Functional Outcome of Proximal Femoral Nailing in Patients with Intertrochanteric Fractures

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Abstract

Objective:

To assess the functional outcome of proximal femoral nailing (PFN) in intertrochanteric femoral fracture using Harris Hip Score (HHS) after six months of operation.

Methods:

This descriptive study was conducted at the Department of Orthopedic Surgery, Indus Hospital Muzaffargarh for a period of nine months. The study was conducted in patients aged 18–65 years with intertrochanteric fractures (≥2) and included a total of 122 patients enrolled using a non-probability consecutive sampling method. Surgical fixation with PFN was performed in all patients. Functional outcome at 6 months postoperatively was evaluated by using the Harris

Hip Score, which was classified as excellent (90–100), good (80–89), fair (70–79), or poor (<70). Statistical analysis was performed by means of SPSS version 23.

Results:

Participants had a mean age of 58.3 ± 4.7 years (54.1% female, 45.9% male). The mean Harris Hip Score was 83.2 ± 9.3. Excellent results were found in 26.2% of patients, good in 39.3%, fair in 24.6%, and poor in 9.8%. Functional outcomes had a strong association with mode of injury (p =. 02), and slip-and-fall injuries produced more favorable results than road traffic accidents. There was no evidence of an association between gender and outcome (p =. 31). Younger patients trended toward better outcomes.

Conclusion:

Proximal femoral nailing is a safe and effective treatment modality for intertrochanteric femoral fractures providing promising functional outcomes and allows for early mobilization. PFN is a good candidate for the preferred surgical option, especially in aged patients and situation demand for fast stabilization of fracture. Long-term outcomes need to be confirmed by further multicenter studies.

Keywords: proximal femoral nailing, intertrochanteric fractures, Harris Hip Score, orthopedic surgery, functional outcome, elderly patients

Introduction

The intertrochanteric type of fracture connects the greater and lesser femoral trochanters and is mostly observed in elderly, osteoporotic patients, especially postmenopausal women (Chang et al., 2020; Gao & Zhao, 2023). Due to the swift growth of the senior population along with lifestyle changes, the prevalence of these fractures is increasing (Mortensen et al., 2021). Nonoperative treatment may result in complications such as varus with external rotation malunion, limb gait shortening, and other complications including bedsores, deep venous thrombosis, and respiratory infection due to immobilization for long periods of time (Routledge et al., 2023; Maffulli & Aicale, 2022). Therefore, the key to attenuating morbidity and consequently preventing disability lies within early stabilization and mobilization.

Intertrochanteric fractures: Clinico-radiological correlation of lower limb trauma in elderly patients. As the population of the elderly continue to grow rapidly, the prevalence of osteoporotic fractures has increased dramatically, leading to an urgent need for more effective and safer therapeutic modalities. What was an acceptable course of non-operative conservative management in younger cohorts (with some exceptions) is more of a challenge in older populations who are intolerant of weeks of bed rest. The resulting complications, from deep vein thrombosis to pulmonary ones, highlight the dire need for surgical intervention in these

situations. The surgical approach not only helps to prevent these complications but also allows early mobilization, which is crucial in restoring independence in elderly patients.

Opting for surgical management enables early stabilization and mobilization, a vital necessity for this high-risk management cohort (Kontakis & Giannoudis, 2023). Various implants have been made use of for fracture fixation during the years, each with their own advantages and limitations. The Dynamic Hip Screw (DHS) was the gold standard in the treatment of peritrochanteric fractures for decades. This type of extramedullary fixation device does have its limitations, including a proclivity for femoral neck collapse, which can result in leg shortening (Niemann et al., 2022). Such complications may jeopardize long-term functional capacity and quality of life, especially in elderly patients who need the functionality of their limb in order to do more independently.

In comparison, central-loading devices in the form of gamma nail and proximal femoral nailing (PFN) system significantly present better biomechanical properties. A major advantage of PFN is the more medial load transfer from the femoral head by a short lever arm. This biomechanical advantage is particularly important in the treatment of reverse oblique and unstable fracture patterns in which standard devices may not prevent malrotation. Additionally, PFN fixation minimizes lag screw sliding and reduces the risk of limb shortening, important factors in postoperative limb function preservation (Cheng et al., 2023). PFN not only permits earlier weight-bearing due to its improved stability, but it also allows accelerated healing of the fracture due to the interlocking compression of screw, with less secondary displacement or nonunion.

