

EARLY FUNCTIONAL OUTCOME OF DISTAL FEMORAL FRACTURES AT KENYATTA NATIONAL HOSPITAL AND KIKUYU HOSPITAL

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ABSTRACT

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

Objective: To determine early functional outcome of operative treatment of distal femoral fractures.

Design: Hospital based prospective study.

Setting: Orthopaedics and trauma wards and fracture clinics at Kenyatta National Hospital and PCEA Kikuyu Mission Hospital.

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

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

Conclusions: Following operative fixation, functional outcome was predominantly good or excellent. Knee stiffness was the leading complication. Young socio-economically active individuals formed the majority of those with these injuries, with a male: female ratio of 1.6:1 Road Traffic Accidents (RTA) was the leading cause.

INTRODUCTION

Distal femoral fractures cause considerable morbidity and mortality, especially in the elderly (1). In Kenya in a study carried out by Oduor (2) at KNH, the incidence was found to be higher in the younger, socio-economically active age group. The leading cause in this study was motor vehicle accidents (3).

Surgical treatment of these difficult fractures has evolved over time (3). The goals of surgical treatment are anatomical reconstitution of the articular surface; reduction of the metaphyseal component of the fracture to the diaphysis and restoration of normal axial alignment, length and rotation; stable internal fixation and early motion and functional rehabilitation of the limb (3,3-5).

Surgical treatment with open reduction and internal fixation has been recommended since the 1960s and has been shown to be superior to non-operative treatment (3,4,6,7). Wenzel and colleagues (8) reported on 112 patients treated according to AO principles, 73.5% had good or excellent results. For open reduction, these results were far superior to the 52% satisfactory results reported by Neer and associates (9). Several other studies that followed reported similar results, and recommended open reduction over non-operative treatment.

Problems associated with surgery include infection, mal-union, non-union, varus collapse, loss of fixation, diminished knee motion, difficult fixation in osteoporotic bone and short distal fragment (3,5,7,9).

In a systematic review of acute distal femur fracture treatment, Zlowodzki *et al* (11), found overall, the average non-union rate of 6.0%, fixation failure rate of 3.3%, deep infection rate of 2.7% and average secondary surgical procedure rate of 16.8%.

These problems have been addressed sequentially with evolution of treatment devices (9). New, minimally invasive techniques including Retrograde Intramedullary Nailing (RIMN), Minimally Invasive Percutaneous Plate Osteosynthesis (MIPPO), Less Invasive Stabilization System (LISS), Trans-Articular Approach And Retrograde Plate Osteosynthesis (TARPO) avoids metaphyseal and diaphyseal stripping (10). Studies elsewhere indicate that these techniques have lowered the rates of non-union, deep infection and implant failure (5,7,9). However, the diminished knee motion component still persists and contributes to adverse functional outcome (9).

In a study by Oduor (2), the treatment modalities used at KNH were as follows: 66.7% used conservative methods; 27.8% combined conservative and operative methods; and 5.5% used operative methods only. The conservative measures used included skeletal traction in 97% of the patients on conservative treatment, followed in 50% with Long Leg Cast (LLC) and in 29% with operation; only 2.9% used LLC without traction (13, 14 years). Operations done included: In 58.3%, plate and screw fixation, of which 50% were Condylar Blade Plate (CBP), 8.3% Buttress Condylar Plate (BCP); and 41.7% retrograde intramedullary nailing.

However, there is no data on functional outcomes for all these modalities in this setup, and the various contributing factors. This study was designed to determine the functional outcome of operative treatment of these injuries at KNH and PCEA Kikuyu Mission Hospitals.

MATERIALS AND METHODS

Participants recruitment: Forty-six patients with distal femoral fracture who were treated operatively were recruited post-operatively in the wards and in the fracture clinics. Their medical records and X-rays were reviewed by the investigator to ascertain pertinent information regarding the injury and associated injuries, fracture classification, soft tissue status, initial treatment and any secondary procedures performed, local and systemic complications.

