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Original Research Article

FUNCTIONAL OUTCOME OF SUBTROCHANTERIC FEMUR FRACTURE FIXATION USING PROXIMAL FEMORAL NAIL: A PROSPECTIVE STUDY

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ABSTRACT

Background: Subtrochanteric femur fractures are difficult injuries to manage because of high biomechanical stress, deforming muscular forces, cortical comminution, and relatively reduced vascularity in the proximal femoral shaft. **Objectives:** To evaluate the functional outcome and complication profile of subtrochanteric femur fractures treated with proximal femoral nail fixation. **Materials and Methods:** A prospective study was conducted in 40 skeletally mature patients with closed subtrochanteric femur fractures treated with proximal femoral nailing over a two-year period at a tertiary care teaching hospital. Fractures were classified by Seinsheimer type, and patients were followed serially with clinical and radiographic assessment. Functional outcome was evaluated using the Harris Hip Score. **Results:** Most patients were aged 20–40 years (55%), male (80%), injured in road traffic accidents (75%), and had right-sided fractures (70%). Seinsheimer type 3A and 3B fractures together accounted for 50% of cases. Final Harris Hip Score categories showed poor outcome in 1 patient (2.5%), fair in 6 (15.0%), good in 25 (62.5%), and excellent in 8 (20.0%), giving an overall good-to-excellent outcome in 82.5% of patients. Complications occurred in 5 patients (12.5%) and included delayed union in 2, superficial surgical site infection in 2, and mild varus malalignment in 1. **Conclusion:** Proximal femoral nailing provided stable fixation, satisfactory functional recovery, and an acceptable complication profile in subtrochanteric femur fractures. Careful reduction, restoration of medial support, and structured rehabilitation appear central to achieving favorable outcomes.

INTRODUCTION

Subtrochanteric fractures involve the proximal femoral shaft just distal to the lesser trochanter and remain among the most demanding injuries in trauma practice.[3,4] Their complexity arises from a combination of high compressive and tensile stresses across the subtrochanteric region, a predominance of cortical bone, and strong deforming muscle forces that displace the fracture fragments into flexion, abduction, external rotation, shortening, and varus.[3,4] These features make reduction difficult, compromise stability, and increase the risk of delayed union, malunion, implant failure, and reoperation.[3-5] In younger individuals, these fractures commonly follow high-energy trauma such as road traffic accidents or falls from height, whereas in older adults they are more often linked to low-energy falls and poor bone quality.[3,4]

Several classification systems have been described, but the Seinsheimer classification remains one of the most widely used because it considers fracture configuration and stability, both of which are relevant to operative planning and prognosis.[1,3] Historically, treatment strategies ranged from traction and casting to plating systems such as blade plates and dynamic condylar screws. Although extramedullary devices can achieve anatomical reconstruction, they often require wider exposure, greater periosteal stripping, and longer lever arms, which can increase mechanical stress at the implant-bone interface.[3,6,8] Earlier reports also documented higher rates of fixation failure and varus collapse with less stable constructs in complex patterns.[5,6,]

Modern intramedullary fixation has improved the management of subtrochanteric fractures by placing the implant closer to the mechanical axis, thereby reducing bending stress and allowing a more load-sharing construct.[4,7,10,11] Proximal femoral nails

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additionally provide proximal fixation into the femoral head and neck, improve rotational control, and support early mobilization when reduction is satisfactory.[11] Even so, successful treatment still depends less on implant choice alone and more on obtaining acceptable alignment, preserving biology, and reconstructing medial cortical support whenever possible.[4,8] Recent literature has emphasized that malreduction, inadequate medial buttress, and unstable fixation remain important determinants of delayed union or nonunion.

Against this background, prospective institutional studies continue to be valuable because they describe local injury patterns, operative practice, complications, and functional recovery after proximal femoral nailing. The present study was therefore undertaken to evaluate the demographic profile, fracture characteristics, complications, and functional outcome of patients with subtrochanteric femur fractures treated with proximal femoral nail fixation. The specific objective was to assess final hip function using the Harris Hip Score and to document treatment-related complications during follow-up.

MATERIALS AND METHODS

Study design and setting. This prospective observational study evaluated patients with subtrochanteric femur fractures managed with proximal femoral nail fixation over a two-year period in the Department of Orthopaedics of a tertiary care teaching hospital. Ethical clearance and informed consent were obtained before enrolment, and all patients were managed according to standard institutional trauma and perioperative protocols.

