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Comparison of Clinical Outcomes and Union Rates Between Proximal Femoral Nail and Gamma Nail in Intertrochanteric Fractures

Muhammad Awais Iqbal, Zohaib Nadeem, Hasnain Ali, Mustafa Javed Bhalli, Laiba Ahsan, Saad Tauheed Rao

Abstract

Objective: To compare the efficacy and outcomes of two different surgical procedures, the PFN and the GAMA nail, in the treatment of intertrochanteric femur fractures.

Study Design and Settings: It was a comparative study. From 1 July 2024 to 1 Feb 2024, 35 patients with intertrochanteric fractures treated with PFN or GAMMA Nail at Shifa International Hospital's Department of Orthopaedics were part of this prospective study.

Results: In this study the mean age of the cases in Group A was 69.27 ± 19.44 and in Group B was 62.15 ± 23.52. Greater tip apex at 6 weeks and 6 months is associated with higher leg length discrepancies as the pearson correlation showed significant p-value 0.000. For the PFN group (n = 13), there was a significant positive correlation between tip-apex distance and leg length discrepancy (r = 0.634, p = 0.020). Similarly, for the Gamma Nail group (n = 22), a significant positive correlation was observed (r = 0.560, p = 0.007).

Conclusion: Our study showed that both gamma nail and proximal femoral nail are trusted devices for intertrochanteric fracture (boyd and griffin type ii) treated by PFN vs Gamaa nail. The comparison of union rate at 6 weeks and 6 months showed and pain score showed comparative results. Moreover, the results showed that Greater tip apex at 6 weeks and 6 months is associated with higher leg length discrepancies as the pearson correlation showed significant p-value 0.000.

Key Words: Boyd and Griffin, Gamaa Nail, Intertrochanteric Fracture, PFN, Union Rate

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INTRODUCTION:

There is a high incidence of intertrochanteric fractures in the older population, particularly as a result of the increasing prevalence of osteoporosis. Intramedullary implants, such as the proximal femoral nail (PFN) and the GAMMA nail, have been shown to have positive outcomes in a number of trials; nevertheless, other research indicates that the rates of complications are higher. [1]

There has been a significant increase in the number of proximal femoral fractures as a consequence of an increase in the number of patients having osteoporosis as a result of a longer life expectancy.[2] This increase has been brought about by an increase in the number of road traffic incidents that have affected younger individuals. Young individuals frequently suffer from intertrochanteric fractures as a consequence of significant trauma, such as being involved in a car accident or falling from a considerable height, as stated by Lavallière et al. (2020).[3] Ninety percent of all intertrochanteric fractures that occur in elderly people are the result of accidental falls.[4] Because of the growing elderly population and the prevalence of osteoporosis, the trend of an increasing number of intertrochanteric femoral fractures over the past few decades is likely to persist into the foreseeable future. Intertrochanteric fractures are not as common in some countries as others. [5-6] The anticipated total number of hip fractures is projected to reach 2.6 million in 2025 and 4.5 million in 2050. Intertrochanteric hip fractures accounted for 26% of all hip fractures in Asia in 1990, but that number could increase to 37% in 2025 and 45% in 2050.[7] Stable fixation, which permits early patient mobilisation, is the treatment goal for these fractures.

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Significant morbidity and mortality are linked to these breaks.

The major purpose of the PFN was to solve the acknowledged inadequacies and potential problems that were associated with the Gamma device by the implementation of enhancements. The PFN has a fluted tip and a lowered diameter, both of which help to reduce the amount of bone strain and eliminate the likelihood of shaft fractures. Static or dynamic locking is achieved by moving one distal locking screw closer to the apex. This is done in order to strengthen the structural integrity of the structure. It is necessary to insert a smaller adjustment screw into the superior section of the femoral neck in order to avoid insert cutoff and to stop the head-neck fragment from rotating.[8]

The intramedullary nail system was combined with the sliding hip screw to create the gamma nail, which became a classic intramedullary fixation approach for the treatment of intertrochanteric fractures.[9] Inserting the primary nail into the intra-medulla cavity is the method that is utilised to accomplish central fixation.[10] Farhat et al. (2021) state that one of the several possible advantages of utilising gamma nails on the femoral head, neck, and shaft is that they improve stability at fracture sites and speed up the healing process, which ultimately leads to the early union of the fracture.[11] This is only one of the many potential benefits of employing gamma nails.[12] Additionally, the stabilisation of the medullary cavity enables the afflicted legs to bear their entire weight and participate in early functional activities. During the process of inserting the main nail, the gamma nail may produce stress fractures of the distal femoral shaft as well as a worsening of the intertrochanteric fractures. There is, however, a standardised surgical procedure that may be utilised by medical professionals in order to implant gamma nails. Both the amount of time required for the therapy and the number of incisions performed are minimal.