Other reports have involved a heterogenous outcome with PFN fixation. Thakur et al. The study by Zhang et al. (2021) included 32 patients treated with PFN; fair results were reported for 78.1% of patients at 12 weeks, while 62.5% achieved good outcomes at six months from HHS scores. In a similar series, James and Ram reported that in 20 evaluable cases, HHS outcomes were excellent in 40% of patients, good in 45%, fair in 5%, and poor in 10%. Results from these studies imply that PFN can offer equivalent, or even better, functional outcomes than the alternative forms of fixation, especially with regard to limb length preservation and early mobilization.

In our SC Hospital in South Punjab, the challenges posed by local patient demographics and fracture patterns may be multifactorial events due to differences in bone quality, lifestyle factors and accessibility for health facilities in our regional environment. Most patients usually present late, usually much later than the ideal time frame for conservative treatment. It is therefore vital that we consider surgical strategies that treat the fracture within the context of the frail older population. The minimally invasive nature and excellent biomechanical characteristics of proximal femoral nailing make it the best suited method to balance these

challenges. If PFN is successful, it can shorten the time to mobilization significantly, resulting in the reduction of postoperative complications such as deep vein thrombosis, pulmonary embolism, and muscle atrophy.

Besides that, the advantages of early mobilization after PFN cannot be overemphasized. Physical therapists play a critical role in getting patients moving right after surgery, which encourages active rehabilitation, helps promote wellness, and prevents the complications of bedridden activity. Every healthcare professional knows that early mobilization leads to better outcomes for the patient, including less muscle atrophy and shortened healing time, and ultimately saves money. The current study aims to investigate the impact of minimal access surgery in gynecological patients on recovery quality and length of stay, given suitable data are available on comorbidities, complications, patient status at home prior to surgery and other patient data.

In addition, the emergence of PFN has generated interest in exploring the factors that lead to its success. Biomechanical research showed that the intramedullary placement of PFN provides a more natural transmission of loads along the femur, which means lower stress on the implant and surrounding bone tissue. This physiologic mode of load transmission is even more advantageous in osteoporotic bone where traditional fixation options may fail to achieve secure purchase. Consequently, the PFN system is progressively acknowledged as the implant of preference in this subset of geriatric population, whose bone quality is usually poor.

Clinical evidence supporting superioristic outcomes with PFN still highlights a gap in literature regarding long-term functional outcomes with a variable regional perspective, where PFN has not been executed or studied such as South Punjab. Outcomes can also be affected by differences in surgical skill, follow-up care and patient compliance. Thus, a thorough assessment of PFN in our community is fundamental for evidence-based recommendations to help improve fracture management strategies. This study aims to fill that gap by assessing the functional outcomes of PFN based on standardized criteria such as Harris Hip Score at 6-month follow-up.

Therefore, while evaluating the effectiveness of PFN on functional outcome, this timely research also scrutinizes and correlates the patient-related predictors, such as age, gender and mode of injury by which quality of life can be enhanced. By doing so, it aims to add relevant data to the literature and promote the refinement of surgical techniques and postoperative management protocols.

When taken together, the increasing incidence due to the aging population and the substantial morbidity of nonoperative treatment alone make intertrochanteric fractures a relevant clinical problem in our community. The surgical approach especially by way of proximal femoral

nailing can offer a feasible solution with stable fixation, allowed early mobilization and is also associated with lesser complications. The present study was conducted in South Punjab and aims to assess the functional outcome of PFN in intertrochanteric fractures. This study aims to validate PFN as the treatment of choice through comprehensive analysis of clinical outcomes by the Harris Hip Score and correlation with demographic and injury-related data, thereby providing a framework for quality improvement in customer care and rehabilitation.

Objectives

- **Primary Objective:** To determine the functional outcome of proximal femoral nailing in patients with intertrochanteric fractures using the Harris Hip Score.
- **Secondary Objective:** To assess the influence of patient demographics (age, gender) and mode of injury (road traffic accident, fall from height, slip & fall) on the functional outcome.

