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ORIGINAL ARTICLE

Intraoperative complication in gamma nail versus proximal femur locked plate in treatment of intertrochanteric femur fractures.

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ABSTRACT

Keyword: gamma nail, trochanteric femur fractures, proximal femur locked plate

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Background: management of intertrochanteric femur fractures is challenging, different method of fixation used such as gamma nail, proximal femur locked plate. **Aim of study:** to compare the intraoperative complications between gamma nail and proximal femur locked plate in treatment of intertrochanteric femur fractures. **Subjects and methods:** fifty patients with intertrochanteric femur fractures were enrolled in a prospective study and divided into two groups, each group included 25 patients; group (A) fixed with proximal femur locked plate and group (B) fixed with gamma nail. The recorded intraoperative data: amount of bleeding, operative time , image fluoroscopy exposure , varus malposition and lag screw cut out. **Results** the intraoperative blood loss in the group A (322 ±66 ml) was significantly greater than that in the group B (136 ±103 ml; p value < 0.05). Image fluoroscopy exposure in the group B was (82.12 ±8.66) and in group A was (20.24 ±4.3 (p value < 0.05). varus malposition in 5 (20%) cases in group A compared to 6 cases (24%) in group B. Operative time was similar. **Conclusion**: the Gamma Nail achieve lesser blood loss than gamma nail, although the higher exposure to image fluoroscopy

INTRODUCTION

Treatment of intertrochanteric femur fractures is challenging, Because of the difficulty in the decision for optimal method of fixation, complicated nature and their high incidence in elderly patients thereby need for efficient care to reduce morbidity and regain mobility [(1) (2)]. There are various fixation techniques used to treat intertrochanteric femur fractures, including proximal femoral locked plate (PFLP), gamma nail (GN) dynamic hip screw (DHS) and Dynamic condylar screw (DCS). [(4)] Although GN and PFLP achieve the best results in intertrochanteric femur fractures, but they have prons and cons . Both GN and PFLP exhibit intraoperative complications that may have an impact on the patient's prognosis [(9)] .GN related intraoperative complications include instability, insufficient fracture fixation, malpositioning and more imaging exposure for the patient and the surgeon. Also, difficult fracture reduction , nail breakage and screw cutout are reported with GN [(4) (5)]. on the other hand, PFLP exhibit distinct intraoperative problems, such as longer operating time and greater blood loss, in addition to difficulty of achieving a satisfactory reduction, plate failure, and screw pullout[(6)(17)] . Comprehending these

benefits and drawbacks is crucial for optimizing strategy and determining complications. There are inadequate Studies comparing intraoperative complications in gamma nail versus proximal femur locked plate in treatment of intertrochanteric femur fractures. we hypotheses that GN has lower intraoperative complication rate than PFLP in fixation of intertrochanteric femur fractures, where the aim of the study is to compare the intraoperative complications of GN and PFLP in the fixation of intertrochanteric femur fractures, highlighting the benefits and drawbacks of each fixation technique in order to maximize clinical judgment

PATIENTS AND METHODS

50 patients with intertrochanteric femur fractures were enrolled in this prospective study and divided into two groups, each group included 25 patients; group (A) fixed with proximal femur locked plate and group (B) fixed with gamma nail. The study was conducted from March 2023 to April 2024 at the orthopedic department of Aswan University Hospital. Inclusion criteria: Age of the patients more than 18 years, All type of fracture according to AO classification [(9)] and recent (less than 3 weeks) fractures . Exclusion criteria: Pathological fractures, Open fractures, associated pelvic or acetabulum fractures, previous hip surgery.

Preoperative data recording: hip and femur x-rays (antero-posterior and lateral views), comorbidities such as HTN and DM, associated fractures, and the limb's neurovascular condition. The patient had skin traction, and under cover of anticoagulants and analgesic drugs.

Assessment of intraoperative complications such as: amount of bleeding, operative time, image fluoroscopy exposure, varus malposition, neck shaft angle (NSA), intraoperative iatrogenic fractures and lag screw cut out.

Surgical technique;

Under spinal or general anesthesia the patients lie on radiolucent orthopaedic fracture table, followed by intravenous dose of 1 gram of 1st generation cephalosporin antibiotic. The affected lower limb was sterilized starting from the umbilicus down to the foo and drapped.

