EARLY FUNCTIONAL OUTCOME OF OPERATIVE TREATMENT OF DISPLACED FEMORAL NECK FRACTURES IN TWO KENYAN ORTHOPAEDIC CENTRES

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PART FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF
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DEDICATION

"Chance favors the prepared mind."

(Louis Pasteur, 1822-1895)

This work is dedicated to my dear wife Mercy Mildred and my loving children George Moses and Marie Anne. You made this study worthwhile.

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"If I have seen further, it is by standing upon the shoulders of giants."

(Isaac Newton, 1642-1727)

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

AMP	-	Austin Moore Prosthesis
ADL	-	Activities of Daily Living
ASA	-	American Society of Anesthesiologists
AVN	-	Avascular Necrosis
CDC	-	Centers for Disease Control and Prevention
ELISA	-	Enzyme-linked Immunosorbent Assay
FNF	-	Femoral Neck Fracture/ Fracture neck of femur
FNFs	-	Femoral Neck Fractures
HA	-	Hemiarthroplasty
HHS	-	Harris hip score
HIV	-	Human Immunodeficiency Virus
HOOS	-	Hip disability and osteoarthritis outcome score
KMH	-	Kikuyu Mission Hospital
KNH	-	Kenyatta National Hospital
LOS	-	Length of in-hospital stay
MRI	-	Magnetic Resonance Imaging
OHS	-	Oxford hip score
OS	-	Osteosynthesis/ Internal fixation
POSSUM	-	Physiological and operative severity score for the enumeration of Mortality and morbidity
RTI	-	Road Traffic Injuries
SOPC	-	Surgical Out-patient Clinic
SPSS	-	Statistical Package for the Social Sciences
THA/R	-	Total Hip Arthroplasty/Replacement
TWBC	-	Total White Blood Cell Count
UON	-	University of Nairobi
VTE	-	Venous thrombo-embolism
WOMAC	-	Western Ontario and McMaster universities osteoarthritis index

ABSTRACT

Background: Worldwide, the incidence of fracture neck of femur (FNF) has been projected to increase significantly. FNF increases both morbidity and mortality especially to the elderly. Locally, majority of these fractures occur in young economically productive individuals, mainly following road traffic injuries. The functional outcome of these fractures has however not been well studied in Kenya.

Objective: To determine the early functional outcome following operative treatment of displaced FNF.

Design and setting: A six months prospective cohort study was conducted between 12th November, 2008 and 11th May, 2009 at Kenyatta National Hospital (KNH) and Kikuyu Mission Hospital (KMH), in Kenya.

Patients and methods: Sixty consecutive patients were enrolled using a pre-tested questionnaire. The Western Ontario and McMaster Universities Osteoarthritis index (WOMAC) was used to determine the functional state before injury and at three months post-operatively. The functional outcome measures included pain, stiffness and activities of daily living (ADL). Data were analyzed using the Statistical Package for the Social Sciences (SPSS). The Student's t-test and χ^2 test were used for comparison between variables as appropriate; a p value < 0.05 was considered statistically significant. The results are presented as tables, graphs, bar charts and pie charts.

Results: There were 41 males and 19 females. The age ranged from 18 to 96 years (mean: 51.6 ± 18.2). Osteosynthesis, using multiple screws or Dynamic Hip Screws was the main method of treatment (24 patients). Eighty eight percent of the patients had a

mean negative early functional outcome score. Hemiarthroplasty and THA had a similar early post-operative functional outcome while OS had a poorer ADL outcome. There was no correlation between the pre-operative duration and functional outcome. Prolonged hospital stay was associated with a poor ADL outcome (p value 0.020). The use of the antero-lateral approach to the hip was associated with a better ADL outcome compared to the lateral approach in patients above 50 years of age (p value 0.007). Both spinal and general anaesthesia resulted in similar early functional outcome.

Conclusions: At three months post-operatively, most patients had not fully recovered their pre-injury level of function and independence. Both HA and THA were associated with better early functional outcome compared to OS.

INTRODUCTION

There is significant morbidity and mortality associated with fracture neck femur (FNF) especially in the elderly.[1] In Kenya however, majority of these fractures occur in the young and economically productive age-group mainly following road traffic injuries (RTI).[2] Despite advances in surgical hardware and techniques, femoral neck fractures (FNFs) still pose a significant clinical challenge and are also expensive to manage.[3] Several factors mainly related to the anatomy of the femur neck; especially the blood supply, are thought to be responsible.[4]

The management of FNF has evolved over time. The problem was considered "unsolved" by the earlier orthopedic surgeons; Ambroise Pare and Sir Asley Cooper. The advice of Sir Asley Cooper (1822) was to treat the patient and let the fracture go.[5] Even today, there are a number of controversies concerning the methods of treatment of displaced fractures of the femoral neck and the main problem is whether to reduce the fracture and use internal fixation or to perform total or partial hip replacement arthroplasty.[5,6] Studies have shown variation in functional outcome based on certain patient and non-patient factors which are known to vary from one set-up to another.[5-11] Thus each set-up need to assess its functional outcome especially based on the patient's age to establish the modality of treatment with optimal outcome.[7,8] Furthermore, in the contemporary setting, outcome assessment has been necessitated by the dramatic increase in health care costs and practice-pattern variations.[3,12-14] In Kenya however, there is paucity of data on the outcome following operative treatment of these fractures.[2,15,16] The purpose of this study was to determine the early functional outcome following operative treatment of displaced FNF at Kenyatta National and Kikuyu Mission hospitals in Kenya. The factors affecting this outcome were also assessed.

LITERATURE REVIEW

INCIDENCE AND PREVALENCE

Worldwide, the number of hip fractures has been projected to rise from 1.7 million in 1990 to 6.26 million by the year 2050.[17] This is due to the improvement in life expectancy and hence an increase in population in nearly all countries.[17-19] In Finland, the age-specific incidence rose from 273/100,000 in 1970 to 412/100,000 in 1991 among women aged 50 or over and from 108/100,000 to 194/100,000 among Finnish men, respectively.[19] In the USA, the incidence of hip fractures exceeds 250,000 per year with an estimated management cost of $8.7 billion.[17]

Nyarango[2] in a study conducted at KNH found the majority of FNF to occur in the 40-49 years age class with a male preponderance. Ochiel[16] later noted the peak age group to be 18-50 years with a male preponderance. Studies from other centers however, reports that the majority of FNF occurs amongst females above 70 years of age.[17, 19]

ETIOLOGY AND PATHOPHYSIOLOGY

Femoral neck fractures in the elderly occur more frequently following falls with low-energy (mild) trauma or chronic stress instead of a single supra-physiologic traumatic event.[2,4,16,20] Osteoporosis is the most important risk factor contributing to these fractures in old patents. This is mainly due to senility but can also be attributed to prolonged corticosteroid use.[21,22] Medical conditions such as hyperthyroidism and diabetes mellitus have also been found to be associated with an increased risk of fracture and associated complications.[5,6,23,24] On the other hand, the risk of fall is increased by physical

deconditioning, malnutrition, impaired vision or balance, neurologic problems, and slower reflexes[25]; features known to be more common in old-age.

FNFs in children, adolescents and young adults usually result from high-energy (severe) trauma associated with multiple concomitant injuries.[2,16,26] Nyarango[2] found that most FNF results from Road Traffic Injuries (RTI) while Ochiel[16] noted majority of the fractures to occur following a fall with minor trauma. Studies from other centers however, reports that the majority of FNF results from falls.[17,19] Locally, about a third of trauma cases results from road traffic injuries.[27]

FUNCTIONAL ANATOMY OF NECK OF FEMUR

The femoral neck contributes to both the stability and mobility of the hip joint.[4] The femoral neck has essentially no periosteal layer; hence, all healing is endosteal in origin. The synovial membrane incorporates the entire femoral head and the anterior neck, but only the proximal half of the posterior neck. The synovial fluid bathing the fracture may interfere with the healing process. Angiogenic-inhibiting factors in synovial fluid can inhibit fracture repair.[3]

The blood supply to the head and neck of femur varies with age and significantly influences fracture healing.[8, 28, 29] Crock[28] divided the blood supply to the proximal end of the femur into 3 major groups. The first, an extracapsular arterial ring located at the base of the femoral neck, is formed by branches from the medial and lateral femoral circumflex arteries. The second ring of vessels is formed as the ascending cervical vessels approach the articular margin of the femoral head from which the epiphyseal arteries are formed. These branches course recurrently along the joint capsule past the femoral neck to supply the femoral head. The lateral epiphyseal arterial group supplies the lateral

weight-bearing portion of the femoral head. Fractures of the femoral neck or damage to the capsule can disrupt these supplying vessels. Widely displaced intracapsular fractures tear the synovium and the surrounding vessels. The epiphyseal vessels are joined by the inferior metaphyseal vessels and vessels from the ligamentum teres. The latter vessels which may at times be completely atretic at puberty form the third ring.[4,8,28,29] In the skeletally mature individuals, the barrier of the epiphyseal plate breaks down allowing vascular anastomosis between the epiphyseal vessels, vessels in the ligamentum teres and the metaphyseal vessels.[29]

The retinacular arteries on the surface of the femoral neck and the ligamentum teres artery are sensitive to changes in intracapsular pressure.[4,8,30] Increased pressure from an intracapsular bleed compromises this circulation thus contributing to poor healing. Because of the inelastic character of the joint capsule, small increases in the intra-articular volume can result in large increases in joint pressure.[4,8,30]

These factors, along with the precarious blood supply to the femoral head make healing unpredictable and complications fairly common.[4,8]

Furthermore, the biomechanics of the hip joint have been shown to influence healing of FNF. Forces acting on the upper part of the femur including the body weight and load from muscular action play a significant role in healing of femoral neck fractures.[8,20,31,32] Blount[32] in addition, demonstrated the significance of the biomechanics at the hip and the role played by an external support such as a walking stick.

MANAGEMENT

Pre-hospital and emergency care

The management of patients with FNF requires a multidisciplinary approach with the life threatening conditions being addressed first before specific treatment is given to the fracture.[8,33] The patient should be immobilized until confirmation of the nature of the fracture since weight bearing can easily convert an incomplete fracture into a complete one.[4] The initial resuscitation follows the principles outlined in the Advanced Trauma Life support (ATLS®) guidelines.[33] Laboratory studies have shown that immediate reduction of a displaced fracture results in improved blood supply and hence better healing.[4,8]

Imaging studies

Plain radiography is the preferred initial imaging modality in evaluating femoral neck fractures because of its near universal availability, ease of acquisition, and documented correlation with surgical results over many years of use.[4] Some femoral neck fractures are not visible on plain radiographs obtained during the initial evaluation. If the clinical suspicion is strong, these cases can be further evaluated with magnetic resonance imaging (MRI), which is also useful in follow-up for FNF complications; or bone scintigraphy which though non-specific, in the right clinical setting such as known trauma however, is highly sensitive for the detection of fractures.[4] Computerized tomography (CT) scan is useful for assessing fracture comminution preoperatively and in determining the extent of union (or lack thereof) postoperatively.[4]

Classification of femoral neck fractures

Although there are many classification systems for FNF,[20,26,31,34-36] Garden's classification[36] is the most widely used today. Stage I and stage II Garden fractures are not displaced and considered stable fractures with favorable prognoses.[36] Stage III and stage IV Garden fractures (Figures 1 and 2) are displaced and are considered unstable with a poor prognosis.[36] Clinically differentiating the various Garden's classes is difficult hence classifying FNF as displaced or non-displaced is more appropriate. The Pauwels' classification is based on the angle of fracture line with the degree of angulation being directly proportional to the risk of displacement.[31,35]

Figure 1: Garden's III fracture of the left femoral neck

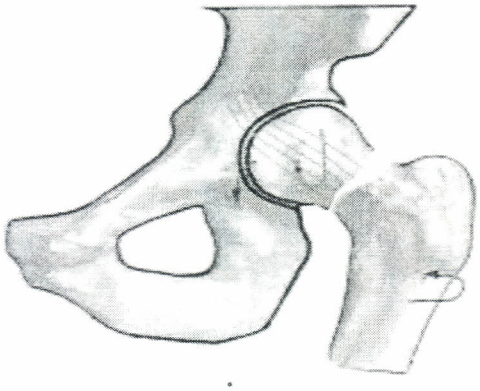
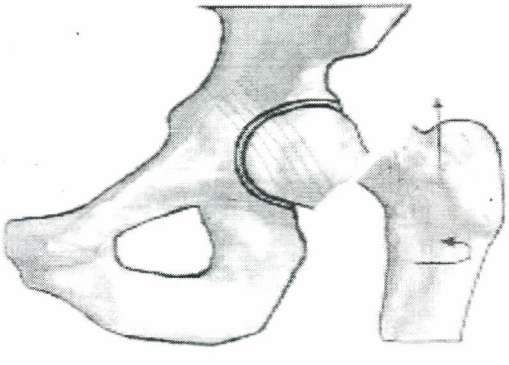


Figure 2: Garden's IV fracture of the left femoral neck



Management options and choice determinants

Currently, the options available for treatment of FNF are either surgical or conservative. Surgical treatment includes Hemiarthroplasty (HA), Total Hip Arthroplasty/Total Hip Replacement (THA/R) or Osteosynthesis (OS)/ Internal fixation.[4,8,9,37]

Factors considered in choosing the appropriate treatment modality include the chronological age of the patient, the comorbidities, fracture pattern/ grade, availability of appropriate surgical facilities and expertise, as well as the patient's socio-economic status.[8,9,37] The Sernbo score reflecting the patients' age, home circumstances, walking ability and mental status is used in some centers to choose between THA and HA.[9]

Osteosynthesis (internal fixation) with hook pins, nails, screws or sliding screw and plate can be used in patients below 50 years of age, patients with Garden's grade I and II fractures irrespective of age as well as those below 70 years of age with Garden's grade III FNF.[8,9,37]

Total hip arthroplasty should be considered in the case of acute displaced femoral neck fractures in previously active elderly individuals with acetabular articular cartilage changes. Other indications for THA may include rheumatoid arthritis, Paget's disease, mental deficiency, short life expectancy in otherwise active individuals, and Garden's grade IV FNF in those less than 50 years of age.[9,38] It is also recommended to patients with normal functional capacity and high functional demands.[39]

Hemiarthroplasty is considered the treatment of choice for patients with grade III and IV Garden fractures and when the general condition of the patient is not optimal for a major procedure like THA.[4,6,37]

Non-*operative management* is still a feasible option for the truly non-ambulatory, demented or/and aged patients with FNF.[40]

Figure 3: Cemented bipolar Hemiarthroplasty undertaken at KNH in a 60 year old male patient with Garden's III fracture left neck of femur

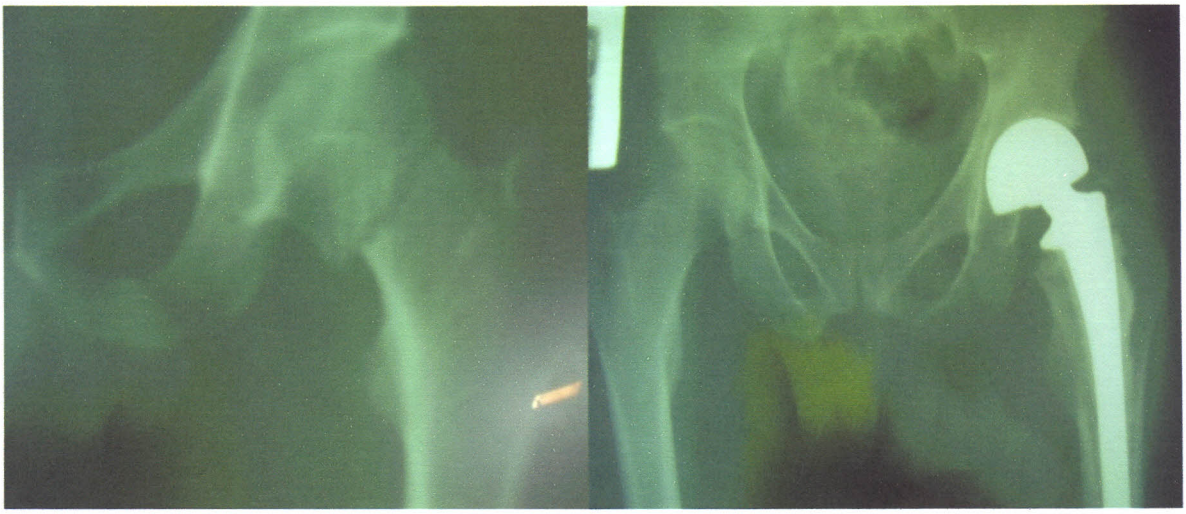


Figure 4: Mono-block Cemented Total Hip Arthroplasty undertaken at KMH in a 72 year old female patient with Garden's IV fracture left neck of femur