The objective of our research was to compare the efficacy and outcomes of two different surgical procedures, the PFN and the GAMA nail, in the treatment of intertrochanteric femur fractures. We aimed to determine which method yields higher union rates and produces better functional outcomes in patients.

METHODOLOGY:

This comparative study was conducted from 1 July 2024 to 1 Feb 2025 under IRB number 247-24. 35 patients with intertrochanteric fractures treated with PFN or GAMMA Nail at Shifa International Hospital's Department of Orthopaedics were part of this study. The sample size was calculated using the WHO sample size calculator for comparison of two proportions. Taking expected union rates of 95% in the Gamma nail group and 75% in the PFN group from the study by Badawy et al., with a 95% confidence level and 80% power, the calculated sample size was 46 patients per group. After adjusting for an anticipated dropout rate of approximately 20–25%, the final sample size was taken as 35 patients in each group.[9] Non-probability consecutive sampling technique was used to divide patients in both groups.

Patients aged 18 to 90 years with intertrochanteric fractures classified as type II according to the Evans and Boyd & Griffin criteria, as well as those receiving primary or index surgery, were included in the study.

Patients with fractures resulting from diverse clinical conditions, a prior surgical history involving the proximal femur, unstable intertrochanteric femur fractures managed with various internal fixation techniques, and those with past non-unions or malunions were excluded from the study.

Each patient received one intravenous dose of third-generation cephalosporin during surgery, and they were instructed to continue taking the medication every 12 hours for seven days following the procedure.

All patients were operated on a traction table while in the supine position. The fracture was successfully reduced using abduction, traction, and internal rotation under fluoroscopic guidance, employing minimally invasive procedures for nailing. The lower limb was adducted to facilitate the insertion of the Gamma nail.

A cut was made into the skin five centimetres from the greater trochanter's tip. Aligning the guiding k-wire under the C-Arm guide, it was put into the greater trochanter after the superficial fascia and muscles were dissected. The lateral and perioperative X-rays reveal that the guide K-wire was inserted into the femoral shaft midline. To manually ream the proximal femur, a sharp tool was utilized. The nail was manually placed into the femoral shaft. Once the lag screw was centrally positioned in the lateral and anteroposterior x-ray views, the targeting arm, which was attached to the insertion device, helped enter the guide k-wire into the femoral neck for the first time. In PFN, a guide K-wire and an anti-rotational screw were added to a comparable technique. The lag screw was put in after the anti-rotational screw, which was inserted with its tip around 25 mm medial to the fracture line. Moving on to the last stage, distal screws, static or dynamic, were inserted.

Prior to the operation, a postoperative x-ray was compared with a pelvic radiograph that included the hip and full-length femur on the fracture side.

Anticoagulants (LMWH) were commenced for each patient unless a significant risk of haemorrhage was evident. Patients were seen during designated appointments at 2 weeks, 6 weeks, 3 months, and 6 months. At each follow-up consultation, the patient received clinical and radiological assessments. The assessment of leg length discrepancy, thigh discomfort, or hip pain score was conducted.

Anteroposterior measurements of the operated side's neck-

shaft angle, which is typically 125 degrees, were used to assess the reduction quality. A reduction was deemed satisfactory if it deviated by fewer than five degrees from the typical range, acceptable if it deviated between five and ten degrees, and unsatisfactory if it deviated by more than ten degrees.

On pelvic radiographs, which included both lateral and anteroposterior views of the operative femur, the fixation quality was assessed using the Cleveland index and tip apex distance. The fracture union rate was assessed using serial radiographs at follow-up consultations at 6 weeks and 6 months.

The data were analyzed via the Student's t-test and the chi-square test. The Pearson correlation was employed to assess the relationship between tip-apex distance and leg-length discrepancies. A P-value less than 0.05 were deemed statistically significant. The analysis was conducted utilizing SPSS, version 23.

RESULTS

In this study the mean age of the cases in Group A was 69.27 ± 19.44 and in Group B was 62.15 ± 23.52. There were 13 (59.1%) male and 9 (40.9%) females enrolled in Gamma Nail and 11 (84.6%) male and 2 (15.4%) females found in PFN. The comparison of different risk factors showed insignificant results p-value > 0.05. (Table 1). In this study the mean height, weight and BMI in Gamma Nail was 164 ± 10.20, 65.39 ± 14.76 and 24.34 ± 5.73. Similarly, the mean height, weight and BMI in PFN was 161 ± 8.41, 65.69 ± 17.19, 25.28 ± 5.67 respectively. (Table 2) In this study the comparison of preoperative Hb, postoperative Hb and thigh pain at 6 weeks and 6 months showed insignificant difference with p-value > 0.05. (Table 3). In this study union rate at 6 weeks in gamma nail was 19 (86.4%) while in PFN union rate was (84.6%). Similar results were found at 6 months. These results were insignificant p-value 1.00. (Table 4) Greater tip apex at 6 weeks and 6 months is associated with higher leg length discrepancies as the pearson correlation showed significant p-value 0.000. (Table 5) For the PFN group (n = 13), there was a significant positive correlation between tip-apex distance and leg length discrepancy (r = 0.634, p = 0.020). Similarly, for the Gamma Nail group (n = 22), a significant positive correlation was observed (r = 0.560, p = 0.007). (Table 6)

