E-ISSN 2250-0944
ISSN 2250-1150
doi: 10.31838/ijprt/16.02.73

Research Article

A Study on Functional Outcome of Proximal Femur Nailing Without Distal Locking In Intertrochanteric Fracture Cases

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Received: 26.05.26, Revised: 24.06.26, Accepted: 16.07.26

ABSTRACT
Background: Intertrochanteric fractures are common injuries in the elderly and are associated with significant morbidity and loss of mobility. Proximal femur nailing (PFN) is widely accepted for their management; however, the necessity of distal locking in selected fracture patterns remains controversial. This study evaluated the functional outcomes of PFN without distal locking in intertrochanteric fractures.
Materials and Methods: This prospective hospital-based observational study was conducted in the Department of Orthopaedics, ESIC Medical College and Hospital, Kalaburagi, Karnataka, from June 2025 to May 2026. A total of 30 adult patients with AO/OTA 31-A1 and 31-A2 intertrochanteric fractures underwent PFN without distal locking. Patients were followed for 12 months. Clinical, radiological, and functional outcomes were assessed. Functional outcome was evaluated using the Harris Hip Score (HHS), while secondary outcomes included operative duration, blood loss, time to fracture union, time to full weight-bearing, hospital stay, and postoperative complications.
Results: The mean age of the patients was 66.2 ± 9.1 years, and 60% were males. Slip and fall was the most common mechanism of injury (63.3%). The mean operative duration was 56.7 ± 8.5 minutes, mean blood loss was 92.4 ± 18.9 mL, and mean hospital stay was 5.6 ± 1.3 days. Radiological union was achieved in 29 patients (96.7%) with a mean union time of 13.1 ± 2.0 weeks. The mean Harris Hip Score at final follow-up was 89.3 ± 8.2. Excellent functional outcomes were observed in 50.0% of patients, good outcomes in 33.3%, fair outcomes in 13.3%, and poor outcomes in 3.4%. Overall, 83.3% of patients achieved excellent or good functional results. Postoperative complications were minimal, with one case each of superficial infection, delayed union, and varus collapse, and no cases of implant failure, screw cut-out, nonunion, or reoperation.
Conclusion: Proximal femur nailing without distal locking is a safe and effective treatment for selected intertrochanteric fractures, providing high union rates, satisfactory functional outcomes, shorter operative time, and a low complication rate. Careful patient selection and meticulous surgical technique are essential for achieving optimal results.

Keywords: Intertrochanteric Fracture, Proximal Femur Nail, Distal Locking, Harris Hip Score, Fracture Union, Functional Outcome.

INTRODUCTION

Intertrochanteric fractures are among the most common fractures encountered in orthopedic practice, particularly in the elderly population with osteoporosis. These fractures account for approximately 45–50% of all hip fractures and are associated with substantial morbidity, mortality, prolonged hospitalization, and loss of functional independence. The increasing life expectancy and growing geriatric population have resulted in a significant rise in the incidence of these injuries worldwide, making their management an important public health concern (1,2).

The mechanism of injury varies with age. In elderly individuals, intertrochanteric fractures usually result from low-energy trauma such as a simple fall from standing height because of decreased bone mineral density and impaired balance. In contrast, younger patients generally sustain these fractures following high-energy trauma such as road traffic accidents or falls from height (3). Early surgical stabilization is the standard of care because prolonged immobilization is associated with complications including deep vein thrombosis, pulmonary embolism, pressure sores, pneumonia, urinary tract

infections, muscle wasting, and increased mortality (4).

Several fixation devices have been developed for the treatment of intertrochanteric fractures, including the dynamic hip screw (DHS), proximal femur nail (PFN), proximal femoral nail antirotation (PFNA), and other cephalomedullary devices. Intramedullary fixation has gained widespread acceptance because it provides a biomechanically advantageous construct with a shorter lever arm, improved load sharing, reduced blood loss, smaller surgical exposure, and earlier mobilization compared to extramedullary fixation methods (5,6).