As regard to GN fixation, there are few crucial measures. The patient lies in lateral position to facilitate easy access and imaging. We performed closed reduction of the fractures through internal rotation and traction of the leg by the assistant. Through a 2–3 cm skin incision proximal to the tip of greater trochanter (GT), we performed the nail entry in the tip of the GT using the awl [(8)]. It's crucial to ream the medullary canal to ensure that the nail passes easy without resistance. Then we introduced the gamma nail, and confirmed that it was parallel to the femoral axis by the image intensifier. Using the guided device of the GN, the lag guide wire was advanced centrally through the femoral neck and head, followed by reaming, under guide of the image intensifier. The lag screw introduced under guide of image intensifier. Finally, 2 distal locked screws were inserted to secure the nail position. [(13)] [(14)].

On the other hand, through lateral approach, PFLP was applied on the proximal femur and anatomical reduction was done under direct vision. Several proximal locking screws through the plate engaged the femoral head and neck to provide angular stability. Several distal locking screws were used to secure the plate to the shaft [(11)] [(15)]

Statistical analysis:
Data were analyzed using Statistics Package for Social Sciences (SPSS) version 27.0 (SPSS Inc., Chicago, IL, USA). Normality test (**Kolmogorov-Smirnov** & **Shapiro-Wilk** test) was performed and data (**age**) were normally distributed. In contrast, data for (**Other scale parameters)** were not normally distributed. **Continuous data** were expressed as mean $\pm$ standard deviation (Mean±SD) or median and Interquartile range (Median (IQ)). Differences between the two groups were detected using **Independent samples T- test** for parametric data and were detected using **Mann-Whitney U** test for non-parametric data. Differences between

more than two groups were detected using **Kruskal-Wallis H** for non-parametric data. **Nominal** data were expressed as percentage, differences between the two groups were detected using **Chi square** test. **A two-tailed p < 0.05** was considered statistically significant.

RESULTS

The mean Age in PFLP group was (53.32±12.66) years and GN group was (49.76±14.81) years with no statistical significance. Ten (40%) patient associated with comorbidities; DM, HTN, Renal diseases in PFLP group compared to 15 (60%) patient in GN group.

Table 1. show demagoghraphic data compared between gamma nail and proximal femur locked plate patients

	Fixation		**P. value**
	PFLP (n=25)	**Gamma nail (n=25)**	
Sex			
Male	15(60%)	10(40%)	0.157
Female	10(40%)	15(60%)	
Age			
Min. - Max.	33 – 80	25 – 71	
Mean±SD	53.32±12.66	49.76±14.81	0.365
Median(Q1-Q3)	51(45.5-60)	55(35-62)	
Side			
Rt	13(52%)	18(72%)	0.145
Lt	12(48%)	7(28%)	
Comorbidities			
Non	14(56%)	10(40%)	
Asthmatic	0(0%)	3(12%)	
Dm	0(0%)	2(8%)	
HTN	4(16%)	6(24%)	0.167
RA	1(4%)	2(8%)	
Renal	2(8%)	0(0%)	
DM, HTN	2(8%)	0(0%)	
DM, cardiac	2(8%)	2(8%)	
AO type			
A1	5(20%)	6(24%)	
A2	9(36%)	9(36%)	0.933
A3	11(44%)	10(40%)	
Cause of injury			
Accident	9(36%)	10(40%)	
Fall from height	7(28%)	8(32%)	0.831
Fall on ground	9(36%)	7(28%)	

The operative blood loss in PFLP group (322 ±66 ml) was significantly more than GN group (136 ±103 ml ;p value < 0.05). In addition, image fluoroscopy exposure in GN group (82.12 ±8.66) was significantly more than PFLP group (20.24 ±4.3; p value < 0.05).

