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Outcome of Surgical Fixation of Intertrochanteric Femoral Fractures with Dynamic Hip Screw

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Abstract: ***Background: Intertrochanteric fracture of the femur is one of the common fractures in the elderly with osteoporosis due to trivial fall. When occurs in the young, intertrochanteric fracture is usually due to high-energy injuries such as motor vehicular accident or fall from height. Dynamic Hip Screw (DHS) fixation has remained the gold standard for the treatment of stable intertrochanteric femoral fractures to which other options are compared.The aim of this study was to assess radiological and functional results in stable intertrochanteric femoral fractures treated with Dynamic Hip Screw fixation.This study was a prospective, interventional study involving 48 consecutive patients with stable intertrochanteric femoral fractures that were treated using internal fixation with DHS between December 2015 and November 2018 at the National Orthopaedic Hospital, Dala - Kano. All patients were followed up for a minimum of 6 months. The mean age of the patients was 56.8 ± 15.0 years. There was a preponderance of males over females in a ratio 4.3:1. At the end of 6 months postoperatively, 45 (93.8%) patients had their fractures united with mean RUSH score of 27.1 ± 3.1. The mean HHS in the preoperative period was 19.2 ± 24.8. At the end of 6th postoperative month, the mean score was 91.7 ± 12.5. It was concluded that DHS is a reliable implant in surgical treatment of stable intertrochanteric fractures.***

Keywords: Intertrochanteric fracture, dynamic hip screw, outcome

1. Introduction

Intertrochanteric fractures are fractures that involve the proximal region of the femur from the extra capsular part of the femoral neck to the transverse line at the level of the distal end of the lesser trochanter [1]. Nearly 90% of these fractures occur in patients older than 65 years. They are more common in women than in men with ratio 3:1. Other risk factors include white race, neurological impairment, malnutrition, impaired vision, malignancy, and decreased physical activity [2].

Intertrochanteric fractures are predominantly seen following low energy injuries in elderly women due to osteoporosis and they are associated with high morbidity and mortality especially in patients with medical comorbidities whose declining health status is further worsened by trauma [1, 3, 4].

When they occur in younger individuals, intertrochanteric fractures are usually the result of a high-energy injury, such as motor vehicle accident, fall from a height and sports activities such as football, skiing, rodeo, horse racing, and ice dancing that involve high-energy impacts [3,5,6]. Successful treatment of intertrochanteric fractures depends on many factors including the age of patients, the patients' general health, the time from fracture to treatment, concurrent medical illness and the stability of fixation [7].

Therefore, the care and rehabilitation of elderly patients with hip fractures, intertrochanteric fractures inclusive, raise social and economic issues that extend beyond just orthopaedic management to a multidisciplinary care approach [8 – 10]. There are various types of hip fracture fixation devices available for treatment of intertrochanteric fractures. Dynamic hip screw (DHS) is the gold standard device of fixation of this fracture, regardless of number of parts, by which all other fixation devices are to be measured. This is because of its telescoping properties, which allows impaction of the fracture site (controlled collapse), thereby achieving bone-on-bone stability and reducing chances of implant failure [4, 11, 12]. This principle of "controlled collapse" works better in a stable fracture with intact posteromedial wall in the region of the lesser trochanter. It is not always successful in unstable fracture patterns such as reverse oblique fractures, fractures with large posteromedial fragment and fractures with subtrochanteric extension [4, 13].

In early 19th century, when the operative technique was not versatile enough to do stable fixation, non-operative treatment used to be the treatment of choice. However, since the introduction of various stable fixation techniques, non-operative treatment is considered only in non-ambulatory patients, patients with terminal illness with very short life expectancy, unresolved comorbidities that preclude anaesthesia and surgery, active infection and incomplete intertrochanteric fractures diagnosed by magnetic resonance imaging [14].

Numerous internal fixation devices have been used to stabilize intertrochanteric femoral fractures. These devices can be divided into 2 categories: extramedullary fixation devices and intramedullary fixation devices. It is generally accepted that dynamic hip screw (DHS) is the implant of choice in the treatment of stable intertrochanteric femur fractures [15]. For unstable intertrochanteric femoral fractures, the commonly used extramedullary fixation devices, such as DHS, dynamic condylar screw (DCS), and angular blade plates are often problematic [15]. The importance of a well-performed surgical treatment in hip fracture care is undisputable; however, treating the patients

from a holistic point of view is probably even more important in order to improve the overall outcome for these patients [16].