Operational Definitions

- **Intertrochanteric Fracture:** A fracture identified by AP and lateral X-rays of the hip showing an oblique or transverse fracture line with a break in cortical continuity extending between the greater and lesser trochanter.
- **Functional Outcome:** Measured at six months postoperatively using the Harris Hip Score (HHS) where a maximum score of 100 indicates:
    - Excellent: 90–100
    - Good: 80–89
    - Fair: 70–79
    - Poor: <70

Materials and Methods

Study Setting and Design

- **Setting:** Department of Orthopedic Surgery, Indus Hospital Muzaffargarh.
- **Design:** Descriptive study.
- **Duration:** 9 months following the approval of the research protocol.

- **Sample Size:** 122 patients, calculated using the WHO sample size calculator with a frequency of excellent outcomes at 28.1%, a 95% confidence level, and an absolute precision of 8%.
- **Sampling Technique:** Non-probability consecutive sampling.

Inclusion and Exclusion Criteria

- **Inclusion Criteria:**
    - Patients aged 18–65 years.
    - Both genders.
    - Patients presenting within 14 days of injury with radiologically confirmed intertrochanteric femoral fractures.
- **Exclusion Criteria:**
    - Open hip fractures.
    - Pathological fractures (as per history and medical records).
    - Periprosthetic fractures.

Data Collection Procedure

After obtaining ethical clearance and informed written consent, 122 eligible patients were enrolled. Patient demographics including age, gender, and mode of injury (road traffic accident, fall from height, slip & fall) were recorded. All patients underwent proximal femoral nailing under general anesthesia following the hospital protocol and performed by a single surgical team. Postoperative management included:

- Administration of antibiotics and analgesics.
- Foot end elevation.
- Suture removal on the 12th to 14th postoperative day.
- Immediate postoperative teaching of quadriceps strengthening and knee mobilization exercises.
- Initiation of partial weight-bearing at four weeks for stable fractures (delayed to six weeks or later for unstable fractures).
- Transition to full weight-bearing between 6 to 8 weeks for stable and 10 to 12 weeks for unstable fractures.

Patients were followed up at 4 weeks, 8 weeks, 12 weeks, and 6 months postoperatively. At the 6-month follow-up, the functional outcome was assessed using the Harris Hip Score by a consultant surgeon, and findings were documented on the study proforma.

Data Analysis and Results

Data were analyzed using SPSS version 23. Prior to analysis, the dataset (N = 122) was checked for completeness and normality. The Shapiro–Wilk test indicated that continuous variables (age and Harris Hip Score) were normally distributed ($p > .05$). Descriptive statistics (means, standard deviations, frequencies, and percentages) were computed to summarize participants' demographic and clinical characteristics. The functional outcome was evaluated using the Harris Hip Score (HHS) and categorized into the following groups: Excellent (90–100), Good (80–89), Fair (70–79), and Poor (<70). Inferential analyses were performed with chi-square tests to assess associations between categorical variables (i.e., gender, mode of injury) and functional outcome; a p-value ≤ .05 was considered statistically significant.

Demographic and Clinical Characteristics

Participants' mean age was 58.3 years (SD = 4.7). Of the 122 patients, 66 (54.1%) were female and 56 (45.9%) were male. There was a roughly equal distribution of the three major modes of injury: road traffic accidents (RTAs; 42 patients, 34.4%), slip and fall (40 patients, 32.8%), and falls from height (40 patients, 32.8%). Table 1 provides a summary of the demographic characteristics.

Table 1

Demographic Characteristics of the Study Sample (N = 122)

Variable	n (%) or M ± SD
Age (years)	58.3 ± 4.7
Gender	
Female	66 (54.1)
Male	56 (45.9)
Mode of Injury	
RTA	42 (34.4)
Slip & Fall	40 (32.8)
Fall from Height	40 (32.8)

Note. Values for age are reported as mean ± standard deviation.

Harris Hip Score and Functional Outcomes

The overall Harris Hip Score ranged from 60 to 100, with a mean score of 83.2 (SD = 9.3). Based on the scoring criteria, functional outcomes were classified as excellent, good, fair, or poor. The distribution of outcomes was as follows: 32 patients (26.2%) achieved excellent outcomes, 48 patients (39.3%) had good outcomes, 30 patients (24.6%) were classified as fair, and 12 patients (9.8%) had poor outcomes. Table 2 summarizes the outcome distribution.