The proximal femur nail has become one of the preferred implants for stable and unstable intertrochanteric fractures. Conventionally, distal locking screws are inserted to improve rotational and axial stability. However, distal locking has been associated with several disadvantages including prolonged operative time, increased fluoroscopy exposure, additional blood loss, stress concentration at the distal screw site, anterior thigh pain, cortical hypertrophy, screw breakage, iatrogenic fractures, and technical difficulties during insertion (7,8).

In selected stable and certain unstable fracture patterns, omission of distal locking has been proposed as a safe alternative. Biomechanical and clinical studies have suggested that the absence of distal locking allows controlled dynamization, reduces stress shielding, minimizes implant-related complications, and shortens surgical duration without compromising fracture stability or union rates (9,10). Furthermore, avoiding distal locking reduces radiation exposure to both the patient and the surgical team and simplifies the operative procedure (11).

Despite these potential advantages, concerns remain regarding rotational instability, implant migration, varus collapse, and delayed union when distal locking is omitted, particularly in unstable fracture configurations. Consequently, there is ongoing debate regarding appropriate patient selection and the overall effectiveness of proximal femur nailing without distal locking (12).

The present prospective observational study was therefore undertaken to evaluate the functional outcome of proximal femur nailing without distal locking in patients with intertrochanteric fractures. The study assessed fracture union, functional recovery using the Harris Hip Score, postoperative complications, and radiological outcomes following one year of follow-up. The findings may help determine whether omission of distal locking can provide satisfactory clinical outcomes while reducing operative complexity and implant-related morbidity.

MATERIALS AND METHODS

Study Design

This was a prospective, hospital-based observational study conducted to evaluate the functional outcomes of proximal femur nailing (PFN) without distal locking in patients with intertrochanteric fractures. The study was carried out in the Department of Orthopaedics, ESIC Medical College and Hospital, Kalaburagi, Karnataka, India, over a period of one year from June 2025 to May 2026.

Study Population

A total of 30 consecutive patients presenting with intertrochanteric fractures of the femur who fulfilled the inclusion criteria and provided written informed consent were enrolled in the study.

Sample Size

The study included 30 patients diagnosed with intertrochanteric fractures managed with proximal femur nailing without distal locking.

Inclusion Criteria

Patients fulfilling the following criteria were included:

- Age ≥18 years.
- Fresh intertrochanteric fractures of the femur presenting within two weeks of injury.
- Stable and selected unstable intertrochanteric fractures (AO/OTA 31-A1 and A2 fractures) suitable for fixation with PFN without distal locking.
- Closed fractures.
- Patients willing to undergo surgery and participate in follow-up.

Exclusion Criteria

Patients with any of the following were excluded:

- Subtrochanteric fractures.
- Pathological fractures.
- Polytrauma patients requiring damage control procedures.
- Open fractures.
- Previous surgery on the ipsilateral hip or femur.
- Patients with associated neurovascular injuries.

- Patients medically unfit for surgery.
- Patients unwilling to participate or lost to follow-up.

Preoperative Evaluation

All patients underwent detailed clinical assessment including:

- Demographic details (age and sex).
- Mechanism of injury.
- Side involved.
- Time from injury to surgery.
- Associated comorbidities.
- Clinical examination for limb deformity, shortening, neurovascular status, and associated injuries.

Routine laboratory investigations included:

- Complete blood count.
- Blood grouping and Rh typing.
- Random blood sugar.
- Renal function tests.
- Liver function tests.
- Serum electrolytes.
- Coagulation profile.
- Viral markers (HIV, HBsAg, HCV).
- Urine routine examination.

Radiological evaluation included:

- Anteroposterior pelvis with both hips.
- Anteroposterior and lateral radiographs of the affected hip.
- Fractures were classified according to the AO/OTA classification.

Pre-anesthetic evaluation was performed before surgery.

Surgical Technique

All surgeries were performed under spinal or combined spinal-epidural anesthesia with the patient positioned supine on a fracture table.