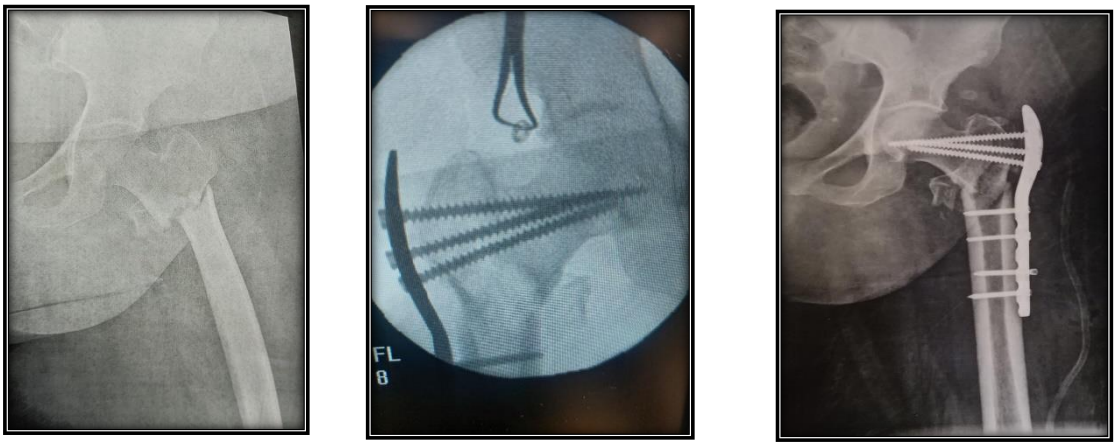
Table 2 comparison according to image fluroscopy

	Fixation		**P. value**
	PFLP (n=25)	**Gamma nail (n=25)**	
image fluoroscopy			
Min. - Max.	15 – 30	70 – 95	
Mean±SD	20.24±4.3	82.12±8.66	
Median(Q1-Q3)	20(16.5-22)	87(74-90)	<0.001**

The operative time was prolonged in PFLP group (122.8 ±31 min) compared to GN group (111.8±39 min) with no statistical significance. 6 (24%) cases showed intraoperative varus malposition with mean NSA (125.04±13.76^0) in PFLP group compared to 6 (24%) cases in gamma nail group with mean intraoperative NSA (122.52±14.67^0) with no statistical significance. Nine cases out of the 12 cases that showed varus collapse in both PFLP and GN groubs were unstable (classified A3 in AO classification) which is statistically significant . No cases with intraoperative iatrogenic fractures or lag screw cut out was detected

Table 3comparison according to blood loss

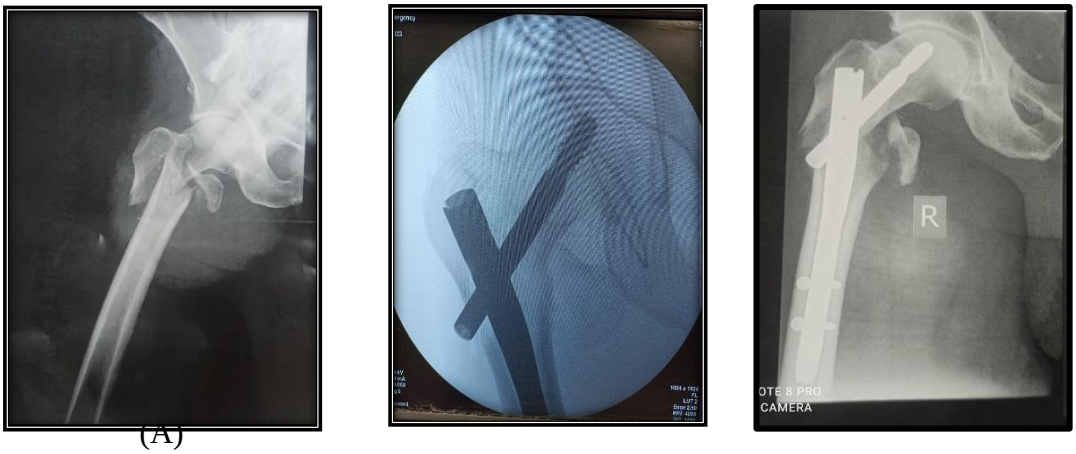
	Fixation		**P. value**
	PFLP (n=25)	**Gamma nail (n=25)**	
Blood loss			
Min. - Max.	250 – 450	50 - 400	
Mean±SD	322±66.27	136±103.48	
Median(Q1-Q3)	300(250-375)	110(90-130)	<0.001**



(A) (B) (C)

Figure 1 show a case of 58 female patient with subtrochanteric femur fracture fixed with PFLP in varus malposition

