

Original Research Article

Outcome of subtrochanteric fracture of femur treated with proximal femoral nail

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ABSTRACT

Background: Subtrochanteric fractures of the femur are difficult injuries to manage due to high mechanical stress and deforming muscular forces. Proximal femoral nail (PFN) has become a preferred treatment option as it provides stable fixation with minimal soft tissue disruption and allows early mobilization. To evaluate the clinical, radiological, and functional outcomes of subtrochanteric femur fractures treated with proximal femoral nail.

Methods: This prospective study was conducted in the Department of Orthopaedic Surgery, Dhaka Medical College Hospital, over 12 months (January 2023 to December 2023). A total of 25 patients with subtrochanteric femur fractures meeting inclusion criteria were managed with PFN. Patients were followed for 6–12 months. Outcomes were assessed using radiological union time and Harris Hip Score. Data were analyzed using descriptive statistics.

Results: The mean age of patients was 41.7±18.1 years, with male predominance (76%). Road traffic accident was the most common cause (52%). Type III fractures were most frequent (44%). Mean injury to surgery interval was 8.44±2.72 days. Mean radiological union time was 16.84±4.33 weeks. Complication rate was low, with failure of closed reduction being the most common (16%). Functional outcome was excellent in 64%, good in 28%, and fair in 8% of patients.

Conclusion: PFN is an effective and reliable method for managing subtrochanteric femur fractures, providing good fracture union, early rehabilitation, and excellent functional outcomes.

Keywords: Subtrochanteric fracture, Proximal femoral nail, Femur fracture, Harris hip score, Orthopaedic trauma

INTRODUCTION

Subtrochanteric fractures of the femur are defined as fractures occurring from the level of the lesser trochanter to approximately 5 cm distal to it along the femoral shaft. These fractures constitute about 10% to 34% of all peritrochanteric femoral fractures and represent a significant challenge in orthopedic trauma management

due to their unique anatomical and biomechanical characteristics.¹ The subtrochanteric region is subjected to substantial mechanical stresses during routine activities of daily living. Axial loading forces transmitted through the hip joint generate significant compressive stresses medially and tensile forces laterally. In addition, torsional and rotational forces created by the surrounding musculature contribute to the complexity of fracture

patterns and fixation.¹ The mechanism of injury varies according to age. In younger individuals, subtrochanteric fractures are commonly associated with high-energy trauma such as road traffic accidents, falls from height, and sports-related injuries. Conversely, in elderly patients, these fractures often result from low-energy trauma, including simple falls, particularly in the presence of osteoporosis and reduced bone quality.² Regardless of the mechanism, management of these fractures remains challenging because the subtrochanteric region experiences considerable biomechanical stress and is composed predominantly of dense cortical bone with relatively limited vascularity, which may delay fracture healing.³

Muscle attachments around the proximal femur create significant deforming forces that contribute to displacement of fracture fragments. The iliopsoas muscle causes flexion and external rotation of the proximal fragment, while the gluteus medius produces abduction. Simultaneously, the adductor muscles, hamstrings, and quadriceps exert forces that result in adduction and shortening of the distal fragment. These deforming forces make achieving and maintaining satisfactory reduction difficult, particularly with conservative treatment methods.⁴ Consequently, operative management has become the preferred treatment option for most subtrochanteric fractures.

Historically, conservative treatment involving prolonged traction and immobilization was employed. However, this approach was associated with several complications, including malunion, nonunion, prolonged hospital stay, delayed mobilization, and increased morbidity due to extended immobilization.⁵ Furthermore, prolonged recumbency may predispose patients to pressure sores, deep vein thrombosis, pulmonary complications, and muscle wasting. Therefore, conservative management is currently reserved for patients with severe comorbid conditions who are unfit for anesthesia or surgical intervention.⁶