Participants. Forty skeletally mature patients of either sex with closed subtrochanteric femur fractures were included. Subtrochanteric fractures were defined as fractures occurring within 5 cm distal to the lesser trochanter [1,3]. Patients with open fractures, pathological fractures, neglected fractures, skeletally immature status, or major medical contraindications to surgery were excluded. At presentation, patients underwent clinical examination, radiographic confirmation, and trauma stabilization. Associated injuries were documented systematically.

Preoperative assessment. Standard anteroposterior and lateral radiographs of the affected femur and hip were obtained. Fractures were classified using the Seinsheimer system [1]. Routine laboratory workup and anesthetic fitness assessment were completed before surgery. Temporary traction was used when immediate surgery was not feasible. Preoperative planning included assessment of nail length, nail diameter, and the anticipated position of proximal and distal locking screws.

Operative technique. All patients underwent operative fixation with a proximal femoral nail under image intensifier guidance. Reduction was first attempted by traction, adduction, and rotational correction on a fracture table. When satisfactory closed reduction could not be achieved, open or mini-open reduction techniques were employed to restore alignment and improve cortical apposition. After creation of the entry point near the greater trochanter, the nail was inserted and locked proximally with cervical screws and distally with locking bolts according to fracture morphology and intraoperative stability.

Postoperative rehabilitation and follow-up. Patients received antibiotics, pain control, wound care, and early physiotherapy. Quadriceps and hamstring exercises were initiated early, followed by mobilization with protected weight bearing. Progression to partial or full weight bearing was guided by fracture stability and radiographic callus formation. Follow-up assessments were performed at regular intervals, including early postoperative review and subsequent outpatient visits extending into longer-term follow-up.

Outcome assessment and statistics. Functional outcome was assessed using the Harris Hip Score, with scores categorized as poor (<70), fair (70-79), good (80-89), and excellent (90-100) [2]. Complications such as superficial surgical site infection, delayed union, and varus malalignment were recorded. Continuous variables were summarized descriptively, while categorical variables were expressed as frequency and percentage. The final analysis focused on demographic characteristics, fracture pattern distribution, functional recovery, and complications after proximal femoral nail fixation.

RESULTS

Forty patients with subtrochanteric femur fractures underwent proximal femoral nail fixation and completed serial follow-up. Most patients were in the third and fourth decades of life, reflecting the predominance of high-energy trauma in this series. Age distribution is summarized in Table 1.

Table 1: Age distribution of study participants

Age group (years)	n	%
20-30	14	35.0
30-40	8	20.0
40-50	6	15.0
50-60	6	15.0
>60	6	15.0

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Sex distribution, mode of injury, and side involved are shown in Table 2. Males constituted 80.0% of the cohort, road traffic accidents accounted for 75.0% of cases, and right-sided fractures predominated (70.0%).

Table 2: Sex distribution, mode of injury, and side of injury

Characteristic	Category	n	%
Sex	Male	32	80.0
Sex	Female	8	20.0
Mode of injury	Road traffic accident	30	75.0
Mode of injury	Accidental fall	10	25.0
Side of injury	Right	28	70.0
Side of injury	Left	12	30.0

Fracture morphology according to the Seinsheimer classification is presented in Table 3. Type 3A fractures were the single largest subgroup (30.0%), followed by type 3B fractures (20.0%). Taken together, type 3A and 3B patterns represented half of the study population, indicating that unstable fracture configurations were common.

Table 3: Distribution of fractures by Seinsheimer classification

Seinsheimer classification	n	%
Type 2A	2	5.0
Type 2B	4	10.0
Type 2C	6	15.0
Type 3A	12	30.0
Type 3B	8	20.0
Type 4	6	15.0
Type 5	2	5.0

Case-level follow-up data showed that the mean final Harris Hip Score was 84.6, with scores ranging from 68 to 94. Functional outcome categories at final review are presented in Table 4. Good outcomes were observed in 25 patients (62.5%) and excellent outcomes in 8 patients (20.0%), giving an overall good-to-excellent result in 82.5% of the cohort.