(A) show preoperative x-ray. (b) show intraoperative fluoroscopy image. (C) show early postoperative x-ray



(A) (B) (C)

Figure 2 show a case of 66 male patient with trochanteric femur fracture fixed with GN in varus malreduction

(A)show preoperative x-ray. (b) show intraoperative fluoroscopy image. (C) show early postoperative x-ray

DISCUSSION

GN and PFLP are two famous methods of fixation of intertrochanteric femer fractures[7]. GN may cause number of problems such as stress fractures of the distal femoral shaft that occur during main nail insertion, main nail breaking and lag screw length and placement issues [13].on the other hand the PFLP must adhere to the tension band principles as an extra medullary fixation device, which necessitates the stability of the support structure at the posterior inner-side trochanter [3]. Complications such as screw breakage and coxa vara are more likely to develop in cases with displaced lesser trochanters unless reduced fixation or delayed weight bearing on the fracture occurs [11]. In this study we compare the intraoperative data such as blood loss, operative time and fluoroscopy exposure between the two methods. Our results confirmed that both GN and PFLP are effective in treatment of intertrochanteric femur fracture . However, GN has the advantage of less blood loss compared to PFLP, but the fluoroscopy exposure show increase with cases treated with GN.

There was no statistical significance in our research for the age, sex, fracture side, injury etiology, or fracture type .The mean age in PFLP and Gamma nail was (53.32±12.66) and (49.76±14.81) respectively. Our study demographic data is similar to that of Mohamed et al.[13]. We found a statistically significant difference in the frequency of blood loss between the PFLP which was higher than Gamma Nail groups (322±66.27) and (136±103.48) respectively. While Han et al. goes against our findings, they found less overall blood loss in PFLP compared to GN and explained that by the presence of hidden blood loss associated with reaming during GN fixation [9], He et al. demonstrated that extensive dissection for plate placement increases the amount of blood loss [20]. We reported significant higher image fluoroscopy usage in GN group (82.12±8.66 sec) than PFLP group (20.24±4.3 sec) . Han et al. found that image fluoroscopy exposure increase with GN group than PFLP group[9] . While the image fluoroscopy is a valuable and important instrument in today's world, it is not devoid of hazards for the surgeon and patient. To reduce the adverse effects of fluoroscopy, it is crucial to comprehense the ALARA principle. It is also vital to keep in mind the phrase "As low as reasonably achievable" whenever utilizing a image fluoroscopy [20] . In our study, we recorded 6 (24%) cases show intraoperative varus malposition with mean NSA (125.04±13.76^0) in PFLP group compared to 6 (24%) cases in GN group with mean intraoperative NSA (122.52±14.67^0) with no statistical significance . Han et al

found that intraoperative varus malposition is more common in gamma nail due to difficult technique in obtaining good reduction[9]. We found that varus malreduction is significantly related to the stability of the fracture as 9 (75%) of the cases displayed varus malreduction were unstable. This similar to the finding of Li et al. Who found that increased varus malreduction in unstable intertrochanteric fractures compared to stable fractures[21]. Compared to the GN group, whose average operating time was (111.8±39.26 min), the PFLP group had a longer operating time (122.8±31.56 min), statistically insignificant. Han et al., the gamma nail offers a shorter operation length compared to the with no statistical significance [9].

RECOMMENDATION:

- Consideration of patient characteristics such as age, bone density, and fracture characteristics is important for choosing an appropriate fixation technique.
- Surgeons should be sufficiently trained and experienced in handling both techniques to reduce the risk of intraoperative problems.
- good surgical hemostasis especially in cases with PFLP
- applying safety precautions to reduce the effects of fluoroscopy on the patient and the surgeon
- early surgical interventions to decrease complications associated with malreductions
- great effort should be performed to reduce the fracture in valgus position with NSA more than 130^0

Limitations of the study; small sample size, one center study and different experiences and skill levels of the orthopedic surgeon who performed the surgeries.

CONCLUSION, GN and PFLP are both effective treatments for intertrochanteric femur fractures; however, GN has the advantage of less blood loss, although the higher exposure to fluoroscopy must be carefully considered. Patient variables, surgeon expertise, and the particular clinical setting should all be taken into consideration when choosing a fixation method.

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