Although the outcomes of fixation of this fracture with DHS have been very encouraging, complications are also common due to mechanical failures such as penetration of the joint by the tip of the device, loss of reduction with varus deformity and cutting-out of the device through the superior part of the head and neck of femur [1, 5, 6]. The ideal implant therefore, should be easy to handle, enable immediately postoperative full weight bearing, and provide sufficient purchase in the femoral head and neck fragment to limit cutouts secondary to varus deviation and rotation [17].The aim of this study was to determine the outcome of surgical fixation of stable Intertrochanteric femoral fractures with dynamic hip screw (DHS).

2. Patients and Methods

This study was carried out at the National Orthopaedic Hospital Dala (NOHD) - Kano, North - West Nigeria. The study was a hospital based, prospective, interventional conducted between December 2015 and November 2018. The study included all cases of stable (Evans type 1A and 1B) intertrochanteric femoral fractures in adults that were surgically fixed with dynamic hip screws during study period and patients consented to be part of the study. The following categories of patients were however excluded from the study: Pathological fractures (e.g. tumours or Paget's disease), unstable intertrochanteric fractures (Evans 1C, 1D and 2), inflammatory arthritis and osteoarthritis of the hip, patients who are bedbound prior to the fractures, intertrochanteric fractures treated with implants other than DHS, fractures treated non-operatively, malunited intertrochanteric fractures, and nonunion of intertrochanteric fractures.

Patients were diagnosed using clinical examination and plain radiographs AP view of the pelvis and lateral view of the affected hip. Informed and written consent was obtained. The study was carried out after approval from the hospital research ethics committee. All patients were operated by two experienced surgeons. Patients were ambulated partial weight bearing with bilateral axillary crutches for the first 6 weeks, single axillary crutch for the next 6 weeks and full weight bearing was allowed after 3 months postoperatively. Immediate post - operative and structured follow up plain radiographs (at 6 weeks, 3 months and 6 months) were taken for assessment using (Radiographic Union Score for the Hip) RUSH. Clinical evaluation including Harris hip score was also done at the structured follow – up. The findings were noted and documented appropriately. Also, the complications noted were documented and addressed. The statistical analysis of the results was done using SPSS version 20.

3. Results

A total of 48 patients completed a minimum of 24 weeks of follow up and were analyzed for the study. The mean age of the patients was 56.8 ± 15.0 years with an age range of 29 – 79 years. Intertrochanteric fractures showed a predilection for the age bracket of 61 – 70 years accounting for 35.4%. There were 39 (81.3%) male patients and 9 (18.7%) female patients giving a male to female ratio of 4.3: 1. The mechanism of injury was fall from standing height in 20 (41.7%) patients while the remaining 28 (58.3%) patients were involved in high energy road traffic accident (RTA).

Table 1: Demographic profile of the patients

		Frequency	*Percent*
Age Group	*21 – 30*	4	8.3
	31 – 40	8	16.7
	41 – 50	5	10.4
	51 – 60	8	16.7
	61 – 70	17	35.4
	71 – 80	6	12.5
	TOTAL	48	100
Gender	Male	39	81.3
	Female	9	18.7
Laterality	Right	27	56.2
	Left	21	43.8
Fracture Classification	Evans 1A	13	27.1
	Evans 1B	35	72.9
Type of Trauma	Fall	20	41.7
	RTA	28	58.3

At the end of 6th postoperative months, 45 patients (93.8%) had their fractures united successfully. Three patients (6.3%) had screw cutout and subsequently had hemiarthroplasty with bipolar endoprosthesis.

Table 2 below shows the mean and standard deviation of RUSH at 3 and 6 months postoperatively. The mean RUSH at 3 and 6 months postoperatively was 18.9 ± 2.0 and 27.1 ± 3.1 respectively.

Table 2: Radiographic Union Score for Hip (RUSH)

Postoperative Period	*Mean score*	*Standard deviation*
3 months	18.9	2.0
6 months	27.1	3.1

Table 3 below shows the mean preoperative and postoperative Harris hip scores (HHS). The mean preoperative HHS was 19.2 ± 24.8. At the end of 12th and 24th postoperative week, the mean HHS was 63.8 ± 12.4 and 91.7 ± 12.5 respectively.

