

Complications, Alignment, and Limb-Length Outcomes Following Proximal Femoral Nail Fixation in Subtrochanteric Femoral Fractures: A Prospective Cohort

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Abstract

Background: Subtrochanteric femoral fracture is a complex fracture with high levels of biomechanical stress, a high rate of complications, and the potential for malalignment, implant failure, and leg length discrepancy. Proximal femoral nail fixation is now an accepted method for the treatment of subtrochanteric fractures, given its biomechanical advantages and the ability to permit early mobilisation. This study aims to evaluate complications, alignment outcomes, and limb-length discrepancy following proximal femoral nail fixation in patients with subtrochanteric femoral fractures.

Methods: This prospective observational study was conducted in the Department of Orthopaedics at Mymensingh Medical College Hospital, Bangladesh, from August 2022 to July 2023. Twenty adult patients of post-traumatic subtrochanteric femoral fractures who presented within three weeks of the injury were included in the study using purposive sampling. All the patients underwent PFN fixation. The patients were followed up for 24 weeks. Information on demographic details, the mode of injury, technical difficulties during surgery, postoperative complications, fracture alignment, and limb length discrepancy was collected. The functional outcome was assessed using the Modified Harris Hip Score. Data were analysed using SPSS version 25, with statistical significance set at $p < 0.05$.

Results: The mean age of patients was 44.65 ± 12.30 years, with the highest proportion in the 31–40 years age group (40%). Males constituted 65% of the study population. Road traffic accidents were the leading cause of injury (80%). Technical difficulties during intraoperative procedures were absent in 50% of the patients, whereas difficulties in reduction and proximal screw insertion were each present in 20%. Postoperative complications were also low, with 70% of the patients showing no complications. Restricted movement of the knee, restricted movement of the hip, and superficial infection of the wound were each present in 10% of the patients. At the end of the follow-up, 80% of the patients showed no limb-length discrepancy, and 80% showed no varus malalignment.

Conclusion: Proximal femoral nail fixation for subtrochanteric femoral fracture results in satisfactory outcomes, with low rates of complications, satisfactory alignment, and minimal limb length discrepancy. It is an effective method of treating subtrochanteric femoral fractures.

Keywords: Subtrochanteric, Intramedullary Fixation, Alignment, Hip Fracture

I. INTRODUCTION

The proximal femoral segment is one of the specific regions with particular anatomy, including the femoral head, neck, and subtrochanteric area, with dense cortical bone, which is subject to heavy axial and rotational loads during activities like weight-bearing. The subtrochanteric area, which extends 5 cm from the lesser trochanter, is subject to heavy compressive and tensile stresses, and fractures in this area are unstable and difficult to manage [1]. Fractures in this area are also known to have a higher complication rate compared to intertrochanteric fractures due to the strong deforming forces of muscles and poor vascularity. Hip fractures worldwide are estimated to be over 1.6 million annually, which may increase to almost 6.3 million by 2050 due to an increasing elderly population and trauma [3]. In the Asian community, hip fractures are also increasing rapidly, with almost half of hip fractures expected to occur in the Asian community by 2050 [4]. There has been a rising trend of proximal femoral fractures in South Asian countries like Bangladesh because of road traffic injuries, osteoporosis, and an ageing population, with a rise in cases being reported in tertiary care centres [5]. Subtrochanteric fractures of the femur are known to have high morbidity, prolonged hospital stay, and mortality

rates of 8% to 20% in the first year following the injury [6]. Mechanical issues, such as varus alignment, nonunion rates ranging from 5% to 20%, and failure rates of up to 10%, have been documented, making it clear that managing such fractures is not an easy task [7,8]. The problem of achieving stable fixation is compounded by the deforming forces of the surrounding muscles [2]. Intramedullary fixation using Proximal Femoral Nails (PFN) has emerged as the preferred method due to its biomechanical superiority, such as shorter lever arm and load-sharing. The rate of union is 85-98 % with better functional recovery than extramedullary fixation, along with decreased operative blood loss and earlier mobilisation [9-11]. Although the benefits are clear, the complications of malalignment, screw cut-out, infection, reoperation, and limb length inequality remain of clinical significance, with limb length inequality occurring in up to 15% of patients and malalignment rates ranging from 6% to 23% [7,12]. Radiological alignment parameters, such as the restoration of the neck shaft angle and the preservation of femoral length, are important factors in long-term biomechanical function, gait efficiency, and patient satisfaction. Nevertheless, most of the literature is more focused on functional results or union rates, with less prospective information available regarding alignment parameters and limb length discrepancy, especially in developing nations [8,13]. There is little information available in the literature from the region, and most of it is limited by small numbers and variability in methodology. Therefore, this study aims to assess complications, alignment values, and limb length results after proximal femoral nail fixation in subtrochanteric femoral fractures.