The patients underwent a rehabilitation programme set as follows: Passive and active knee range of motion

exercises within 1st week of operation. Quadriceps strengthening exercises, SLR. Static cycling. This regime was followed twice weekly for six weeks then once weekly for the next 6 weeks. Patients were allowed touch-down weight-bearing with crutches or walker as tolerated 8 weeks after surgery, then gradual FWBAT.

A physical examination was performed by the investigator to determine femoro-tibial alignment, knee range of motion, neurovascular status and knee ligament stability 12 weeks after surgery. Bilateral AP radiographs of the knees and a single lateral radiograph of the involved knee were evaluated for residual alignment, time to union and mal-union at 8 and 12 weeks after surgery.

Femoro-tibial alignment was determined clinically by examination of the knee and by evaluation from AP and lateral knee radiographs of the anatomical axes of the femur and tibia, and measurement of the angle of intersection at the knee to determine the varus or valgus angle (12-14).

Knee range of motion was determined by visual inspection during knee assessment and confirmed with goniometric passive range of motion measurement. One metallic goniometer with a 12.7cm movable arm and a scale marked in 1-degree increments was used to take measurements (15).

Data on neurovascular status was obtained from the patient's records to determine the status immediately after injury; and at twelve weeks during evaluation of function. Clinical assessment was used thus: assessment of strength and quality of dorsalis pedis pulse (16).

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

- (i) Medial/ lateral instability in extension
- (ii) Medial/ lateral instability in 30-degrees; for medial and lateral collateral ligament stability.
- (iii) Lachman test
- (iv) Anterior drawer in 90-degree flexion
- (v) Pivot shift in extension; for anterior cruciate ligament stability.
- (vi) Posterior drawer
- (vii) Posterior tibial sag in 90-degrees; for posterior cruciate ligament instability.

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

Malunion:

- (i) Five degrees variation from the contra lateral limb in varus/valgus or extension/flexion.
- (ii) Ten degrees mal-rotation and >1cm shortening.

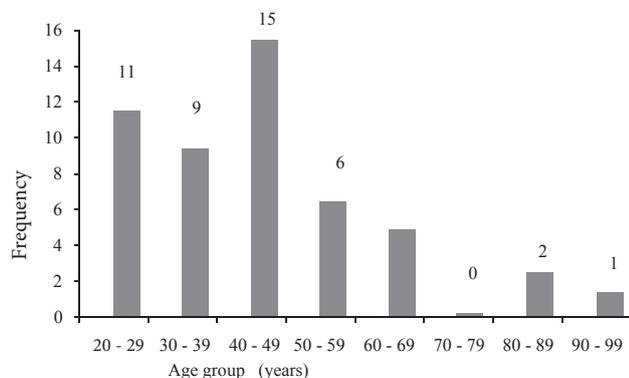
Modified HSS knee scores were determined for each patient at twelve weeks after surgery. HSS knee score is a surgeon assessed weighted score developed through consensus by knee society in 1989. It has been validated and is responsive and reproducible (17).

Data analysis: Data collected by questionnaires was coded and analyzed using STRATA to derive descriptive statistics and frequency distributions. For continuous predictor variables t test was used; and expressed as means and standard deviations. For categorical predictor variables Pearson’s chi-square test was used; and expressed as proportions, and Conditional (ordered) logistic regression for multivariable analysis.

RESULTS

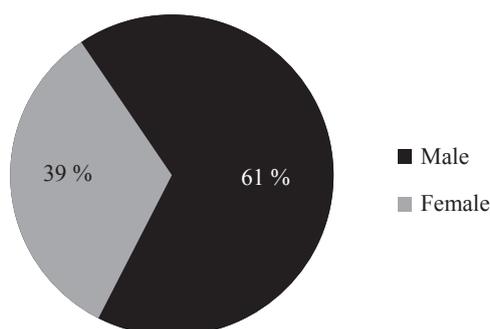
A total of 46 study participants were recruited and all were included in the analysis. The majority of the participants were in the 25-45 years age group with the mean of 42.9 years (range: 22 – 96) (Figure 1).

