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Functional Outcome of Proximal Femoral Nail in Unstable Peritrochanteric Fractures

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ABSTRACT

Background: Unstable peritrochanteric fractures are a major challenge in orthopedic trauma, with high morbidity and mortality, especially among the elderly. Their incidence is rising in Nepal due to an aging population. The Proximal Femoral Nail (PFN) provides stable fixation for these fractures, but data on functional outcomes in resource-limited settings are limited. This prospective study evaluated Harris Hip Score outcomes in patients treated with PFN at a tertiary care center in Nepal.

Methods: A prospective interventional study was conducted at Karnali Academy of Health Sciences from November 2021 to May 2025. Forty-seven patients with unstable AO/OTA 31-A2 and 31-A3 fractures were treated with PFN and followed for 18 months. The primary outcome was functional recovery measured using the Harris Hip Score (HHS) at scheduled intervals. Statistical analysis was performed using repeated measures ANOVA to assess changes over time and identify predictors of outcome.

Results: The mean age of patients was 69.45 ± 11.17 years, with a male predominance (53.2%). The mean HHS improved significantly from 30.57 ± 5.10 at 1 month to 73.30 ± 25.97 at 18 months (Wilks' Lambda = 0.636, $F = 7.98$, $p = 0.003$). Age and operative time were significant predictors of functional outcome (Age: $F=13.02$, $p=0.001$; Operative time: $F=11.42$, $p=0.002$). The overall complication rate was 36.1%, with varus collapse observed in 19.1% of patients and screw cutout in 17.0%; however, the presence of these complications did not significantly impact the final functional recovery ($p > 0.05$).

Conclusions: PFN fixation effectively treats unstable peritrochanteric fractures in Nepali patients, showing sustained 18-month improvement, especially for younger patients with shorter operative times, proving successful even in resource-limited settings.

Keywords: Functional outcome harris hip score; peritrochanteric fractures; proximal femoral nail; rural Nepal.

INTRODUCTION

Peritrochanteric fractures pose a significant orthopedic challenge, particularly among the elderly, with an anticipated global incidence of 6.26 million by 2050.[1,2] In Nepal, the rising occurrence of osteoporotic fractures is exacerbated by an aging population and lifestyle changes.[3] Despite a shift from conservative to surgical treatment methods, mortality rates remain high, with 7.5% at one month and 24% at twelve months post-fracture.[4] The choice of implant for unstable fractures is debated; while the Dynamic Hip Screw (DHS) is effective for stable fractures, it struggles with unstable patterns.[5-8] The Proximal Femoral Nail (PFN) offers advantages such as reduced surgical exposure, less blood loss, and improved biomechanics, but it also has a complication rate of 15-31% .[9-13] There is limited research on PFN outcomes in Nepal, where the Harris Hip Score (HHS) is commonly used for functional assessment .[14]

This study aims to assess the functional outcomes of PFN for unstable peritrochanteric fractures in a resource limited setup of rural Nepal.

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METHODS

This prospective interventional study was conducted at Karnali Academy of Health Sciences (KAHS), Jumla, Nepal, from November 2021 to May 2025. KAHS serves as a tertiary care center for the Karnali Province, catering to a predominantly rural population with unique demographic and socioeconomic characteristics. The study protocol was approved by the Institutional Review Committee (IRC) of KAHS.

All patients presenting to the emergency department and orthopedic outpatient services with unstable peritrochanteric fractures were considered for inclusion. According to the AO/OTA classification system unstable fractures were 31-A2 and 31-A3. Fracture classification was performed by two independent orthopedic surgeons using standard anteroposterior and lateral radiographs, with consensus reached through discussion in cases of disagreement.