Table 4: Final functional outcome according to Harris Hip Score

Outcome category	Score range	n	%
Poor	<70	1	2.5
Fair	70-79	6	15.0
Good	80-89	25	62.5
Excellent	90-100	8	20.0

Complications were documented in 5 patients (12.5%) and are summarized in Table 5. Delayed union occurred in 2 patients, superficial surgical site infection in 2 patients, and mild varus malalignment in 1 patient. The two delayed unions and the mild varus case nevertheless achieved acceptable final function, while both infections settled with appropriate treatment. Overall, the complication profile remained limited and no major catastrophic implant failure was recorded in the analyzed dataset.

Table 5: Complications after proximal femoral nail fixation

Complication	n	%
No complication	35	87.5
Delayed union	2	5.0
Superficial surgical site infection	2	5.0
Mild varus malalignment	1	2.5

DISCUSSION

Subtrochanteric femur fractures continue to test operative judgment because reduction is influenced by both local anatomy and fracture mechanics. The present series showed that most injuries occurred in males and were caused by road traffic accidents, underscoring the strong link between subtrochanteric fractures and high-energy trauma reported in prior studies.[4] The predominance of Seinsheimer type 3A and 3B patterns also reflects the unstable and frequently comminuted nature of these injuries, which often require more than simple traction-based reduction.[1,3]

The overall functional outcome in this study was encouraging. More than four-fifths of patients achieved good or excellent final Harris Hip Scores, suggesting that proximal femoral nailing provided reliable restoration of function in the majority of cases. Similar favorable outcomes with intramedullary fixation have been described by Wiss and Brien and by Jiang et al., both of whom emphasized the biomechanical advantage of load-sharing fixation placed closer to the mechanical axis of the femur.[5,10] The ability of intramedullary implants to reduce bending moments compared with

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plate constructs has also been highlighted in biomechanical work by Roberts et al.[7] These principles help explain why proximal femoral nailing remains a preferred option for unstable subtrochanteric fractures.

Another important observation in the present study was the relatively modest complication burden. Delayed union, superficial infection, and mild varus malalignment accounted for the recorded adverse events, and no major catastrophic implant failure was observed in the analyzed dataset. This finding is clinically relevant because loss of reduction and varus malalignment are well-recognized precursors of nonunion and implant failure.[11,12,14] Riehl et al. showed that malreduction greater than 10° substantially increases the likelihood of delayed union or non-union,[12] while Krappinger et al. identified lack of medial cortical support and mechanical instability as key risk factors for failure to unite.[14] The low rate of serious mechanical complications in this study therefore suggests that alignment and fixation were adequate in most cases.

The results also support the practical role of open or mini-open reduction in selected fractures. Although closed reduction is desirable for preserving biology, some unstable subtrochanteric patterns cannot be reduced satisfactorily without direct manipulation. Mehta et al. reported that open reduction with adjunct fixation in complex subtrochanteric fractures reduced implant failure and the need for further surgery.[13] Likewise, Vaidya et al. demonstrated that biological reduction techniques could achieve union while limiting soft-tissue damage.[8] The present findings align with that principle: anatomical restoration and medial support appear more important than insisting on closed reduction in every case.

Taken together, this study reinforces the view that proximal femoral nailing is an effective treatment for subtrochanteric femur fractures when meticulous preoperative planning, accurate reduction, stable fixation, and structured rehabilitation are achieved. Functional recovery was generally good, and the observed complications were manageable. These results compare favorably with prior reports supporting intramedullary fixation as a sound strategy for this difficult fracture pattern.[8,10-14]

Limitations

This study has several limitations. It was a single-center series with a modest sample size and no comparison arm using alternative implants or plating methods. Some radiographic and functional variables were analyzed descriptively rather than through multivariable modeling. The follow-up duration, although adequate for union and functional assessment in most cases, did not permit stronger evaluation of long-term implant-related sequelae or late degenerative changes.

CONCLUSION

Proximal femoral nail fixation yielded favorable functional recovery in this prospective series of subtrochanteric femur fractures. The study population was dominated by high-energy injuries in younger males, and unstable Seinsheimer type 3 patterns were common. Despite the biological and mechanical difficulty of these fractures, most patients achieved good or excellent Harris Hip Scores, while complications were infrequent and largely manageable. The findings support proximal femoral nailing as an effective load-sharing construct for this region, particularly when reduction is meticulous and medial cortical support is restored. Attention to fracture alignment, judicious use of open or mini-open reduction when required, and early supervised rehabilitation remain central to optimizing union and final hip function.

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