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



There were a total of 18 (39%) females and 28 (61%) males giving a female: male ratio of 1:1.6. (Figure 2).

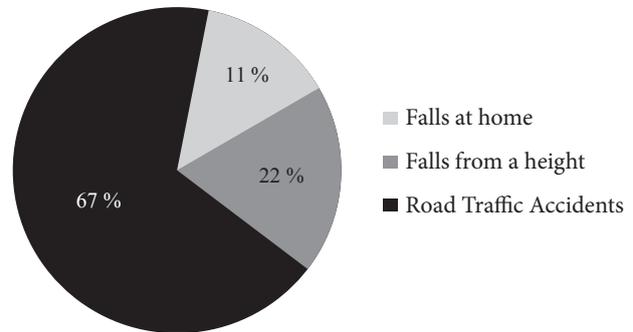
Figure 2
Gender involvement



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

Figure 3

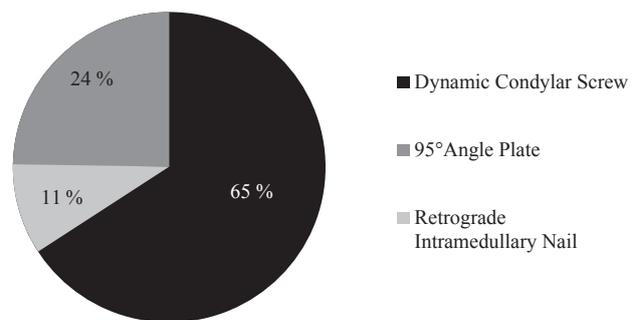
The mechanisms of injury in the study population



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

Figure 4

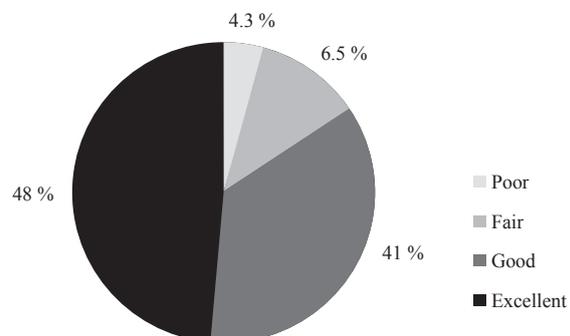
The treatment options used



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

Figure 5

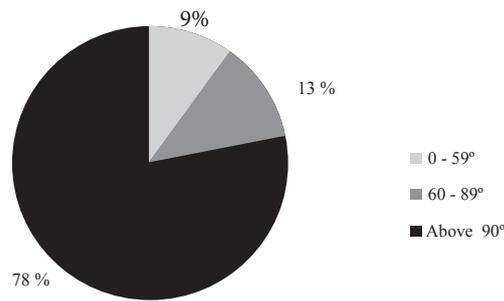
Proportion of the study population with various early functional outcomes (HSS scores) at 3 months post treatment



One patient suffered periprosthetic fracture and had poor function at 3 months while the other was an elderly woman who remained on wheelchair. Four (9%) patients had knee stiffness (below 59° flexion), while 6 (13%) patients had flexion of 60° – 89° giving a total of 22% with knee stiffness (Figure 6).

Figure 6

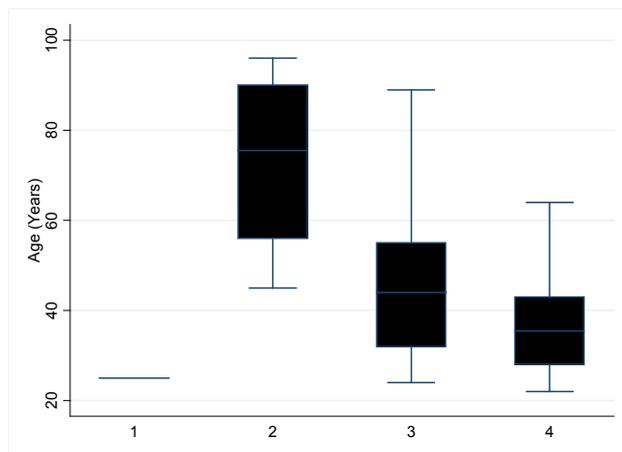
The knee range of motion 12 weeks after surgery



