

Management Of Subtrochanteric Femoral Fractures Using Proximal Femoral Nail

Riad Mansour Megahed, Mohamed Abdalla M. Abdelsalam,
Ahmed Mohammed Abdelwahab, Yousuf Ali Ahmed Farhat*

Department of Orthopedic Surgery, Faculty of Medicine, Zagazig University, Egypt

*Corresponding author: Yousuf Ali Ahmed Farhat, Mobile : (+20)01559441022, Email : ayousuf91@yahoo.com

ABSTRACT

Background: Fractures of the proximal femur are a big challenge in traumatology. Rapid strides in implant and instrumentations in quest of ideal fixation of subtrochanteric femoral fractures have made various options available. **Objective:** The present study aims to study the role of standard proximal femoral nail (PFN) in the management of these fractures. This study aimed to evaluate the results of treatment of subtrochanteric femoral fractures using PFN. **Patients and methods:** This prospective study conducted at Orthopedic Department, Zagazig University Hospital, from November 2020 to July 2021. It included 24 patients, complaining of closed subtrochanteric fractures treated with PFN (Gamma intramedullary nail). The age ranged from 23 to 87 years (with mean 54.21 years), 13 of them were males and 11 females. Road traffic accident (RTA) represented the most common mechanism of injury in 10 patients (41.7%) while fall down represented (37.5%) in 9 patients, and fall from height in 5 patients (20.8%). **Results:** there was statistically significant difference in HHS among patients with different age groups, mechanism of injury and presence of diabetes mellitus (DM) as associated condition. Statistically there was significant correlation between type of reduction and diabetes mellitus with Harris hip score. **Conclusion:** This study concluded that the Gamma nail is an excellent choice in treatment of subtrochanteric fractures as it has many advantages as allowing for early functional exercise and full weight-bearing of the affected limb, shortening the duration of operation, high rotation stability, small wounds and minimizing blood loss along with risk of infection

Keywords: Proximal femoral nail, subtrochanteric fractures, trochanteric fractures.

INTRODUCTION

The subtrochanteric region is usually exposed to high stresses during routine activities. Axial loading forces through the hip joint create a large moment arm, with significant lateral tensile stresses and medial compressive loads. In addition to the bending forces, muscle forces at the hip also create torsional effects that lead to significant rotational shear forces⁽¹⁾. High compressive and tensile forces of muscles separate the fracture fragments and cause instability of the fracture. Hence this fracture is difficult to manage and is associated with many complications including malunion, delayed union, non-union and implant failure⁽²⁾. Due to these anatomical features conservative treatment is not preferred, and if there are no absolute contraindications and the patient can tolerate surgery, surgery is the treatment of choice. The goal of operative treatment is restoration of normal length, anatomical alignment and angulation to restore adequate tension to the abductors⁽³⁾. Early mobilization and weight bearing are possible with advances in implants and fixation technology. The two primary options for treatment of subtrochanteric fractures are intramedullary fixation and surface fixation⁽⁴⁾.

Primary nail is placed in the intramedullary cavity, creating central fixation⁽⁵⁾. Several advantages of the proximal femoral nail have been proposed, such as its application to the femoral head and neck and femoral shaft to increase stability at fracture sites and to promote healing⁽⁶⁾. The aim of the current study was to evaluate the results of treatment of

subtrochanteric femoral fractures using proximal femoral nail.

PATIENTS AND METHODS

A prospective study conducted at Zagazig University Hospital, from November 2020 to August 2021; included 24 patients, complaining of closed subtrochanteric fractures treated with proximal femoral nail (gamma intramedullary nail). The age ranged from 23 to 87 years (with mean 54.21 years), 13 of them were males and 11 females. Road traffic accident (RTA) represented the most common mechanism of injury in 10 patients (41.7%) while fall down was present in 9 patients (37.5%) and fall from height in 5 patients (20.8%).

Inclusion criteria: Any patient after skeletal maturity presenting with subtrochanteric femoral fractures included in the study.

Exclusion criteria: Any patient with unstable pelvic fractures and open fractures, severe medical comorbidity.

Preoperative assessment:

History Taking: Name, age, sex, special habits, causes and the time of injury, any previous injuries and previous surgical interventions, any medical comorbidity and medications.

General examination: Blood pressure, pulse, temperature, respiration, examination of the spine, knee, pelvis and calcaneus was very important for associated injury.