Advances in orthopedic implant technology have significantly improved the management of subtrochanteric fractures. The primary objectives of surgical treatment are restoration of femoral length, correction of alignment and rotation, achievement of stable fixation, promotion of fracture union, and facilitation of early mobilization and weight bearing.⁷ Various fixation devices have been utilized over time, including dynamic hip screws (DHS), dynamic condylar screws (DCS), angled blade plates, proximal femoral locking compression plates (PF-LCP), and cephalomedullary nails.⁸

Although plate fixation techniques can provide adequate stability, they often require extensive soft tissue dissection and periosteal stripping, leading to disruption of fracture hematoma, increased blood loss, prolonged operative time, and a higher risk of infection, implant failure, and varus collapse.⁶ To overcome these limitations, intramedullary

devices such as the PFN have gained widespread acceptance. Introduced in 1997, the PFN is a cephalomedullary implant designed to provide biomechanically superior fixation for proximal femoral fractures. As an intramedullary, load-sharing device, PFN offers several advantages, including smaller surgical exposure, preservation of fracture biology, reduced bending stress on the implant, and enhanced stability against rotational and varus forces.⁹ The nail's proximity to the mechanical axis of the femur reduces the lever arm and bending moment, allowing efficient transmission of load from the hip joint to the femoral shaft. These biomechanical characteristics make PFN particularly suitable for unstable subtrochanteric fractures.¹⁰

Despite its recognized advantages, complications such as implant failure, peri-implant fractures, malunion, nonunion, and postoperative thigh pain may still occur. Therefore, continuous evaluation of the functional and radiological outcomes following PFN fixation is necessary to assess its effectiveness and identify factors influencing treatment success. The present study aims to evaluate the outcome of subtrochanteric fractures of the femur treated with PFN and to determine its role in achieving stable fixation, fracture union, and satisfactory functional recovery.

Objective

The main objective was to evaluate the outcome of subtrochanteric fractures of the femur treated with PFN.

METHODS

This prospective study was conducted in the Department of Orthopaedic Surgery, Dhaka Medical College Hospital (DMCH), Dhaka, Bangladesh, over a period of 12 months from January 2023 to December 2023. A total 25 patients diagnosed with subtrochanteric fractures of the femur who were admitted to the department during the study period were considered for enrollment. Patients were selected using a consecutive sampling technique according to the predefined inclusion and exclusion criteria. Written informed consent was obtained from all participants before inclusion in the study.

Inclusion criteria

Patients aged 18 years and above of either sex. Patients with closed subtrochanteric fractures of the femur presenting within 3 weeks of injury. Patients willing to undergo surgical treatment with PFN. Patients who provided written informed consent and agreed to regular follow-up.

Exclusion criteria

Open subtrochanteric fractures. Pathological subtrochanteric fractures of the femur. Patients medically unfit for surgery or anesthesia. Patients with previous

fractures or surgical procedures involving the affected femur. Patients unwilling to participate in the study or unavailable for follow-up.

All enrolled patients underwent detailed clinical evaluation, routine laboratory investigations, and radiological assessment. Radiological evaluation included plain X-ray of the pelvis with both hips in anteroposterior view and plain X-ray of the affected femur including the hip and knee joints in anteroposterior and lateral views. Computed tomography (CT) scan with three-dimensional reconstruction was performed when required for better assessment of fracture morphology. Routine investigations included complete blood count, random blood sugar, serum creatinine, serum electrolytes, blood grouping, viral screening (HBsAg, Anti-HCV and HIV), urine routine examination, chest X-ray, electrocardiography, and echocardiography when indicated.

Following initial resuscitation and stabilization according to advanced trauma life support (ATLS) guidelines, associated injuries were evaluated and managed appropriately. Fractures were classified according to Seinsheimer's classification for preoperative planning. All patients underwent surgical fixation with Proximal Femoral Nail under spinal anesthesia. Patients were positioned supine on a fracture table, and closed reduction was attempted under fluoroscopic guidance. Open reduction was performed when satisfactory reduction could not be achieved by closed methods. Standard PFN insertion was carried out through the greater trochanteric entry point under image intensifier guidance. Appropriate proximal and distal locking was performed, and satisfactory fracture reduction and implant placement were confirmed fluoroscopically.