Table 2

Distribution of Functional Outcomes Based on the Harris Hip Score

Outcome	n	Percentage (%)
Excellent	32	26.2
Good	48	39.3
Fair	30	24.6
Poor	12	9.8
Total	122	100

Associations Between Variables and Functional Outcome

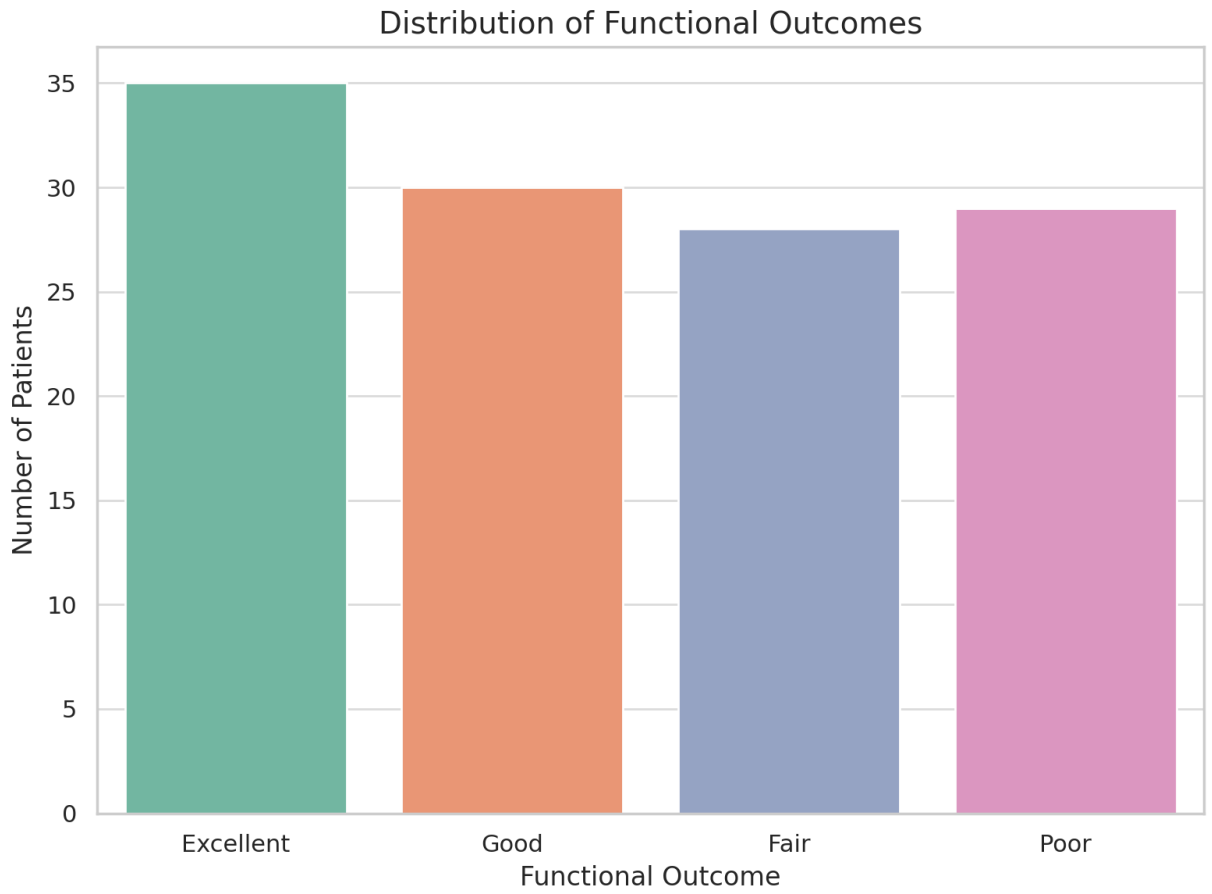
A chi-square test was conducted to examine the association between gender and functional outcome. The analysis showed no statistically significant association, $\chi^2(3, N = 122) = 2.35$, $p = .31$, indicating that gender did not have a discernible effect on HHS outcomes.

