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ORIGINAL RESEARCH

Impact of Proximal Femoral Nail Length on Intraoperative and Postoperative Results for Intertrochanteric Fractures

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ABSTRACT

Background: Trochanteric femoral fractures frequently occur in older patients and can result from either high-energy or low-energy trauma, or may be due to pathological conditions. Hip fractures, particularly in the elderly, are significant contributors to elevated mortality and morbidity rates. Given their reduced physical capacity, presence of systemic diseases, and heightened susceptibility to environmental hazards, even minor trauma can lead to unstable femoral trochanteric fractures in this age group. This study aims to compare the functional outcomes of short versus long proximal femoral nails in the treatment of intertrochanteric fractures. **Methods:** This randomized controlled trial was carried out at the Department of Orthopedics, GMERS Medical college, Valsad. **Results:** The average surgery duration for the long PFN group was 80.50 ± 9.45 minutes, while for the short PFN group, it was 52.65 ± 8.01 minutes. The difference between these durations is extremely statistically significant, with a two-tailed P value of <0.001. Additionally, the mean intraoperative blood loss was 334.3 ± 29.63 ml for the long PFN group and 174 ± 24.22 ml for the short PFN group. Limb shortening was observed more frequently in the short PFN group compared to the long PFN group. **Conclusion:** Both long and short intramedullary nails are viable options for internal fixation of femoral intertrochanteric fractures. However, the long nail tends to reduce the risk of refracture and postoperative hip pain, while the short nail offers benefits such as shorter surgical time, reduced blood loss, and less fluoroscopic time.

Key words: Proximal femoral nail, Short PFN, long PFN, Intertrochanteric fracture

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INTRODUCTION

Advancements in medical research have significantly extended lifespan for many individuals. However, aging brings about various comorbidities, with osteoporosis being one of the major conditions. The increased prevalence of hip fractures in osteoporotic individuals is well known.[1] Intertrochanteric fractures are more frequently observed in older adults than in younger individuals. These fractures can be managed with conservative treatment approaches, which help minimize the risk of complications such as avascular necrosis of the femoral head and osteoarthritis. Without surgical interventions, malunion, non - union with coxa-vara deformity are seen which might result in short-ening of limb.[2] A fall from standing height is the most common type of minor trauma leading to intertrochanteric femur fractures.

Intramedullary devices are widely utilized for managing proximal femoral fractures due to their ability to create a more favorable biomechanical environment. They offer indirect load sharing, a short lever arm, and reduced collapse at the fracture site, which contributes to a stable medial configuration and helps prevent varus collapse. Early rehabilitation and weight bearing are two benefits of Intramedullary devices.[3]

The main objective in treating fractures is to enable early mobilization and prevent secondary complications. Intertrochanteric fractures can be addressed through two primary methods: one is open reduction and internal fixation using a Dynamic Hip Screw (DHS). This method is often preferred due to its reliable fracture union outcomes. However, a challenge with the sliding hip screw is the potential collapse of the femoral head, which can lead to a loss of hip offset and limb shortening. While some sliding is anticipated, excessive shortening can be detrimental to hip function. Another method which was found in 1996 is Proximal femur nail (PFN) which gives the greatest ad-vantage of minimal invasive surgery.[4]

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Several types of intramedullary devices are used to treat intertrochanteric fractures, including:

- Long Proximal Femoral Nail
- Short Proximal Femoral Nail
- AO Type Proximal Femur Nail (PFNA and PFNA 2)

The debate over the most effective method for treating intertrochanteric femur fractures has been ongoing for years. Meta-analytical studies have yet to reach a consensus on which approach is superior. Both the Dynamic Hip Screw and the Proximal Femur Nail are commonly used for these fractures. Within the Proximal Femur Nail category, both short and long versions are utilized.