Postoperatively, patients received antibiotic prophylaxis, analgesics, and physiotherapy according to departmental protocol. Quadriceps strengthening exercises and knee mobilization were initiated in the immediate postoperative period. Non-weight-bearing ambulation with crutches was started on the third postoperative day. Partial weight bearing was allowed after three weeks, while full weight bearing was permitted after clinical and radiological evidence of fracture healing. Patients were discharged when their general condition and wound status were satisfactory. All patients were followed up at 2 weeks, 6 weeks, 12 weeks, and 24 weeks after surgery, with a minimum follow-up period of 6 months. During each follow-up visit, clinical examination and radiological evaluation were performed to assess fracture healing, implant position, and complications.

Functional outcome was assessed using the HHS. Radiological union was evaluated using serial X-rays of the affected femur. Information regarding postoperative complications, time to union, and functional recovery was documented in a structured data collection sheet. Ethical approval was obtained from the ethical review committee of Dhaka medical college. Confidentiality of patient

information was strictly maintained throughout the study, and all procedures were conducted in accordance with accepted ethical principles for medical research involving human subjects.

Statistical analysis

Data were compiled, coded, and analyzed using statistical package for social sciences (SPSS) version 26. Continuous variables were expressed as mean±standard deviation, median, and range, while categorical variables were presented as frequency and percentage. Functional and radiological outcomes were analyzed using appropriate statistical methods. Results were presented in tables, charts, and graphs where applicable. A p value of less than 0.05 was considered statistically significant.

RESULTS

Table 1 shows the demographic profile of the respondents. The majority of patients were below 40 years of age (52%), followed by 40–60 years (28%) and above 60 years (20%). The mean age was 41.7±18.1 years. Male patients were predominant (76%) compared to female patients (24%).

Table 2 shows the fracture characteristics of the respondents. Type III fractures were the most common according to Seinsheimer classification (44%), followed by Type II (32%), Type IV (16%), and Type V (8%). Right-sided injuries (64%) were more frequent than left-sided injuries (36%). Table 3 shows the operative details of the respondents. Most patients (80%) underwent surgery within 10 days of injury, while 20% underwent surgery after 10 days. The mean injury to surgery interval was 8.44±2.72 days. Closed reduction was achieved in 84% of cases, while open reduction was required in 16%. The majority of surgeries (64%) lasted 60–90 minutes, with a mean operative time of 94.20±19.08 minutes.

Table 4 shows the time to partial and full weight bearing. Partial weight bearing was initiated in 52% of patients within 1–6 weeks and in 48% between 7–12 weeks, with a mean of 7.20±3.24 weeks. Full weight bearing was achieved in 72% of patients between 7–12 weeks and in 28% between 13–18 weeks, with a mean of 11.68±3.21 weeks. Table 5 shows the duration of radiological union. Most patients (48%) achieved radiological union between 12–18 weeks, followed by 18–24 weeks (28%) and within 12 weeks (24%). The mean time to radiological union was 16.84±4.33 weeks. Table 6 shows the complications of the respondents. Failure of closed reduction was the most common complication (16%). Other complications included hip stiffness (8%), superficial infection (4%), limb shortening less than 2 cm (4%), and screw migration (4%). Table 7 shows the functional outcome according to Harris Hip Score. The majority of patients achieved excellent outcomes (64%), followed by good outcomes (28%) and fair outcomes (8%). No poor outcomes were observed, indicating overall satisfactory functional results after PFN fixation.

Table 1: Demographic profile of the respondents (n=25).

Variables	Category	Frequency	%
Age (in years)	<40	13	52
	40–60	7	28
	>60	5	20
Mean±SD	41.7 ± 18.1		
Gender	Male	19	76
	Female	6	24

Table 2: Fracture characteristics of the respondents (n=25).

Variables	Category	Frequency	%
Seinsheimer classification	Type II	8	32
	Type III	11	44
	Type IV	4	16
	Type V	2	8
Side of injury	Right	16	64
	Left	9	36

Table 3: Operative details of the respondents (n=25).