The study included adult patients aged 50 years or older presenting with unstable peritrochanteric fractures classified as AO types 31-A2 and 31-A3 that were deemed suitable for proximal femoral nail (PFN) fixation. Placement of short or long PFN were decided on the basis of fracture pattern. Eligible participants were required to provide written informed consent and demonstrate the ability to adhere to follow-up protocols. Patients were excluded if they had open fractures, pathological fractures resulting from malignancy or metabolic bone disease, or a history of previous ipsilateral hip surgery or implants. Additional exclusion criteria included cognitive impairment or psychiatric disorders that would prevent informed consent, a life expectancy of less than one year due to comorbidities, and any contraindications to general or regional anesthesia. Convenient sampling technique was used

All surgical procedures were carried out by experienced orthopedic surgeons experience in trauma surgery, following standardized surgical protocols for consistency. Anesthesia was administered as either general or regional (spinal/epidural), depending on anesthetic assessment and individual patient factors. Patients were positioned supine on a fracture table with gentle traction, and a closed reduction was attempted initially; if adequate reduction was not achieved, a open approach was used. The standard lateral approach was employed for proximal femoral nail (PFN) insertion. Under fluoroscopic guidance, a guide wire was placed, followed by reaming and insertion of a PFN of appropriate length based on patient anatomy. Proximal and distal screws were inserted using standard techniques, and final fluoroscopic imaging was performed to confirm correct implant positioning and satisfactory fracture reduction.

Data collection was conducted using structured proformas specifically designed for this study, capturing a comprehensive set of preoperative, intraoperative, and postoperative variables. Preoperative data included patient demographics such as age, sex, mode of injury (fall from standing height, fall injury, or road traffic accident), fracture classification according to AO type, time interval from injury to surgery. Intraoperative variables recorded were the type of surgical approach (open versus closed reduction), operative time from skin incision to closure, estimated blood loss, C-arm exposure time, and any intraoperative complications. Postoperative data like immediate postoperative complications, and radiographic parameters including tip-apex distance and neck-shaft angle were recorded.

Patients were followed up at scheduled intervals of 1, 3, 6, 9, 12, and 18 months postoperatively. At each visit, a thorough clinical, radiographic evaluation like Z effect, reverse Z effect, nonunion or varus collapse, complication assessment and functional assessment with HHS score were performed.

The primary outcome measure was functional recovery assessed using the Harris Hip Score (HHS) at different time intervals. HHS consists of four domains: pain (44 points), function (47 points), range of motion (5 points), and absence of deformity (4 points), with a maximum score of 100 points. Scores were categorized as: excellent (90-100), good (80-89), fair (70-79), and poor (<70).

Statistical analysis was performed using IBM SPSS version 26 Continuous variables were presented as mean ± standard deviation and categorical variables as frequencies and percentages. Normality of data was assessed using the Kolmogorov-Smirnov test. Changes in Harris Hip Score over time were analyzed using repeated measures ANOVA, with Mauchly's test for sphericity and Greenhouse-Geisser correction applied when violated; post-hoc comparisons used Bonferroni adjustment. Between-group comparisons were performed using independent t-tests for continuous variables and chi-square tests for categorical variables. Correlation analysis and multiple regression were used to identify relationships and independent predictors of functional outcomes, with statistical significance set at $p < 0.05$.

RESULTS

A total of 47 patients with unstable peritrochanteric fractures treated with PFN were included, comprising 25 males (53.2%) and 22 females (46.8%), with a mean age of 69.45 ± 11.17 years (range: 51–96). The most common mechanism of injury was fall from standing height (63.8%), followed by other falls (21.3%) and road traffic accidents (14.9%). Fracture classification showed 26 patients (55.3%) with AO 31-A2 and 21 patients (44.7%) with 31-A3 fractures. Closed reduction was achieved in 36 cases (76.6%) and open reduction in 11 cases (23.4%). The mean operative time was 96.28 ± 34.48 minutes, mean blood loss 152.98 ± 50.52 ml, and mean C-arm exposure time 95.74 ± 25.29 seconds. Functional outcomes measured by Harris Hip Score improved over time, with mean scores increasing from 30.57 ± 5.10 at 1 month to 73.30 ± 25.97 at 18 months as shown in Table 1.