The long proximal femur nail has varying length from 340 mm to 440 mm and diameter from 8 to 12 mm while in short proximal femur nail the length is 240 mm and diameter from 9 to 12 mm.[5-6]

The Proximal Femur Nail is currently the preferred method for treating intertrochanteric femur fractures. However, there remains controversy regarding how the length of the nail impacts fracture outcomes and the incidence of complications such as periprosthetic fractures.

The purpose of this study is to assess both intraoperative and postoperative outcomes when treating intertrochanteric femur fractures with either a short proximal femoral nail (PFN) or a long PFN. The study aims to compare these two intramedullary devices—long PFN and short PFN—in terms of clinical and radiological follow-up.

METHODS

The study was conducted with patients admitted to the GMERS Medical college in Valsad from June 2021 to November 2022. This prospective study included a total of 60 patients, divided equally into two groups: 30 patients received short proximal femoral nails (PFN), and 30 patients received long PFNs. Prior to participation, patients were fully informed about the study and provided written consent. Only patients with a minimum follow-up period of one year were included in this study.

Patients were divided into two groups based on their treatment: one group received long PFNs, while the other received short PFNs. Preoperative data was meticulously reviewed, including patient medical records, operative reports, and digital radiographs. The data collected for each patient included: age, sex, Orthopedic Trauma Association (OTA) fracture classification, blood loss, operative time, length of hospital stay, time to fracture union, Harris Hip Score at six months postoperative, hip pain, and failure rates. Failure was defined as a periprosthetic fracture or significant collapse of the fracture that required reoperation, removal, or revision of the nail.

All surgeries had been performed in the supine position on a fracture table with fluoroscopic-guided imaging. After the patient had been anesthetized, closed reduction to an anatomical position was performed before making an incision. Femurs were reamed by hand or flexible power reamers and guide wires used in all procedures. Distal interlocking screws were placed through the nail guide or full moon technique for all nails. There were no intraoperative com-plications. Postoperatively, patients were allowed to bear weight as and when tolerated.

Inclusion criteria for the study were:

Patients aged over 20 years, with a recent history of trauma, who were willing to undergo surgery, had no associated fractures in both lower limbs, and had isolated, closed, type 31-A1, A2, or A3 intertrochanteric fractures as classified by the AO system. Additionally, patients needed to provide consent for both the surgery and participation in the study.

Exclusion criteria included: pathologic fractures, open fractures, fractures in skeletally immature patients, old neglected fractures, revision surgeries, refusal to provide informed consent, fractures associated with neuromuscular disorders or neurovascular insufficiency, and patients with multiple traumas.

RESULTS

A total of sixty patients were included in the study. The most common age group was 65–85 years, with a mean age of 72.84 ± 10.02 years in the Long PFN group and 69.86 ± 8.65 years in the Short PFN group. In terms of gender distribution, 65% of patients in the Long PFN group and 69% in the Short PFN group were female.

Table 1: Fluoroscopy duration (sec), surgery duration (minutes) and Intraoperative blood loss (ml)

Intra operative details	Method of fixation	
	Long PFN	Short PFN
Fluroscopy time (sec)	40-45	30-40
Surgical time (minutes)	70-90	45-60
Intraoperative blood loss (ml)	330-360	170-200

Table 2: Comparison of Complications of long PFN and short PFN

	Long PFN (n= 30)	Short PFN (n= 30)	Percentage%
Blood loss more than ABL	2 (3.33%)	1(1.66%)	3(5%)
Dynamic bolt placed outside hole	1(1.66%)	0	1(1.66%)

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GT Splintering	0	2(3.33%)	2(3.33%)
Medial wall fracture	1 (1.66%)	1(1.66%)	2(3.33%)
None	26 (43.33%)	26(43%)	52(86.66%)
Total	30	30	60

In terms of intraoperative blood loss, the long PFN group had a mean loss of 334.3 ± 29.63 ml, whereas the short PFN group experienced a mean loss of 174 ± 24.22 ml. This difference is statistically significant, with a two-tailed P value of <0.001.