Local examination: Inspection: deformity, skin condition and associated injuries. Palpation: skin



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temperature, dorsalis pedis and posterior tibial pulse, and popliteal arteries. Neurovascular examination.

Radiological studies: Plain X-ray (Antero-posterior and Lateral views) of the hip joint was done.

Laboratory investigations: Complete blood count. Renal function test. Liver function test. Random blood sugar. Bleeding profile was assessed in all patients.

Surgical technique:

Systemic broad spectrum intravenous antibiotic was given 30 minute before the operation. Anesthesia was chosen according to the patient's condition by either spinal anesthesia or general anesthesia. After induction of anesthesia, the patient was placed supine on a radiolucent orthopedic traction table. The uninjured limb was flexed and abducted at the hip. It is important to ensure that the ipsilateral hip was in an adducted position. To accomplish this, the torso was pushed 10 to 15 degrees to the contralateral side. To reduce the fracture, traction was applied in the direction of the length of the extremity. This helped to distract the fragment and regain length. Each step was checked with the image intensifier. Anteroposterior and true lateral images were taken. The image intensifier was checked and a lateral view showing the head and neck of the femur was insured to be feasible before starting the operation. A qualified X-ray technician was essential in order to produce proper images and to save time and reduce radiation exposure. The patient was then prepared and draped as for the standard hip fracture fixation. Draping is applied up to the pelvic rim.

On the traction table, the fractured leg was adducted approximately 10–15° to achieve the optimal entry point. The table was then tilted to the opposite direction to eliminate external rotation of the proximal fragment. Rotational alignment of the distal fragment was evaluated with the fluoroscopy and corrected by rotating the foot plate. If the distal fragment drops posteriorly, the foot plate was elevated 2–3 cm (20–30°), or a crutch was positioned under the distal fragment at the respective height that is assessed by fracture reduction with the fluoroscopy. A mallet or a hammer could be used for indirect reduction in the subtrochanteric fracture; this applies an external force to the fracture fragment into proper reduction. The disadvantage of this technique is that the maneuver used for fracture reduction and guide wire passing must be repeated during reaming to avoid eccentric reaming that may result to improper reduction.

Postoperative care:

Postoperatively, patients pulse, blood pressure, respiration, temperature were monitored. Foot end elevation was used depending on blood pressure. Antibiotics were continued in the postoperative period. Analgesics were given as per patient's compliance. Blood transfusion was given depending on the requirement. Suction drain if used was removed after 48 hours. Sutures were removed between 10th to 15th postoperative days.

Patients were encouraged to sit in the bed after 24 hours after surgery. Patients were taught quadriceps setting exercises and knee mobilization at once the suction drain was removed.

Patient was taught gait training before discharge from the hospital. Only in very unstable fracture patterns weight bearing was not advised. Rest of the patients was encouraged to weight bear partially with axillary crutches or walker depending on the pain tolerability of individual patient.

Follow up: Clinical and radiological assessments were done for all patients at 2 weeks, 1 month, 3 months and 6 months searching for any complication of the device or technique of fixation. At every visit patient was assessed clinically regarding hip and knee function, walking ability, fracture union, deformity and shortening. X-ray of the involved hip with femur was done to assess fracture union and implant bone interaction.

Assessment of union: The presence of malunion (defined as deformity >10 degrees in the coronal plane and 20 degrees in the sagittal plane), delayed union (time to union between 6 and 9 months), nonunion (union not achieved by 9 months) were assessed after 9 months.

Radiological assessment: Serial X-rays were taken and every one was checked to determine 3 parameters, union (delayed and non-union and malunion), implant failure and fixation failure (lag screw cut-out, penetration or loosening).

Clinical assessment of outcome: At the end of follow-up all patients were evaluated clinically based on Harris hip score.

Ethical consent:

An approval of the study was obtained from Zagazig University Academic and Ethical Committee. Every patient signed an informed written consent for acceptance of the operation and participation in the study. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans.

Statistical Analysis:

Data collected throughout history, basic clinical examination, laboratory investigations and outcome measures were coded, entered and analyzed using Microsoft Excel software. Data were then imported into Statistical Package for the Social Sciences (SPSS version 20.0) software for analysis. Qualitative were represented as number and percentage and were compared by Chi square test (X^2). Correlation was calculated by Pearson's correlation. P value was set at <0.05 for significant results and <0.001 for high significant result.

RESULTS

According to Harris hip score (HHS) this study showed that 37.5% of patients obtained excellent HHS (Table 1).

