use of blade plates that were either too long or too far from the joint⁶⁰.

Slatis et al, (1971) reported on 21 'severe' fractures of the lower end of the femur treated by open reduction according to AO method. 16 were available for follow up longer than a year; 83% had good to excellent result.

They recommended the technique as 'reliable' but 'should be restricted to fractures of considerable severity and to selected cases among patients with multiple injuries'⁵⁹.

Olerud found 92% good to excellent results in 15 patients with complex articular distal femur fractures treated using angled blade plate^{61, 62}.

Chiron et al (1974) reviewed 137 patients with distal femoral fractures treated with 95 degree condylar blade plate. 72% had good to excellent results⁶³.

Mize et al (1982) reported on 30 supracondylar and intracondylar fractures reduced and stabilized by the AO technique. 80% had good to excellent results³⁰.

Healy and Brooker (1983) reviewed 98 distal femoral fractures to compare open and closed treatment methods; 38 of the 47 fractures treated by open methods and 18 of 51 treated by closed methods had good functional results. Of significance in this review was that age, with an increasing degree of osteoporosis, did not adversely affect the operative results. They concluded that distal femur fractures, except in more simple cases, are best managed by open methods⁴⁵.

A. A. Syed et al (2004) in a prospective study evaluated the results of the LISS locking plate fixation for stabilization of distal femoral fractures. They reviewed 25 patients using the modified hospital for special surgery (HSS) knee score and Schatzker and Lambert score. The mean age was 60.9 years with mean follow up of 18 months. Eleven patients were tertiary referrals from other hospitals (seven due to failure of primary fixation). Average time to union in 22 cases was 3.5 months (2-5 months). All of the acute cases united without the need for bone grafting. There were 3 out of 7 cases of non-union in the salvage group still undergoing treatment. The overall result in the acute cases was good and in the salvage cases fair. The HSS scores for the acute cases were 5 excellent, 8 good, 3 fair and 2 poor results. The Schatzker and Lambert scores in the same group were 4 excellent, 9 good, 3 fair and 2 poor results. The average HSS score for group A was 76.9 points. Average Schatzker and Lambert score was good.

In the salvage group (B), there were 1 excellent, 2 good, 1 fair and 3 poor results⁶⁴.

A. Brian Thomson et al, in a retrospective comparative review of 23 DFF in 22 patients treated by traditional ORIF vs. RIMN reported: rate of subsequent bone grafting procedures (67% vs. 9%); mal-union (42% vs. 0%); increased infection (25% vs. 0%); non-union (33% vs. 9%). The physical function component of the SF-36 was approximately 2 standard deviations below the U.S population mean, and 50% of the patients demonstrated radiographic changes of post-traumatic arthritis. No patient had a subsequent TKR⁶⁵.

Zlowodzki M. et al, in a systematic review of two comparative studies and 45 case series (1989-2005) concluded that operative treatment results in a 32% reduction in the risk of poor results compared to nonoperative treatment⁹. They observed no differences between implants in non-union, infections, fixation failures and revision surgeries⁹. Sub muscular locked fixators may reduce infection rates but at an increased risk of fixation failure and revision surgery compared to techniques that require compression of the implant to the femoral shaft (blade plate, DCS, nonlocking CBP). Surgeons with increased experience may significantly reduce the risk of revision surgery⁹.

KS Leung et al used interlocking Intramedullary nailing of distal femur fractures. 30 type A fractures and 7 type C1 & C2 fractures were involved. Nailing was done percutaneous. The functional results assessed by the modified knee rating system of the hospital for special surgery were: 13 knees (35%) had an excellent result; 22 knees (59%), a good result and 2 (5%) a fair result. They concluded: closed interlocking intramedullary nailing is an excellent technique for both supracondylar and simple intercondylar fractures in which closed reduction and percutaneous fixation of the articular fracture is possible¹⁴.

Kregor PJ et al reviewed the early results of distal femoral fracture fixation using the LISS (April 1997 to March 1999.) 66 patients (33F, 33M) were reviewed with the mean follow-up of 9 months (5-24). The Mean Age was 49 years (17-90). (46 patients were <60 years and 20 were >60 years).

Following postoperative reductions, there were deformities of hyperextension of 10° in one case, external rotation deformity of 10° in one case and valgus deformity of $>5^{\circ}$ in one case. All the fractures healed, with the mean time to full weight-bearing of 11 weeks.

The mean range of motion was 2° (0-30) of extension, to 103° (20-140) of flexion.

No loss of fixation in distal femoral condyles was observed.

They obtained high union rates without autogenous bone grafting (95%), low infection rates (3%) and maintenance of distal femoral fixation¹⁰.

Research question:

What are the early functional outcomes of distal femoral fractures treated operatively at the KNH and PCEA Kikuyu mission Hospital?

STUDY RATIONALE AND JUSTIFICATION

A number of treatment modalities have evolved over time, for the treatment of distal femoral fractures. They each vary in cost and functional outcome.

In the west the majority of the fractures occur in the elderly, mobilization as soon as possible and subsequent ambulation and discharge from hospital with least delay is the primary goal of treatment.

In Kenya, majority of distal femoral fractures occur in the young economically active individuals. How well these patients are able to regain their pre-injury level of function and independence is a measure of the success or failure of the treatment regime.

Both patient and non-patient factors have been shown to impact on functional outcome; and vary from set-up to set-up.

There is no data that critically look at functional outcome for distal femoral fractures in Kenya.

This would be invaluable, both for the caregiver and the patient in formulating the optimal treatment option that achieves the primary goal of care for each patient category.

STUDY OBJECTIVES

BROAD OBJECTIVE

To determine the early functional outcome of operative treatment of distal femoral fractures at KNH and PCEA Kikuyu mission Hospital.

SPECIFIC OBJECTIVES

1. To establish demographic patterns and injury characteristics for patients with distal femoral fractures at KNH and KMH
2. To establish operative treatment patterns of distal femoral fractures at KNH and KMH
3. To establish early functional outcome of distal femoral fractures managed operatively at KNH and KMH
4. To establish how the following factors affect the early functional outcomes of operative treatment of distal femoral fractures at KNH and KMH
 - Age and sex
 - Mechanism of injury
 - Early complications.

PATIENTS AND METHODS

STUDY DESIGN

This is a prospective cohort study, conducted at the orthopaedics trauma wards and fracture clinics at Kenyatta national hospital and Kikuyu mission hospital after approval by KNH ethics and research committee, and the P.C.E.A. Kikuyu mission hospital management committee.

STUDY POPULATION

All patients diagnosed to have distal femoral fractures and treated operatively at KNH and KMH.