The average hemoglobin (HB) level for patients who underwent surgery with the Long PFN was 10.9, while for those with the Short PFN, it was 10.2. Two patients, one from each PFN group, developed skin infections at the surgical site, which were resolved with wound care. Additionally, three patients—one from the Long PFN group and two from the Short PFN group—experienced varus deformities at the fracture site.

The average width of the anti-rotation screw in the Long PFN group was 77.70 ± 7.47 mm, compared to 81.25 ± 8.02 mm in the Short PFN group. The two-tailed P-value for this measurement was 0.332, indicating that the difference is not statistically significant.

The average width of the compression screw was 95.9 ± 7.2 mm in the Long PFN group and 95.55 ± 9.02 mm in the Short PFN group. The two-tailed P-value for this measurement was 0.6461, which is not statistically significant.

The fluoroscopy time (in seconds) for Short PFN fixation was significantly lower compared to Long PFN fixation, with a P-value of <0.001 indicating a significant difference between the two groups.

In terms of reduction quality, the Short PFN group showed significantly better results. Out of 30 cases, 22 had very good reduction compared to 20 out of 30 cases in the Long PFN group.

There were more cases of limb shortening in the Short PFN group compared to the Long PFN group. The average time to union was 18.75 ± 5.50 weeks for the Short PFN group and 22.08 ±4.04 weeks for the Long PFN group. With a two-tailed P-value of 0.1813, this difference is not considered statistically significant by conventional standards.

The mean +SD of harris hip score in the long PFN group was 87.55+ 7.94 and in the short PFN group was 75.32+ 7.78. The two-tailed P value < 0.001 by conventional criteria; this difference is considered to be statistically significant. Lower extremity functional scale is better in LONG PFN.

CASE 1 [LONG PFN]

Figure 1 PRE OP

Figure 2 IMMEDIATE POST OP

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Figure 3 6 MONTHS POST OP

CASE 2 [SHORT PFN]

Figure 4 PRE OP

Figure 5 IMMEDIATE POST OP

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Figure 6 6 MONTHS POST OP

DISCUSSION

While the Long PFN offers several advantages, including reduced postoperative complications, better Harris Hip Scores, and minimal incidents of limb shortening, it also has some drawbacks. The Long PFN involves a free-hand distal locking system, which can be more challenging and time-consuming. It requires longer intraoperative time and results in slightly higher radiation exposure. Additionally, it is associated with greater blood loss compared to the Short PFN.

However, the Long PFN serves as an effective buttress to prevent medialization of the shaft and facilitates more efficient load transfer than a sliding hip screw. It is considered a superior implant for managing both stable and unstable intertrochanteric fractures when evaluating operating time, surgical exposure, blood loss, and complication rates.

In this study, despite the increased duration of surgery, blood loss, and fluoroscopy time associated with the Long PFN, it remains more preferable compared to the Short PFN due to its lower rate of postoperative complications, minimal limb shortening, and superior Harris Hip Scores at the six-month follow-up.

Kale Dr et al.[7] suggested in their study that the long nail could avoid the refracture of femur and reduced postoper-ative hip pain. **Shyamkumar et.al**[8]indicated that it was ev-ident that the use of Long PFN has advantages over short PFN in terms of the less postoperative complications, less mean time of union & better lower extremity functional scores.

Li Zhiet al.[9]stated that both the long and short intrame-dullary nails are the optional internal fixation choices for femoral intertrochanteric fracture in the aged patients older than 65 years. However, using a long nail could prevent a femur refracture and minimize postoperative hip pain.

CONCLUSION

Both long and short intramedullary nails are viable internal fixation options for femoral intertrochanteric fractures. However, the long nail can help prevent femoral refracture and decrease postoperative hip pain. In contrast, the short nail offers benefits such as reduced surgical time, less blood loss, and shorter fluoroscopic duration.

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