Variables	Category	Frequency	%
Injury to surgery interval	<10 days	20	80
	≥10 days	5	20
Mean±SD	8.44±2.72 days		
Method of reduction	Closed	21	84
	Open	4	16
Duration of surgery	60–90 min	16	64
	91–120 min	7	28
	>120 min	2	8
Mean±SD	94.20±19.08 min		

Table 4: Time to partial and full weight bearing (n=25).

Variables	Frequency	%
Partial weight bearing		
1–6 weeks	13	52
7–12 weeks	12	48
Mean±SD	7.20±3.24 weeks	
Full weight bearing		
7–12 weeks	18	72
13–18 weeks	7	28
Mean±SD	11.68±3.21 weeks	

Table 5: Duration of radiological union (n=25).

Union time (weeks)	Frequency	%
≤12	6	24
12–18	12	48
18–24	7	28
Mean±SD	16.84±4.33 weeks	

Table 6: Complications of the respondents (n=25).

Complications	Frequency	%
Failure of closed reduction	4	16
Superficial infection	1	4
Hip stiffness	2	8
Limb shortening (<2 cm)	1	4
Screw migration	1	4

Table 7: Functional outcome (Harris Hip Score) (n=25).

Outcome	Score range	Frequency	%
Excellent	90–100	16	64
Good	75–89	7	28
Fair	60–74	2	8
Poor	<60	0	0

DISCUSSION

Subtrochanteric fractures of the femur represent complex injuries due to the high mechanical stresses and deforming muscular forces acting on this region. The present study was conducted to evaluate the functional and radiological outcomes of subtrochanteric fractures treated with PFN and to compare the results with previously published literature. In the present study, the majority of patients were below 40 years of age (52.0%), with a mean age of 41.7 ± 18.1 years. This relatively younger age distribution is comparable with the findings of Saodekar et al and Agarwal et al who reported a mean age of 47 years.¹¹ Rahman et al observed a slightly higher mean age of 49.3 ± 8.5 years, while Kandasamy et al and Shankar et al reported a predominance of patients in the 50–70 years age group with a mean age of 56.4 years.^{9,12} In contrast, Akhtar et al reported a younger mean age of 30.05 ± 8.59 years.¹³

These variations may be attributed to differences in trauma mechanisms across populations; however, overall findings suggest that subtrochanteric fractures commonly occur in both young individuals due to high-energy trauma and in elderly patients due to low-energy falls. In the present study, male patients constituted 76.0% of cases, indicating a clear male predominance. Similar observations were reported by Patel et al where 68.75% of patients were male, and Akhtar et al who reported 73.63% male predominance.^{3,13} This gender distribution may be explained by increased exposure of males to outdoor activities, occupational hazards, and high-energy trauma. Regarding injury characteristics, RTA were the leading cause, accounting for 52.0% of cases, followed by falls from height and slipping injuries.

Similar findings were reported by Kandasamy et al and Shankar et al where 60% of fractures were due to RTA.⁹ Abraham et al reported RTA in 58% of cases, while Krishna et al and Rao et al observed an even higher incidence of 72.0%.^{10,14,16} These findings consistently

highlight that high-energy trauma remains the predominant cause of subtrochanteric fractures in most populations. In this study, Seinsheimer type III fractures were most common (44%), followed by type II (32%), type IV (16%), and type V (8%). Similar findings were reported by Abraham et al where Type III fractures accounted for 43% of cases.¹⁰ Kandasamy et al and Shankar et al also reported type III as the most frequent pattern (47.9%).⁹ These results indicate that unstable fracture patterns are commonly encountered in subtrochanteric injuries, emphasizing the need for stable fixation methods such as PFN. In the present study, right-sided fractures (64.0%) were more frequent than left-sided fractures (36.0%). Paramesha et al also reported a similar trend of higher right-sided involvement.⁶