ETHICAL CONSIDERATIONS

1. Approval was sought from the KNH Ethics and Research committee and KMH management.
2. Patients or their parents/ guardians gave written informed consent before inclusion in the study.
3. The information collected from patients was handled with utmost confidentiality and only used for the purposes of this study.

ELIGIBILITY CRITERIA

INCLUSION CRITERIA:

- All patients 18 years of age and above
- Fracture of the metaphyseal distal femur with or without intra-articular extension
- Treated operatively at KNH and KMH.
- Closed or open fractures (Tscherne grade 0-3, Gustilo type 1 -3b)

- Unilateral or bilateral femur fractures
- Informed consent obtained.

EXCLUSION CRITERIA

Patients who declined to sign consent

Pathological fractures.

- Multiple fractures

SAMPLE SIZE CALCULATION

The information at the department of orthopaedic surgery at KNH indicate that there were 96 distal femoral fractures out of 630 total fractures in the year 2008 and 84 distal femoral fractures out of 484 in the year 2009. This information gives the proportion of distal femoral fractures as 15% and 18% in the two years respectively. Similar prevalence of distal femoral fractures is observed at PCEA Kikuyu Mission Hospital. The recruitment of patients with distal femoral fractures will be carried out in the two centres. Therefore, an estimate of 16% is used for sample size determination. The formula given below for calculating sample size for proportion is used:

$$no \geq \frac{z^2 xp(1-p)}{m^2}$$

Where m is the desired precision or margin of error, p is the expected proportion and z is the quintile value from the normal table corresponding to 95% confidence interval. This formula gives the sample for generally large population but since the population of bone fractures is finite, the sample size formula is adjusted to include finite population correction (fpc). The effective sample size is then given by the formula below;

$$n = \frac{n_o \times N}{n_o + (N - 1)}$$

Using the proportion of 16%, margin of error 5% and expected number of distal femoral fractures of about 100 in each centre in a year, it results into a sample size of about 23 from each centre. Therefore, the study included 46 patients with distal femoral fractures accrued for a period of three months from both centres.

PRIMARY OUTCOME MEASURES

- Modified HSS (Hospital for Special Surgery) knee score

SECONDARY OUTCOME MEASURES

- Reoperation (secondary procedures)
- Superficial infection rates (wound only)
- Deep infection (bone implant interface)
- Knee range of motion.

PARTICIPANTS RECRUITMENT

Patients with distal femoral fracture who were treated operatively were recruited post-operatively in the ward. Their records and x-rays were reviewed to ascertain the fracture characteristics and assess eligibility of the fracture for inclusion in the study.

Recruitment was continued until the desired sample size of 46 was achieved.

Patients signed informed consent forms at recruitment and their demographic data obtained at the same time.

DATA COLLECTION

Recruited Patients' Medical records were reviewed by the investigator to ascertain pertinent information regarding the injury and associated injuries, fracture classification, soft tissue status, initial treatment and any secondary procedures performed, local and systemic complications.

All the patients underwent a rehabilitation programme set as follows:

Passive and active knee range of motion exercises within 1st week of operation.

Quadriceps strengthening exercises, SLR.

Static cycling.

This regime was followed twice weekly for six weeks then once weekly for the next 6 weeks.

Patients were allowed touch-down weight-bearing with crutches or walker as tolerated 8 weeks after surgery, then gradual full weight bearing as tolerated (FWBAT)

A physical examination was performed by the investigator to determine femoro-tibial alignment, knee range of motion, neurovascular status and knee ligament stability 12 weeks after surgery.

Bilateral AP radiographs of the knees and a single lateral radiograph of the involved knee were evaluated for residual alignment, time to union and mal-union at 8 and 12 weeks after surgery.

Femoro-tibial alignment was determined clinically by examination of the knee and by evaluation from AP and lateral knee radiographs of the anatomical axes of the femur and tibia, and measurement of the angle of intersection at the knee to determine the varus or valgus angle^{66, 67,}

68, 69

Knee range of motion was determined by visual inspection during knee assessment and confirmed with goniometric passive range of motion measurement. One metallic goniometer with a 12.7cm movable arm and a scale marked in 1-degree increments was used to take measurements^{70, 71, 72}.

Data on neurovascular status was obtained from the patient's records to determine the status immediately after injury; and at twelve weeks during evaluation of function. Clinical assessment was used thus: assessment of strength and quality of dorsalis pedis pulse.⁷³

Knee ligament stability was determined clinically by carrying out the following tests:

- Medial/ lateral instability in extension
- Medial/ lateral instability in 30-degrees; for medial and lateral collateral ligament stability.
- Lachman test
- Anterior drawer in 90-degree flexion
- Pivot shift in extension; for Anterior cruciate ligament stability.

- Posterior drawer
- Posterior tibial sag in 90-degrees; for posterior cruciate ligament instability.

A clinical officer in orthopaedics was recruited to assist collect data in a similar manner at P.C.E.A. Kikuyu Mission hospital.

Malunion:

- five degrees variation from the contra lateral limb in varus/valgus or Extension/flexion.
- Ten degrees mal-rotation and >1cm shortening.

Modified HSS knee scores were determined for each patient at twelve weeks after surgery. HSS knee score is a surgeon assessed weighted score developed through consensus by knee society in 1989. It has been validated and is responsive and reproducible⁷⁴.

To calculate the score, the answers to the questions on pain and function; and findings on clinical examination of the knee (range of motion, muscle strength, flexion contracture and ligament stability) are given a value based on the results. The results are totalled to obtain the score; a maximum of which is 100 points. There are subtractions made to the score to get the final score.

See table 9.

DATA ANALYSIS

Data collected by questionnaires was coded and analyzed by a statistician using STRATA to derive descriptive statistics and frequency distributions.

For continuous predictor variables t test was used; and expressed as means and standard deviations⁵⁶. For categorical predictor variables Pearson's chi-square test was used; and expressed as proportions, and Conditional (ordered) logistic regression for multivariable analysis.

The results are presented as tables, bar charts and pie charts.

STUDY LIMITATIONS

1. The study duration is not long enough to allow proper assessment of long term functional outcome; but long term follow up will be instituted through the routine follow up clinics.
2. Limited theatre space may delay operative intervention; this will impact on patient's perception of outcome.
3. Different surgical teams, and plaster technicians may affect outcome.
4. Some patients were not able to cope with the rehabilitation programme due to lack of time.