Table (1): Clinical outcome according to Harris hip score (HHS) among studied group

Harris hip score	N	%
Excellent	9	37.5%
Good	8	33.3%
Fair	4	16.7%
Poor	3	12.5%

There was a statistical significant effect of the age on final clinical outcome (Table 2).

Table (2): Relation between score and age

Age group	Harris Hip Score				χ^2	p
	Excellent NO. (9)	Good NO. (8)	Fair NO. (4)	Poor NO. (3)		
20-40 years	7	1	0	0	23.27	0.006
41-59 years	2	3	0	0		
60-70 years	0	3	1	1		
> 70 years	0	1	3	2		

As shown in the table below the gender had no statistical effect on final outcome.

Table (3): Relation between score and gender

Gender group	Harris Hip Score				χ^2	p
	Excellent NO. (9)	Good NO. (8)	Fair NO. (4)	Poor NO. (3)		
Male	6	5	1	1	2.685	0.443
Female	3	3	3	2		

As the table below shows all (100%) the fractures caused due to RTA had satisfactory outcome, also the vast majority (80%) of fractures caused by FFH had satisfactory outcome, while most of patients injured due to FD had unsatisfactory outcome (66.67%) according to HHS.

Table (4): Relation between score and mechanism of injury

Mechanism of injury	Harris Hip Score				χ^2	p
	Excellent NO. (9)	Good NO. (8)	Fair NO. (4)	Poor NO. (3)		
RTA	7	3	0	0	15.12	0.02
FD	0	3	4	2		
FFH	2	2	0	1		

According to table below there was statistically significant difference between presence and absence of comorbidities with HHS. Presence or absence of hypertension (HTN) had no statistical effect on final outcome. While presence of DM had statistically significant effect on the final outcome.

Table (5): Relation between score and comorbidities

Comorbidities	Harris Hip Score				χ^2	p
	Excellent NO. (9)	Good NO. (8)	Fair NO. (4)	Poor NO. (3)		
No comorbidities	6	1	0	0	10.08	0.02
With comorbidities	3	7	4	3		
Absence of HTN	7	2	2	2	4.98	0.173
Presence of HTN	2	6	2	1		
Presence of DM	1	5	4	3	12.86	0.005
Absence of DM	8	3	0	0		

As regard in table (6), there was a significant correlation between poor HHS score with time before surgery, age, union time.

Table (6): correlation with poor HHS

	R	P value
Time before surgery (days)	0.873	<0.001
Union time (months)	0.780	<0.001
Age in years	0.449	0.028
Diabetes mellitus	0.348	0.096
Hypertension	-0.095	0.659

DISCUSSION

Subtrochanteric fracture of the femur occurs within the area that is 5 cm below the lesser trochanter. The incidence of fractures of the proximal femur is markedly increasing because of increasing life expectancy and motor vehicle accidents. Subtrochanteric fractures of the femur cause a great problem due to high level of stresses over this area, which cause diversity of fracture patterns and difficulty in attaining anatomical reduction and if not managed properly results in poor outcome. In elderly individuals; low-energy trauma usually results in multi-fragmentary fractures, sometimes with an unstable configuration (6).

Intramedullary nails provide a biomechanical advantage with increased stiffness, rigidity, and a shorter moment arm, which translates to a stronger construct and decreased strain experienced by the implant. Nail entry point and construct design can affect fracture reduction and stability, therefore; the surgeon should understand the modifiable variables that can improve surgical outcomes (7). Intramedullary nailing has many advantages, including easy insertion using a closed technique, retaining the fracture hematoma, and a lower infection rate due to less surgical dissection. Closed nailing constitutes a form of biological fixation of the femur, which may be credited for a shorter time to union (6).

This prospective study conducted at Orthopedic Department, Zagazig University Hospital, from November 2020 to July 2021, included 24 patients, complaining of closed subtrochanteric fractures treated with proximal femoral nail (gamma intramedullary nail) to study the better management and improving outcome of patient with subtrochanteric fracture.

The current study showed that the mean age of included patients was 54.21 years, from them 54.2% were males and 45.8% were females. The current study showed that the side of fracture was right in 12 (50.0%) patients and left in 12 (50.0%) patients. The mechanism of injury was road traffic accident in 10 (41.7%), fall down in 9 (37.5%) and fall from height in 5 (20.8%). The type of reduction was open in 6 (25.0%), closed in 18 (75.0%).