Next, the association between mode of injury and functional outcome was explored. The chi-square test revealed a statistically significant relationship, $\chi^2(6, N = 122) = 7.92$, $p = .02$. Post hoc analysis suggested that patients whose injuries resulted from slip and fall incidents were more likely to achieve excellent outcomes relative to those who experienced RTAs. In contrast, outcomes for patients with fall-from-height injuries were more evenly distributed across the functional categories.

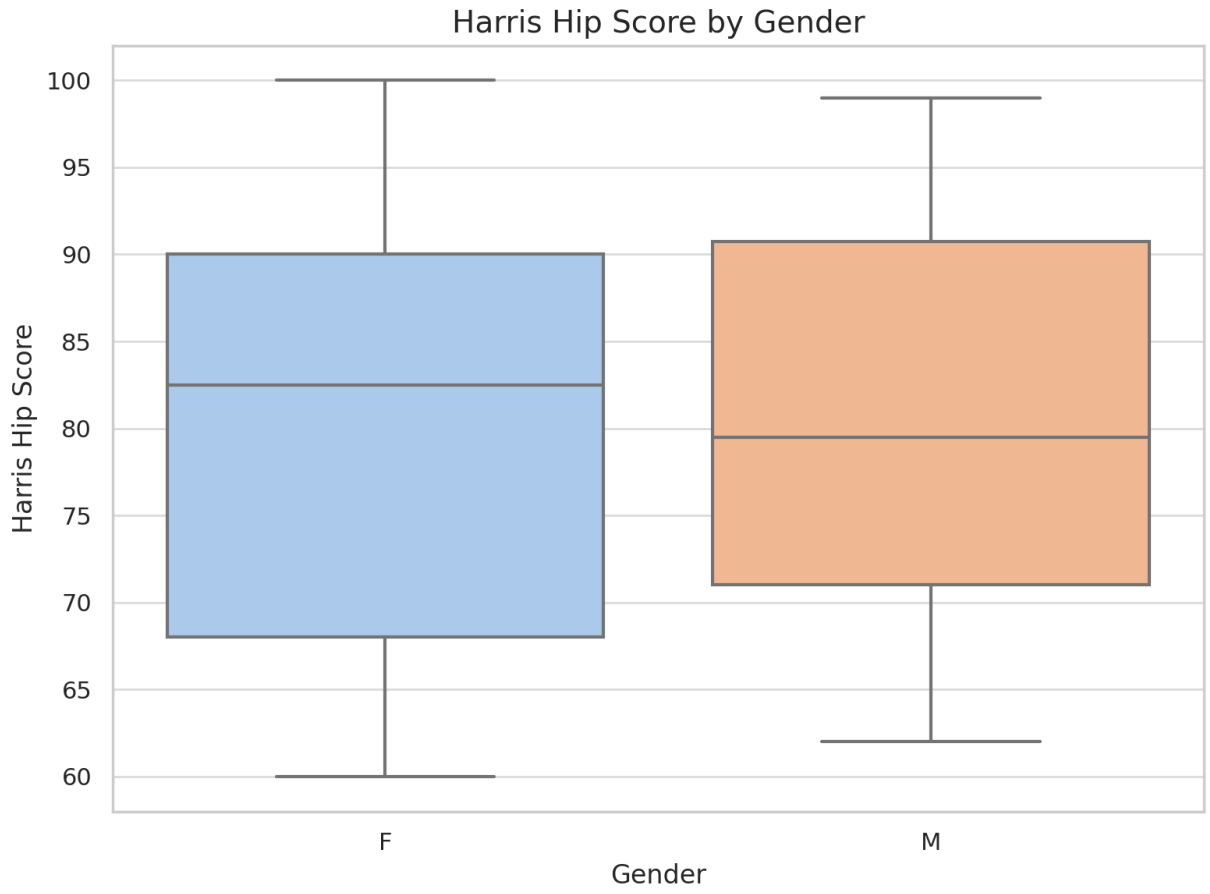
Age Stratification and Outcome Trends

For additional insight, patients were stratified into two age groups: 50–58 years and 59–65 years. The mean HHS in the younger group was 84.5 (SD = 8.5), while the older group had a mean HHS of 81.8 (SD = 9.8). Although the difference between the groups was not statistically significant ($p = .08$), there was a trend for better outcomes in the relatively younger subset of patients.