There was 1 (2%) superficial wound infection and 2 (4.35%) patients were reoperated, one patient had poor reduction (varus angulation of 12°) and was re-operated with DCS after 5 days. 82.4% had knee range of motion above 90° and 8.8% had below 60°. Thirty two (69.6%) patients had radiological union, 11 (23.9%) had evidence of progressive union while 3 (6.5%) had no evidence of callus at 12 weeks. The mean duration of injury to surgery was 11.47 days and mean hospital stay was 10.65 days

Figure 7

Box plots of age distribution by HSS Score



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

Table 1

Baseline socio-demographic characteristics (categorical variables)

Characteristic	Total (%)
Sex	
Female	18 (39)
Male	28 (61)
Level of education	
None	3 (6)
Primary	6 (13)
Secondary	18 (39)
Tertiary	19 (41)
Knee range of motion (degrees)	
0-59	4 (9)
60-89	6 (13)
Above 90	36 (78)
HSS SCORE	
Excellent	22 (48)
Good	19 (41)
Fair	3 (6.5)
Poor	2 (4.3)
Hospital stay (days)	
1 – 10	25 (54)
11 – 20	18 (39)
21 – 30	2 (4)
31 – 40	1 (2)
Employment status	
Unemployed	6 (13)
Self employed	9 (19.56)
Formal employment	28 (60.9)
Retired	3 (6.5)
Mechanism of injury	
Fall at home	5 (10.87)
Fall from a height	10 (21.7)
Road traffic accident	31 (67.3)
Co-morbidity	
None	40 (87)
Hypertension	2 (4)
Diabetes	3 (6.5)
Both hypertension and diabetes	1 (2)
Treatment method	
Dynamic Condylar Screw (DCS)	30 (65)
Retrograde nailing	11 (24)
Angle plate	5 (10.9)
Anaesthesia	
Spinal	37 (80)
General Anaesthesia (GA)	9 (20)
Transfusion	
Not transfused	42 (91)
Transfused	4 (9)
Antibiotic prophylaxis	
Ceftriaxone	36 (78)
Flucloxacillin	10 (22)
Anticoagulation	
None	11 (24)
Clexane	35 (76)
Re-operation	
No	44 (96)
Yes	2 (4)
Early complications	
None	44 (96)
Poor reduction	1 (2)
Superficial wound infection	1 (2)

Table 2
Baseline socio-demographic characteristics (continuous variables)

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

Table 3
Pearson – chi square analysis of influence of type of implant on HSS score

Tabulate HSS score Rx, chi²

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

Pearson chi²(6) = 5.9296 Pr = 0.431

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

Table 4
Multi-variate regression using ordered logistic regression model

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

There was a statistically significant influence of age on the HSS score (P < 0.05) when controlled for sex, days to surgery, hospital stay, education, employment, mode of injury, co-morbidity and method of treatment. There is also a tendency towards statistical significance of co-morbidity influence on HSS score (P = 0.071) when controlled for the other 8-independent variables.

Though sex, days to surgery, hospital stay, education, employment, mode of injury and method of treatment all seem to have some influence on the HSS score, these was not shown to be statistically significant when controlled for other confounding factors in a regression model.

DISCUSSION

Leung *et al* (19) in a review of early functional outcome of distal femur fractures using the modified HSS score, after interlocking intramedullary nailing obtained 35% excellent, 59% good and 5% fair outcome. Kregor *et al* (20) reviewed distal femur fixation with LISS. All the fractures healed, with the mean time to full weight bearing of 11 weeks. The mean knee range of motion was 2^o extension to 103^o flexion. They obtained no loss of fixation and union rates without bone graft of 95% and infection rate of 3%. They concluded that closed interlocking intramedullary nailing is an excellent technique for both supracondylar and simple intercondylar fractures in which closed reduction and percutaneous fixation of the articular fracture is possible.