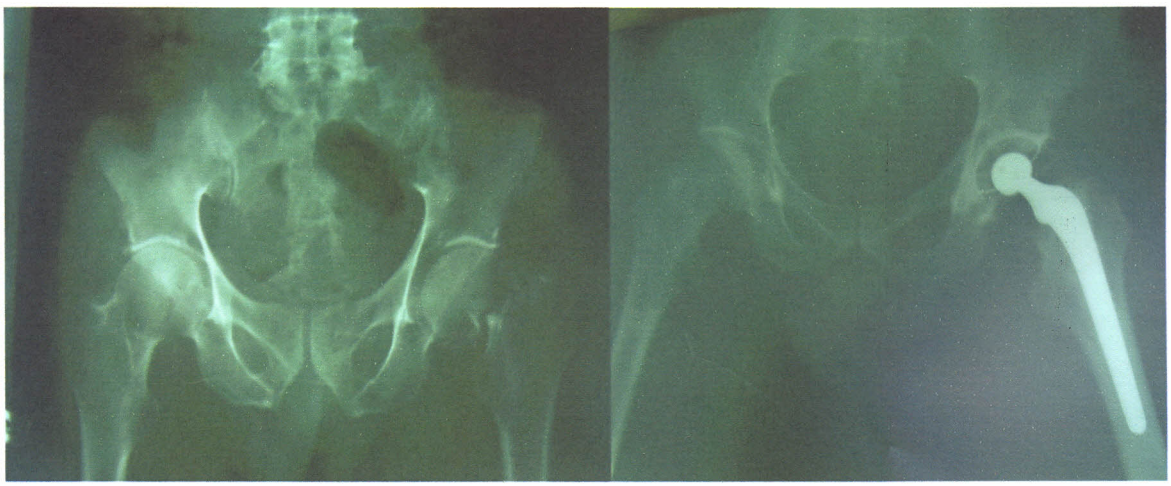


Figure 5: Non-cemented THA in a 42 year old Female at KMH

Figure 6: Dynamic Hip Screw in a 36 year old male at KNH

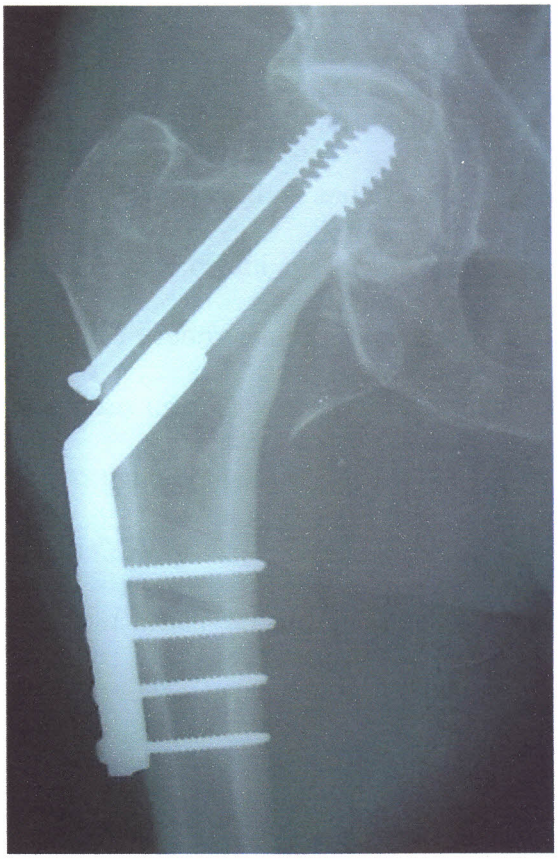
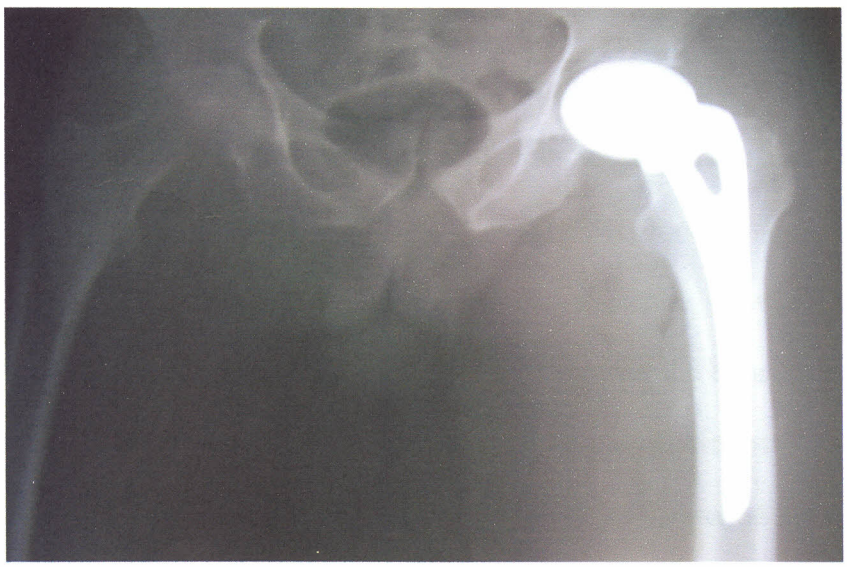


Figure 7: Austin Moore Hemiarthroplasty in a 60 year old patient undertaken at KMH



FUNCTIONAL OUTCOME

General overview

How well patients are able to regain their pre-injury level of function and independence is a good indicator of the efficacy of the treatment with regard to the socioeconomic aspects.[41] Functional status on admission predicts the occurrence of a hospital-acquired complication, and functional recovery has also been used to determine the effect of rehabilitation of hip fracture patients.[41,42] The two major functional outcome measures usually assessed are pain and mobility.[5,6,43] Lu Yao et al[6] graded pain into four categories; *none* where there is no pain, *minimal* when no analgesic is required, *occasional* when analgesic is sometimes used and *severe* when analgesics are regularly used. They also classified mobility into *good* (able to walk with minimal or no aid) and *poor* (requires a walker or human assistance or are confined to a wheel chair or are unable to walk). D'Arcy et al[5] combined pain and mobility into four grades.

Functional outcome determinants

The overall functional outcome is influenced by several factors broadly classified as patient and non-patient factors. The *patient factors* include age,[6,7] co-morbidities,[6,7,23,24,37] pre-fracture functional status,[39] and both local and systemic complications; such as anaemia, infection, haemarthrosis, sciatic nerve palsy, dementia/ confusion, venous thromboembolism, orthostatic pneumonia, avascular necrosis of the femoral head, and non union.[7-9,44,45] The non-*patient factors* include the type of operation and the surgical approach,[6,7,9,15,46] concomitant medication (e.g. oral corticosteroids)[22] as well as discharge destination.[48] The type of anesthesia used,[41,47] or the period between injury and operative intervention (duration to surgery)[49,50] have no significant effect on functional outcome.

Patient factors: Several studies have shown that there is a dose-effect-like relationship between advancing age and poor functional outcome.[6,7,10] Sex has not been shown to influence functional outcome[6,7,10,44] though being female has been associated with increased post-operative complications.[44] Several studies found the presence of co-morbidities or postoperative complications to be associated with poor functional outcome,[6,7,9,23,24,37,41,44,45] while other studies found no effect of post-operative complications on functional outcome.[8,51] Anaemia independently impact negatively on mobility,[45] while pre-fracture functional status independently influences functional outcome.[10,41,42,44] However, timing of surgery has been found to have no influence on functional outcome.[49,50] In a study of 1206 patients aged fifty years and more, Orosz et al[49] found that early surgery is not associated with improved function though it resulted in reduced rate of complications and length of hospital stay (LOS).

Non-patient factors: Several comparative prospective studies on the use of different types of pins, screws, or nails have not reported any significant differences in outcome.[52-54] Christie et al[54] found no statistically significant difference in mobility but they were in favor of screws due to better union of the fracture and the lower infection rates. Khan et al[11] and Godsiff et al[55] in separate studies found lower side effects involving the cardiopulmonary system and technically easier revision following treatment of displaced intracapsular FNF with an uncemented implant compared to a cemented HA. In these studies however,[11,55] early loosening associated with worse pain and poor function were found with uncemented compared to a cemented implant.

THA in selected cases of acute femoral neck fracture may provide consistent pain relief and a good functional outcome without any increase in complications.[48]

Several studies comparing THA and OS have found better functional outcome with THA.[39,56-58] However, THA is associated with more intraoperative blood loss, longer operation time and increased post operative infection rates.[39,51,56-58] A study by Jónsson et al[58] involving 47 patients, reported that the patients who were treated with THA used less outdoor walking aids, and were more likely to do their own shopping than patients treated with OS.

In a randomized comparative study on the functional outcome between OS and HA, Söreide et al[59] found no significant differences, while in a meta-analysis of one hundred and six published reports, Lu-Yao et al[6] found better pain relief and better mobility with HA compared to OS. Some other studies also recommend HA as more suitable for the treatment of FNF.[9,46] Rogmark et al[9] in a prospective randomized study of 409 patients aged 70 years and above found better mobility and pain relief in the arthroplasty group compared to the OS group. In the OS group after two years, 36% had impaired walking and 6% had severe pain compared with 25% and 1.5% respectively, in the arthroplasty group.[9] Bhandari et al[51] in a meta-analysis of 14 randomized controlled trials found no significant difference in functional outcome between OS and arthroplasty.

Studies comparing the functional outcome between HA and THA have shown varying results. Squires et al[60] found poorer functional outcome following HA compared to THA while Narayan et al[61] found no statistically significant difference. Smrke et al[62] found, HA to give a better range of motion compared to THA but the total Harris hip score showed no statistically significant difference. Ravikumar et al, [63] found that both OS and HA resulted in the poorest functional outcome compared to THA.

Sikorski and Barrington[46] in a prospective randomized study of 218 patients found better functional outcome with a posterior (Moore) approach compared to an anterior (Smith-

Petersen) approach in those treated using Thompson's arthroplasty though the posterior approach was associated with a significantly higher mortality. Similar findings were reported by Montgomery et al.[64] Warrakah,[15] in a study on patients treated with Austin Moore HA found the lateral (Hardinge or Liverpool) approach to be associated with better functional results (82% satisfactory) compared to the anterolateral (Watson-Jones) approach (66% satisfactory) or an anterior (Smith-Petersen) approach (50% satisfactory). Taine et al found that those in residential homes had better functional outcome compared to those discharged to nursing homes.[48]

Functional outcome assessment

The assessment of outcome after surgical intervention is not a new science. As early as 1750 BC, King Hammurabi of Babylon issued a number of decrees relating to surgeons and the outcome of surgery.[12] As the reliability of orthopaedic surgical procedures improves, the outcome assessment is shifting from the success or failure of a procedure towards patient satisfaction and quality-of-life indicators.[13] For an outcome measure to be meaningful, it must be psychometrically evaluated and shown to be reliable, valid and sensitive to change[13]. Several quality-of-life surveys are available and include the generic, disease-specific and hip joint-specific surveys.[13,14,65]

The generic quality-of-life outcome measures are used to assess health status or health-related quality of life and include the 36-item Short form health survey (SF-36), 12-item Short form health survey (SF-12), the Nottingham health profile questionnaire and the EuroQol questionnaire.[13,14]

The disease specific quality-of-life outcome measures are used to assess aspects of a specific condition and include the Western Ontario and McMaster Universities (WOMAC) Osteoarthritis index and the arthritis impact measurement scale.

The hip specific outcome measures include the Harris hip score (HHS), the Charnley score, the Oxford hip score (OHS) and the Hip disability and osteoarthritis outcome score (HOOS).[8,13,14,43] The HHS and Charnley score are less patient-oriented unlike the WOMAC, OHS and HOOS. The HHS, Charnley score and OHS were developed to assess patients undergoing THR irrespective of the underlying pathology while the HOOS can be used to assess any intervention on any hip pathology.[13]

The WOMAC index has been found to be valid, reliable, responsive, easy to complete and simple to score. It also has a high internal consistency and acceptable test-retest reliability. It has been used successfully not only for osteoarthritis, but also for other hip conditions including FNF.[13,50] The HOOS LK 2.01 questionnaire contains all WOMAC LK 3.0 questions in unchanged form but with a better patient responsiveness.[12-14] It has two additional subscales; sports and recreation function and hip related quality of life, which assess more strenuous activities not tolerable by most patients at three months post-operatively.[12-14]

Since the results from outcome studies can be affected by patient co-morbidity and peri-operative factors, the orthopaedic physiological and operative severity score for enumeration of mortality and morbidity (orthopaedic POSSUM) was developed to address this issue.[12,13] Unfortunately, it over predicts mortality and can only be used in retrospect and not pre-operatively.[66] The American Society of Anesthesiologists (ASA) classification is simple and reliable in predicting post-operative outcome and it can be used pre-operatively.[66,67]

STUDY JUSTIFICATION

Worldwide, the incidence of femoral neck fractures has been projected to increase significantly.[17] Outcome assessment has been necessitated by the dramatic increase in health care costs and practice pattern variation.[41] Most femoral neck fractures are reported to occur in the elderly especially in western European series.[17,19] These patients are often physiologically compromised and must be immediately mobilized to avoid further morbidity and mortality.[4] In Kenya however, FNFs are more common in the young economically active individuals[2,16] with attendant negative socio-economic impact. How well these patients are able to regain their pre-injury level of function and independence is a measure of the recovery of their socio-economic productivity.

Studies have shown variation in functional outcome following operative treatment of femoral neck fracture, based on certain patient and non-patient factors which are known to vary from one set-up to another[5-11]; yet the functional outcome of these fractures has not been well studied in Kenya. Knowledge of the early functional outcome following operative treatment of displaced FNF will be useful to the health care providers as well as policy makers in the formulation of appropriate treatment protocols, optimal utilization of health-care resources as well as in prognostication.

STUDY OBJECTIVES

BROAD OBJECTIVE

To determine the early functional outcome of operative treatment of displaced fracture neck of femur at Kenyatta National and Kikuyu Mission Hospitals.

SPECIFIC OBJECTIVES

1. To establish the demographic patterns and injury characteristics of patients undergoing operative treatment of displaced FNF at KNH and KMH.
2. To establish the treatment patterns of displaced fracture neck of femur managed operatively at KNH and KMH.
3. To establish the early functional outcome of displaced fracture neck of femur managed operatively at KNH and KMH.
4. To establish how the following factors affected the early functional outcome of operative treatment of displaced FNF at KNH and KMH:
    a) Age and sex.
    b) Co-morbidities.
    c) Pre-fracture functional status.
    d) Time taken to surgical intervention.
    e) Length of hospital stay.
    f) Type of surgical operation and surgical approach.
    g) Early complications.

PATIENTS AND METHODS

DESIGN AND SETTING

This was a six-month prospective cohort study conducted at the orthopedic trauma wards and the surgical out-patient clinics (SOPC) of Kenyatta National and Kikuyu Mission Hospitals between November 12th, 2008 and May 11th, 2009. Kenyatta National Hospital is the largest referral and teaching hospital in Kenya while Kikuyu Mission Hospital is a peri-urban district hospital with a one hundred bed capacity and a busy orthopaedic and trauma unit.