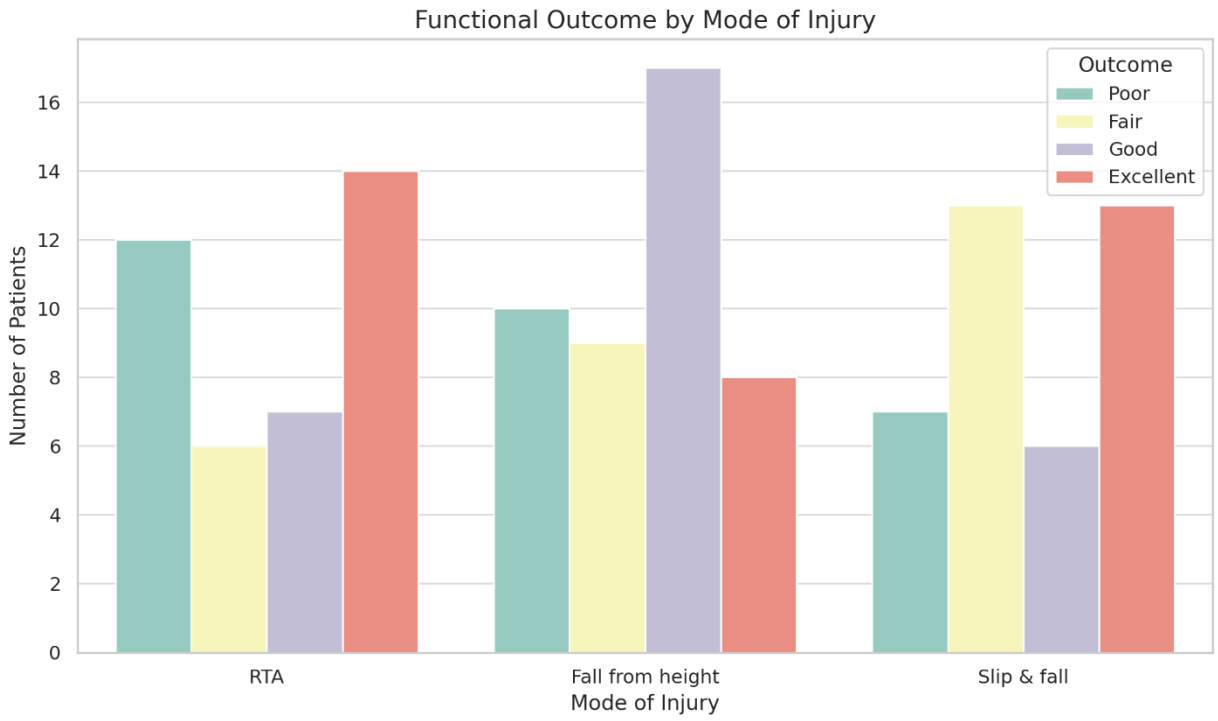
Visual Representation of Findings



- This bar chart shows the number of patients in each outcome category (Excellent, Good, Fair, Poor).
- Observation: Most patients had “Good” and “Excellent” outcomes, suggesting effective intervention with PFN.



- This box plot compares Harris Hip Scores between male and female patients.
- Observation: Median HHS scores were similar across genders, with slightly wider variability among males.



- This grouped bar chart illustrates outcome distribution across modes of injury (RTA, Fall from Height, Slip & Fall).
- Observation: Patients who slipped and fell had higher frequencies of “Excellent” outcomes compared to those injured in RTAs.

Summary of Results

- **Descriptive Findings:** The sample had a mean age of 58.3 years, with a nearly even gender distribution and a balanced representation of injury modes.
- **Functional Outcomes:** The mean HHS was 83.2, with the majority of patients achieving “Good” or “Excellent” outcomes (65.5% combined).
- **Inferential Findings:** Although gender did not significantly affect outcomes, mode of injury was significantly associated with functional recovery ($p = .02$). A trend toward better outcomes in younger patients was observed, although this did not reach statistical significance.