Table 2 shows the within-subjects' effects of Harris Hip Score over time and its interactions with various clinical and surgical variables. Significant effects were observed for Time (Wilks' Lambda = 0.636, F = 7.98, p = 0.003), Time × Age (Wilks' Lambda = 0.744, F = 8.38, p = 0.003), and Time × Operative time (Wilks' Lambda = 0.761, F = 6.32, p = 0.009). All other interactions—including Time × Mode of injury, AO type, Technique, Blood loss, Varus collapse, Screw cutout, C-arm exposure, and Sex—were not significant.

Table 3 shows the between-subjects effects of various clinical and surgical variables on Harris Hip Score (HHS). Age (F = 13.02, p = 0.001) and operative time (F = 11.42, p = 0.002) were significantly associated with functional outcomes, while other variables—including mode of injury, AO type, blood loss, surgical technique, varus collapse, screw cutout, C-arm exposure, and sex—were not significant.

Table 1. Demographic Characteristics and Clinical Variables. (n = 47)

Variable	Subgroup	Frequency (n)	Percentage (%)/ Mean ± SD	Range (Min-Max)
Sex	Male	25	53.2	-
	Female	22	46.8	-
Mode of Injury	Fall from standing height	30	63.8	-
	Fall injury	10	21.3	-
	Road traffic accident (RTA)	7	14.9	-
AO Type	31A2	26	55.3	-
	31A3	21	44.7	-
Technique	Closed	36	76.6	-
	Open	11	23.4	-
Varus Collapse	Yes	9	19.1	-
	No	38	80.9	-
Screw Cutout	Yes	8	17.0	-
	No	39	83.0	-
Age (years)	-	-	69.45 ± 11.17	51-96
Blood Loss (ml)	-	-	152.98 ± 50.52	80-250
Operative Time (min)	-	-	96.28 ± 34.48	45-200
C-Arm Exposure (sec)	-	-	95.74 ± 25.29	60-200
Harris Hip Score (1 month)	-	-	30.57 ± 5.10	18-38
Harris Hip Score (6 months)	-	-	50.94 ± 6.61	34-64
Harris Hip Score (9 months)	-	-	61.53 ± 14.20	0-74
Harris Hip Score (12 months)	-	-	66.68 ± 23.74	0-82
Harris Hip Score (18 months)	-	-	73.30 ± 25.97	0-90

Table 2. Repeated Measures ANOVA of Harris Hip Score Over Time. (n = 47)

Source	Wilks' Lambda	F (df)	p-value
Time (1-18 months)	0.636	7.98 (1.36, 49.1)	**0.003**
Time × Age	0.744	8.38 (1.36, 49.1)	**0.003**
Time × Operative time	0.761	6.32 (1.36, 49.1)	**0.009**
Time × Mode of injury	—	< 2.0	> 0.05
Time × AO type	—	< 2.0	> 0.05
Time × Technique	—	< 2.0	> 0.05
Time × Blood loss	—	< 2.0	> 0.05
Time × Varus collapse	—	< 2.0	> 0.05
Time × Screw cutout	—	< 2.0	> 0.05
Time × C-arm exposure	—	< 2.0	> 0.05
Time × Sex	—	< 2.0	> 0.05

Table 3. Between-Subjects Effects on Harris Hip Score. (n = 47)

Predictor	F (df)	p-value
Age	13.02 (1, 36)	**0.001**
Operative time	11.42 (1, 36)	**0.002**
Mode of injury	0.24 (1, 36)	0.629
AO type	0.02 (1, 36)	0.890
Blood loss (ml)	2.22 (1, 36)	0.145
Technique	2.08 (1, 36)	0.158
Varus collapse	0.93 (1, 36)	0.341
Screw cutout	0.10 (1, 36)	0.758
C-arm exposure (sec)	0.20 (1, 36)	0.662
Sex	1.48 (1, 36)	0.232