Table 3: Harris Hip Scores

Harris Hip Score	Mean	Standard deviation
Preoperative	19.2	24.8
3 months postop	63.8	12.4
6 months postop	91.7	12.5

Table 4 shows a paired sample t test done between preoperative HHS and HHS at 3 and 6months. There were statistically significant differences between the pre-operative Harris hip score and the Harris hip scores at 3 months and 6months respectively (P<0.05).

Table 4: A paired sample t test between preoperative & postoperative HHS

Variables	*Mean*	*Mean difference*	*Standard deviation*	*P - value*
PAIR 1: Preoperative HHS	19.2		24.8	
HHS at 12 weeks	63.8	44.6	12.5	< 0.0001
PAIR 2: Preoperative HHS	19.2		24.8	
HHS at 6 months	91.7	72.5	12.5	< 0.0001

Table 5 shows the distribution of Harris hip score grades preoperatively, 3 months and 6 months post operatively.

Table 5: Harris hip Score (HHS) grading

HHS Grade	*Preoperative*	*3 months Postop*	*6 months Postop*
	Frequency (%)	*Frequency (%)*	*Frequency (%)*
0 – 69 (Poor)	42 (87.5)	31 (64.6)	3 (6.3)
70 – 79 (Fair)	2 (4.2)	8 (16.7)	0 (0.0)
80 – 89 (Good)	4 (8.3)	9 (18.8)	8 (16.7)
90 – 100 (Excellent)	0 (0.0)	0 (0.0)	37 (77.1)
Total	48 (100)	48 (100)	48 (100)

During the study period, the patients were assessed clinically and radiologically for complications at the immediate, 6 weeks, 12 weeks and 24 weeks post-operative. The complications seen during the study were presented as shown in table 6 below.

Table 6: Postoperative Complications

Complications	*Frequency*	*Percentage*
Diathermy burn	1	2.1
Limb length discrepancy	2	4.2
Surgical site infection (Superficial)	2	4.2
Screw cutout	3	6.3

At the last follow-up (6 months postoperative), patients' level of satisfaction was assessed by the research assistant that was not involved in the management of the patients, using Likert satisfaction rating scale. Figure 1 below summarizes the patients' level of satisfaction with the outcome of the surgical treatment.

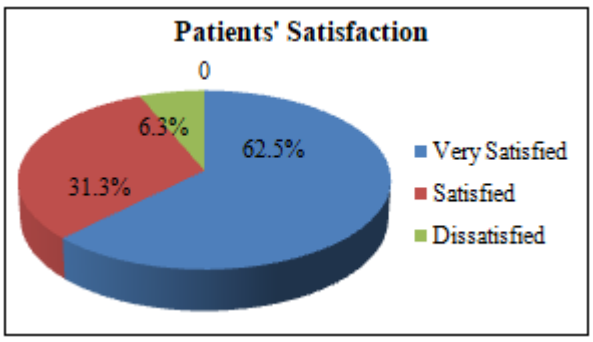

Figure1: Patients' Satisfaction

4. Discussion

Dynamic hip screw is an effective and safe method commonly used to treat intertrochanteric fractures. It has the mechanical advantage of static compression during surgery and dynamic compression after resumption of physiological loading. The benefit of continuous decrease in stress over the implant due to the sliding nature of the lag screw resulting in fracture union makes dynamic hip screw a good choice of implant for Evans type 1intertrochanteric fractures according to various clinical and radiological studies. Fractures treated with this devise achieve bone healing within 6 months [11].

The age range in this study was 27 to 79 years, with mean age of 56.8 ± 15.0 years. This is in keeping with results obtained from local studies [3, 4]. However, this is a little lower than those from developed countries probably due to their higher life expectancy [18, 19]. Males were more commonly affected in this study than females; this is similar to what was obtained from local studies. On the contrary, in the west, the leading cause is simple fall in postmenopausal osteoporotic women. So, women suffer more intertrochanteric fracture than men [20, 21].

In this present study, at the end of 6 months, the union rate was 93.8%. The mean radiographic union score for hip (RUSH) at 6 months postoperative was 27.1 ± 3.1 indicating good radiographic union because RUSH of 18 and above has been shown to be highly predictive of union in hip fractures. This high union rate is similar to what has been documented both locally and internationally for intertrochanteric fractures fixed with DHS ranges from 65 to 100% at the end of 6 months [4, 11]. However, the objective determination of radiographic union was not stated in most of these studies. Determination of radiographic union objectively with RUSH was used in this present study. This high union rate has been ascribed to the fact that the cancellous bone in the intertrochanteric region is well vascularized andnonunion and osteonecrosis arerarely encountered following intertrochanteric fractures [16].