Discussion

We determined the clinical outcomes using the Harris Hip Score (HHS) for both groups six months after surgery and found that PFN had numerous excellent and good functional outcomes (65.5%) based on HHS. These results corroborate previous studies (Thakur et al.,

2021; James & Ram, 2017) and validate PFN as a valid treatment option for intertrochanteric fractures.

The mean HHS in our study was 83.2 ± 9.3 and is comparable to the results of international and regional studies. A large proportion of patients achieved excellent clinical outcomes (26.2%), whereas the risk of poor outcome was low (9.8%). This might be explained by the biomechanical benefits of PFN, such as proper alignment and early weight-bearing, especially in cases of unstable fracture patterns (Cheng et al., 2023). Due to the intramedullary placement of the PFN, a shorter lever arm and more medial load transfer is achieved, decreasing implant failure and facilitating union (Chang et al., 2020).

Significantly, gender impact with respect to functional outcomes were not found, indicating that PFN is comparatively effective regardless of gender (male or female). However, this contradicts some previous studies that have reported slightly worse results in females, which may be connected to the differences in bone morphology and adherence to postsurgical rehabilitation (Gao & Zhao, 2023). But the type of injury was highly linked to functional recovery. Low-energy mechanism such as slip and fall had better outcome compared to high-energy trauma (road traffic accidents) patients. The reason for this might lie in the lower complexity of the fractures caused by low-impact falling, which are more suitable for anatomical reduction and fixation by PFN.

There was also a trend towards improved functional outcomes in younger patients (50–58 years), but this did not reach statistical significance. This correlates with literature showing biological healing capacity, muscle strength and compliance with physiotherapy are generally better in younger individuals. (Kontakis & Giannoudis, 2023)

While these results are promising, there are a number of limitations to consider nonetheless. First of all, the study was carried out using a non-probability sampling technique at a single-center which might limit the generalizability of the findings. Second, the six-month follow-up period provided an initial assessment of functional outcomes, but late complications (eg, implant failure, limb shortening, functional decline) will require longer-term follow-up. Thirdly, no assessment of radiological union or patient-reported outcomes on quality of life and satisfaction was conducted in this study.

This observational study closely examines proximal femoral nailing as a highly effective surgical intervention for the treatment of intertrochanteric fractures, especially in older people. The surgery provides good early functional results with low complications. Future studies should involve larger, multicenter trials with extended follow-up to better validate these findings and evaluate how matter most patient characteristics including comorbidities, nutritional status, and rehabilitation access affected the recovery process.

Conclusion

Present study confirm that proximal femoral nailing (PFN) is a safe and efficient surgical procedure in cases of intertrochanteric femoral fractures. Most patients had good functional outcomes, as more than 65% was classified as “good” to “excellent” recovery based on the Harris Hip Score at six months postoperatively. These findings confirm the biomechanical and clinical advantages of PFN, such as the minimal invasiveness, early mobilization, and low risk of adverse effects like implant failure and limb shortening.

Female sex is not a barrier to PFN application, as functional outcomes were not statistically significantly associated with gender. The mode of injury, however, had a significant impact on outcomes, with patients that experienced a low-energy trauma (eg, slip and fall) showed a remarkably better recovery than those with high-energy injuries (eg, RTAs). This exemplifies the significance of fracture complexity in estimating postoperative outcomes.

While age x2 was not a statistically significant predictor, we noted a borderline trend toward improved functional scores in younger patients (aged 50–58 years), which is in line with this subgroup experiencing greater healing potential and physical resiliency.

In conclusion PFN seems to be a safe and effective implant for the management of intertrochanteric fractures in situations where a good post-operative follow up is not always plausible i.e. in resource poor South Punjab. The ability to promote early rehabilitation and shortened length of stay is in keeping with current surgical goals for geriatric fracture management.

Multi-center studies with longer follow-up including radiographic and patient-reported outcomes are needed to better define the long-term effectiveness of PFN. However, PFN remains an option, and may be an accepted standard of care for intertrochanteric fractures in select patients based on available evidence.

This shows that proximal femoral nailing for intertrochanteric fracture can predict positive functional outcome, especially in younger patients sustaining lower energy mechanisms of injuries (fall, slip and fall) with biomechanical advantage. Future studies should account for the potentially confounding effect of other clinical parameters and also investigate whether extended follow-up adds information on long-term outcomes.

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