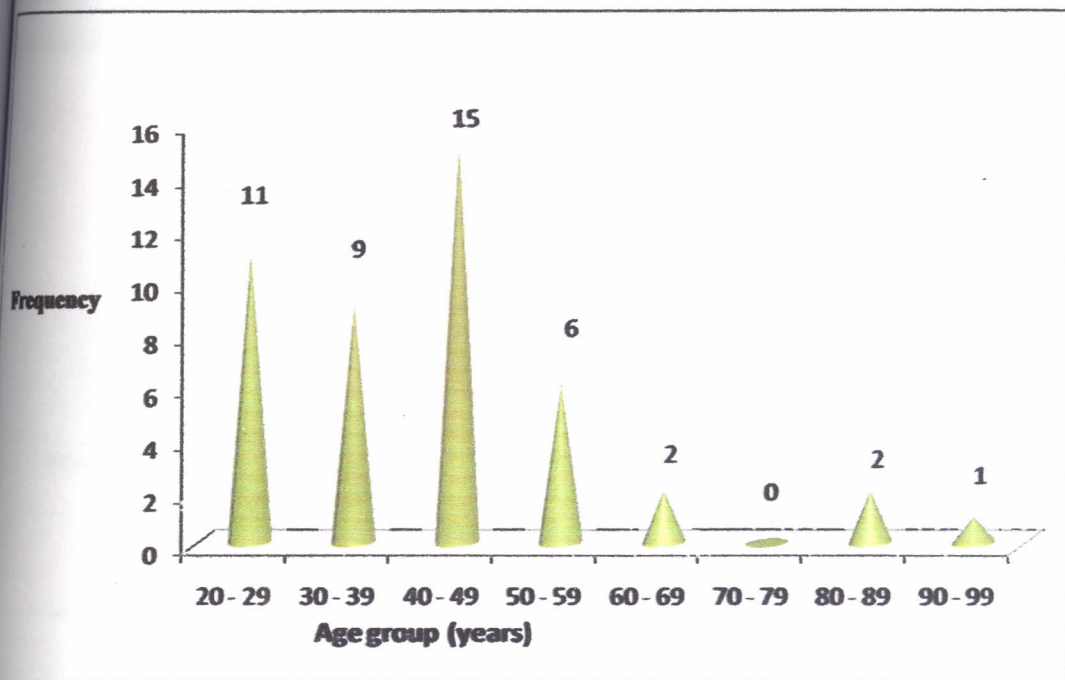
RESULTS

A total of 46 study participants were recruited and all were included in the analysis.

The majority of the participants were in the 25-45 years age group with the mean of 42.9 years

(range: 22 – 96) (Figure 1).

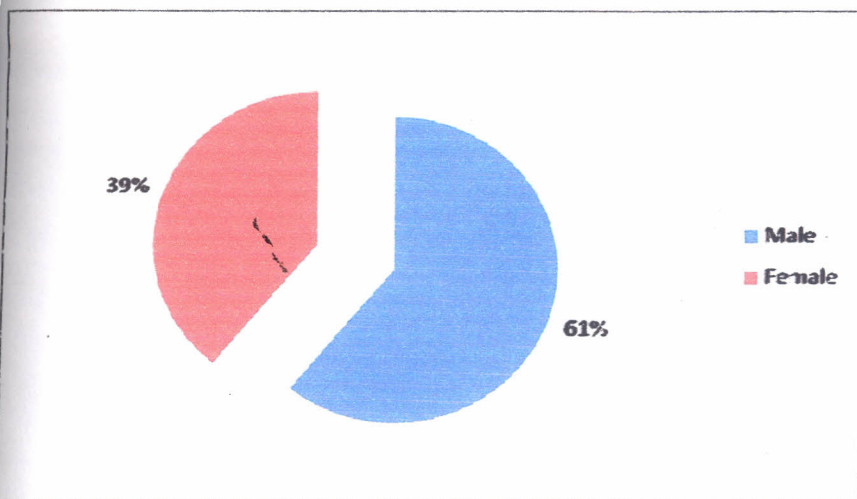
Figure 1: The frequency of various age-groups in the study population



There were a total of 18 (39%) females and 28 (61%) males giving a female: male ratio of 1:1.6. (Figure

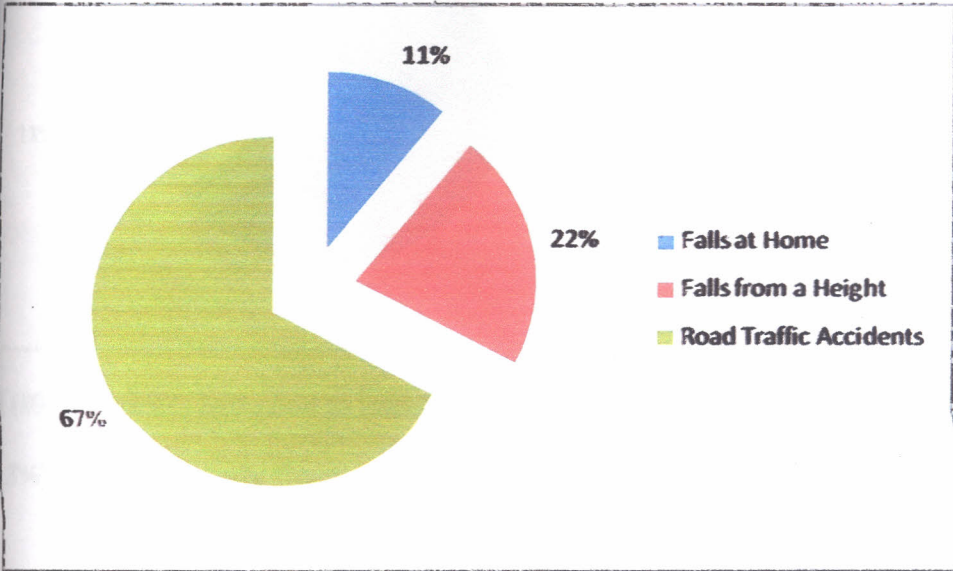
2)

Figure 2: Pie chart depicting gender involvement



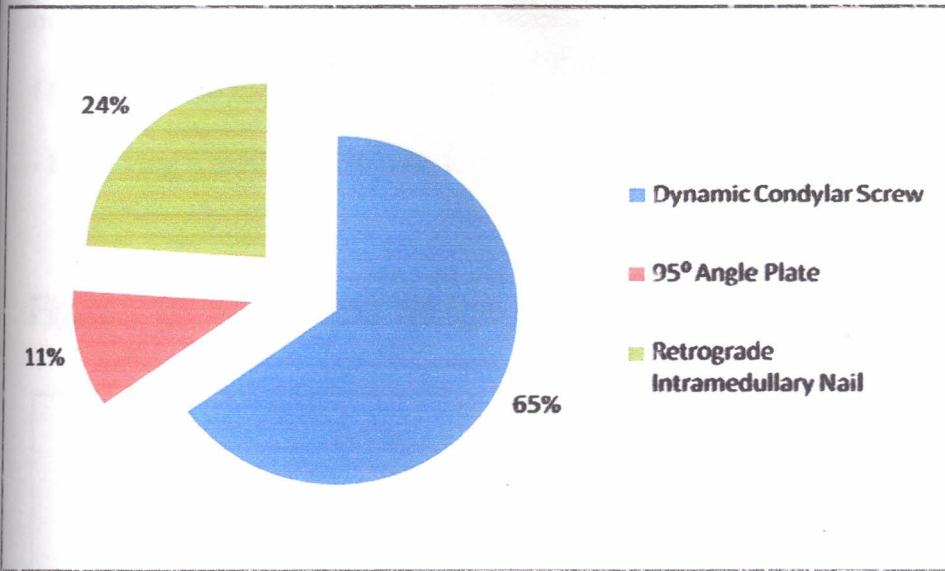
Road traffic accidents were the leading cause at 31 (67.3%) patients followed by falls from a height at 10 (21.7%). Mild trauma from falls at home contributed 5 (10.9%). (Figure 3)