ETHICAL CONSIDERATIONS[68]

a) This study was conducted only after approval by the Kenyatta National Hospital/ University of Nairobi Ethics and Research Committee (KNH/UON-ERC) and the Kikuyu Mission Hospital's board of management.

b) There was a modification of the study title from the initial one presented for approval to Kikuyu Mission Hospital, without a change in the aims and objectives of the study. An approval letter to that effect was sought and granted.

c) Patients or their parents/ guardians gave written informed consent to take part in the study before being included.

d) The information collected from the patients has been handled with utmost confidentiality and is being used solely for the purpose of the study.

DEFINITION OF TERMINOLOGIES

The ***duration of stay to surgery*** was the period between admission and definitive surgical operation; while the ***total length of stay*** was from admission to discharge from hospital.

Fall with mild trauma referred to a fall on a relatively flat ground (mainly tripping) or from a height lower than 4.5 meters; while ***fall with severe trauma*** referred to a fall from a height, either one floor or higher (at least 4.5 meters high).

Confusion referred to disorientation in time, place or person; ***Surgical wound infection*** was diagnosed based on the CDC criterion for defining surgical site infection.

Early outcome was outcome within three months of definitive surgical intervention while ***early complications*** were complications occurring within three months post-operatively.

Chronic pain syndrome meant pain lasting longer than three months from the initial noxious stimuli and not responding to commonly used first-line analgesics.

Skeletal maturity was confirmed on plain radiography as fusion of the proximal femoral capital epiphyses.

The ***"Michuki rules"*** are a set of legislation recently passed by the Kenya government aimed at improving on road traffic safety.

ELIGIBILITY CRITERIA

Inclusion criteria

All patients 18 years of age and above (and skeletally mature) who underwent operative treatment for displaced fracture neck of femur at Kenyatta National Hospital and Kikuyu Mission Hospital during the study period were included.

Exclusion criteria

1. All patients with any of the following were excluded from the study:
    - Un-displaced or bilateral FNF.
    - Concomitant pelvic or lower limb fracture/ dislocation.
    - Multiple injuries.
    - Confusion.
    - Previous ipsilateral FNF or FNF surgery.
    - Operative treatment done outside the study setting.
    - Malignant pathological fractures or peri-prosthetic fractures.
2. Patients who were non-ambulatory prior to injury.
3. Chronic pain syndrome and/ or chronic opioid use.
4. Patients who declined to give written informed consent.

STUDY SAMPLE

The sample size was derived from the formula provided for by Lwanga and Lemesha[69];

$$n = z^2pq/d^2$$

Where "p" is the expected proportion of patients undergoing operative treatment for displaced fracture neck of femur in KNH and KMH;

"d" the confidence limit;

"q" = (1-p) % and;

"z" is the standard deviation of the 95th percentile (1.96).

A confidence limit of 0.05 is used.

Therefore;

$$n = (1.96)^2 \times 0.041\ (1 - 0.041) / (0.05)^2 = 60.419.$$

The calculated sample size was 60 patients.

The "p" value has been derived from the proportion of patients with displaced FNF (who underwent operative intervention) from patients admitted with fractures in KNH and KMH orthopedic trauma wards during the months of January to August 2008, which was 4.1 %. During this period, there were about 2700 fracture patients admitted with 112 undergoing operative treatment for displaced FNF. There is no published literature on local prevalence of FNF or on the proportion of patients undergoing operative treatment.

DATA COLLECTION

Sixty consecutive patients were enrolled over a six months period. Recruitment involved consecutive enrolment of patients who satisfied the set eligibility criteria. Enrollment was done at admission to the hospital or within three months of admission. A pre-tested questionnaire was administered face to face by the investigator or trained assistants and patients' records examined to verify details. Skeletal maturity was confirmed on initial pelvic radiographs at admission.

Functional assessment was conducted at enrollment into the study for the pre-injury functional status and at three months post-operatively for the post-operative functional status. The Western Ontario and McMaster Universities Osteoarthritis index (WOMAC) was used to assess function. The outcome measures included pain, stiffness and activities of daily living (ADL). The functional outcome correlates assessed included the patients' demographic features, pre-injury functional status, type of operation and surgical approach, patients' co-morbidities and complications. The timing for wound assessment was arbitrarily fixed by the investigator to fit in the discharge and clinic attendance routines of the two hospitals. The ASA score was used to assess the patients' peri-operative morbidity and risk of complications. No randomization was done and patients remained in their study groups according to the intention-to-treat principle.

DATA ANALYSIS

Data collected from the questionnaires were entered into a coded data sheet and analyzed by a statistician using the Statistical Package for the Social Sciences (SPSS), Inc., for windows version 15, Chicago, Illinois, U.S.A; to derive descriptive statistics and frequency distributions.[70]

In this study, those above 50 years of age were regarded as elderly and this informed the basis for the age stratification used in data analysis. This was based on the life expectancy at birth in Kenya currently estimated at 53 years of age[18] and also the retirement age of 55 years for most civil servants (though recently revised upwards). Narayan et al, in their study also used the life expectancy at birth (in India) in defining old-age to guide their exclusion criteria.[61]

The WOMAC scores for each subscale (pain, stiffness and ADL) were normalized into a scale of 0-100 (zero indicating no symptoms and 100 extreme symptoms). Each subscale was evaluated independently. The scores were either categorized or analyzed as means. The categories included; 90-100 for excellent results, 80-89 for good results, 70-79 fair, 60-69 poor, and below 60 a failed result.

Categorical data were expressed in terms of proportions while comparison between variables was performed by cross tabulation and Pearson's Chi-squared test. Continuous variables were expressed as means, and standard deviations. The Student's *t*-test was used to compare the differences for significance. For comparable data, a p value less than 0.05 was considered statistically significant.

Results are presented as tables, graphs, bar charts and pie charts.

STUDY LIMITATIONS

- Follow-up period was not long enough to identify further morbidity and survival.
- Concomitant academic interests leading to constraints on the investigator in patient follow-up since he is a post-graduate student with other academic engagements. Study assistants were engaged to help obviate this limitation.
- The practice of discharging patients to the nearest health facilities made it difficult to follow-up some patients. Patients' telephone contacts were recorded in the questionnaire to help trace those who didn't turn up for out-patient clinic visits as scheduled though at an extra cost. All participating patients were reviewed within the planned time frame.

RESULTS

This chapter presents the results of the study on early functional outcome of operative treatment of displaced femoral neck fractures in two Kenyan orthopedic centers (Kenyatta National Hospital and Kikuyu Mission Hospital) conducted between 12th November, 2008 and 11th May, 2009.

A total of sixty patients were enrolled. All the patients were skeletally mature. The patients remained in their study groups according to the intention-to-treat principle and there was no conversion from one treatment modality to another. All the patients were discharged to residential homes and none to a nursing home.

DEMOGRAPHIC CHARACTERISTICS

Most of the patients were males (41 patients, 68%). The mean age of the patients was 51.6 years (±18.2) with a range of 18 to 96. Seventy five percent of the patients had received formal education and sixty five percent were on employment (Table 1).

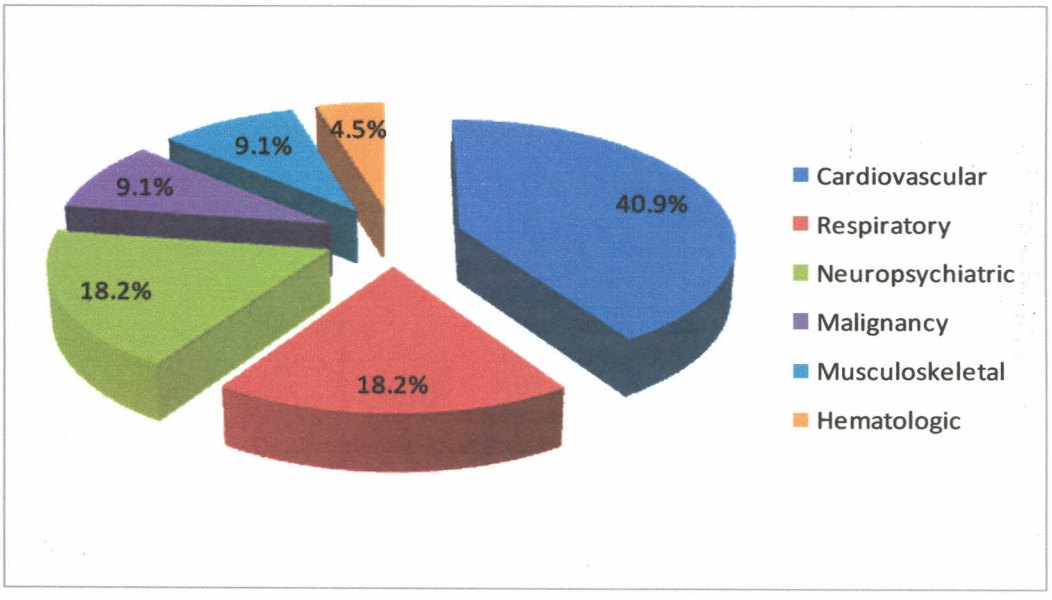
All the co-morbidities involving the cardiovascular system resulted from hypertension (9 patients, 40.9%) while the neuropsychiatric co-morbidities included two cases of epilepsy and one case each of Parkinson's disease and cerebro-vascular accident. Three patients had upper respiratory tract infection while one patient had lobar pneumonia. Only one patient had pre-operative anaemia with a hemoglobin level of 8.9g/dl. This was corrected before surgery by blood transfusion. The malignancies were uterine cervical carcinoma and invasive ductal carcinoma of the breast, both of which were treated successfully with at least 5 years disease free period (Figure 8). Classification of most patients into ASA II was mainly due to age and not co-morbidity (Table 1).

Table 1: Demographic characteristics

Factor		Frequency (n)	Percentage (%)
Sex	**Male**	41	68.0
	Female	19	32.0
Age groups (in years)	**18-30**	07	11.6
	31-50	22	36.7
	51-70	21	35.0
	>70	10	16.7
Level of formal education	**None**	15	25.0
	Primary	16	26.7
	Secondary	17	28.3
	Tertiary	12	20.0
Employment status	**Not employed**	20	33.3
	Self employed	15	25.0
	Employed by other	24	40.0
	Retired	01	1.7
ASA class (pre-operative)	**I**	30	50.0
	II	26	43.0
	III	04	7.0

N/B: The male patients who were ≤ 50 yrs of age were 25 (42%) while females were 4 (7%)

Figure 8: Patients' co-morbidities (n = 22)



N/B: Thirty eight patients (63.3%) had no co-morbidity.
All the musculoskeletal conditions were osteoarthritis of the hip.

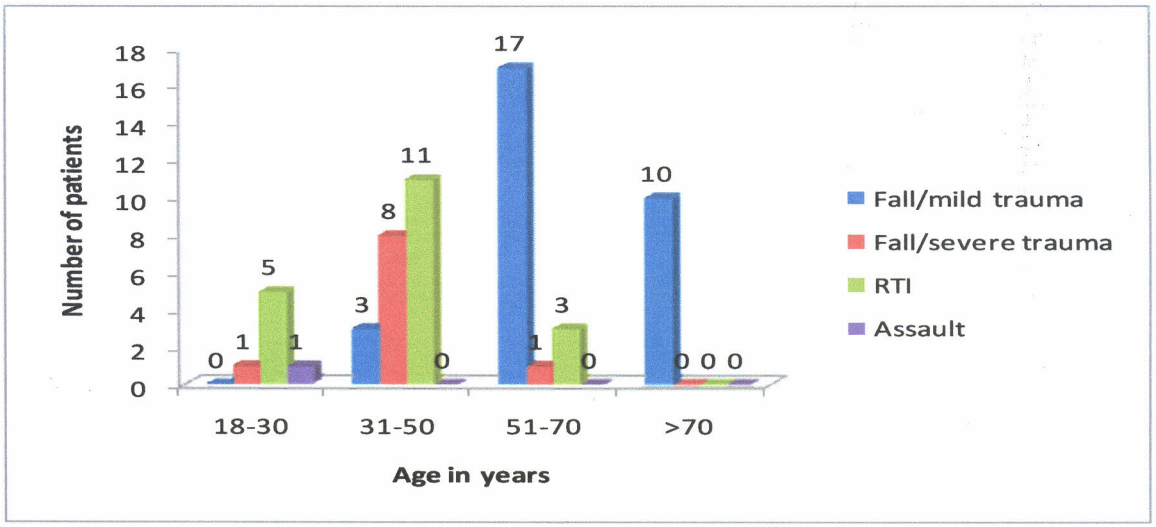
INJURY CHARACTERISTICS

Injuries sustained from minor trauma accounted for a similar proportion (50%) as those sustained from severe trauma (Table 2). Severe trauma was either following a fall from a height (10 patients, 16.7%), RTI (19 patients, 31.7%) or assault with direct trauma to the hip (one patient, 1.7%). Falls accounted for 66.7% of the injuries. RTI mainly occurred in those of 50 years of age and below while fall with mild trauma, mainly in those above 50 years (Figure 9). Sixty two percent of the fractures were Garden's IV (Table 2).

Table 2: Injury characteristics

Factor		Frequency (n)	Percentage (%)
Mechanism of injury	Fall/mild trauma	30	50.0
	Fall/severe trauma	10	16.7
	RTI	19	31.7
	Others	01	1.7
Side affected	Right	29	48.0
	Left	31	52.0
Garden's class	III	23	38.0
	IV	37	62.0

Figure 9: Mechanism of injury according to age (n = 60)



TREATMENT CHARACTERISTICS

Osteosynthesis was used in the treatment of majority of the fractures (24 patients, 40%); with 20 patients being treated using multiple screws and four by Dynamic Hip Screws. This was mainly amongst those aged 50 years and below. Twenty patients (33.3%) underwent HA and 16 patients (26.7%), THA (Table 3 and figure 10). Twelve patients underwent cemented HA and 8, uncemented HA. Amongst the THA group, only two had uncemented THA (Figure 11). There were no patients below 31 years of age who underwent HA or THA and there were only two patients above 50 years of age who underwent OS. The lateral surgical approach was used in all the patients treated by OS (Table 3 and figure 10).

Table 3: Treatment characteristics

Factor		Frequency (n)	Percentage (%)
Treatment modality	**OS**	24	40.0
	HA	20	33.3
	THA	16	26.7
Surgical approach	**Lateral**	31	52.0
	Antero-lateral	29	48.0
Type of anaesthesia	**General**	18	30.0
	Spinal	42	70.0
Transfusion pattern	**Transfused**	36	60.0
	Not transfused	24	40.0
Prophylaxis against VTE	**Heparin**	21	35.0
	Enoxaparin	39	65.0
Antibiotic prophylaxis	**Ceftriaxone**	27	45.0
	Cefuroxime	13	21.7
	Cloxacillin	11	18.3
	Others	09	15.0

N/B: Type of anaesthesia used was chosen by individual anesthesiologists.