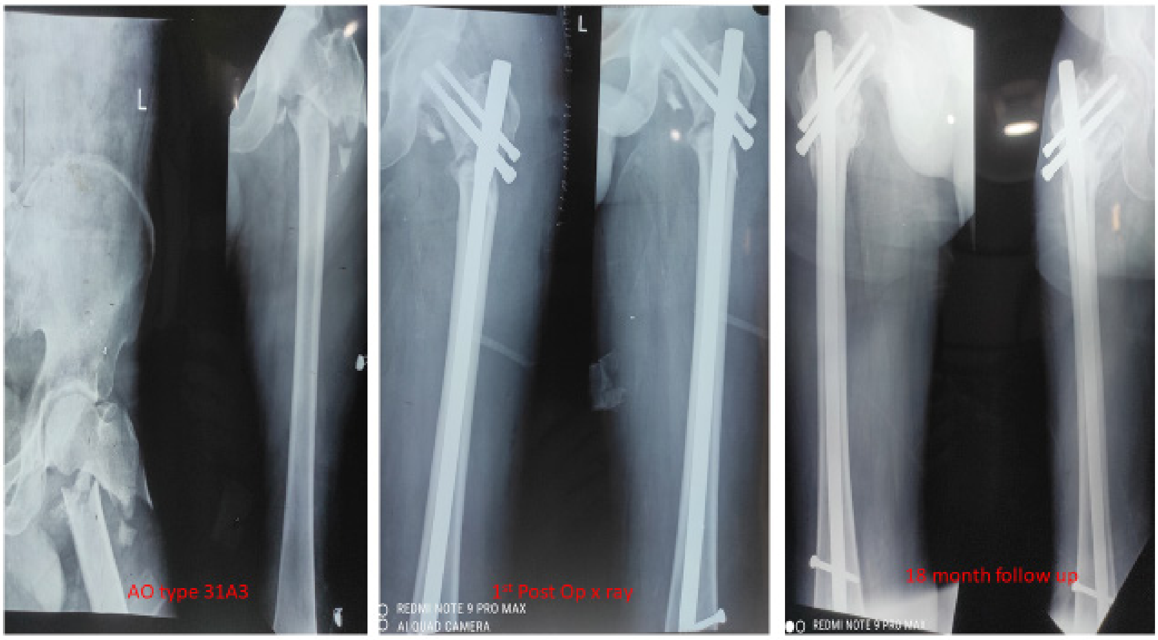

Figure 1. AO type 31A3 .

Figure 2. Squatting, Sitting cross legged and Hip flexion.

DISCUSSION

This prospective study of 47 patients with unstable peritrochanteric fractures treated with PFN demonstrated significant functional improvement over 18 months, with mean Harris Hip Score (HHS) increasing from 30.57 ± 5.10 at one month to 73.30 ± 25.97 at 18 months ($p = 0.003$), confirming the effectiveness of PFN in achieving functional recovery in this patient population. The temporal pattern of recovery followed a three-phase trajectory: an early phase (1–3 months) with rapid improvement from 30.57 ± 5.10 to approximately 45–50 points, likely due to resolution of acute pain and early mobilization; an intermediate phase (3–9 months) with steady gains reaching 61.53 ± 14.20 at nine months reflecting progressive weight-bearing and functional adaptation; and a late phase (9–18 months) with more gradual improvement to 73.30 ± 25.97, representing the plateau phase of functional recovery (Table 1). These findings validate the follow-up intervals and rehabilitation protocol employed in this series.