DISCUSSIONS

Anteroposterior measurements of the operated side's neck-shaft angle, which is typically 125 degrees, were used to assess the reduction quality. A reduction was deemed satisfactory if it deviated by fewer than five degrees from the typical range, acceptable if it deviated between five and ten degrees, and unsatisfactory if it deviated by more than ten degrees.[13,14]

The prevalence of proximal femoral fractures has been on the rise, driven by factors such as longer life expectancy, osteoporosis in the elderly, and traffic accidents in younger generations. The most common causes of intertrochanteric

Table 1: Comparison of demographic variables and risk factors

Age		Gamma Nail n=22	PFN n=13	P-Value
(Mean ± S.D)		69.27 ± 19.44	62.15 ± 23.52	0.340
Gender	Male	13 (59.1%)	11 (84.6%)	0.116
	Female	9 (40.9%)	2 (15.4%)	
Diabetes	Yes	2 (9.1%)	4 (30.8%)	1.00
	No	20 (90.9%)	9 (69.2%)	
Hypertension	Yes	12 (54.5%)	7 (53.8%)	0.968
	No	10 (45.5%)	6 (46.2%)	
IHD	Yes	3 (13.6%)	1 (7.7%)	0.593
	No	19 (86.4%)	12 (92.3%)	
NKCM, Epilepsy	Yes	1 (4.5%)	0 (0%)	0.641
None	Yes	13 (59.1%)	8 (61.5%)	
CAD	Yes	1 (4.5%)	0 (0%)	
CKD	Yes	2 (9.1%)	1 (7.7%)	
Laryngeal SSC	Yes	1 (4.5%)	0 (0%)	
Hypothyroidism	Yes	1 (4.5%)	1 (7.7%)	
Hepatitis A	Yes	1 (4.5%)	0 (0%)	
History of TB	Yes	1 (4.5%)	0 (0%)	
Asthma	Yes	0 (0%)	1 (7.7%)	
Osteoarthritis	Yes	0 (0%)	1 (7.7%)	
Lumbar stenosis	Yes	0 (0%)	1 (7.7%)	
Parkinsons,TIA	Yes	0 (0%)	1 (7.7%)	

Table 2: Descriptive statistics of height, weight and BMI

	Procedure	Mean ± SD
Height (cm)	Gamma Nail	164 ± 10.20
	PFN	161 ± 8.41
Weight (kg)	Gamma Nail	65.39 ± 14.76
	PFN	65.69 ± 17.19
Body mass index (kg/m2)	Gamma Nail	24.34 ± 5.73
	PFN	25.28 ± 5.67

Table 3: Comparison of clinical variables

	Procedure	Mean ± SD	P-Value
Pre_Hb	Gamma Nail	11.15 ± 1.98	0.608
	PFN	11.48 ± 1.49	
Post_Hb	Gamma Nail	9.44 ± 1.47	0.755
	PFN	9.30 ± 1.06	
Thigh pain 6 weeks	Gamma Nail	3.72 ± 1.64	0.243
	PFN	4.53 ± 2.40	
Thigh pain 6 months	Gamma Nail	1.95 ± 2.06	0.287
	PFN	2.92 ± 3.25	

fractures in children under the age of 10 are severe traumas like car accidents or falls from great heights. In the elderly, a small fall is the cause of 90% of intertrochanteric fractures. Factors such as osteoporosis, vascular disease, and concomitant musculoskeletal diseases increase the likelihood of falls.[15] Factors that contribute to the high likelihood of death after hip fractures include being older, having systemic disorders that are either untreated or poorly controlled, undergoing internal fixation before comorbidities are handled, and problems that arise after surgery. In addition to reducing mortality, the goals of hip fracture management include assuring adequate patient independence, minimising complications, restoring patients to their pre-fracture functional level as quickly and safely as possible, and avoiding prolonged disability.[16] It is recommended that patients be mobilised early after rigid fixation as a routine treatment method. This greatly improves walking and speeds up the process of getting back to normal. The aim of our research is to assess the efficacy and results of two distinct surgical methods, the PFN and the GAMA nail, in treating intertrochanteric femur fractures. Our objective is to ascertain whether strategy results in superior union rates and enhances functional outcomes in patients.