In this study, using the modified HSS score, DCS, retrograde locked intramedullary nailing and 95^o angle plating, the early functional outcome (Figure 5) was 48% excellent, 41% good, 6.5% fair and 4.3% poor. The overall mean modified HSS score was good. There was no statistically significant difference in HSS score between the three implants (Table 3: P = 0.431). These results are comparable with the results of the two studies. They all obtained an overall good early functional outcome. Use of locked plating, LISS and MIPPO was not recorded in this study probably due to the high cost of the implants required. They are generally not available in public health facilities.

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

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

In this study, the mean hospital stay was 10.54 days. The rehabilitation programme was instituted within the week of surgery and continued to and after obtaining the HSS scores. Patients who undergo operative fixation had spent a much shorter duration in hospital

than the conservatively managed ones. They were also able to start rehabilitation programmes much earlier. The Oduor study (2) included conservatively treated patients hence the longer hospital stay. But in the same study, patients who had operative-only treatment had a comparable hospital stay as that for patients in this study.

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

Martinet *et al* (21) analyzed AO data on femoral fractures from 1980 to 1989. Distal femoral fractures were 6% of the total (2165 out of 34319). M:F ratio was 1:1 (1114:1051). They found a bimodal distribution with one maximum affecting young patients, particularly men aged about 20 years, the other one affecting the elderly, particularly women aged about 70 years. They concluded that there are two distinct groups as a function of age, the gender and aetiology:

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

In this study, the M: F ratio was 1.6:1 (28:18) shows a slight male preponderance. In Martinet's analysis, the mean age in the younger age-group was about 20 years, whereas in this study the mean age was 41 years. Figure 1 depicts a unimodal distribution with respect to age, skewed to the left. This could be explained by the fact that the Kenyan population is younger than the generally ageing western population. At age 41 years, (the mean age) the number of women affected progressively approach the number of males, but falls short of overtaking the males due to a comparatively shorter life expectancy among the Kenyan population (21).

In this study, the most frequent aetiology was road traffic accidents (Table 1: RTA = 67.3%). This was followed by falls from a height then falls at home. This again compares with the Martinet analysis in which road traffic accidents formed the predominant aetiology among the younger age group.

Butt *et al* (23) in a study of operative vs. non-operative treatment of distal femur fractures, the mean age for operated group was 77.6 years. Using Schartzker and Lambert score they obtained 53% excellent and good functional outcome

In this study, age had a statistically significant influence on HSS score (Table 4: multi-variate progression using ordered logistic progression mode, $P < 0.05$). Age was found to be inversely related to the HSS score by univariate linear regression (Table 1). The same relationship is depicted in Figure 7, the box

plot depicting relationship between age and HSS score. Participants who were old scored lower than their young counterparts. The relatively poorer functional outcome in the Butt study could be attributed to the relatively advanced age of the patients involved.

Sex in this study did not show a statistically significant influence on the early functional outcome (Table 4, $P = 0.275$ using ordered logistic regression model). Both males and females of the same age had similar early functional outcomes.

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

CONCLUSIONS

- (i) Males formed a slight majority over females (ratio 1.6:1). This was attributed to the relatively younger population in Kenya unlike the more aged population in the west. Incidence of fragility fractures is therefore correspondingly lower.
- (ii) The predominant age (25 – 45 years) is young people, who are still in the socio-economically productive age group.
- (iii) Road traffic accidents and high energy falls form the leading causes of distal femur fractures. This may be explained by the fact that in pursuit of socioeconomic activities, the people in this age group are exposed to high energy lifestyles and hence, their predominant involvement.
- (iv) Early functional outcome was not affected by the type of implant used.
- (v) The complication rate was low. Mainly knee stiffness. Overall mean range of knee motion was 93.5° with 8.8% of the patients had KROM below 60°.

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