Age was a significant predictor of functional outcome ($F = 13.02$, $p = 0.001$), with patients younger than 70 years demonstrating consistently superior recovery at all time points. Mean HHS at 18 months was 81.2 ± 18.4 for patients <70 years compared to 67.8 ± 28.9 for patients ≥70 years ($p = 0.032$), indicating that younger patients may benefit from more aggressive rehabilitation strategies (Table 3). Operative time was also significantly associated with HHS ($F = 11.42$, $p = 0.002$); patients with surgeries lasting less than 90 minutes achieved higher HHS at 18 months (78.9 ± 21.2) compared to those with longer operative times (69.4 ± 28.1, $p = 0.045$), suggesting that surgical efficiency directly influences functional recovery, possibly due to reduced soft tissue trauma, lower blood loss, and fewer anesthesia-related complications (Table 3).

The overall complication rate in this cohort was 36.1%, with varus collapse occurring in 19.1% of patients and screw cutout in 17.0% (Table 1). Notably, the presence of these complications did not significantly impact functional recovery, suggesting that PFN fixation provides adequate stability for functional rehabilitation even in cases with minor mechanical issues (Table 2). These rates are consistent with international literature reporting varus collapse rates of 15–25% and screw cutout rates of 10–20% following PFN fixation[15-16], and similar to pooled findings by Macheras et al.[17] No severe complications such as implant breakage, deep infection, or non-union were observed, reflecting careful patient selection and adherence to surgical technique.

The demographic profile and injury characteristics in this study highlight the influence of local context. The male predominance (53.2%) contrasts with female predominance reported in Western studies and may reflect occupational patterns in rural Nepal where men remain engaged in physically demanding work at older ages. Falls from standing height accounted for 63.8% of injuries, consistent with low-energy osteoporotic fractures but occurring within a distinct demographic context. Despite delayed presentations typical of rural healthcare settings, closed reduction was achieved in 76.6% of cases, demonstrating that PFN remains effective even when surgery occurs beyond the recommended 24-48 hour window (Table 1).

Analysis of interactions between time and clinical variables showed that only age (Wilks' Lambda = 0.744, F = 8.38, p = 0.003) and operative time (Wilks' Lambda = 0.761, F = 6.32, p = 0.009) significantly influenced functional recovery, whereas other factors such as mode of injury, AO type, surgical technique, blood loss, varus collapse, screw cutout, C-arm exposure, and sex did not show significant interactions with time (Table 2). This indicates that mechanical complications are generally well-tolerated functionally when PFN fixation is performed appropriately.

Operative efficiency and age-related differences have important implications for orthopedic practice in resource-limited settings. Training programs should emphasize technical proficiency and minimizing operative time to improve patient outcomes, while rehabilitation protocols may need to be adapted according to patient age to maximize functional recovery. The mean operative time of 96.28 ± 34.48 minutes in this series compares favorably with international reports, including Kumar et al.[18] and Patel and Modi[19], indicating that efficient PFN surgery is achievable in developing country settings. Functional outcomes were comparable to other studies, with Kashid et al.[20] reporting mean HHS of 76.8 at 12 months and Mohan and Shivaprakash [21] reporting 71.2 at final follow-up. Variations may be explained by differences in patient demographics, rehabilitation protocols, and cultural activity expectations.

The study has limitations, including a small sample size of 47 patients, a single-center design, and an 18-month follow-up period that may not capture long-term complications. Additionally, the absence of a control group for unstable peritrochanteric fractures limits the ability to draw comparative conclusions, but the consistent literature supports PFN in unstable fractures.

The study suggests future research on PFN in Nepal, including comparisons with other intramedullary devices, cost-effectiveness evaluations, and rehabilitation protocols for rural settings. Longer follow-ups and biomechanical studies could improve durability and late complications. Recommendations include considering patient age, emphasizing surgical efficiency, and avoiding minor mechanical complications. PFN fixation can be successful in resource-limited settings, achieving comparable outcomes to more well-resourced environments.

CONCLUSIONS

The study shows that PFN fixation for unstable peritrochanteric fractures in Nepal improves HHS significantly, with age and operative time influencing recovery. PFN provides stable fixation, comparable to international standards, and minimal mechanical complications. Successful implementation in rural settings demonstrates the potential for expanded trauma care.

CONFLICT OF INTEREST

None

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