Figure 10: Modalities of treatment according to age (n = 60)

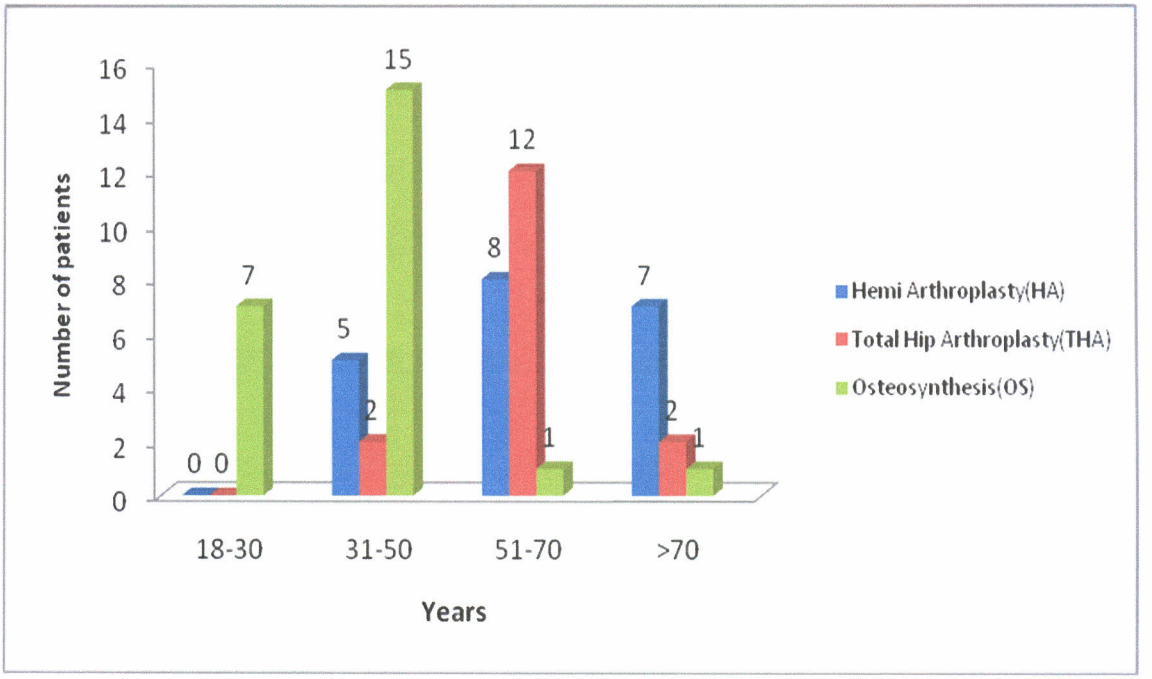
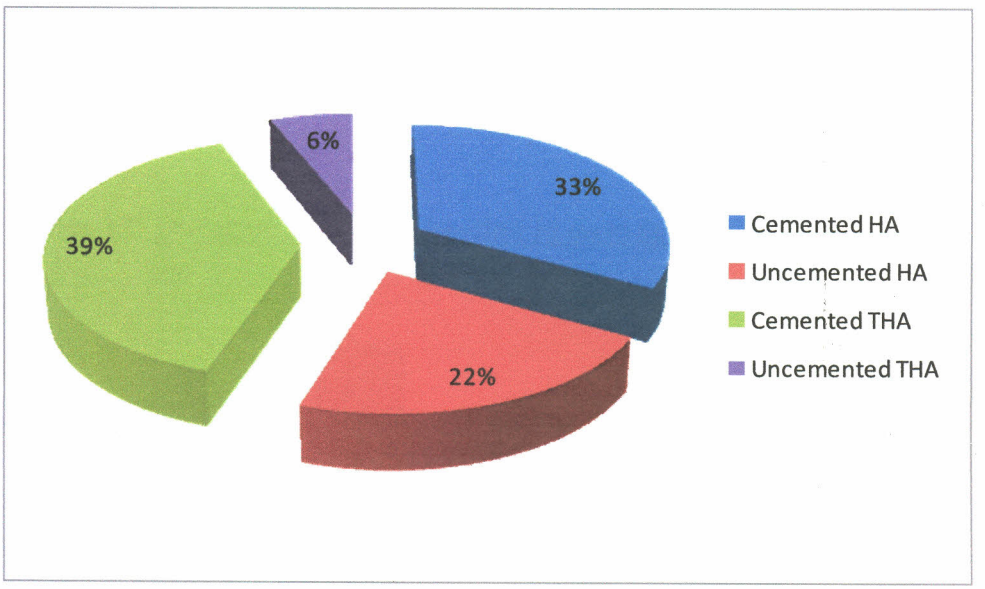


Figure 11: Cemented versus uncemented arthroplasty (n = 36)



N/B: Four of the un-cemented HA and both the un-cemented THA patients were ≤50 years of age.

EARLY POST-OPERATIVE COMPLICATIONS

Most of the patients had no early post-operative complication (90%). The commonest complication was anaemia affecting 4 patients (Figure 12). Two patients had superficial wound infection. Fifty six patients (93.3%) had wound healing within seven days post-operatively. Only one patient (1.7%) took between 15-21 days to heal (Figure 13).

Figure 12: Early post-operative complications (n = 60)

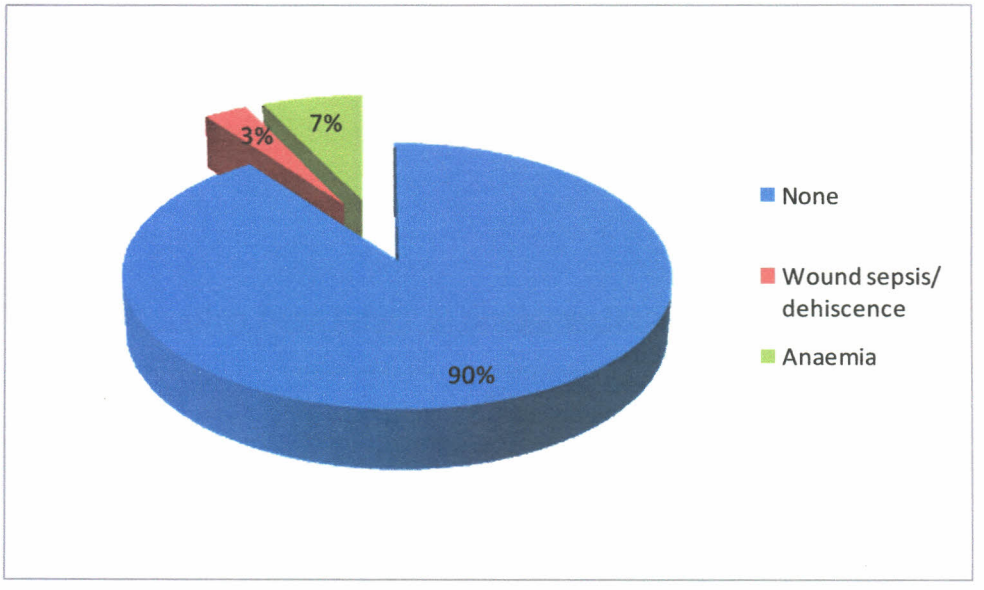
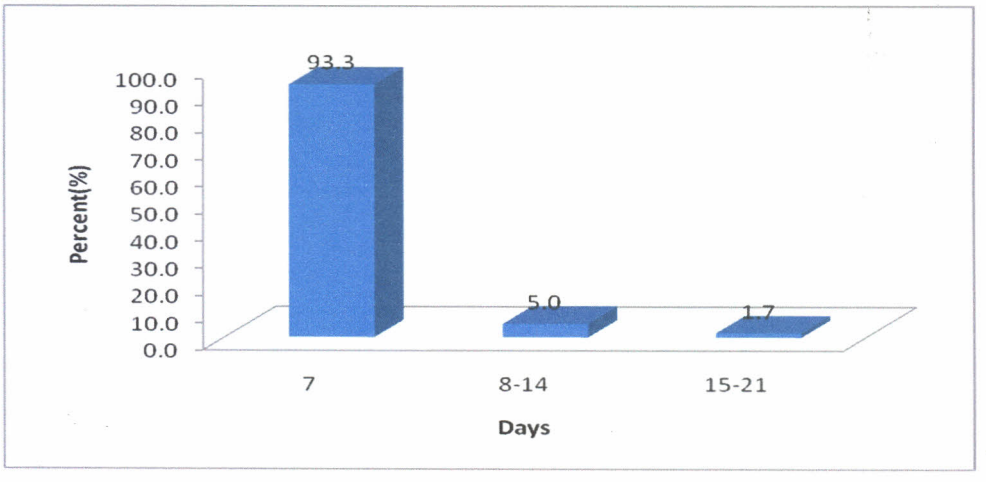


Figure 13: Duration of wound healing in days (n = 60)



N/B: All wounds had healed by 21 days post-operatively.

DURATION FROM INJURY TO DISCHARGE FROM HOSPITAL

The duration of stay to surgery was between1 to 140 days with a median of 7 days. The delay to surgery was mainly during the period between hospital admission and operative intervention. The duration from injury to surgery had a median of 26 days.

The total length of hospital stay was between 4 to 163 days with a median of 14 days (Table 4). Majority of the patients were operated between one to fourteen days after injury and there was no patient operated on within one day of injury (Figure 14).

Thirty five (58.7%) patients stayed in the hospital for a period of 1-14 days with only 4 patients (6.7%) staying beyond sixty days from admission to discharge (Figure 15).

Table 4: Duration from injury to discharge from hospital (n = 60)

Duration (days)	Mean (SD)	Median	Minimum	Maximum
Injury to hospital admission	31.9 (60.0)	5.0	1.0	268
Admission to surgery	17.4 (28.2)	7.0	1.0	140
Injury to surgery	49.3 (61.5)	26.0	4.0	269
Surgery to hospital discharge	8.2 (5.9)	6.5	2.0	42
Length of hospital stay (LOS)	25.6 (32.4)	14.0	4.0	163

N/B: Most of the parameters show a standard deviation (SD) more than the mean; hence the median values are used in the analysis.

Figure 14: Duration from injury to surgery (n = 60)

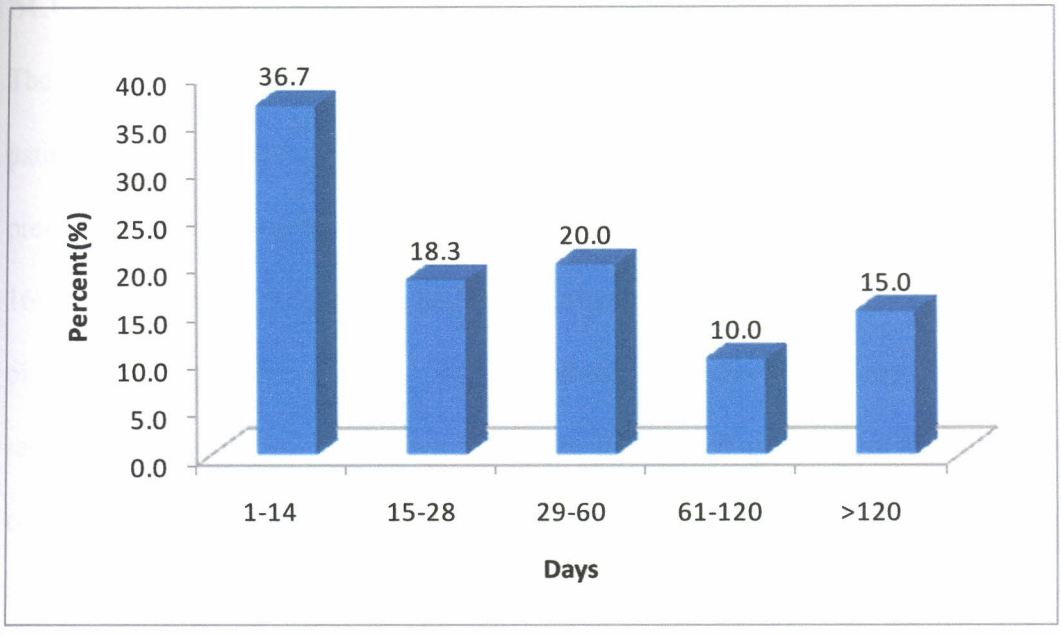
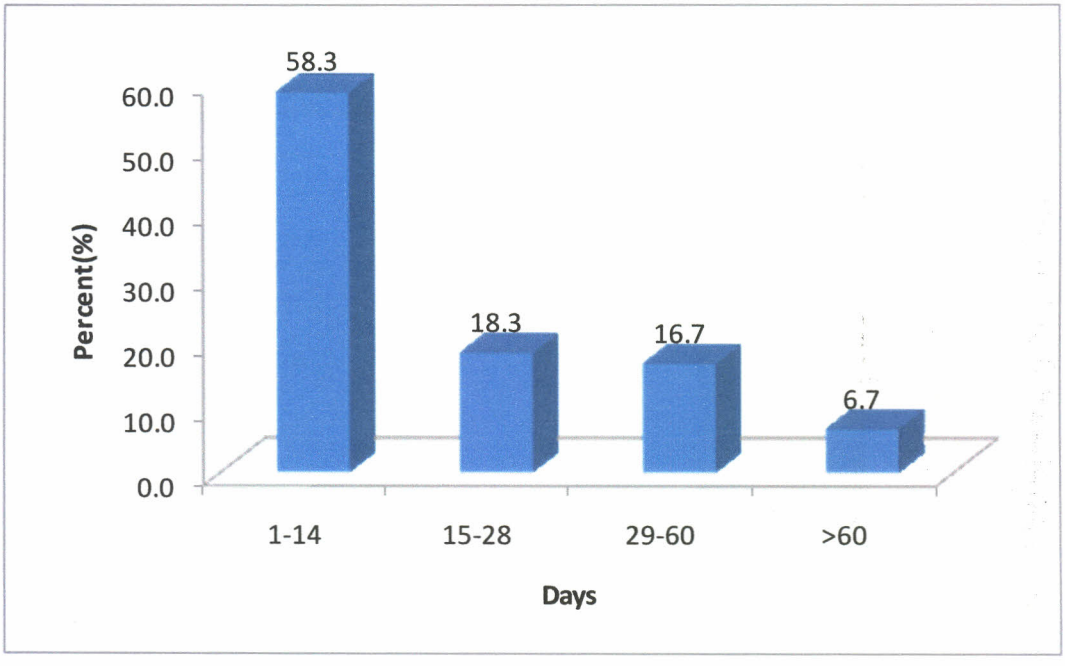


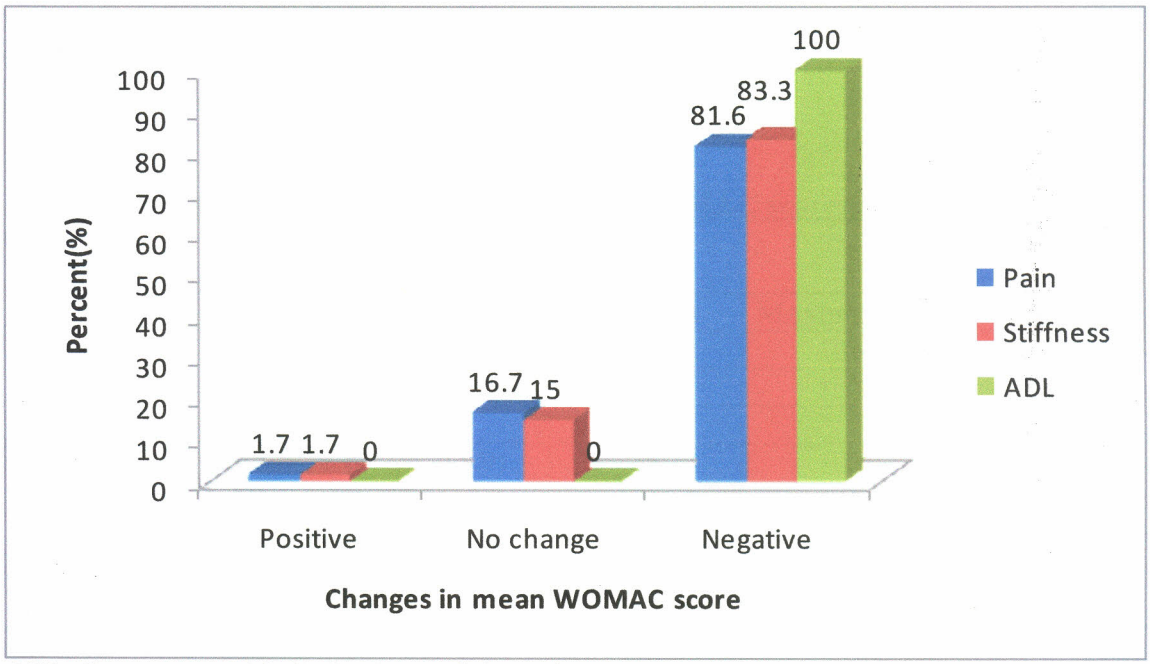
Figure 15: Length of hospital stay in days (n = 60)



PRE-INJURY VERSUS EARLY POST-OPERATIVE WOMAC SCORES

The ADL scores showed a negative outcome in all the patients while majority of the patients had a negative score for pain (81.6%) and stiffness (83.3%) outcome when the pre-injury and post-operative WOMAC scores were compared for each patient (Figure 16). Thus 88.3% of the patients had not recovered their pre-injury WOMAC scores (level of function) by three months post-operatively (Figure 16). There was a significant reduction in WOMAC scores when the pre-injury and post-operative mean scores are compared for pain (p value 0.003), Stiffness (p value 0.043) and ADL (p value 0.034) (Table 5). When the population was stratified by age, there was still a significant reduction in mean post-operative WOMAC scores in both age groups when compared to the pre-injury scores (Tables 6 and 7). The difference in the pre-injury WOMAC scores amongst the study population was not statistically significant.