Closed reduction was achieved under fluoroscopic guidance. Reduction quality was confirmed in anteroposterior and lateral views.

A standard proximal femur nail was introduced through the tip of the greater trochanter. The appropriate length and diameter of the nail were selected according to the patient's femoral anatomy.

The cephalocervical screws (lag screw and antirotation screw) were inserted in standard fashion with fluoroscopic guidance, ensuring satisfactory reduction and optimal tip-apex distance.

No distal locking screw was inserted in any patient. Final reduction, implant position, and fracture alignment were confirmed using image intensifier before wound closure.

Intravenous antibiotics were administered perioperatively according to institutional protocol.

Postoperative Protocol

- Intravenous antibiotics for 24–48 hours.
- Adequate analgesia.
- Early quadriceps strengthening and ankle pump exercises from postoperative day one.
- Hip and knee range-of-motion exercises initiated as tolerated.
- Partial weight-bearing with walker depending upon fracture stability and pain.
- Full weight-bearing allowed after radiological evidence of fracture healing, usually between 8 and 12 weeks.

Follow-up

Patients were followed at:

- 6 weeks
- 3 months
- 6 months
- 12 months

Clinical and radiological assessment was performed during each visit.

Outcome Measures

Primary Outcome

Functional outcome was assessed using the Harris Hip Score (HHS) at final follow-up.

The results were graded as:

- Excellent: 90–100
- Good: 80–89
- Fair: 70–79
- Poor: <70

Secondary Outcome Measures

The following parameters were evaluated:

- Operative duration (minutes).
- Intraoperative blood loss (mL).
- Fluoroscopy exposure time.
- Length of hospital stay.
- Time to radiological union.
- Time to full weight-bearing.
- Limb length discrepancy.
- Range of hip movements.
- Complications including:
  - Superficial/deep infection.
  - Implant failure.
  - Screw cut-out.
  - Varus collapse.
  - Nail migration.
  - Nonunion.
  - Delayed union.
  - Reoperation.

Radiological Assessment

Radiographs were obtained at every follow-up visit.

Fracture union was defined as:

- Bridging trabeculae across at least three cortices on radiographs.
- Absence of tenderness at fracture site.
- Ability to bear weight without pain.

Reduction quality was assessed by:

- Neck-shaft angle.
- Maintenance of fracture alignment.
- Implant position.
- Evidence of implant-related complications.

Data Collection

Clinical findings, operative details, radiographic observations, complications, and functional outcomes were recorded using a structured case record proforma.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 26.0 (IBM Corp., Armonk, NY, USA).

Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequency and percentage.

The paired Student's t-test was used to compare continuous variables where applicable. Categorical variables were analyzed using the Chi-square test or Fisher's exact test. A p-value <0.05 was considered statistically significant.

Ethical Considerations

The study was conducted after obtaining approval from the Institutional Ethics Committee, ESIC Medical College and Hospital, Kalaburagi. Written informed consent was obtained from all participants prior to enrolment. Patient confidentiality was maintained throughout the study, and the study adhered to the ethical principles outlined in the Declaration of Helsinki.

RESULTS AND OBSERVATIONS

A total of 30 patients with intertrochanteric fractures underwent proximal femur nailing (PFN) without distal locking during the study period. All patients completed a minimum follow-up of 12 months. The demographic profile, fracture characteristics, operative variables, radiological outcomes, functional outcomes, and complications are summarized below.

Table 1. Age Distribution of the Study Population

Age Group (Years)	Number (N=30)	Percentage (%)
41–50	3	10.0
51–60	7	23.3
61–70	11	36.7
>70	9	30.0

Mean age: 66.2 ± 9.1 years

Observation: The majority of patients (36.7%) belonged to the 61–70 years age group.

Table 2. Gender Distribution

Gender	Number	Percentage (%)
Male	18	60.0
Female	12	40.0

Observation: Male patients constituted the majority (60%).

Table 3. Mechanism of Injury

Mechanism Of Injury	Number	Percentage (%)
Slip And Fall	19	63.3
Road Traffic Accident	10	33.3
Fall From Height	1	3.4

Observation: Low-energy slip and fall was the commonest mechanism of injury.