Figure 3: The mechanisms of injury in the study population



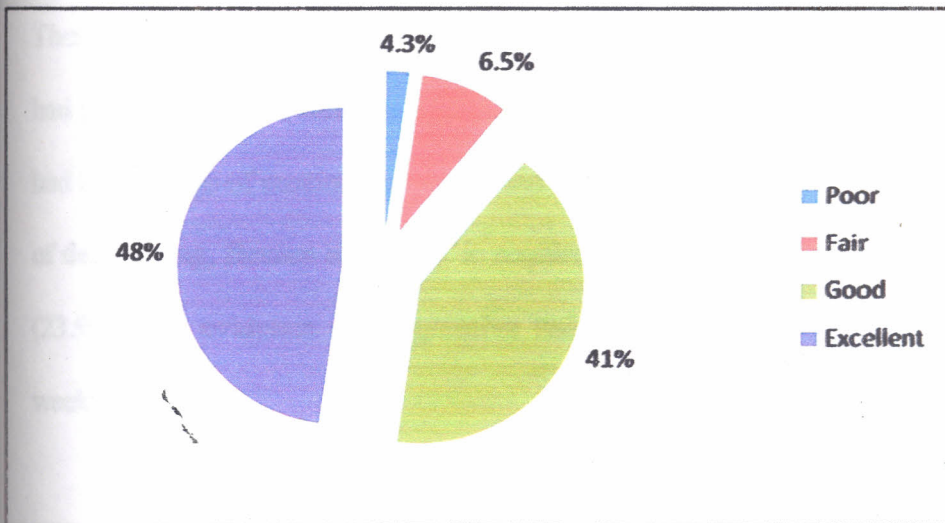
30 (65%) patients were treated using DCS, 11 (24%) were treated using retrograde intramedullary nailing and 5 (11%) were treated using a 95°-angle plate. (Figure 4)

Figure 4: The treatment options used



41 (89%) patients had good to excellent early functional outcome, 3 (6.5%) had fair, and 2 (4.3%) had a poor early functional outcome (Figure 5).

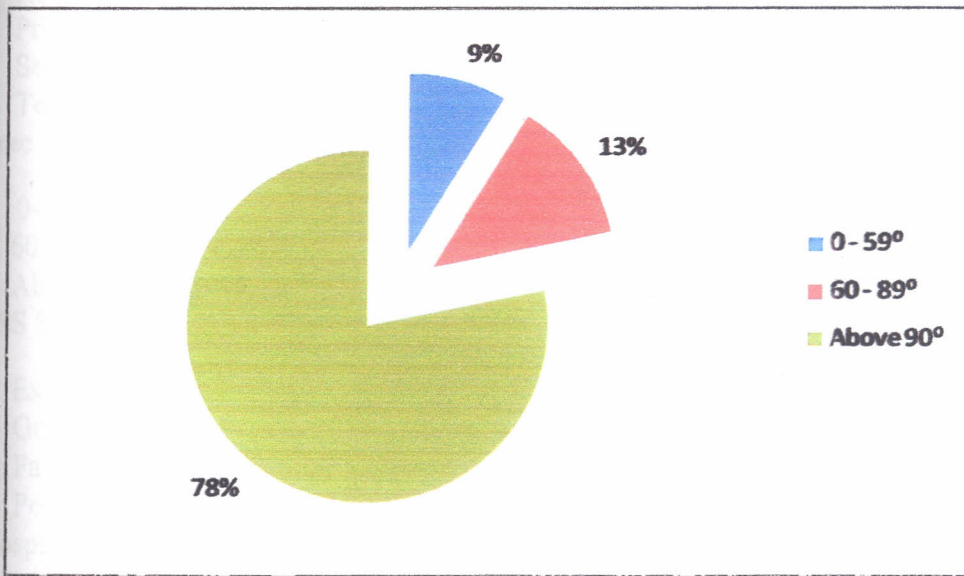
Figure 5: A pie-chart showing the proportion of the study population with various early functional outcomes (HSS scores) at 3 months post treatment.



1 patient suffered periprosthetic fracture and had poor function at 3 months while the other was an elderly woman who remained on wheelchair.

4 (9%) patients had knee stiffness (below 59° flexion), while 6 (13%) patients had flexion of 60° - 89° giving a total of 22% with knee stiffness. (Figure 6)

Figure 6: The knee range of motion 12 weeks after surgery



There was 1 (2%) superficial wound infection and 2 (4.35%) patients were reoperated, 1 patient had poor reduction (varus angulation of 12°) and was re-operated with DCS after 5 days. 82.4% had knee range of motion above 90° and 8.8% had below 60°. For good function during activities of daily living, flexion above 90° is required^{76,77}. 32 (69.6%) patients had radiological union, 11 (23.9%) had evidence of progressive union while 3 (6.5%) had no evidence of callus at 12 weeks.

The mean duration of injury to surgery was 11.47days and mean hospital stay was 10.65 days.