Figure 16: Changes between pre-injury and post-operative WOMAC scores (n = 60)



N/B: Zero percent, 16.7% & 18.4% of the patients had not fully recovered their pre-injury level of function at 3 months as measured by ADL, stiffness and pain scores respectively.

Table 5: Mean pre-injury versus postoperative WOMAC scores (n= 60)

		Mean(SD)	Minimum	Maximum	*p value*
Pain	Before	99.3(1.95)	90	100	0.003*
	After	83.2(13.50)	35	100	
Stiffness	Before	97.5(6.78)	75	100	0.043*
	After	79.2(14.30)	25	100	
ADL	Before	98.5(4.01)	79.4	100	0.034*
	After	80.3(9.24)	57.4	94.1	

Significant *p* value < 0.05*

Table 6: Mean pre-injury versus postoperative WOMAC scores in patients aged ≤ 50 years (n = 29)

		Mean(SD)	Minimum	Maximum	*p value*
Pain	Before	99.5(1.6)	95	100	<0.001*
	After	78.3(14.6)	35	100	
Stiffness	Before	97.4(7.7)	75	100	<0.001*
	After	86.1(8.1)	35	100	
ADL	Before	98.9(3.0)	89.7	100	<0.001*
	After	80.1(8.1)	69	94	

Significant *p* value < 0.05*

Table7: Mean pre-injury versus postoperative WOMAC scores in patients aged > 50 years (n = 31)

		Mean(SD)	Minimum	Maximum	*p value*
Pain	Before	99.2(2.3)	90	100	<0.001*
	After	87.7(10.7)	70	100	
Stiffness	Before	97.7(5.9)	75	100	<0.001*
	After	72.8(15.9)	25	100	
ADL	Before	98.2(4.8)	79.4	100	<0.001*
	After	80.4(10.4)	57.4	94.1	

Significant *p* value < 0.05*

DIFFERENCE IN MEAN PAIN OUTCOME SCORES

There was a statistically significant difference in mean pain score at three months post-surgery based on age (*p* value 0.006) with those above 50 years of age having a better mean score for pain (less pain) compared to those aged 50 years and below (Table 8). Though there was no statistically significant difference in early post-operative mean pain scores based on presence or absence of co-morbidity and presence or absence of complication, the presence of co-morbidity or complication was associated with a poorer outcome (Tables 8, 9 & 10). When the study population was stratified by age (Tables 9 and 10), there was a statistically significant effect of treatment modality on pain for those of 50 years of age and below (*p* value 0.031) with those who underwent OS scoring poorly compared to those treated by HA.

Table 8: Difference in mean pain outcome scores according to age, sex, co-morbidity, treatment modality, surgical approach, type of anaesthesia and complication(s)

Factor	Pain score after operation				*P value*
	n	Mean(SD)	Minimum	Maximum	
Age in years					
≤ 50	29	78.3(14.6)	35	100	0.006*
51+	31	87.7(10.7)	70	100	
Sex					
Male	41	81.7(14.8)	35	100	0.222
Female	19	86.3(9.7)	70	100	
Co-morbidity					
Yes	22	78.6(17.5)	35	100	0.089
No	38	85.8(9.8)	70	100	
Treatment modality					
HA	20	83.0(20.3)	35	100	0.082
THA	16	89.1(9.5)	70	100	
OS	24	79.4(5.4)	70	90	
Surgical approach					
Lateral	31	82.3(8.74)	70	100	0.602
Anterolateral	29	84.1(17.30)	35	100	
Type of anaesthesia					
General	18	82.5(10.18)	55	100	0.094
Spinal	42	83.5(14.8)	35	100	
Complication (s)					
Yes	06	80.0(12.2)	70	100	0.961
No	54	83.5(13.7)	35	100	

Significant *p* value < 0.05*

Table 9: Difference in mean pain outcome scores according to sex, co-morbidity, treatment modality, surgical approach and type of anaesthesia in patients aged ≤ 50 years

Factor	Pain score after operation				*P value*
	n	Mean(SD)	Minimum	Maximum	
Sex					
Male	25	77.4(15.3)	35	100	0.429
Female	4	83.8(8.5)	75	95	
Co-morbidity					
Yes	7	65.0(21.4)	35	85	0.075
No	22	82.5(8.7)	70	100	
Treatment modality [β]					
HA	5	87.8(12.6)	76	100	0.031*
OS	22	79.6(5.1)	70	90	
Surgical approach					
Lateral	24	81.9(7.5)	70	100	0.157
Anterolateral	5	61.0(26.8)	35	100	
Type of anaesthesia					
General	14	81.8(9.9)	55	100	0.330
Spinal	15	75.0(17.6)	35	100	

Significant p value < 0.05. *

Only 2 patients in this age bracket underwent THA and so were not analyzed. [β]

Table 10: Difference in mean pain outcome scores according to sex, co-morbidity, treatment modality, surgical approach and type of anaesthesia in patients aged >50 years

Factor	Pain score after operation				*P value*
	n	Mean(SD)	Minimum	Maximum	
Sex					
Male	16	88.4(11.5)	70	100	0.716
Female	15	87.0(10.1)	70	100	
Co-morbidity					
Yes	15	85.0(11.3)	70	100	0.172
No	16	90.3(9.7)	70	100	
Treatment modality [α]					
HA	15	89.0(11.7)	70	100	0.776
THA	14	87.9(9.6)	70	100	
Surgical approach					
Lateral	7	83.57(12.8)	70	100	0.445
Anterolateral	24	88.96(10.0)	70	100	
Type of anaesthesia					
General	4	85.0(12.2)	70	100	0.562
Spinal	27	88.2(10.7)	70	100	

Only 2 patients in this age bracket underwent OS and so were not analyzed. [α]

DIFFERENCE IN MEAN STIFFNESS OUTCOME SCORES

There was a statistically significant difference in mean stiffness score at three months post-operatively based on age (p value <0.0001), with better score for those 50 years of age and below; and based on sex (p value 0.027), with better score amongst the male population. When stratified by age (Table 12 and 13), there was no statistically significant difference in mean stiffness outcome score based on sex. There was no statistically significant difference in mean stiffness outcome scores at three months post-operatively based on comorbidity and presence or absence of complications though those with either co-morbidities or complications had a poorer score (Table 11).

Table 11: Difference in mean stiffness outcome scores according to age, sex, co-morbidity, treatment modality, surgical approach, type of anaesthesia and complication(s)

Factor	Stiffness score after operation				*P value*
	n	Mean(SD)	Minimum	Maximum	
Age in years					
≤ 50	29	86.1(8.1)	75	100	<0.0001*
51+	31	72.8(15.9)	25	100	
Sex					
Male	41	82.0(12.9)	50	100	0.027*
Female	19	80.9(8.4)	25	100	
Co-morbidity					
Yes	22	75.3(10.2)	63	88	0.109
No	38	81.5(15.9)	25	100	
Treatment modality					
HA	20	74.6(17.9)	25	100	0.195
THA	16	80.7(14.3)	63	100	
OS	24	82.1(9.9)	50	88	
Surgical approach					
Lateral	31	82.2(12.03)	50	100	0.707
Anterolateral	29	76.0(16.0)	25	100	
Type of anaesthesia					
General	18	80.8(13.1)	50	100	0.747
Spinal	42	78.5(14.9)	25	100	
Complication (s)					
Yes	06	75.3(11.2)	63	88	0.426
No	54	79.7(14.6)	25	100	

Significant p value < 0.05*

Table 12: Difference in mean stiffness outcome scores according to sex, co-morbidity, treatment modality, surgical approach and type of anaesthesia in patients aged ≤ 50 years

Factor	Stiffness score after operation				*P value*
	n	Mean(SD)	Minimum	Maximum	
Sex					
Male	25	85.8(7.9)	75	100	0.662
Female	4	87.8(10.2)	75	100	
Co-morbidity					
Yes	7	82.4(6.9)	75	88	0.175
No	22	87.2(8.2)	75	100	
Treatment modality[β]					
HA	5	87.6(12.5)	75	100	0.389
OS	22	84.5(5.9)	75	88	
Surgical approach					
Lateral	24	86.3(7.7)	75	100	0.328
Anterolateral	5	85.2(10.5)	75	100	
Type of anaesthesia					
General	14	85.1(8.8)	75	100	0.224
Spinal	15	87.0(7.5)	75	100	

Only 2 patients in the age bracket underwent THA and so were not analyzed. [β]

Table 13: Difference in mean stiffness outcome scores according to sex, co-morbidity, treatment modality, surgical approach and type of anaesthesia in patients aged >50 years

Factor	Stiffness score after operation				*P value*
	n	Mean(SD)	Minimum	Maximum	
Sex					
Male	16	76.0(16.7)	50	100	0.256
Female	15	69.4(14.9)	25	88	
Co-morbidity					
Yes	15	72.0(9.9)	63	88	0.790
No	16	73.6(20.4)	25	100	
Treatment modality[α]					
HA	15	70.2(17.6)	25	100	0.187
THA	14	77.9(13.0)	63	100	
Surgical approach					
Lateral	7	68.3(14.3)	50	88	0.915
Anterolateral	24	74.13(16.4)	25	100	
Type of anaesthesia					
General	4	66.0(15.9)	50	88	0.998
Spinal	27	73.8(16.0)	25	100	

Only 2 patients in this age bracket underwent OS and so were not analyzed. [α]

DIFFERENCE IN MEAN ADL OUTCOME SCORES

There was a statistically significant difference in ADL status at 3 months post-surgery based on treatment modality (*p* value 0.002) with OS group having the lowest mean score of 75.2 (SD 6.7). Though there was no statistically significant difference in mean ADL outcome scores based on age, the presence or absence of co-morbidity (or complication), the presence of co-morbidity or complication was associated with a poorer mean ADL score at three months post-operatively (Table 14).

Table 14: Difference in mean ADL outcome scores according to age, sex, co-morbidity treatment modality, surgical approach, type of anaesthesia and complication(s)

Factor	ADL score after operation				*P value*
	n	Mean(SD)	Minimum	Maximum	
Age in years					
≤ 50	29	80.1(8.1)	69.2	94.1	0.906
51+	31	80.4(10.4)	57.4	94.1	
Sex					
Male	41	80.0(9.7)	57.4	94.1	0.730
Female	19	80.8(8.4)	58.8	94.1	
Co-morbidity					
Yes	22	78.1(9.6)	57.4	89.7	0.164
No	38	81.5(8.9)	61.8	94.1	
Treatment modality					
HA	20	83.4(9.4)	58.8	94.1	0.002*
THA	16	83.9(9.3)	57.4	94.1	
OS	24	75.2(6.7)	60.3	88.2	
Surgical approach					
Lateral	31	76.1(9.3)	57.4	94.12	0.295
Anterolateral	29	84.7(6.9)	72.1	94.12	
Type of anaesthesia					
General	18	76.8(9.2)	60.3	94.12	0.659
Spinal	42	81.8(9.0)	57.4	94.12	
Complication (s)					
Yes	06	71.6(8.1)	57	82	0.257
No	54	81.2(8.9)	59	94	

Significant *p* value < 0.05*

When the study population was stratified by age, there was still a statistically significant difference in mean ADL outcome scores for those of 50 years of age and below based on treatment modality (p value <0.0001) with those treated by OS scoring poorly compared to the HA group (Table 15). There was also a statistically significant difference in mean ADL outcome score for those more than 50 years of age based on presence or absence of co-morbidity (p value 0.016) and type of surgical approach (p value 0.007). Those with co-morbidity scored poorly compared to those without comorbidity (means of 75.9 and 84.7 respectively) while those who underwent surgery via the lateral approach scored poorly compared to those operated via the anterolateral approach (means of 68.1 and 84.0 respectively). There was no statistically significant difference in ADL outcome between the HA and THA groups (Table 16).

Table 15: Difference in mean ADL outcome scores according to sex, co-morbidity, treatment modality, surgical approach and type of anaesthesia in patients aged ≤ 50 years

Factor	ADL score after operation				*P value*
	n	Mean(SD)	Minimum	Maximum	
Sex					
Male	25	79.9(8.1)	69.1	94.1	0.769
Female	4	81.3(9.1)	73.5	91.2	
Co-morbidity *					
Yes	7	79.3(8.2)	69.1	94.1	0.326
No	22	82.8(7.6)	70.6	89.7	
Treatment modality[β]					
HA	5	90.3(2.5)	88.2	94.1	<0.0001*
OS	22	76.5(5.3)	69.1	88.2	
Surgical approach					
Lateral	24	78.5(7.6)	69.1	94.1	0.169
Anterolateral	5	87.9(5.3)	79.4	94.1	
Type of anaesthesia					
General	14	78.9(8.1)	69.1	94.1	0.959
Spinal	15	81.3(8.1)	70.6	94.1	

Significant p value < 0.05*

Only 2 patients in the age bracket underwent THA and so were not analyzed.[β]

Table 16: Difference in mean ADL outcome scores with sex, co-morbidity, treatment modality, surgical approach and type of anaesthesia in patients aged >50 years

Factor	ADL score after operation				*P value*
	n	Mean(SD)	Minimum	Maximum	
Sex					
Male	16	80.1(12.1)	57.4	94.1	0.849
Female	15	80.1(8.6)	58.8	94.1	
Co-morbidity					
Yes	15	75.9(9.9)	57.4	86.8	0.016*
No	16	84.7(9.1)	61.8	94.1	
Treatment modality [α]					
HA	15	81.1(9.8)	58.8	94.1	0.692
THA	14	82.5(9.0)	57.4	94.1	
Surgical approach					
Lateral	7	68.1(10.8)	57.4	82.4	0.007*
Anterolateral	24	84.0(7.1)	72.1	94.1	
Type of anaesthesia					
General	4	69.5(9.8)	60.3	77.9	0.694
Spinal	27	82.0(9.6)	57.4	94.1	

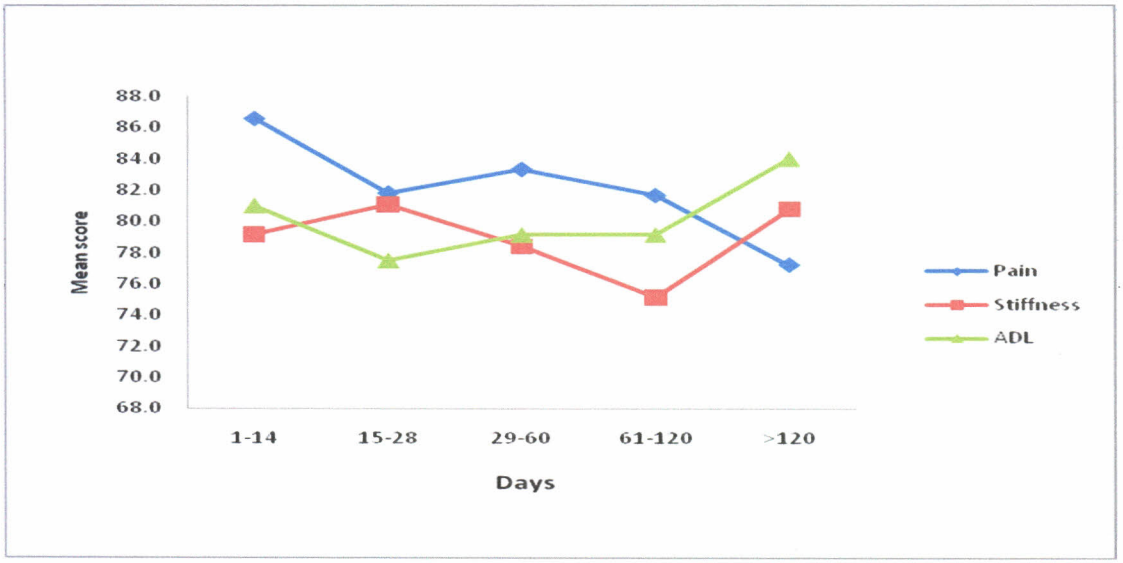
Significant p value < 0.05 *

Only 2 patients in this age bracket underwent OS and so were not analyzed. [α]

EFFECT OF DURATION TO SURGERY ON EARLY FUNCTIONAL OUTCOME

The mean outcome scores for pain, stiffness and ADL at three months post-operatively had no statistically significant correlation with duration from fracture to surgery (*p* values 0.514, 0.941 and 0.603 respectively).