The current study showed that 37.5% of patients obtained excellent HHS, while 33.3% obtained good HHS, 16.7% had fair HHS and 12.5% obtained poor HHS. Which is in agreement with the study of **Abraham et al.** (8), which found that there

were 10 patients (38.5%) with an excellent Harris hip score, 9 patients (34.6%) patients with a good score, 4 patients (15.4%) with fair score and 3 patients (11.5%) had poor scores.

Juskovic et al. (9) reported that excellent was reported in 41 patients (85.4%), good was reported in 4 patients (8.3%) and poor was reported in 3 patients (6.3%), this high score in this study maybe due to younger age group included in his study, as the mean age was 42 years, compared with 55.33 years in the current study. **Shah and Shah** (10) reported that Harris hip score showed excellent result in 39 patients, good results in 3 cases and poor results in 5 cases. The poor result in one patient (case 5) was basically because of pathological fracture which leads to delayed union and low Harris Hip score.

The current study showed that there was statistically significant difference in HHS among patients with different age groups, as most of excellent patients (77.8%) were aged between 20 and 40 years, and the rest of them were aged from 41 to 59 years and no case were excellent in patients with age more than 60 years. On the other hand all the unsatisfactory outcomes (fair + poor HHS) were above age of 60 years. It had been noted that only one case out of 7 cases aged above 70 years had good outcome while the rest (85.71%) were either fair or poor outcome. Also the mechanism of injury had statistical significant effect on HHS, as there were 7 patients had road traffic accident obtained excellent HHS, while no patient injured due to RTA was poor or fair. While no patient injured due to FD was excellent and most of patients (66.67%) were either fair or poor. Also there was statistically significant difference in HHS among patients with and without diabetes mellitus. There were 8 patients obtained excellent HHS in non-diabetic patients while only one patient in diabetic patients obtained excellent HHS. Moreover all the poor HHS score patients were diabetic, while no patient obtained fair or poor HHS in non-diabetic patients. There were no statistically significant differences in HHS score among different gender, side of fracture, reduction type, Russell Taylor classification and presence of hypertension.

Pisoude et al. (11) found that sex and age could significantly decrease the HHS. Thus, the HHS was influenced by female sex (OR = 0.851) and age of more than 60 (OR = 0.829) and there was no significant relationship between the HHS and other variables.

The current study showed that regarding complications after proximal femoral nail, there were 4.2% with nonunion, 16.7% with surgical site infection and 8.3% with delay union. **Seenappa et al.**⁽¹²⁾ found that postoperative complications were noted in 15 (24.2%) patients. Limb length discrepancy in 6 (9.7%) patients and 2 (3.2%) patients had implant loosening. Subtrochanteric nonunion was noted in 3 (4.8%) patients. 4 patients had surgical site infection, which was controlled by adequate antibiotic administration with third generation cephalosporin for two weeks. **Thakur et al.**⁽¹³⁾ found that the complications studied included wound infection in 2 patients (8.69%), knee stiffness in 2 patients (8.69%), shortening in 2 patients (8.69%) and delayed union in 1 patient (4.47%).

The current study showed that there were a significant correlation between time before surgery (p value <.001) and the presence of diabetes mellitus (p value <0.001) with union time. While no correlation between side of fracture or type of reduction or hypertension with union time. The current study showed that there were a significant relationship between poor HHS score with time before surgery, age, and union time and no correlation between poor HHS and DM or hypertension.

Basani et al.⁽¹⁴⁾ reported that Harris hip score was used to assess the functional outcome of patients. The mean HHSs at 6 months and 12 months were 81.57±12.39 and 87.33±8.2, respectively.

The current study showed that regarding the presence or absence of complications, there were a significant difference in type of reduction (p value = 0.020) and Harris hip score (p value = 0.009) and diabetes (p-value = 0.047). There were no differences between complicated and non-complicated patients in age, sex, side of fracture, mechanism of injury or the presence of hypertension.

Seenappa et al.⁽¹²⁾ found that the factors like age, gender, comorbidities and postoperative complications don't affect functional outcomes..

CONCLUSION

This study concluded that the Gamma nail is an excellent choice in treatment of subtrochanteric fractures as it has many advantages as allowing for early functional exercise and full weight-bearing of the affected limb, shortening the duration of operation, high rotation stability, small wounds and minimizing blood loss along with risk of infection.

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Conflict of interest: Nil.

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