Table 1: Baseline Socio-Demographic Characteristics (categorical variables)

Characteristic	Total (%)
Sex	
Female	18 (39)
Male	28 (61)
Level of Education	
None	3 (6)
Primary	6 (13)
Secondary	18 (39)
Tertiary	19 (41)
Knee Range of Motion	
0-59 degrees	4 (9)
60-89 degrees	6 (13)
Above 90 degrees	36 (78)
HSS SCORE	
Excellent	22 (48)
Good	19 (41)
Fair	3 (6.5)
Poor	2 (4.3)
Hospital stay	
1 – 10 days	25 (54)
11 – 20 days	18 (39)
21 – 30 days	2 (4)
31 – 40 days	1 (2)
Employment status	
Unemployed	6 (13)
Self employed	9 (19.56)
Formal employment	28 (60.9)
Retired	3 (6.5)
Mechanism of injury	
Fall at home	5 (10.87)
Fall from a height	10 (21.7)
Road traffic accident	31 (67.3)
Co-morbidity	
None	40 (87)
Hypertension	2 (4)

Diabetes	3 (6.5)
Both Hypertension and Diabetes	1 (2)
Treatment method	
Dynamic Condylar Screw (DCS)	30 (65)
Retrograde Nailing	11 (24)
Angle Plate	5 (10.9)
Anaesthesia	
Spinal	37 (80)
General Anaesthesia (GA)	9 (20)
Transfusion	
Not transfused	42 (91)
Transfused	4 (9)
Antibiotic prophylaxis	
Ceftriaxone	36 (78)
Flucloxacillin	10 (22)
Anticoagulation	
None	11 (24)
Clexane	35 (76)
Re-operation	
No	44 (96)
Yes	2 (4)
Early complications	
None	44 (96)
Poor reduction	1 (2)
Superficial wound infection	1 (2)

Table 2: Baseline Socio-Demographic Characteristics (continuous variables)

Characteristic	Mean (Range)
Age (years)	41 (22 – 96)
Duration between injury to surgery (days)	11 (1-63)
Length hospital stay (days)	10.54 (3 – 31)
Knee Range of Motion (KROM) (degrees)	93.5 ⁰ (30 ⁰ – 120 ⁰)

Univariate Analysis: Effect of Different Independent Factors on the HSS

Score

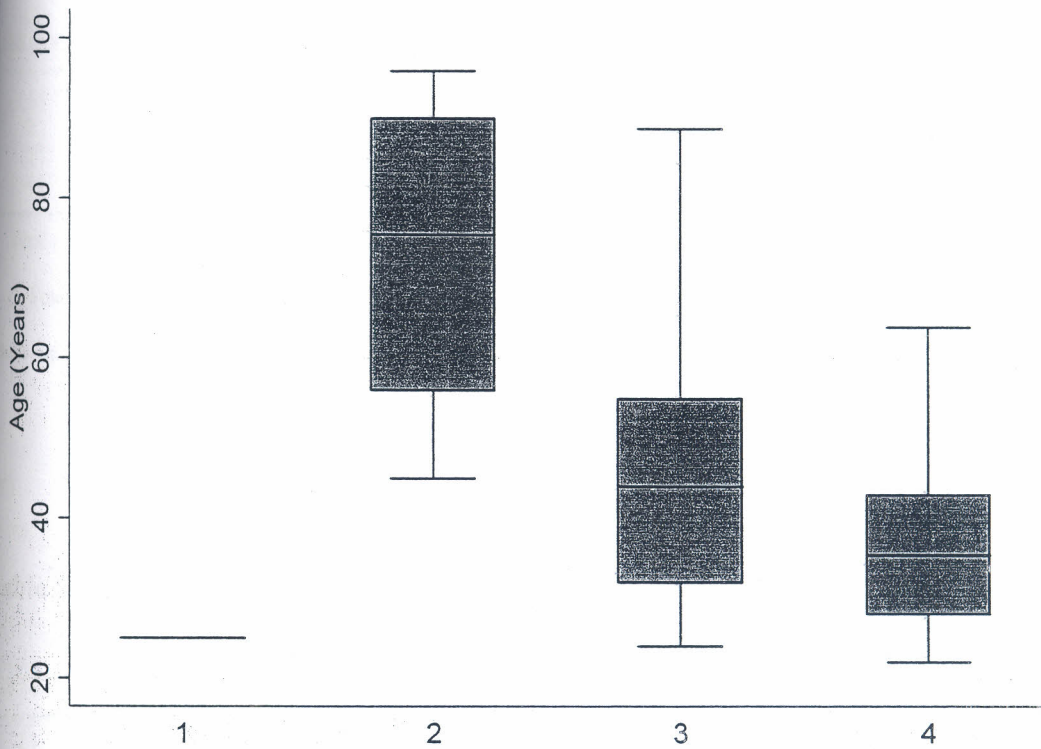
a) Effects of Participants' Age on the HSS Score

Table A: A Linear Regression model showing the effect of age on the HSS score

Source	SS	df	MS	Number of obs = 46
				F(1, 44) = 7.52
Model	3.56650152	1	3.56650152	Prob > F = 0.0088
Residual	20.8682811	44	.474279116	R-squared = 0.1460
				Adj R-squared = 0.1266
Total	24.4347826	45	.542995169	Root MSE = .68868

hssscore	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]
age	-.016799	.006126	-2.74	0.009	-.0291452 - .0044528
_cons	4.069453	.2820637	14.43	0.000	3.500991 4.637915

Figure 7: Box Plots of Age Distribution by HSS Score



Age was found to be inversely related to the HSS score by univariate linear regression. Every 10 year increase in age led to a statistically significant reduction of 0.17 in the HSS Score ($p=0.009$).

(b) **Effects of Participants' Sex on the HSS Score**

Table 3: Pearson – chi square analysis of influence of sex on HSS score

HSS SCORE	Sex		Total
	1	2	
1	0	1	1
2	2	2	4
3	7	12	19
4	9	13	22
Total	18	28	46

Pearson $\chi^2(3) = 0.9123$ Pr = 0.822

There was no statistically significant influence of sex on the HSS score. (P = 0.822)

(c) **Effects of the Knee Range of Motion on the HSS Score**

Table 5: Pearson –chi square analysis of influence of knee range of motion on HSS score

HSS SCORE	RECODE of krom (KROM)			Total
	1	2	3	
1	0	1	0	1
2	2	1	1	4
3	2	3	14	19
4	0	1	21	22
Total	4	6	36	46

Pearson $\chi^2(6) = 20.5988$ Pr = 0.002

There was a statistically significant influence of knee range of motion on the HSS score. (P < 0.05)

d) Effects of the Type of Implant on the HSS Score

Table 6: Pearson – chi square analysis of influence of type of implant on HSS score

tabulate hssscore Rx, chi2

HSS SCORE	Rx			Total
	1	2	4	
DCS	1	0	0	1
RIMN	4	0	0	4
AP	10	4	5	19
4	15	1	6	22
Total	30	5	11	46

Pearson chi2(6) = 5.9296 Pr = 0.431

the type of treatment (DCS, Retrograde intramedullary nailing or angle plating) did not have a statistically significant influence on HSS score. (P = 0.431)

e) Effects of the Mechanism of Injury on the HSS Score

Table 7: Pearson – chi square analysis of influence of mechanism of injury on HSS score

tabulate hssscore moi, chi2

HSS SCORE	MOI			Total
	1	2	3	
1	0	0	1	1
2	3	0	1	4
3	0	8	11	19
4	2	2	18	22
Total	5	10	31	46

Pearson chi2(6) = 25.8620 Pr = 0.000 (p<0.001)

there was a statistically significant influence of mechanism of injury on the HSS Score (p<0.001).