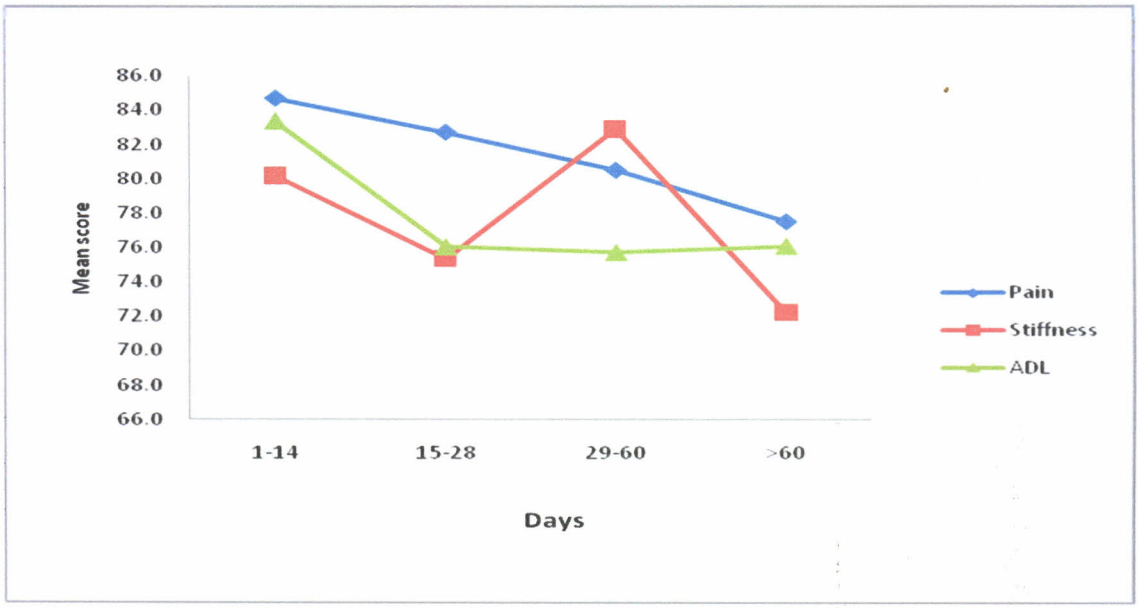
Figure 17: Difference in mean WOMAC outcome scores according to duration from fracture to surgery



EFFECT OF LENGTH OF STAY ON EARLY FUNCTIONAL OUTCOME

The mean outcome scores for ADL at three months post-operatively had a statistically significant correlation with LOS (*p* value 0.020). The mean outcome scores for pain and stiffness had no statistically significant correlation with LOS (*p* values 0.677 and 0.473 respectively), though the mean pain outcome scores are poorer with prolonged LOS (Figure 18).

Figure 18: Difference in mean WOMAC outcome scores according to length of hospital stay



DISCUSSION

How well patients are able to regain their pre-injury level of function and independence is a measure of the success or failure of a treatment regime[41]. To date there are still controversies in the choice of appropriate treatment for displaced femoral neck fractures and the problem is whether to reduce the fracture and use internal fixation or perform partial or total hip replacement arthroplasty.[5,6] Locally, the choice of an appropriate treatment modality was noted to be guided by both the principles applicable internationally[6,9,46,51,56-59,61-64] and also the affordability of the necessary implants on the part of the patient.

There was a male preponderance noted in the study and majority of the patients were relatively young (mean age, 51.6 ± 18.2 years). This was consistent with findings reported in other local series.[2,13] Studies from the USA and western European countries however, indicate a female preponderance with a relatively elderly population (mean ages above 70 years).[17,19] Nyarango[2] and Ochiel[16] in separate local studies found that these fractures are commoner in the younger age group (mean ages of 45 and 53 years respectively), though Ochiel[16] further noted that the male population was younger than the females; findings corroborated by this study. The younger population noted in the local studies compared to the western series, could probably be due to the relatively shorter life expectancy in the local setting compared to the western European countries.[18] Nyarango[2] found that RTI was the commonest etiologic factor (84.5%), while Ochiel[16] found that a fall with minor injury predominate (48%). The latter is also the commonest finding in western series.[17,19] This study, found that severe trauma resulted in equal proportions of FNF (50% each) just as minor trauma, possibly due to the almost equal

distribution of the study population (mean 51.6 years and median 51 years) and the improving life expectancy locally[18] with a more elderly population than before. A fall, either with mild or severe trauma, was the commonest etiologic factor (66.7%) though RTI resulted in a significant proportion of the injuries (31.7%). RTI was the main etiologic factor in those of 50 years and below while fall with minor trauma was the dominant etiologic factor in those above 50 years of age. The increased predisposition to a fall and the increased rate of osteoporosis with advancing age makes falling, especially with minor trauma the commonest etiologic factor in the elderly population.[21,22,25]

It is worth noting that this study only looked at skeletally mature patients who underwent operative treatment for displaced FNF. Nyarango's study[2], undertaken more than twenty years ago, looked at those who underwent operative treatment for FNF irrespective of age or Garden's class. Many changes have occurred especially in the demographics, which are likely to affect not only the etiologic patterns but also the subsequent treatment outcome. Ochiel's study[16] looked at all cases of FNF irrespective of age, Garden's class or treatment modality despite being a more recent study.

Pre-injury functional status versus early post-operative functional outcome

At three months postoperatively, most patients had not fully recovered their pre-injury level of function and independence. All the patients had not fully recovered there pre-injury ADL function and only 18.4% and 16.7% respectively had recovered their pre-injury function as measured by pain and stiffness score.

Koot et al[7] in a study looking at patients aged 55-102 years who underwent OS and HA, found that at 4 months, only 36% of the patients had fully recovered their mobility while the overral functional recovery was 29%. Though this population was more elderly, the

functional results seem to be better than the local findings. This probably could be due to better rehabilitation facilities, still lacking in our set-up.

Effect of age on early post-operative functional outcome

Those older than 50 years had a better functional outcome for pain (p value 0.006), but a poorer outcome for stiffness (p value <0.0001) than those of 50 years and below. Age had no significant effect on ADL. However, majority of those above 50 years of age in this study underwent treatment by arthroplasty while those of 50 years and below were mainly treated using OS. This can explain the poorer outcome for pain in the younger group since OS is associated with a poorer outcome compared to arthroplasty as found in this study and other series.[6,9,56-58] Age has been shown in many studies to influence functional outcome, with advancing age generally being associated with a poor outcome.[6,7,10] Warrakah[15] however, found no significant effect of age on functional performance though his study population was slightly elderly (average age of 62 years) hence relatively of the same age stratum.

Effect of sex on early post-operative functional outcome

Sex had no significant effect on early post-operative pain and ADL outcome. There was a statistically significant effect on stiffness outcome (p value 0.027), with better outcome amongst the male population, though when corrected for age, the difference was not significant.

Sex has been shown to have no influence on functional outcome in other series.[15,44] Merchant et al[44] found that sex has no influence on the post-operative functional outcome though they found high rates of complication in females than males.

Effect of co-morbidity on early post-operative functional outcome

Co-morbidity has been found to be associated with a negative impact on functional outcome in many studies.[6,7,37] This study found that the presence of co-morbidity was associated with a poor functional outcome though this was not statistically significant. However, when stratified by age, there was a statistically significant difference in ADL outcome for those above 50 years of age with those having co-morbidity scoring poorly than those without co-morbidity (*p* value 0.016).

Effect of treatment modality on early post-operative functional outcome

There are controversies in the choice of the best treatment modality for displaced FNF especially in the middle age groups. In an attempt to circumvent this challenge, several studies have compared outcome following the use of these modalities.[6,9,46,51,56-59,61-64] In this study, it was noted that arthroplasty was mainly used amongst patients older than 30 years while OS was popular in those younger than 50 years. This was consistent with the understanding of the pattern of blood supply to the hip and healing of FNFs and also other treatment choice determinants already alluded to earlier in this dissertation.[4,8,9,37]

This study found that the HA group had a better outcome for pain (*p* value 0.031) and ADL (*p* value <0.0001) compared to OS. Both THA and HA groups had a better outcome for ADL compared to OS (*p* value 0.002). There was no statistically significant difference in stiffness outcome between the THA/HA group and OS group. Many studies have found better pain relief and mobility following HA compared to OS.[6,9,46,64] Lu-Yao et al[6] in a meta-analysis of 106 published reports, found better pain relief and better mobility in the arthroplasty group (HA or THA) compared to the OS group. The difference for mobility in this study however, was not statistically significant (*p* value

0.48). Other studies comparing THA and OS have found better function and less pronounced decline in the health-related quality of life following THA than OS.[39,56-58] However, Bhandari et al[51] in a meta-analysis of 14 randomized controlled trials found no significant difference in functional outcome between arthroplasty and OS (relative risk, 1.12 for pain relief and 0.99 for function). Söreide et al[59] reported similar findings.

Most studies comparing HA and THA have only looked at the long-term functional outcome at periods ranging from 12 months to 13 years with varying results. This study found no difference in early functional outcome between the HA and THA groups. Squires et al[60] found poorer functional outcome following HA compared to THA while Narayan et al[61] found no statistically significant difference in functional outcome. Smrke et al[62] found, HA to give a better range of motion compared to THA but the total Harris hip score showed no statistically significant difference. Ravikumar et al,[63] found that both OS and HA resulted in the poorest functional outcome compared to THA.

Effect of duration from fracture to surgery on early post-operative functional outcome

The in-hospital delay to surgery had a median of 7 days while the duration from injury to surgery had a median of 26 days. Nyarango[6] had previously reported that the in-hospital delay can take up to 20 weeks, mainly worse amongst the cases referred from other institutions to KNH. This study found no significant effect of the duration from injury to surgery on functional outcome, findings corroborated by other studies.[49,50] Delay to surgery could have been due to the delay by the patients or their families in raising funds to meet the cost of the necessary implants despite a good socio-economic standing (65% on employment and 75% literacy level). Most of the patients were not economically productive during this period.

Effect of length of in-hospital stay (LOS) on early post-operative functional outcome

The LOS was mainly contributed to by the duration from hospital admission to operative intervention (median 7 days). Prolonged in-hospital stay was associated with a poor ADL outcome at three months post-operatively (p value 0.020) while pain and stiffness outcome were not affected by the length of in-hospital stay. Warrakah[15] found poor function with prolonged post-operative in-hospital stay.

Effect of surgical approach on early post-operative functional outcome

The lateral (Hardinge or Liverpool) approach was the preferred method of access to the hip especially for OS. These findings were consistent with a previous report by Warrakah[15] who found that the lateral approach was more popular locally being used in 84% of the patients who underwent Austin Moore HA. The antero-lateral (Watson-Jones) approach was associated with a better ADL outcome amongst patients above 50 years of age when compared to the lateral approach (p value 0.007), though there was no statistically significant difference in postoperative pain and stiffness outcome between these two groups. Amongst the patients undergoing Austin Moore HA, Warrakah[15] found that the lateral approach was associated with a better functional outcome compared to the antero-lateral approach. In this study, 82% of the patients who underwent treatment by the lateral approach had satisfactory results compared to 66% for antero-lateral approach and 50% for anterior approach. Most other studies however, compared anterior (Smith-Petersen) and posterior (Moore) approaches, none of which was used amongst the study population.[46,64] These studies have shown that a posterior approach is associated with a better functional outcome but more complications when compared to the anterior approach.[46,64]

Effect of type of anaesthesia on early post-operative functional outcome

Spinal anaesthesia was used in the majority of the patients (70%) in this study. There was no significant difference in outcome between those treated under general anaesthesia and the spinal anaesthesia group. Few published studies have looked at the difference in outcome following either regional or general anaesthesia. In a meta-analysis of 15 randomized trials, Urwin et al[47] found fewer incidences of mortality and deep vein thrombosis in the regional anaesthesia group compared to general anaesthesia. These studies however, did not assess functional outcome.

Effect of early post-operative complication on early post-operative functional outcome

Most of the patients had no post-operative complication (90%). Anaemia was the commonest complication affecting 4 patients (7%) while two patients (3%) had wound sepsis/dehiscence. Nyarango[2] and Warrakah[15] separately found that wound sepsis was the commonest post-operative complication. Nyarango[2] found an infection rate of 8.5% in his study. The low rate of wound sepsis currently reported could be due to the widespread use of prophylactic antibiotics noted in the current study.

The study found that the presence of complication(s) was associated with a poor early post-operative functional outcome though this was not statistically significant. Anaemia has been shown to independently impact negatively on mobility[45]. Other postoperative complications are also associated with poor functional outcome.[6,7,9,23,24,37,41,44]

Some other studies however, found no effect of post-operative complication(s) on functional outcome.[8,51] Bhandari et al[51] in a meta-analysis of 14 published reports, found no effect of post-operative complication(s) on functional outcome.

CONCLUSIONS:

This study reveals that:

1. Majority of the patients who undergo operative treatment of displaced fracture neck of femur at KNH and KMH are males (male: female ratio, 2.15: 1).
2. The most affected age class (31-50 years) comprises people in the economic prime age.
3. The commonest etiologic factor is a fall either with low energy trauma or severe trauma, though Road Traffic Injuries (RTI) still contributes to a significant proportion of the fractures.
4. The delay to surgery is mainly from admission to operative intervention (within the hospital) and not the period from injury to hospital admission.
5. Hypertension is the commonest co-morbid condition amongst patients undergoing operative treatment for displaced FNF at the KNH and KMH.
6. The commonly used treatment modality is OS with THA being the least used modality of treatment, though OS is mainly used in those below 51 years of age.
7. There is a significant effect of age on early functional outcome with those above 50 years of age having less pain and more stiffness compared to those of 50 years and below though age has no significant effect on ADL outcome.
8. Sex has no significant effect on early functional outcome for pain, stiffness and ADL.
9. The presence of co-morbidity is associated with a poorer functional outcome for pain, stiffness and ADL though this difference is only significant for ADL outcome in those above 50 years of age.

10. There is no significant difference in early post-operative functional outcome for pain, stiffness and ADL between those treated using HA and THA.
11. The early post-operative functional outcome for ADL is better for those patients who undergo treatment by HA or THA compared to those treated by OS.
12. Duration from fracture to surgery (delay to surgery) has no significant effect on functional outcome.
13. The prolonged in-hospital stay (LOS) is mainly pre-operative, and is associated with poor ADL outcome but no effect on pain and stiffness outcome.
14. The antero-lateral surgical approach is associated with a better ADL outcome compared to the lateral approach in patients above 50 years of age though there is no significant effect on pain and stiffness outcome.
15. There is no statistically significant difference in early functional outcome between spinal anaesthesia and general anaesthesia in the treatment of FNF.
16. The commonest early post-operative complication is anaemia though early post-operative complication has no significant effect on early functional outcome.