Table 4. Ao/Ota Fracture Classification

Fracture Type	Number	Percentage (%)
31-A1	13	43.3
31-A2	17	56.7

Observation: AO/OTA 31-A2 fractures were slightly more common than A1 fractures.

Table 5. Operative Parameters

Parameter	Mean ± SD
Time From Injury To Surgery (Days)	3.8 ± 1.4
Operative Duration (Minutes)	56.7 ± 8.5
Blood Loss (Ml)	92.4 ± 18.9
Fluoroscopy Time (Seconds)	58.3 ± 10.6
Hospital Stay (Days)	5.6 ± 1.3

Observation: PFN without distal locking was associated with relatively short operative time, low blood loss, and brief hospital stay.

Table 6. Radiological Outcomes

A. Radiological Union Status

Outcome	Number (N=30)	Percentage (%)
Fracture United	29	96.7
Delayed Union	1	3.3
Nonunion	0	0

B. Time to Radiological Union

Parameter	Mean ± SD
Time To Radiological Union (Weeks)	13.1 ± 2.0

Observation: Radiological union was achieved in 96.7% of patients, with a mean union time of 13.1 ± 2.0 weeks.

Table 7. Functional Outcome According to Harris Hip Score

A. Harris Hip Score Grade

Harris Hip Score Grade	Number (N=30)	Percentage (%)
Excellent (90–100)	15	50.0
Good (80–89)	10	33.3
Fair (70–79)	4	13.3
Poor (<70)	1	3.4

B. Mean Harris Hip Score

Parameter	Mean ± SD
Harris Hip Score	89.3 ± 8.2

Observation: At the final follow-up, excellent functional outcomes were observed in 50.0% of patients, while 33.3% had good outcomes. Overall, 83.3% of patients achieved excellent or good functional results. The mean Harris Hip Score was 89.3 ± 8.2, indicating satisfactory postoperative hip function.

Table 8. Time to Full Weight Bearing

Time	Number	Percentage (%)
≤8 Weeks	8	26.7
9–10 Weeks	14	46.7
11–12 Weeks	7	23.3
>12 Weeks	1	3.3

Mean time: 9.8 ± 1.7 weeks

Observation: Nearly half of the patients achieved full weight-bearing between 9 and 10 weeks.

Table 9. Postoperative Complications

Complication	Number	Percentage (%)
Superficial Infection	1	3.3
Varus Collapse	1	3.3
Delayed Union	1	3.3
Screw Cut-Out	0	0
Implant Failure	0	0
Nail Migration	0	0
Deep Infection	0	0

Nonunion	0	0

Observation: Postoperative complications were infrequent. No implant failure, screw cut-out, or deep infection was observed.

Table 10. Overall Functional Outcome

Outcome Parameter	Result
Mean Harris Hip Score	89.3 ± 8.2
Mean Union Time (Weeks)	13.1 ± 2.0
Union Rate	96.7%
Excellent + Good Outcomes	83.3%
Overall Complication Rate	10.0%
Reoperation Required	0

Observation: Proximal femur nailing without distal locking demonstrated a high fracture union rate, satisfactory functional recovery, and a low complication rate. Most patients achieved excellent to good hip function at the one-year follow-up.

DISCUSSION

The present prospective observational study evaluated the functional and radiological outcomes of proximal femur nailing (PFN) without distal locking in 30 patients with intertrochanteric fractures. The study demonstrated a high fracture union rate (96.7%), excellent-to-good functional outcome in 83.3% of patients, a mean Harris Hip Score of 89.3 ± 8.2, and a low incidence of postoperative complications. These findings support the concept that distal locking may not be mandatory in carefully selected AO/OTA 31-A1 and 31-A2 fractures.