Multi-variate Analysis: Ordered Logistic Regression Model Assessing the Effect of Different Independent Factors on the HSS Score

Table 8: Multi-variate regression using ordered logistic regression model

Hss score	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
age	-.0832876	.0356828	-2.33	0.020	-.1532245	-.0133507
sex	-.9883608	.9062766	-1.09	0.275	-2.76463	.7879087
daystosx	-.0544986	.0338351	-1.61	0.107	-.1208141	.0118169
hospital_s~y	.0531145	.0700662	0.76	0.448	-.0842127	.1904416
education	.5677714	.5691415	1.00	0.318	-.5477254	1.683268
employment	-.157109	.5892034	-0.27	0.790	-1.311926	.9977084
moi	-.4536896	.7850116	-0.58	0.563	-1.992284	1.084905
comorbidity	1.346993	.7458692	1.81	0.071	-.1148834	2.80887
rx	.1012367	.3305085	0.31	0.759	-.5465481	.7490215

There was a statistically significant influence of AGE on the HSS score ($P < 0.05$) when controlled for Sex, days to surgery, hospital stay, education, employment, mode of injury, co-morbidity and method of treatment.

There is also a tendency towards statistical significance of co-morbidity influence on HSS score. ($P = 0.071$) when controlled for the other 8-independent variables. Though sex, days to surgery, hospital stay, education, employment, mode of injury and method of treatment all seem to have some influence on the HSS score, these was not shown to be statistically significant when controlled for other confounding factors in an regression model.

DISCUSSION

CS Leung *et al.*, in a review of early functional outcome of distal femur fractures using the modified HSS score, after interlocking intramedullary nailing obtained 35% excellent, 59% good and 5% fair outcome¹⁴. Kregor PJ *et al* reviewed distal femur fixation with LISS. All the fractures healed, with the mean time to full weight bearing of 11 weeks. The mean knee range of motion was 2° extension to 103° flexion. They obtained no loss of fixation and union rates without bone graft of 95% and infection rate of 3%. They concluded that closed interlocking intramedullary nailing is an excellent technique for both supracondylar and simple intercondylar fractures in which closed reduction and percutaneous fixation of the articular fracture is possible¹⁴.

In this study, using the modified HSS score, DCS, retrograde locked intramedullary nailing and 95° angle plating, the early functional outcome (figure 5) was 48% excellent, 41% good, 6.5% fair and 4.3% poor. The overall mean modified HSS score was good. There was no statistically significant difference in HSS score between the three implants (table 6: P = 0.431).

These results are comparable with the results of the two studies. They all obtained an overall good early functional outcome.

Use of locked plating, LISS and MIPPO was not recorded in this study because they were not utilised probably due to their high cost and are generally not available in public health facilities.

In spite of this, there was no significant incidence of wound infections (table 1: 2%), and majority of the fractures were forming callus at the time of scoring. There was 1 fracture that had been mal-reduced, the patient was re-operated within the same week to try and achieve near anatomical reduction. His HSS score was good.

a study by Oduor of patterns of distal femur fractures and their treatment at KNH, he obtained a mean hospital stay of 49.1 days for patients treated conservatively, and 67.5 days for patients treated by conservative followed by operative fixation. Patients who underwent operative fixation only had a mean hospital stay of 7 days except 2 patients who stayed longer for financial reasons¹⁹.

In this study, the mean hospital stay was 10.54 days. The rehabilitation programme was instituted within the week of surgery and continued to and after obtaining the HSS scores. Patients who undergo operative fixation spent a much shorter duration in hospital than the conservatively managed ones. They were also able to start rehabilitation programme much earlier. The Oduor study included conservatively treated patients hence the longer hospital stay. But in the same study, patients who had operative-only treatment had a comparable hospital stay to patients in this study.

Overall, it would be correct to conclude thus that operative fixation of these fractures at KNH and P.C.E.A. Kikuyu mission hospitals yields good functional outcome, and recommend use of the same for the patients with fracture patterns that can be reduced openly and fixed.

Martinet et al analyzed AO data on femoral fractures from 1980 to 1989. Distal femoral fractures were 6% of the total (2165 out of 34319). M:F ratio was 1: 1 (1114:1051.)²⁰ They found a bimodal distribution with one maximum affecting young patient, particularly men about 20years,

the other one affecting the elderly, particularly women about 70 years. They concluded that there are two distinct groups as a function of age, the gender and aetiology:

1. Elderly women, older than 50 (osteoporotic) with banal trauma, such as a fall at home.
2. Men between 15 and 50 years with high energy trauma, such as traffic or sport accident.

In this study, the M: F ratio was 1.6:1 (28:18) shows a slight male preponderance. In Mertinet's analysis, the mean age in the younger age-group was about 20 years, whereas in this study the mean age was 41 years. Figure 1 depicts a unimodal distribution with respect to age, skewed to the left. This could be explained by the fact that the Kenyan population is younger than the generally ageing western population. At age 41 years, (the mean age) the number of women affected progressively approach the number of males, but falls short of overtaking the males due to a comparatively shorter life expectancy among the Kenyan population⁷⁵.

In this study, the most frequent aetiology was road traffic accidents (table 1: RTA = 67.3%).

This was followed by falls from a height then falls at home. This again is compared with the Mertinet analysis in which road traffic accidents formed the predominant aetiology among the younger age group.

Butt MS *et al.*, in a study of operative vs. non-operative treatment of distal femur fractures, the mean age for operated group was 77.6 years. Using Schatzker and Lambert score they obtained 63% excellent and good functional outcome.

In this study, age had a statistically significant influence on HSS score (table 8: multi-variate regression using ordered logistic progression mode, $P < 0.05$). Age was found to be inversely related to the HSS score by univariate linear regression (Table 1). The same relationship is depicted in figure 7, the box plot depicting relationship between age and HSS score. Participants who were old scored lower than their young counterparts. The relatively poorer functional outcome in the Butt study could be attributed to the relatively advanced age of the patients involved.

Sex in this study did not show a statistically significant influence on the early functional outcome (table 8, $P = 0.275$ using ordered logistic regression model). Both males and females of the same age had similar early functional outcomes.

The main limitation of this study was that selection of the patients for fixation of the injuries and the implant used depended on the surgeon's comfort with the procedure and implant availability. Patients with 'complex' injuries may have ended up with conservative treatment on traction and were not included for analysis. The results would thus be reflective of functional outcome in patients with relatively simple fractures than the whole spectrum of these injuries. In spite of this fact, the study gives a good analysis of functional outcome for the population which meet the criteria for surgery in these 2 institutions.