II. METHODS

This prospective observational study was conducted from August 2022 to July 2023 in the Department of Orthopaedics at Mymensingh Medical College Hospital, a tertiary care teaching hospital in Bangladesh. Patients admitted with post-traumatic subtrochanteric fractures of the femur within three weeks of injury were selected using purposive sampling. Adult patients (≥ 18 years) of either sex with closed fractures were included, while patients below 18 years, open contaminated fractures, multiple fractures or polytrauma, and pathological fractures other than osteoporotic were excluded. Data on demographic characteristics, mechanism of injury, fracture type, fracture alignment, limb-length discrepancy, weight-bearing status, pain, and range of motion were collected using a structured data collection sheet through clinical and radiological assessment. All patients underwent proximal femoral nail fixation and were followed for at least 24 weeks to evaluate complications and functional outcome using the Modified Harris Hip Score [14]. Ethical approval was obtained from the Institutional Review Board of the hospital. Data were analysed using SPSS version 25. Descriptive statistics were applied, and $p < 0.05$ was considered statistically significant.

III. RESULTS

Table 1 shows that the mean age was 44.65 ± 12.30 years (25-70 years), with the majority of the patients belonging to the age group of 31-40 years (40%) ($p=0.003$). The majority of patients were male (65% of the study population). In terms of occupation, the majority of the patients were housewives or service holders (25%), followed by farmers (20%), labourers (15%), reflecting a predominantly active working-age population.

Table 1: Baseline Characteristics of the Study Patients (n = 20)

Variable	Category	n	%	P-value
Age (years)	18-30	1	5.0	0.003
	31-40	8	40.0	
	41-50	5	25.0	
	51-60	4	20.0	
	61-70	2	10.0	
	Mean \pm SD	44.65 ± 12.30		
Gender	Male	13	65.0	-
	Female	7	35.0	-
Occupation	Housewife	5	25.0	-
	Service holder	5	25.0	-
	Farmer	4	20.0	-
	Laborer	3	15.0	-
	Businessman	2	10.0	-
	Student	1	5.0	-

Table 2 presents that road traffic accidents were the predominant mechanism of injury, accounting for 80% of cases. Falls on the ground contributed 15%, while 5% resulted from falls from height.

Table 2: Mechanism of injury of the study patients (n = 20)

Mechanism of injury	n	%
Road Traffic Accident (RTA)	16	80.0
Fall on the ground	3	15.0

Fall from height	1	5.0
Total	20	100

Table 3 demonstrates that half of the patients (50%) had no intraoperative technical difficulties. However, difficulty in reduction and difficulty in proximal screw insertion each occurred in 20% of cases, and difficulty in distal screw insertion was seen in 10%.

Table 3: Intraoperative Technical Problems among Study Patients (n=20)

Intra- Operative Problem	n	%
Reduction difficulty	4	20.0
Proximal screw insertion difficulty	4	20.0
Distal Screw Difficulty	2	10.0
No	10	50.0

Table 4 shows that the majority of the patients, that is, 70% of the total, did not show any complications after the surgery. Of the complications that did arise, restricted knee ROM, restricted hip ROM, and superficial wound infection were found in 10% of the total number of cases each.

Table 4: Complications of Operated Patients (n=20)

Complication	n	%
No complications	14	70.0
Restricted Knee ROM	2	10.0
Restricted Hip ROM	2	10.0
Superficial wound infection	2	10.0
Deep infection	0	0.0
Implant failure	0	0
Total	20	100

Table 5 reveals that among these patients, 80% showed no shortening of limb length at final follow-up. However, 10% showed shortening of less than 1 cm, and 10% showed shortening of more than 1 cm.

Table 5: Limb length status of study patients at final follow-up (n=20)

Assessment	n	%
No Shortening	16	80.0
Shortening<1cm	2	10.0
Shortening>1cm	2	10.0
Total	20	100

Table 6 shows that the varus malalignment was absent in 80% of the patients, while 5% had <5°, 5% had 6-10°, and 10% had >10° varus malalignment. There were no cases of valgus malalignment, and this shows that there is satisfactory postoperative fracture alignment in most patients.