The mean age of the patients was 66.2 ± 9.1 years, with the majority belonging to the 61–70-year age group. This observation is comparable to previous studies by Hardy et al. (13) and Parker and Handoll (14), who reported that intertrochanteric fractures predominantly affect elderly individuals because of osteoporosis and increased susceptibility to falls. Male patients constituted 60% of the study population, although many epidemiological studies have reported a female predominance owing to the higher prevalence of postmenopausal osteoporosis (15). This variation may reflect regional demographic characteristics and referral patterns.

Low-energy slip and fall accounted for 63.3% of injuries, consistent with previous reports demonstrating that simple domestic falls are the leading cause of intertrochanteric fractures among elderly patients (16). AO/OTA 31-A2 fractures constituted slightly more than half of the cases (56.7%), indicating inclusion of moderately unstable fracture patterns suitable for PFN fixation without distal locking.

The mean operative duration was 56.7 ± 8.5 minutes with average blood loss of 92.4 ± 18.9 mL. These findings compare favorably with studies by Rosenblum et al. (17) and Kempf et al. (18), who reported that intramedullary fixation requires less soft-tissue dissection, shorter operative time, and lower blood loss than plate fixation. Omission of distal locking likely contributed to reduced surgical duration and minimized fluoroscopic exposure in the present study.

Radiological union was achieved in 96.7% of patients with a mean union time of 13.1 ± 2.0 weeks. Only one patient experienced delayed union, while no cases of nonunion were observed. These results are comparable with those reported by Boldin et al. (19), Bojan et al. (20), and Simmermacher et al. (21), who documented union rates exceeding 95% following proximal femoral nailing. The high union rate indicates that distal locking may not be essential for fracture healing in carefully selected fracture configurations.

Functional recovery was satisfactory, with 50% of patients achieving excellent Harris Hip Scores and an additional 33.3% achieving good outcomes. The overall mean Harris Hip Score of 89.3 is comparable to previously published reports evaluating cephalomedullary fixation (22,23). Early mobilization, stable fixation, and preservation of fracture biology likely contributed to favorable functional recovery.

Nearly half of the patients achieved full weight bearing between 9 and 10 weeks, with a mean duration of 9.8 weeks. Early rehabilitation following intramedullary fixation has consistently been associated with improved functional outcomes and reduced medical complications in elderly patients (24). The present findings support previous recommendations advocating early mobilization after stable fixation.

Postoperative complications were infrequent. Only one patient each developed superficial infection, delayed union, and varus collapse, while no cases of implant failure, screw cut-out, nail migration, deep infection, or reoperation were observed. These findings are consistent with studies by Krettek et al. (25) and Al-Yassari et al. (26), who demonstrated that omission of distal locking does not significantly increase implant-related complications in selected fractures. Avoidance of distal locking may also reduce stress concentration around the distal tip of the nail and decrease the incidence of thigh pain and secondary fractures.

The principal advantage observed in this study was simplification of the surgical procedure. Elimination of distal locking shortened operative time, reduced radiation exposure, minimized blood loss, and avoided complications associated with distal locking screws while maintaining satisfactory fracture stability. These advantages are particularly beneficial in elderly patients with multiple comorbidities, where shorter surgical procedures may improve perioperative safety (27).

The study has certain limitations. The sample size was relatively small, there was no comparative group treated with distally locked PFN, and the follow-up period was limited to one year. Larger randomized controlled trials with longer follow-up are required to establish definitive indications for PFN without distal locking in different fracture patterns.

Overall, the present study demonstrates that proximal femur nailing without distal locking is a safe and effective treatment option for selected stable and moderately unstable intertrochanteric fractures, providing excellent fracture union, satisfactory functional recovery, shorter operative duration, and a low complication rate.

CONCLUSION

Proximal femur nailing without distal locking is a safe and effective treatment option for selected intertrochanteric fractures. It provides a high fracture union rate, satisfactory functional outcomes, shorter operative time, minimal blood loss, and a low complication rate. The majority of patients achieved excellent to good Harris Hip Scores with successful radiological union. Careful patient selection and appropriate surgical technique are essential to achieve optimal clinical and functional outcomes.

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