Table 4: Comparison of union rate at 6 weeks and 6 months

		Gamma Nail	PFN	P-Value
Union rate at 6 weeks	Yes	19 (86.4%)	11 (84.6%)	1.00
	No	3 (13.6%)	2 (15.4%)	
Union rate at 6 Months	Yes	19 (86.4%)	11 (84.6%)	1.00
	No	3 (13.6%)	2 (15.4%)	

Table 5: Correlation of tip apex and leg length discrepancies at 6 weeks and 6 months

Tip apex 6 weeks	Pearson correlation	1	0.615
	Sig (2 tailed)		0.000
	N	35	35
Leg Length discrepancies at 6 weeks	Pearson correlation	0.615	1
	Sig (2 tailed)	0.000	
	N	35	35
Tip apex 6 months	Pearson correlation	1	0.702
	Sig (2 tailed)		0.000
	N	35	35
Leg Length discrepancies at 6 months	Pearson correlation	0.702	1
	Sig (2 tailed)	0.000	
	N	35	35

A total of 35 patients scheduled for internal fixation using either a regular gamma nail or a PFN were enrolled in this study. Their preoperative characteristics, risk factors, and postoperative measures were compared. Our investigation demonstrated that there is no statistically significant difference between the two groups for sex, age, fracture side, and risk factors. The average age of participants in Group A was 69.27 ± 19.44, while in Group B it was 62.15 ± 23.52. In Gamma Nail, there were 13 males (59.1%) and 9 females (40.9%) enrolled, while in PFN, there were 11 males (84.6%) and 2 females (15.4%). Conversely, the average age of patients in our study is lower than that reported in previous research, such as that by Mereddy et al. (2009),[17] who documented a mean age of seventy-eight years in their investigation of PFN. Loubignac et al. demonstrated a mean age of 80.3 years in their patients involving the fixation of trochanteric fractures.[18]

This study reports the mean height, weight, and BMI for the Gamma Nail as 164 ± 10.20 cm, 65.39 ± 14.76 kg, and 24.34 ± 5.73, respectively. The average height, weight, and BMI in PFN were 161 ± 8.41 cm, 65.69 ± 17.19 kg, and 25.28 ± 5.67, respectively. In this study, the union rate at 6 weeks for the gamma nail was 19 (86.4%), but the union rate for the PFN was 84.6%. Comparable outcomes were observed at the six-month mark. The results were negligible, with a p-value of 1.00. In the study by Banan et al., including 50 patients with unstable trochanteric fractures, only one instance of implant failure was observed seven months post-operatively, in contrast to our study, which reported two (15.4%) instances in the PFN group and three (13.6%) cases in the gamma nail group.[19]

Table 6: Correlation of tip apex and leg length discrepancies at 6 weeks and 6 months in Gamma Nail and PFN

Gamma Nail	Tip apex 6 month	Pearson correlation	1	0.560
		Sig (2 tailed)		0.007
		N	22	22
	Leg Length discrepancies at 6 months	Pearson correlation	0.560	1
		Sig (2 tailed)	0.007	
		N	22	22
PFN	Tip apex 6 month	Pearson correlation	1	0.634
		Sig (2 tailed)		0.020
		N	13	13
	Leg Length discrepancies at 6 months	Pearson correlation	0.634	1
		Sig (2 tailed)	0.020	
		N	13	13

In this study, the union rate at 6 weeks for the gamma nail was 19 (86.4%), but the union rate for the PFN was 84.6%. Comparable outcomes were observed at the six-month mark. The results were negligible with a p-value of 1.00. In the PFN group (n = 13), a significant positive connection was seen between tip-apex distance and leg length disparity (r = 0.634, p = 0.020). A significant positive connection was discovered in the Gamma Nail group (n = 22) (r = 0.560, p = 0.007).

In a prior trial involving the PFN group, 26 (52%) patients achieved union within 1-2 months, 22 (44%) within 2-3 months, and 2 (4%) within 3-4 months. The average time for union in the PFN group was 2.20 ± 0.50 months. The disparity in mean union time was significant (P < 0.0001), with the DHS group exhibiting a longer union time compared to the cephalomedullary nailing group.[20]

Limitations: It was a single centered study with a small sample size.

CONCLUSION

Our study indicated that both the gamma nail and proximal femoral nail are trusted devices for intertrochanteric fracture (Boyd and Griffin type II) treated by PFN vs. Gamaa nail. The comparison of the union rates at 6 weeks and 6 months, along with the pain scores, yielded similar results. Moreover, the results indicated that a greater tip apex at both 6 weeks and 6 months is associated with higher leg length discrepancies, as the Pearson correlation analysis revealed a significant p-value of 0.000.

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Authors Contribution:
Muhammad Awais Iqbal: Design and analysis of data
Zohaib Nadeem: Design and interpretation of data
Husnain Ali: Data entry
Mustafa Javed Bhalli: Article Writing
Laiba Ahsan: Data Collection
Saad Tauheed Rao: Data Collection

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