Table 6: Distribution of patients by varus and valgus malalignment (n=20)

Malalignment	Rang (degree)	n	%
Varus Malalignment	No	16	80.0
	<5 degrees	1	5.0
	6-10 degrees	1	5.0
	>10 degrees	2	10.0
Valgus Malalignment	No valgus malalignment	-	-
Total		20	100

IV. DISCUSSION

In this study, the average patient's age was 44.65 ± 12.30 years, with the largest number of patients belonging to the 31-40 years age group (40%), thus demonstrating the prevalence of femoral shaft fractures in the economically active population. Hasan et al. reported in a study that the average patient's age was 32.5 ± 11.8 years, with the largest number of cases occurring in young adults due to the high level of exposure to traumatic injuries in this group of people [15]. Similarly, Rodrigues FL et al. found that the effectiveness of intramedullary

nailing, thus supporting the notion that femoral shaft fractures predominantly occur in young and middle-aged adults [16]. The percentage of males was 65% in our study, which reflects the predominance of males. Hasan et al. also noted that the percentage of males with femoral shaft fractures was 92%, which reflects the higher exposure of males to outdoor activities and the higher incidence of high-velocity injuries in males [15]. An analysis from the trauma centre reported that the majority of patients with femoral shaft fractures were male, exceeding 90% [17]. Regarding occupation, it was found that the majority of patients in this study were housewives or service holders (25% each), followed by farmers (20%) and labourers (15%), which indicates that people who are involved in more physically demanding occupations have a higher risk of acquiring traumatic injuries. Similar findings have been reported in a study where the working class is often exposed to hazards in their environment [18]. The mechanism of injury analysis revealed that road traffic accidents were responsible for 80%, followed by falls on the ground, which were responsible for 15%, and falls from height, which were responsible for 5%. Rodrigues FL et al. reported that traffic accidents were responsible for approximately 84.6% of femoral shaft fractures, making it the most common mechanism of injury [16]. Ali ME et al. also reported that more than 95% of femoral shaft fractures were caused by road traffic crashes, emphasising the link between vehicular trauma and femoral fractures [19]. Intraoperative technical difficulties have also been evaluated in this study. 50% of the patients did not have any intraoperative difficulties, while difficulty in reduction and screw insertion in the proximal end occurred in 20%, and difficulty in screw insertion in the distal end occurred in 10%. Ghouri SI et al. also reported similar technical difficulties in the fixation of femoral shaft fracture using the intramedullary nailing method [20]. The incidence of postoperative complications in this analysis was found to be low. 70% of patients had no complications, whereas restricted knee movement, restricted hip movement, and superficial infection were observed in 10% of patients each. Hasan et al. found that the incidence of infection in patients undergoing intramedullary nailing was only 4.5%, whereas the majority of patients had satisfactory outcomes [21]. In this analysis, 80% of the patients had no discrepancy in the length of the limbs, whereas 10% had a discrepancy of less than 1 cm and 10% had a discrepancy of more than 1 cm. This is consistent with the results of an earlier study, which found that the use of modern interlocking intramedullary nailing can effectively restore the length and alignment of the limbs in the majority of patients [22]. Overall, the findings of this research demonstrate that proximal femoral nail fixation provides favourable outcomes with low complication rates, satisfactory fracture alignment, and minimal limb-length discrepancy in patients with subtrochanteric femoral fractures.

Limitations of the Study: The study had several limitations, including a small sample size, a single-centre design, and a short follow-up duration of 24 weeks. In addition, the use of purposive sampling may limit generalizability, and long-term functional outcomes and radiological parameters could not be fully assessed.

V. CONCLUSION

Proximal femoral nail fixation showed satisfactory results in the management of subtrochanteric femoral fractures, where the rates of complications, fracture alignment, and limb length discrepancy were low. The majority of the patients achieved stable fixation without any major postoperative problems. These analyses prove the effectiveness of the PFN technique for the management of subtrochanteric fractures.

VI. RECOMMENDATION

Early surgical fixation using a proximal femoral nail might be considered for subtrochanteric femoral fracture to achieve a stable alignment. Further, large-scale studies would be conducted to evaluate the long-term functional results, alignment, and leg length discrepancy to improve the treatment protocol for similar patients.

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