This study demonstrates a good early outcome following surgical fixation of intertrochanteric fracture using DHS. The mean Harris hip score rose from 19.2 ± 24.8 preoperatively to 63.8± 12.4 at the 12th week and 91.7 ± 12.5 at 24th week post-operative respectively. The increase from the preoperative period to the postoperative period was found to be statistically significant ($P < 0.001$) and this demonstrates significant progressive improvement in the hip function postoperatively. Majority of the patients 42 (87.5%) preoperatively had a poor hip function (poor HHS), while at the final follow up of this study (6 months postoperative), only 3 (6.3%) had poor hip function, 37 (77.1%) had excellent and 8 (16.7%) had good hip function. This result is similar to many other results documented locally[4] and internationally [22, 23].

Two patients (4.2%) in our study developed superficial surgical site infection. They were managed by local wound debridement, wound dressing and a course of oral antibiotics based on sensitivity patters of the organisms. They were completely free of infection at 6 weeks postoperative follow up. Similar results were found locally with infection rate ranges 4 – 20 percent [4, 22]and internationally with infection rate of 0 – 4.7 percent [23, 24].The infection rate is kept low by observing strict aseptic techniques, judicious use of prophylactic antibiotics, keeping operating room clean and keeping patients in the wards away from those for infected patients [25].

The commonest complication in this study was screw cutout which occurs in 3 (6.3%) patients. They were managed by hemiarthroplasty with bipolar endoprosthesis. The cutout rate is within 4 – 13% earlier documented in previous studies [4, 26, 27]. However, the relatively lower incidence of screw cutout in this study may be as a result of the fact that all patients in this study have stable intertrochanteric fractures and a significantly high incidence of lag-screw cut-through is associated with unstable fracture patterns such as reverse oblique fractures, fractures with large posteromedial fragment implyingloss of calcar buttress and fractures with subtrochanteric extension [27].

One (2.1%) patient had diathermy superficial burns on the left leg due to faulty dispersive electrode of the electrosurgical unit, he was managed with local wound care and the wound healed satisfactorily within 2 weeks. On the contrary, Saaiq M [28] reported three cases of diathermy burns; the cause of burns was faulty application of the grounding electrode, all patients sustained deep burns that necessitated surgical wound cover. While using monopolar diathermy, several measures can be adopted to reduce the risk of diathermy burns. The surgeon should have a proactive attitude of ensuring proper checking and application of the components of the diathermy unit. Special care should be exercised to re-check the position of the pad if the patient's position is changed intra-operatively.

Two (4.2%) patients had ≤ 2cm shortening of the limb. The resulting shortening was as a result of osteoclasis before fixation with DHS. They were satisfactory with 2cm shoe raise postoperatively. There are varying rates and extent of LLD following internal fixation of intertrochanteric fractures using DHS. Ina series of 50 patients with intertrochanteric fractures by Dayanand et al [29]; 4 (8%) patients had shortening of ≤ 2 cmand they were treated with shoe raise. In a prospective case series study involving 26 patients of different intertrochanteric fractures by Kumar and Sharafudeen [30]; 42% of patients developed 1 cm shortening, 42% of patients had 2 cm shortening and 16% of patient developed 3 cm shortening.

Finally, from this study, 45 (93.8%) of the patients were at least satisfied with the outcome of treatment of their intertrochanteric fractures using DHS.

The following are the limitations of our study. The follow up of the patients was limited to 6 months. This is not adequate to fully assess the rate of surgical site infection which was one of the complications encountered in this study. The surgeries were performed by 2 surgeons; though the same protocol was used for all the patients; the surgeon related bias would have been completely removed if the surgeries were performed by only one surgeon.

The conclusion is that dynamic hip screw (DHS) is a reliable option for the treatment of stable intertrochanteric femoral fractures as demonstrated by high union rate, good hip function and high patient satisfaction.

Conflict of Interest: The authors declare that they have no conflict of interest.

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Ethical Approval: The study was carried out after approval from the hospital research ethics committee.

Informed Consent: Informed consent was obtained from the patients using a standard informed consent format

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