Finally, it can be stated that:

At three months post-operatively, most patients have not fully recovered their pre-injury level of function and independence. Majority of the fractures occur in the younger, economically productive age group hence FNF has a negative socio-economic impact locally. Both Hemi-arthroplasty and Total Hip Arthroplasty are associated with better early functional outcome compared to Osteosynthesis.

RECOMMENDATIONS

The following recommendations are made:

1. Long term randomized multicenter studies should be undertaken within the country to determine the long-term functional outcome following operative treatment of FNF in Kenya.
2. Local studies should be undertaken to look at the other outcome measures including complications and mortality both in the short-term and long-term.
3. A study should be undertaken to look at the socio-economic impact of fracture neck of femur and its treatment locally.
4. A study should be undertaken to find out the main cause of delay to surgery and prolonged in-hospital stay by the patients, though anecdotal evidence suggests that the in-ability by the patients to buy the necessary implants for operative treatment contributes to the delay.
5. Measures should be instituted to ameliorate the incidence of fracture neck of femur such as execution of stringent traffic rules (the *"Michuki rules"*). RTI is one of the commonest and preventable causative factors.
6. Measures should be instituted to reduce the duration of in-hospital stay by ensuring prompt treatment since prolonged hospital stay has been found to be associated with poor functional outcome. This prolonged stay is contributed to mainly by the pre-operative in-hospital stay.

REFERENCES:

1. **Baudoin C., Fardellone P., Bean K., et al.** Clinical outcomes and mortality after hip fracture: a 2-year follow-up study. *Bone* 1996; ***18:*** *149S–157S.*

2. **Nyarango P.K.,** A critical analysis of operative management of fracture neck of femur at the Kenyatta National Hospital Orthopedic Unit over a five year period. *University of Nairobi 1982; M.Med (Surgery), Dissertation.*

3. **De Laet C.E, van Hout B.A, Burger H, et al.** Incremental cost of medical care after hip fracture and first vertebral fracture: the Rotterdam study. *Osteoporos Int 1999;* ***10:*** *66–72.*

4. **Swiontkowski M.F.** Intracapsular fractures of the hip. *J Bone Joint Surg Am 1994;* ***76:*** *129–138.*

5. **D'Arcy J., and Devas M.** Treatment of fractures of the femoral neck by replacement with the Thompson prosthesis. *J. Bone Joint Surg. 1976;* ***58-B (3)****:279-286.*

6. **Lu-Yao G.L., Keller R.B., Littenberg B., et al.** Outcomes after displaced fractures of the femoral neck. A meta-analysis of one hundred and six published reports. *J. Bone Joint Surg. 1994;* ***76****: 15-25.*

7. **Koot V.C.M., Peeters P.H.M., de Jong J.R., et al.** Functional results after treatment of hip fracture: a multicentre, prospective study in 215 patients. *Eur J Surg 2000;* ***166****: 480-485.*

8. **Ly T.V., Swiontkowski M.F.** Treatment of femoral neck fractures in young adults. *J Bone Joint Surg Am 2008;* ***90:*** *2254–2266.*

9. **Rogmark C., Carlsson A., Johnell O., et al.** A prospective randomized trial of internal fixation versus arthroplasty for displaced fractures of the neck of the femur. Functional outcome for 450 patients at two years. *J Bone Joint Surg Br 2002;* ***84:*** *183–188.*

10. **Cornwall R., Gilbert M.S., Koval K.J., et al.** Functional outcomes and mortality vary among different types of hip fractures. *Clin Orthop & Related Research. 2004(Aug);* ***425****:64-71.*

11. **Khan R.J., MacDowell A., Crossman P., et al.** Cemented or uncemented hemiarthroplasty for displaced intracapsular femoral neck fractures. *Int Orthop 2002;* ***26:*** *229–232.*

12. **Mohamed K., Copeland G.P., Boot D.A., et al.** An assessment of the POSSUM system in orthopaedic surgery. *J Bone Joint Surg Br 2002;* ***84-B:*** *735–739.*

13. **Ashby E., Grocott M.P.W., Haddad F.S.** Outcome measures for orthopaedic interventions on the hip. *J Bone Joint Surg Br 2008; **90-B:** 545–549.*

14. **Suk M., Norvell D.C, Hanson B., et al.** Evidence-based orthopaedic surgery: What is evidence without the outcomes? *J Am Acad Orthop Surg 2008; 16: 123-129.*

15. **Warrakah M.,** Review of functional performance after Austin Moore Arthroplasty in femoral neck fractures. *University of Nairobi 1990; M.Med (Surgery), Dissertation.*

16. **Ochiel D.F.O.,** Review of management of femoral neck fractures in Kenyatta National Hospital. *University of Nairobi 2007; M.Med (Surgery), Dissertation.*

17. **Cooper C., Campion G. & Melton L.J., III.** Hip fractures in the elderly: a world-wide projection. *Osteoporos Int 1992; **2:** 285–289.*

18. **Population Division of the Department of Economic and Social Affairs of the United Nations Secretariat.** World Population Prospects: *The 2008 Revision.*

19. **Parkkari J., Kannus P., Niemi S., et al.** Increasing age-adjusted incidence of hip fractures in Finland: the number and incidence of fractures in 1970–1991 and prediction for the future. *Calcif Tissue Int 1994; **55:** 342–345.*

20. **Markey K.L.** Stress fractures. *Clin Sports Med.* Apr 1987; **6(2):**405-25.

21. **Kanis J.A. & McCloskey E.V.** Evaluation of the risk of hip fracture. *Bone 1996; **18:** 127S–132S.*

22. **van Staa T.P., Leufkens H.G., Abenhaim L., et al.** Oral corticosteroids and fracture risk: relationship to daily and cumulative doses. *Rheumatology (Oxford) 2000; **39:** 1383–1389.*

23. **Wejda B., Hintze G., Katschinski B., et al.** Hip fractures and the thyroid: a case-control study. *J Intern Med 1995; **237:** 241–247.*

24. **Forsén L., Meyer H.E., Midthjell K., et al.** Diabetes mellitus and the incidence of hip fracture: results from the Nord-Trondelag Health Survey. *Diabetologia 1999; **42:** 920–925.*

25. **Hayes W.C., Myers E.R., Morris J.N., et al.** Impact near the hip dominates fracture risk in elderly nursing home residents who fall. *Calcif Tissue Int 1993; **52:** 192–198.*

26. **Ratliff A.H.C.,** Fractures of the neck of femur in children. *J Bone Joint Surg Am 1962; **44-B:** 528–542.*

27. **Saidi H.S., Macharia M.W., Ating'a J.E.O.** Outcome for hospitalized road trauma patients at a tertiary hospital in Kenya. *European Journal of Trauma 2005; **4:** 401-406.*

28. **Crock H.V.** An Atlas of the arterial supply of the head and neck of the femur in man. *Clin Orthop. 1980; **152:**17-25.*

29. **Trueta J.** The normal vascular anatomy of the human femoral head during growth. *J Bone Joint Surg. 1957; **39-B**: 358-394.*

30. **Crawfurd E.J.P., Emery R.J.H., Hansell D.M., et al.** Capsular distension and Intracapsular pressure in subcapital fractures of the femur. *J Bone Joint Surg (Br) 1988; **70-B**: 195-8.*

31. **Pauwels F.** Biomechanics of the normal and diseased hip, *1975.*

32. **Blount W.P.,** Don't throw away the cane. *J Bone Joint Surg 1956; **38-A:** 695-708.*

33. **American College of Surgeons Committee on Trauma**. Advanced trauma life support for doctors. *8th edition. Chicago (IL): American College of Surgeons; 2009.*

34. **Devas M.B.,** Stress fractures of the femoral neck. *J Bone Joint Surg. 1965; **47B**:728-738.*

35. **Bartonicek J.** Pauwels' classification of femoral neck fractures: correct interpretation of the original. *J Orthop Trauma 2001; **15**: 358–360.*

36. **Garden R.S.** Stability and union in subcapital fractures of the femur. *J Bone Joint Surg Br 1964; **46:** 630–647.*

37. **Israr A.** Mortality and morbidity in elderly patients with fracture neck of femur treated by Hemiarthroplasty. *JCPSP 2006; **16 (10)**:655-658.*

38. **Delamarter R. & Moreland J.R.** Treatment of acute femoral neck fractures with total hip arthroplasty. *Clin Orthop 1987; 68–74.*

39. **Johansson T., Jacobsson S.A., Ivarsson I., et al.** Internal fixation versus total hip arthroplasty in the treatment of displaced femoral neck fractures: a prospective randomized study of 100 hips. *Acta Orthop Scand 2000; **71:** 597–602.*

40. **Winter W.G.** Non-operative treatment of proximal femoral fractures in the demented, non-ambulatory patient. *Clin Orthop 1987; 97–103.*

41. **Koval K.J. & Zuckerman J.D.** Functional recovery after fracture of the hip. *J Bone Joint Surg Am 1994; **76:** 751–758.*

42. **Röder C., Staub L.P, Eggli S., et al.** Influence of preoperative functional status on outcome after total hip arthroplasty, *J Bone Joint Surg Am* 2007; **89:11**-17.

43. **Nilsdotter A.K., Stefan L. L., Klässbo M., et al.** Hip disability and osteoarthritis outcome score (HOOS) – validity and responsiveness in total hip replacement, *BMC Musculoskelet Disord. 2003; **4:10**.*

44. **Merchant R.A., Lui K.L., Ismail N.H., et al.** The relationship between postoperative complications and outcomes after hip fracture surgery. *Ann Acad Med Singapore 2005; **34**: 163-168.*

45. **Foss N.B., Kristensen M.T., Kehlet H.** Anaemia impedes functional mobility after hip fracture surgery. *Age and ageing 2008; **37:** 173-178.*

46. **Sikorski J.M. & Barrington R.** Internal fixation versus hemiarthroplasty for the displaced subcapital fracture of the femur. A prospective randomized study. *J Bone Joint Surg Br 1981; **63–B:** 357–361.*

47. **Urwin S.C., Parker M.J., Griffiths R.** General versus regional anaesthesia for hip fracture surgery: a meta-analysis of randomized trials. *Br J Anaesth 2000; **84**:450-5.*

48. **Taine W.H. & Armour P.C.** Primary total hip replacement for displaced subcapital fractures of the femur. *J Bone Joint Surg Br 1985; **67:** 214–217.*

49. **Orosz G.M., Magaziner J., Hannan E.L., et al.** Association of timing of surgery for hip fracture and patient outcomes. *JAMA 2004; **291(14):**1738-1743.*

50. **Jain R., Koo M., Kreder H.S., et al.** Comparison of early and delayed fixation of subcapital hip fractures in patients sixty years of age or less. *J Bone Joint Surg Am 2002; **84:** 1605–1612.*

51. **Bhandari M., Devereaux P.J., Swiontkowski M.F., et al.** Internal fixation compared with arthroplasty for displaced fractures of the femoral neck: A meta-analysis. *J Bone Joint Surg Am 2003; **85:** 1673–1681.*

52. **Herngren B., Mörk-Petersen F. & Bauer M.** Uppsala screws or Hansson pins for internal fixation of femoral neck fractures? A prospective study of 180 cases. *Acta Orthop Scand 1992; **63:** 41–46.*

53. **Lagerby M., Asplund S. & Ringqvist I.** Cannulated screws for fixation of femoral neck fractures. No difference between Uppsala screws and Richards screws in a randomized prospective study of 268 cases. *Acta Orthop Scand 1998; **69:** 387–391.*

54. **Christie J., Howie C.R. & Armour P.C.** Fixation of displaced subcapital femoral fractures. Compression screw fixation versus double divergent pins. *J Bone Joint Surg Br 1988; **70:** 199–201.*

55. **Godsiff S.P., Emery R.J., Heywood-Waddington M.B. et al.** Cemented versus uncemented femoral components in the ring hip prosthesis. *J Bone Joint Surg Br 1992; **74:** 822–824.*

56. **Blomfeldt R., Tornkvist H., Ponzer S., et al.** Comparison of internal fixation with total hip replacement for displaced femoral neck fractures. Randomized, controlled trial performed at four years. *J Bone Joint Surg Am 2005; **87:** 1680–1688.*

57. **Keating J.F., Masson G.M., Scott N.M., et al.** Randomized comparison of reduction and fixation, bipolar hemiarthroplasty, and total hip arthroplasty. Treatment of displaced intracapsular hip fractures in healthy older patients. *J Bone Joint Surg Am 2006; **88:** 249–260.*

58. **Jónsson B., Sernbo I., Carlsson A., et al.** Social function after cervical hip fracture. A comparison of hook-pins and total hip replacement in 47 patients. *Acta Orthop Scand 1996; **67:** 431–434.*

59. **Söreide O., Mölster A. & Raugstad T.S.** Internal fixation versus primary prosthetic replacement in acute femoral neck fractures: a prospective, randomized clinical study. *Br J Surg 1979; **66:** 56–60.*

60. **Squires B., Bannister G.** Displaced intracapsular neck of femur fractures in mobile independent patients: total hip replacement or hemiarthroplasty? *Injury Int J Care Injured 1999; **30:** 345-348.*

61. **Narayan K.K., George T.,** Functional outcome of fracture neck of femur treated with total hip replacement versus bipolar arthroplasty in a South Asian population. *Arch Orthop Trauma Surg 2006; 126: 545-548.*

62. **Smrke D., Beden R. & Stankovski V.** Bipolar versus total hip endoprosthesis: functional results. *Arch Orthop Trauma Surg 2000; **120:** 259–261.*

63. **Ravikumar K.J. & Marsh G.** Internal fixation versus hemiarthroplasty versus total hip arthroplasty for displaced subcapital fractures of femur – 13 year results of a prospective randomized study. *Injury 2000; **31:** 793–797.*

64. **Montgomery S.P., and Lawson L.R.** Primary Thompson prosthesis for acute femoral neck fractures. *Clin. Orthop. 1978; **137**:62-68.*

65. **Kocher M.S., Zurakowski D.** Clinical epidemiology and biostatistics: A primer for orthopaedic surgeons. Current concepts review *J Bone Joint Surg Am 2004; **86 (3):** 607-620.*

66. **Young W., Seigne R., Bright S., et al.** Audit of morbidity and mortality following neck of femur fracture using the POSSUM scoring system. *NZMJ 19 May 2006; 119 (1234):1-8.*

67. **Wolters U., Wolf T., Stutzer H., et al.** ASA classification and perioperative variables as predictors of postoperative outcome. *Br. J. Anaesth. 1996; 77: 217-222.*

68. **The World Medical Association.** Declaration of Helsinki. *World Med J.* 2008; **54**:122–5.

69. **Lwanga S.K and Lemesha.** Sample size Determination in Health Studies. *Epidemiological and Statistical Methodology Unit, WHO Geneva 1988, 1-5.*

70. **SPSS Inc. (2006).** SPSS Base 15.0 for Windows User's Guide. *SPSS Inc., Chicago IL.*

APPENDICES

Appendix 1

CONSENT BY THE PARTICIPATING PATIENT
(English)*

Study No.....

I have understood the explanation by DR OCHIENG' SEPHENIA RADUMA who is carrying out a study at Kenyatta National Hospital and Kikuyu Mission Hospital on the early functional outcome for the operative treatment of fracture neck of femur and hereby give consent to participate in the study. I have understood that this is a fracture involving the hip.
I have also understood that the purpose of this study is to determine the functional outcome of management of this fracture including the factors that influence this outcome.

I agree to participate in this study as a patient on my own free will and also accept to do the following:

- Be interviewed concerning my illness and subsequent management and the answers to be recorded by DR OCHIENG'.
- Be examined physically.

I have also understood that my participation in this study is voluntary and that I can withdraw my consent at any time and failure to participate or withdrawal of the consent will not affect my treatment in any way.

That the information I give will be treated with utmost confidence and my name will not be included in the results.

PARTICIPANT'S NAME
(OR PARENT/GUARDIAN/ CONSULTANT)

..... Signature/Thumb Print.....

WITNESS' NAME

..... Signature/thumb Print.....