CONCLUSIONS

males formed a slight majority over females (ratio 1.6:1). I attribute this to the relatively younger population in Kenya unlike the more aged population in the west. Incidence of fragility fractures therefore correspondingly lower.

1. The predominant age (25 – 45 years) is young people, who are still in the socio-economically productive age group.
2. Road traffic accidents and high energy falls form the leading causes of distal femur fractures. This may be explained by the fact that in pursuit of socioeconomic activities, the people in this age group are exposed to high energy lifestyles and hence, their predominant involvement.
3. Early functional outcome was not affected by the type of implant used.
4. The complication rate was low. Mainly knee stiffness. Overall mean range of knee motion was 93.5° with 8.8% of the patients had KROM below 60° .

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INFORMED CONSENT FORM

Study No.....

I am Dr AGUNDA MOSES, a postgraduate student of orthopaedic surgery at the University of Nairobi. I am doing a study on the early functional outcome of the distal femur fractures treated by operation at Kenyatta National Hospital and P.C.E.A. Kikuyu Mission Hospital.

The aim of this study is to establish any differences between the various methods used during operation of these fractures, and if any one method is superior to the other. This is so that the surgeons and the patients can be able to identify which among the available options best suit treatment of your kind of injury.

During this study, I am supervised by my teachers, Professor Gakuu and Mr. Museve, both of the department of orthopaedics, University of Nairobi.

May I recruit you kindly to participate in it.

I will interview you concerning your injury, treatment received, ability to walk and climb stairs; and about your pain you experience in the knee of the injured limb.

I will then physically examine your lower limbs and the injury site; determine mobility at the knee of the injured limb, stability of the knee ligaments, strength of the thigh muscles and presence of any deformity visible by inspection. I will do this at first encounter and three months after you are operated on.

I will examine you carefully and diligently to avoid any discomfort. There will be no adverse events resulting from the examination process.

There will not be any activity outside the routine treatment as is provided for patients with similar injuries other than the participation in this study.

I will then review your x-ray films to assess the injury and determine its progress towards healing (now and at 3 months).

Your participation in this study is voluntary and you can withdraw your consent at any time and failure to participate or withdrawal of the consent will not affect your treatment in any way.

The information you give will be treated with utmost confidentiality and your name will not be included in the results.

I have understood the explanation by DR. AGUNDA MOSES who is carrying out a study at the Kenyatta National Hospital and PCEA Kikuyu Mission Hospital on the early functional

outcome for the operative treatment of distal femoral fractures and hereby give consent to participate in the study.

PARTICIPANT'S SIGNATURE

I have explained to the participant clearly about my study and the processes involved and I have assured him/her that confidentiality will be respected.

DR AGUNDA MOSES. SIGN

Contacts: DR AGUNDA MOSES mobile: 0722731256;
MR MUSEVE mobile: 0733610775;
PROFESSOR GAKUU mobile: 0722522218; KNH- ERC Tel: 726300-9

FOMU YA MAKUBALIANO KWA MGONJWA ANAYESHIRIKI KATIKA UTAFITI

Ambari ya usajili

Mimi ni Daktari AGUNDA MOSES, mwanafunzi wa upasuaji wa mifupa katika Chuo kikuu cha Nairobi. Ninafanya utafiti juu ya matokeo (hali ya kujitegemea) ya mwanzo baada ya matibabu kwa njia ya upasuaji kufuatia kuvunjika kwa mfupa wa paja kwenye eneo la goti; katika Hospitali kuu ya Kenyatta na Hospitali ya P.C.E.A. Kikuyu.

Mwango la utafiti huu ni kubuni tofauti zilizopo kati ya mbinu mbalimbali zinazotumiwa kwa kutibu kwa njia ya upasuaji kufuatia kuvunjika mfupa wa paja kwenye eneo la goti, na kubainisha ushupavu wa njia moja juu ya nyingine. Hii itawezesha daktari wa upasuaji na wagonjwa wengine wenye maumivu kama haya kuchagua mbinu atakayowafaa zaidi kulingana na maumivu mgonjwa atakwa ameyapata.

Wakati wa huu utafiti nimesimamiwa na wakufunzi wangu Profesa Gakuu na daktari Museve wa idara ya upasuajimifupa ya chuo kikuu cha Nairobi.

Nitakuhoji kuhusu maumivu uliyoyapata, matibabu uliyopata, uwezo wako wa kutembea na kupanda gorofa; na kama una uchungu kwemye goti.

Kisha nitakupima kimwili miguu, mfupa uliovunjika na goti na misuli ya paja na kuangalia kama mfupa uliendelea mahali pa kuvunjika. Nitayafanya haya wakati huu na miezi mitatu baada ya kupasuliwa.

Nitakupima kwa kimaakini na taratibu ili kuzuia maumivu yoyote. Hakuna madhara itakayotokana na kupimwa.

Hakuna chochote cha ziada utakachofanyiwa ila matibabu ya kawaida vile inavyopewa kwa yeyote mwenye maumivu kama haya.

Nitazisoma picha zako ili kuelewa zaidi hali ya maumivu yako wakati huu na miezi mitatu baada ya kupasuliwa.

Kushiriki kwako katika huu utafiti ni kwa hiari yako na uko huru kujiondoa wakati wowote, na kujiondoa kwako hakutadhuru matibabu yako kwa njia yoyote ile.

Habari utakayotoa itatumika kisiri na jina lako halitaonyeshwa kwenye matokeo.

Nimeelewa maelezo ya daktari Agunda Moses ambaye anafanya utafiti juu ya matokeo ya upasuaji kwa kuvunjika mfupa wa paja kwenye eneo la goti katika hospitali kuu ya Kenyatta na P.C.E.A Kikuyu na nina kubali kushiriki.

SAHIHI YA MSHIRIKI.....

Nimemweleza mshiriki kuhusu utafiti ninaoufanya juu ya matibabu kwa njia ya upaswaji ya kuvunjika mfupa wa paja eneo la goti.

Sahihi dkt Agunda M oses.....

Mawasiliano: DR. AGUNDA MOSES: 0722731256; DR. MUSEVE: 0733610775;
PROFESSOR GAKUU: 0722522218; KNH-ERC 726300-9

QUESTIONNAIRE

Tick the appropriate bracket for yes or no, present or absent (where applicable)

A. DEMOGRAPHIC DATA:

Study code No

Age in years ()

Gender male (1); female (2);

Date and time of injury..... date and time of admission

Date and timing of operation..... ; Date and time of discharge/death

.....