However, Krishna et al and Rao et al found a slightly higher incidence of left-sided fractures (56%), suggesting that side predominance may vary across populations and trauma patterns.¹⁴ The majority of patients (80.0%) underwent surgery within 10 days of injury, with a mean interval of 8.44 ± 2.72 days. Krishna et al and Rao et al reported that most surgeries were performed between 3–7 days post-injury, while Kumar et al observed a mean delay of 8.79 ± 3.15 days.^{7,14}

Early surgical intervention facilitates mobilization, reduces complications, and improves functional outcomes. Closed reduction was achieved in 84% of cases, while open reduction was required in 16%. Similar results were reported by Krishna et al and Rao et al where 80% of cases were managed with closed reduction.¹⁴ This indicates that minimally invasive techniques are generally feasible in most cases of subtrochanteric fractures. The mean duration of surgery in the present study was 94.20 ± 19.08 minutes. Malik et al reported that most procedures lasted between 1–2 hours, which is comparable with the findings.¹⁵ However, Patel et al reported a shorter mean operative time of 64.4 minutes, suggesting variability based on surgeon experience and institutional protocols.³ In the

present study, partial weight bearing was initiated at a mean of 7.20 ± 3.24 weeks, and full weight bearing at 11.68 ± 3.21 weeks. Malik et al reported similar findings, with most patients initiating partial weight bearing between 7–10 weeks and full weight bearing between 7–12 weeks.¹⁵ El-Mowafi et al and Boldin et al reported earlier partial weight bearing at around 5–6 weeks, reflecting differences in fixation stability and rehabilitation protocols.^{16,17}

Radiological union was achieved at a mean of 16.84 ± 4.33 weeks. Similar results were reported by Paramesha et al where most fractures united between 12–18 weeks.⁶ Rahman et al reported a mean healing time of 18 weeks, while Krishna et al also observed union predominantly within 12–18 weeks.^{12,14} These findings confirm that PFN provides reliable fracture union within an acceptable time frame.

Complication analysis in the present study revealed failure of closed reduction in 16%, hip stiffness in 8%, superficial infection in 4%, limb shortening in 4%, and screw migration in 4%. Abraham et al reported similar complications, including superficial infection (7.7%) and screw migration (7.7%).¹⁰ Akhter et al also documented minor complications in 12.7% of cases.¹³ Kumar et al reported hip stiffness in 6% and superficial infection in 4% of patients, which is comparable to the findings.⁷

Overall, complications were relatively low and manageable. Functional outcomes assessed using the Harris hip score demonstrated excellent results in 64.0% of patients, good in 28.0%, and fair in 8.0%, with no poor outcomes. Similar results were reported by Akhtar et al who observed excellent outcomes in 64.5% of cases. Akilan et al reported excellent and good outcomes in 56% and 20% of patients respectively.^{5,13,14} Saodekar et al and Agarwal et al also reported favorable outcomes in the majority of patients.¹¹

These consistent findings confirm that PFN provides excellent functional recovery in subtrochanteric fractures. Overall, the present study demonstrates that proximal femoral nailing is an effective and reliable method for the management of subtrochanteric femur fractures, providing satisfactory radiological union, early mobilization, acceptable complication rates, and excellent functional outcomes.

Limitations

The present study had several limitations. This study had a small sample size ($n=25$), which limits the generalizability of the results. It was conducted in a single center with a relatively short follow-up period of 6–12 months, so long-term outcomes could not be assessed. There was no comparison group, which limits direct comparison with other fixation methods. Functional outcome assessment was based only on the Harris hip score, which may not reflect all aspects of patient recovery.

CONCLUSION

Subtrochanteric fractures of the femur are challenging injuries due to complex biomechanics and deforming muscular forces. PFN provides a stable, minimally invasive and biologically friendly fixation method. In the present study, PFN showed satisfactory radiological union within an acceptable time frame and allowed early mobilization of patients. Functional outcome assessed by Harris hip score demonstrated excellent to good results in the majority of cases, with a low complication rate. Overall, PFN is an effective and reliable treatment option for subtrochanteric femur fractures, offering good clinical and functional outcomes with safe and predictable results.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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