INVESTIGATOR
DR OCHIENG' SEPHENIA RADUMA Signature.....
(Cell phone contact: +254-722-652-202)

***There is a Swahili version for those who do not understand English.**

Appendix 2

FOMU YA MAKUBALIANO KWA MGONJWA ANAYESHIRIKI KATIKA UTAFITI (Swahili)*

Nambari ya Kushiriki.....

Nimeelewa maelezo ambayo nimepatiwa na DAKTARI OCHIENG' SEPHENIA RADUMA ambaye anafanya utafiti katika hospitali kuu ya Kenyatta na hospitali ya misheni ya Kikuyu unaochunguza matokeo (hali ya kujitegemea) ya mwanzo/awali baada ya matibabu kwa njia ya upasuaji kufuatia kuvunjika kwa mfupa wa paja kwenye kiungo cha nyonga, na nimekubali kuwa mmoja wa wale wagonjwa wanaoshiriki katika utafiti huu.

Pia, ninaelewa ya kwamba, utafiti huu unachunguza matokeo (hali ya kujitegemea) baada ya matibabu na yale yanayoleta hayo matokeo.

Nimekubali kushiriki katika huu utafiti kama mgonjwa na kwa hiari yangu na pia nimekubali kufanya yafuatayo:

- Kuhojiwa juu ya ugonjwa wangu pamoja na matibabu yale nitapata na kwa DAKTARI OCHIENG', kuandika yale nitasema kwa shuguli za huu utafiti.
- Kupimwa kimwili kwa minajili wa huu utafiti.

Pia, nimeelewa ya kwamba, ninashiriki kwa huu utafiti kwa hiari yangu bila kulazimishwa, na ninaweza kujiondoa wakati wowote. Pia nimeelewa kwamba kutokubali kushiriki au kujiondoa katika utafiti huu hakutaathiri matibabu yangu kwa vyovyote vile haswa kubadilishwa au kukosa matibabu.

JINA LA MSHIRIKI (MGONJWA)
(AU MZAZI/MLINZI/DAKTARI MTAALAMU)

..... Sahihi/Kidole gumba.....

MSHAIDI

..... Sahihi/Kidole gumba.....

MTAFITI
DAKTARI OCHIENG' SEPHENIA RADUMA Sahihi.....
(Nambari ya simu ya rununu: +254-722-652-202)

***Kunayo fomu iliyotafsiriwa kwa lugha ya kiingereza kwa wale hawaelewi Swahili.**

Appendix 3

QUESTIONNAIRE

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

A. DEMOGRAPHIC DATA:

Patient's name.....

Age in years ( ) Address (Permanent Residence).....

IP No .....; Study Code No.....

Gender: Male (**1**); Female (**2**); Telephone contact.....

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. RTI ( )
4. Others (specify).....

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

1. None.....
2. Respiratory.....
3. Cardiovascular.....
4. Neuropsychiatric.....
5. Metabolic.....
6. Haematologic.....
7. Musculoskeletal.....
8. Malignancy (specify) .....
9. Others (specify).....

E. PHYSICAL FINDINGS (on admission)

a) Glasgow coma score ( )
b) Blood Pressure ( )
c) Pulse Rate ( )
d) Respiratory Rate ( )

F. ASA Class I (1); II (2); III (3); IV (4); V (5)

G. The *WOMAC* score within one week before injury (Annex 1)

1. Pain pre-operatively (P) ( )
2. Stiffness (S) ( )
3. ADL score (A) ( )

H. RADIOLOGICAL INVESTIGATIONS

1. Pre-operative plain Pelvic/Hip X-ray

Side affected	Right (**1**)	Left (**2**)
Garden's class	III (**1**)	IV (**2**)

2. Post-operative plain Pelvic/Hip X-ray.....
3. Others (specify).....

I. LABORATORY INVESTIGATIONS (Pre-operatively)

1. TWBC Count.....
2. Hemoglobin.....
3. Serum Sodium.....
4. Serum Potassium.....
5. Blood Urea & Creatinine.....
6. ELISA (HIV I & II).....
7. Others (specify).....

J. TREATMENT MODALITIES

1. Hemiarthroplasty (HA) ( ) Specify.....
2. Total Hip Arthroplasty (THA) ( )
3. Osteosynthesis (OS) ( ) Specify.....
4. Others (specify).....

K. SURGICAL APPROACH

1. Anterior ( )
2. Posterior ( )
3. Lateral ( )
4. Others (specify).....

L. TYPE OF ANAESTHESIA

1. General anaesthesia ( )
2. Regional anaesthesia (specify) ( )……

M. BLOOD TRANSFUSION

1. None ( )
2. Transfused ( )

If transfused, specify the number of units and time of transfusion……..

N. ANTIBIOTIC PROPHYLAXIS

a) None (1)

b) Yes (2) Cefriaxone; (3) Cefuroxime; (4) Flucloxacillin;

(5) Cloxacillin; (5) Others (specify)……

O. ANTICOAGULANT PROPHYLAXIS

a) None (1)

b) Yes (Specify) (2) Heparin; (3) Clexane; (4) Others (specify)…… ……..

P. EARLY COMPLICATIONS

a) None (1)

b) Local:

i.	Wound sepsis/dehiscence	(2)
ii.	Hip Dislocation	(3)
iii.	Deep Joint Infection	(4)
iv.	Haemarthrosis	(5)
v.	Sciatic Nerve Palsy	(6)
vi.	AVN of Femoral Head	(7)
vii.	Others (specify)……	(8)

c) Systemic (specify for each):

i.	Cardiac	(9)……
ii.	Pulmonary	(10)……
iii.	Neuropsychiatric	(11)……
iv.	Anemia (specify Hemoglobin level)	(12)……
v.	Septicemia	(13)……
vi.	Others	(14)……

Q. DURATION TAKEN FOR INCISION WOUND TO HEAL

1. By day 7 ( )
2. 8 to 14 days ( )
3. 15 to 21 days ( )
4. > 21 days ( )

R. **The *WOMAC* score at three months post-operatively (± one week; annex 2)**

1. Pain post-operatively (P) ( )
2. Stiffness (S) ( )
3. ADL score (A) ( )

S. **DISCHARGE DESTINATION**

1. Residential home ( )
2. Nursing home ( )
3. Others (specify).....

T. **REVISION SURGERY**

1. None ( )
2. Yes ( )

If undertaken, specify reason, type and when .....

U. **REMARKS**

.....
.....
.....
.....
.....

PRINCIPAL INVESTIGATOR'S SIGNATURE.....

DR OCHIENG' SEPHENIA RADUMA

Western Ontario and McMaster Universities Osteoarthritis Index, English version LK 3.0

THE WOMAC SCORE (pre-injury functional status evaluation)	Study No.
	Patient's Initials:
	Study Hip: Left ( ); Right ( )
	Date of operation (DD/MM/YY)
	Assessment Date (DD/MM/YY): / /

INSTRUCTIONS:

This survey asks for your view about your hip. This information will help us evaluate how you felt about your hip and how well you were able to do your usual activities within the last one week prior to injury. Answer every question by ticking the appropriate box before the response (only one box for each question). If you are uncertain about how to answer a question, please give the best answer you can.

P(a)-Pain:

*What amount of hip pain were you experiencing in the **last week prior to injury** during the following activities?*

P1(a). Walking on a flat surface

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

P2(a). Going up or down stairs or a slope

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

P3(a). At night while in bed

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

P4(a). Sitting or lying

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

P5(a). Standing upright

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

S(a) - Stiffness:

*The following questions concern the amount of joint stiffness you were **experiencing** during the **last week prior to injury** in your hip. Stiffness is a sensation of restriction or slowness in the ease with which you move your hip joint.*

S1(a). How severe was your hip joint stiffness after first wakening in the morning?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

S2(a). How severe was your hip stiffness after sitting, lying or resting **later in the day**?

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A(a)-Physical function, (activities of daily living):

*The following questions concern your physical function. By this we mean your ability to move around and to look after yourself. For each of the following activities please indicate the degree of difficulty you were experiencing in the **last week prior to injury** due to your hip.*

A1(a). Descending stairs/ walking down a slope

☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A2(a). Ascending stairs/ walking up a slope
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A3(a). Rising from sitting
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A4(a). Standing
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

*For each of the following activities please indicate the degree of difficulty you were experiencing in the **last week prior to injury due** to your hip.*

A5(a). Bending to the floor/pick up an object
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A6(a). Walking on a flat surface
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A7(a). Getting in/out of car or a public service vehicle
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A8(a). Going shopping or to the market
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A9(a). Putting on socks/stockings or shoes
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A10(a). Rising from bed
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A11(a). Taking off socks/stockings or shoes
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A12(a). Lying in bed (turning over, maintaining hip position)
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A13(a). Getting in/out of bath
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A14(a). Sitting
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A15(a). Getting on/off toilet
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A16(a). Heavy domestic duties (moving heavy boxes, scrubbing floors, etc)
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A17(a). Light domestic duties (cooking, dusting, sweeping the compound, etc)
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

SECTION TO BE USED BY THE INVESTIGATOR:

NORMALIZED PRE-INJURY SCORES (a):

1. PAIN: $100 - \frac{\text{Total score P1-P5} \times 100}{20} = 100 - \frac{\_\_\_\_\_}{20} = \_\_\_\_\_$

2. STIFFNESS: $100 - \frac{\text{Total score S1-S2} \times 100}{8} = 100 - \frac{\_\_\_\_\_}{8} = \_\_\_\_\_$

3. ADL: $100 - \frac{\text{Total score A1-A17} \times 100}{68} = 100 - \frac{\_\_\_\_\_}{68} = \_\_\_\_\_$

PRINCIPAL INVESTIGATOR

.....

DR OCHIENG' SEPHENIA RADUMA

Western Ontario and McMaster Universities Osteoarthritis Index, English version LK 3.0

THE WOMAC SCORE (post-operative functional status evaluation)	Study No.
	Patient's Initials:
	Study Hip: Left ( ); Right ( )
	Date of operation (DD/MM/YY)
	Assessment Date (DD/MM/YY): / /

INSTRUCTIONS:

This survey asks for your view about your hip. This information will help us evaluate how you feel about your hip and how well you are able to do your usual activities. Answer every question by ticking the appropriate box before the response (only one box for each question). If you are uncertain about how to answer a question, please give the best answer you can.

P(b)-Pain:

P1(b). Walking on a flat surface
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

P2(b). Going up or down stairs
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

P3(b). At night while in bed
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

P4(b). Sitting or lying
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

P5(b). Standing upright
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

S(b)-Stiffness:

*The following questions concern the amount of joint stiffness you have experienced during the **last week** in your hip. Stiffness is a sensation of restriction or slowness in the ease with which you move your hip joint.*

S1(b). How severe was your hip joint stiffness after first wakening in the morning?
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

S2(b). How severe was your hip stiffness after sitting, lying or resting **later in the day**?
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A(b)-Physical function, (activities of daily living):

*The following questions concern your physical function. By this we mean your ability to move around and to look after yourself. For each of the following activities please indicate the degree of difficulty you have experienced in the **last week** due to your hip.*

A1(b). Descending stairs/ walking down a slope
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A2(b). Ascending stairs/ walking up a slope
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A3(b). Rising from sitting
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A4(b). Standing
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

*For each of the following activities please indicate the degree of difficulty you have experienced in the **last week** due to your hip.*

A5(b). Bending to the floor/pick up an object
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A6(b). Walking on a flat surface
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A7(b). Getting in/out of car or a public service vehicle
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A8(b). Going shopping or to the market
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A9(b). Putting on socks/stockings or shoes
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A10(b). Rising from bed
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A11(b). Taking off socks/stockings or shoes
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A12(b). Lying in bed (turning over, maintaining hip position)
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A13(b). Getting in/out of bath
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A14(b). Sitting
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A15(b). Getting on/off toilet
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A16(b). Heavy domestic duties (moving heavy boxes, scrubbing floors, etc)
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

A17(b). Light domestic duties (cooking, dusting, sweeping the compound, etc)
☐ None ☐ Mild ☐ Moderate ☐ Severe ☐ Extreme

Thank you very much for completing all the questions in this questionnaire.

SECTION TO BE USED BY THE INVESTIGATOR:

NORMALIZED POST-OPERATIVE SCORES (b):

1. PAIN: $100 - \frac{\text{Total score P1-P5} \times 100}{20} = 100 - \frac{\_\_\_\_\_}{20} = \_\_\_\_\_$

2. STIFFNESS: $100 - \frac{\text{Total score S1-S2} \times 100}{8} = 100 - \frac{\_\_\_\_\_}{8} = \_\_\_\_\_$

3. ADL: $100 - \frac{\text{Total score A1-A17} \times 100}{68} = 100 - \frac{\_\_\_\_\_}{68} = \_\_\_\_\_$

PRINCIPAL INVESTIGATOR

.....

DR OCHIENG' SEPHENIA RADUMA

KENYATTA NATIONAL HOSPITAL
Hospital Rd. along, Ngong Rd.
P.O. Box 20723, Nairobi.
Tel: 726300-9
Fax: 725272
Telegrams: MEDSUP", Nairobi.
Email: KNHplan@Ken.Healthnet.org

Ref: KNH/UON-ERC/ A/104

12th November 2008

Dr. Ochieng S. Raduma
Dept.of Surgery
School of Medicine
University of Nairobi

Dear Dr. Raduma

Research Proposal: "Early functional outcome of operative treatment of displaced femoral neck fractures in two Kenyan Orthopaedic centres" (P271/10/2008)

This is to inform you that the Kenyatta National Hospital Ethics and Research Committee has reviewed and **approved** your above cited research proposal for the period 12th November 2008 – 11th November 2009.

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 specimen must also be obtained from KNH-ERC for each batch.

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

This information will form part of database 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. Prof. K.M. Bhatt, Chairperson, KNH-ERC
The Deputy Director CS, KNH
The Dean, School of Medicine, UON
The Chairman, Dept. of Surgery, UON
Supervisors: Prof. J.E.O. Ating'a, Dept.of Surgery, UON
Dr. K. O. Awori, Dept.of Human Anatomy, UON

P.C.E.A Kikuyu Hospital

P.O. Box 45-00902 Kikuyu, Tel:(020)2044765-68, (020)2044769-72,(020)3005645/46
Fax: (020)2044765/772 Mobile:0722-207636 / 0733-606133 / 0736-270192.
1908 - 2008 Celebrating 100 Years of Quality Health Care

October 17, 2008

Dr. Sephenia Raduma Ochien'g
P O Box 58155-00200
Nairobi

Dear Dr. Raduma

Re: Request to Undertake a Study at PCEA Kikuyu Hospital

Your request to carry out a study on 'the short term functional outcome following operative treatment of femoral neck fracture' has been granted. However, please note that once the study is completed, the abstract of the findings of the study should be submitted to the Hospital Management for consideration before you publish the results anywhere.

Wishing you the best in your work!

Yours sincerely
For: PCEA Kikuyu Hospital

Mr. William M. Wambugu
CHIEF EXECUTIVE OFFICER

General Hospital | Eye Unit | Rehabilitation Centre | Dental Unit

Email: kikuyu@pceakikuyuhospital.org / Website: www.pceakikuyuhospital.org
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1908 - 2008 Celebrating 100 Years of Quality Health Care

September 30, 2009

Dr. Sephenia Raduma
P.O. Box 58155 – 00200
NAIROBI

Dear Dr. Raduma

Re: Request to Undertake a Study at PCEA Kikuyu Hospital

Your request to modify the study title to read 'Early Functional Outcome of Operative Treatment of Displaced Femoral Neck Fractures in two Kenyan Orthopaedic Centres" has been granted

Please note that as previously advised, once the study is completed the abstract of the findings should be submitted to the hospital management for consideration before you publish the results elsewhere.

Wishing you the best in your work!

Yours sincerely
For: PCEA Kikuyu Hospital

Mr. William M. Wambugu
Chief Executive Officer

General Hospital | Eye Unit | Rehabilitation Centre | Dental Unit

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

"The love of Christ through healing"