B. SOCIO-ECONOMIC STATUS

a) Education level

1. Illiterate ()

2. Primary ()

3. Secondary ()

4. Tertiary ()

b) Employment status

1. Not employed ()

2. Self employed ()

3. Employed by other ()

4. Retired ()

C. MECHANISM OF INJURY

1. Fall with mild trauma ()

2. Fall with severe trauma ()

3. RTA ()

4. Others (specify)

D. CO-MORBIDITIES (specify if present and any long term medication)

None

Respiratory

- Cardiovascular
- Neuropsychiatric
- Metabolic
- Hematologic
- Musculoskeletal
- Malignancy (specify)
- Others (specify)

E. PHYSICAL FINDINGS (on admission)

- a) Glasgow coma score ()
- b) Blood pressure ()
- c) Pulse rate ()
- d) Respiratory rate ()

F. ASA class 1(1); 11(2); 111(3); IV (4); V (5)

G. RADIOLOGICAL INVESTIGATIONS

- 1. Pre-operative
- 2. Post-operative plain radiograph
- 3. Others (specify)

H. LABORATORY INVESTIGATIONS (pre-operatively)

- 1. TWBC count
- 2. Hemoglobin
- 3. Serum sodium
- 4. Serum potassium
- 5. Blood urea and creatinine
- 6. ELISA (HIV &II)
- 7. Others (specify)

I. TREATMENT MODALITIES

1. DCS ()
2. Angled blade plate ()
3. Condylar blade plate.... ()
4. Intramedullary nail
 - a. Retrograde ()
 - b. Antegrade ()
5. MIPPO ()
6. LISS ()

J. SURGICAL APPROACH

1. Lateral..... ()
2. Medial ()
3. TARPO ()
4. MIPPO..... ()
5. LISS..... ()
6. Others specify ()

K. TYPE OF ANAESTHESIA

1. General anesthesia ()
2. Regional anesthesia ()

L. BLOOD TRANSFUSION

1. None ()
2. Transfused ()

If transfused specify number of units and time of transfusion.

ANTIBIOTICS PROPHYLAXIS

None (1)

Yes (2) ceftriaxone (3) cefuroxime

(4) Flucloxacillin

(5) Cloxacillin

(6) Others (specif)

ANTICOAGULANT PROPHYLAXIS

a). None (I)

b). Yes (specify (2) Heparin (3) clexane (4)

Others (specify)

9. EARLY COMPLICATIONS

a). None (I)

b). Local;

1. wound sepsis/dehiscence (2)

2. Loose screws (3)

3. Deep infection

4. Implant failure. (4)

5. Others (specify)

c). Systemic (specify for each)

(i) DVT

(ii) Pulmonary

(iii) Skin

(iv) Anemia (specify hemoglobin level)

(v) Others

DURATION TAKEN FOR INCISION WOUND TO HEAL

By day7 ()

8 - 14days ()

15 - 21days ()

> 21days ()

Table 9: Modified knee rating system

	No. of points
Pain (30 points)	
Walking	
None	15
Mild	10
Moderate	5
Severe	0
At rest	
None	15
Mild	10
Moderate	5
Severe	0
Function (22 points)	
Walking	
Walking and standing unlimited	12
5-10 blocks, standing > 30 mins	10
1-5 blocks, standing 15-30 mins	8
< 1 block	4
Cannot walk	0
Stairs	
Normal	5
With support	2
Transfer	
Normal	5
With support	2
Range of motion (15 points)	
80 degrees	10
90 degrees	11
100 degrees	12
110 degrees	14
120 degrees	15
Muscle strength (15 points)	
Grade 5	15
Grade 4	12
Grade 3	9
Grade 2	6
Grade 1	3
Grade 0	0
Flexion deformity (10 points)	
None	10
0-10 degrees	8
10-20 degrees	5
>20 degrees	0
Instability (5 points)	
None	5
0-5 degrees	4
6-15 degrees	2
>15 degrees	0
Total	-
Subtractions	
One cane	1
One crutch	2
Two crutches	3
Extension lag	
5 degrees	2
10 degrees	3
15 degrees	5
Deformity	
Deformity	
(5 degrees = 1 point)	
Varus	-
Valgus	-
Total subtractions	-
Knee score	-

* based on the knee rating scale of the hospital for special surgery⁷⁴.

Excellent = 85 points or more, good = 70 to 84 points, fair = 60 to 69 points, and poor = less than 60 points.



KENYATTA NATIONAL HOSPITAL
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26th August 2011

Ref: KNH-ERC/ A/224

Dr. Agunda Moses
Dept. of Orthopaedic Surgery
School of Medicine
University of Nairobi

Dear Dr. Agunda

Research proposal: "Early functional outcomes of Distal Femoral Fractures treated operatively at Kenyatta National Hospital and P.C.E.A Kikuyu Mission Hospital" (P2/01/2011)

This is to inform you that the KNH/UON-Ethics & Research Committee has reviewed and approved your above revised research proposal. The approval periods are 17th August 2011-16th August 2012.

You will be required to request for a renewal of the approval if you intend to continue with the study beyond the deadline given. Clearance for export of biological specimens must also be obtained from KNH/UON-Ethics & Research Committee for each batch.

On behalf of the Committee, I wish you a fruitful research and look forward to receiving a summary of the research findings upon completion of the study.

This information will form part of the data base that will be consulted in future when processing related research study so as to minimize chances of study duplication.

Yours sincerely

PROF A N GUANTAI
SECRETARY, KNH/UON-ERC

c.c. The Deputy Director CS, KNH
The Dean, School of Medicine, UON
The Chairman, Dept. of Surgery, UON
The HOD, Records, KNH
Supervisors: Dr. George K. Museve, Dept. of Orthopaedic Surgery, UON
Prof. Lawrence N. Gakuu, Dept. of Orthopaedic Surgery, UON



P.C.E.A Kikuyu Hospital

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1908 - 2008 Celebrating 100 Years of Quality Health Care

7th September 2011

Dr. Agunda Moses
Department of Orthopaedics
University of Nairobi

Dear Dr. Agunda,

RE: REQUEST TO CONDUCT A RESEARCH

Refer to subject above.

This is to inform you that you have been allowed to conduct a research in our Orthopaedic Rehabilitation Unit.

I hope you will find the information useful.

Yours faithfully,

For: P.C.E.A. Kikuyu Hospital

P. Kimpiatu M.D, FRCSI, FCS-ECSA
CHIEF MEDICAL OFFICER

Cc: D.C.S. Rehab Unit
File Copy



General Hospital



Eye Unit



Rehabilitation Centre



Dental Unit

Email: kikuyu@pceakikuyuhospital.org / Website: www.pceakikuyuhospital.org

"The love of Christ through healing"