

Proximal Femoral Nailing Versus Hemiarthroplasty for Unstable Trochanteric Fractures of Femur in Elderly Patients – A Randomized Controlled Study

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Abstract

Background: Unstable intertrochanteric fractures in elderly patients are associated with substantial morbidity, loss of independence, and complications related to prolonged immobilization. Proximal femoral nailing preserves the native hip and reduces operative trauma, whereas hemiarthroplasty permits early weight-bearing. The objective is to compare the functional and radiological outcomes and complications of proximal femoral nailing and cemented bipolar hemiarthroplasty in elderly patients with unstable intertrochanteric fractures. **Material and Methods:** This randomized controlled study included 60 patients aged 65 years or older with AO/OTA type 31-A2 or 31-A3 unstable intertrochanteric fractures. Patients were randomized into a proximal femoral nail group and a cemented bipolar hemiarthroplasty group, with 30 patients in each. Operative time, blood loss, transfusion requirements, postoperative complications, radiological outcomes, Harris Hip Score, Oxford Hip Score, Visual Analogue Scale, and Activities of Daily Living scores were assessed at three months, six months, and final follow-up. **Results:** Proximal femoral nailing was associated with shorter operative time, lower blood loss, and reduced transfusion requirements ($p < 0.01$). Hemiarthroplasty had fewer respiratory complications and bed sores and demonstrated significantly better Harris Hip and Oxford Hip scores with lower pain at three months. At six months and final follow-up, functional outcomes were comparable between the groups. All fractures in the PFN group united at a mean of 15 weeks. Implant irritation was more frequent after PFN, whereas all hemiarthroplasty patients achieved optimal stem fixation. **Conclusion:** Proximal femoral nailing offers intraoperative advantages, while hemiarthroplasty provides better early function and fewer immobilization-related complications. Both procedures achieve comparable functional outcomes at final follow-up.

Keywords: Intertrochanteric fracture, proximal femoral nail, hemiarthroplasty, elderly, Harris Hip Score, osteoporosis.

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INTRODUCTION

Intertrochanteric fractures of the femur are among the most common fragility fractures encountered in the elderly population and represent a major cause of morbidity, mortality, prolonged hospitalization, and loss of functional independence. Their incidence continues to rise with increasing life expectancy and the growing prevalence of osteoporosis worldwide.^[1,2]

The majority of intertrochanteric fractures occur following low-energy falls in elderly individuals with poor bone quality. Unstable fracture patterns, particularly AO/OTA type 31-A2 and A3 fractures, present significant challenges because of comminution, medial calcar deficiency, and posteromedial cortical disruption, which increase the risk of fixation failure and delayed rehabilitation.^[3]

Proximal femoral nailing (PFN) has become one of the preferred fixation methods for unstable intertrochanteric fractures owing to its minimally invasive nature, biomechanical superiority, preservation of fracture biology, and ability to provide stable fixation with early mobilization. However, complications such as implant cut-out, screw migration, non-union, and prolonged protected weight-

bearing may still occur, particularly in severely osteoporotic bone.^[4]

Primary hemiarthroplasty has emerged as an alternative treatment for unstable intertrochanteric fractures in elderly patients with poor bone stock. By replacing the fractured proximal femur, hemiarthroplasty allows immediate weight-bearing, facilitates early rehabilitation, and reduces complications related to prolonged immobilization, including pressure sores, respiratory infections, and deep vein thrombosis.^[5]

Several comparative studies have demonstrated that hemiarthroplasty provides superior early postoperative

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functional recovery and earlier ambulation, whereas proximal femoral nailing offers the advantages of shorter operative time, reduced blood loss, and preservation of the native hip joint. Nevertheless, long-term functional outcomes remain comparable between the two procedures.^[6]

Despite numerous clinical studies, there is still no clear consensus regarding the optimal treatment of unstable intertrochanteric fractures in elderly patients. The choice between proximal femoral nailing and hemiarthroplasty often depends on fracture configuration, bone quality, associated comorbidities, and surgeon preference.^[7] Therefore, the present study was undertaken to compare the functional outcome, radiological outcome, and postoperative complications following proximal femoral nailing and cemented hemiarthroplasty in elderly patients with unstable intertrochanteric fractures.

MATERIALS AND METHODS

Study Design: This was a prospective randomized controlled trial.

Study Setting: The study was conducted in the Department of Orthopaedics, Basaveshwara Medical College Hospital and Research Centre, Chitradurga.

Study Duration: The study was conducted from March 2021 to August 2022.

Sample Size Estimation

Sample size was estimated using the formula:

$$n = 4pq/L^2$$

where:

- **p = 0.6** (estimated incidence of intertrochanteric fractures among proximal femoral fractures)
- **q = 1 - p = 0.4**
- **L = 0.2** (permissible error)

$$[n = \frac{4 \times 0.6 \times 0.4}{(0.2)^2} = 24]$$

The calculated minimum sample size was 24 patients per group. To improve study power and compensate for possible loss to follow-up, 30 patients were included in each group, resulting in a total sample size of 60 patients.

Study Population: Sixty consecutive elderly patients diagnosed with unstable intertrochanteric fractures who fulfilled the eligibility criteria were enrolled after obtaining written informed consent.

Inclusion Criteria

- Patients aged 65 years or older.
- AO/OTA type 31-A2 and 31-A3 unstable intertrochanteric fractures.

- Evans classification Type III, IV, and V fractures.
- Patients willing to provide written informed consent.

Exclusion Criteria

- Age below 65 years.
- Patients unwilling to participate.
- Patients treated by procedures other than proximal femoral nailing or hemiarthroplasty.

Randomization

Patients were randomized using a computer-generated randomization sequence into:

- **Group A:** Proximal Femoral Nailing (PFN) (n=30)
- **Group B:** Cemented Bipolar Hemiarthroplasty (HA) (n=30)

Surgical Procedure: After routine preoperative evaluation and radiographic assessment, patients underwent either short proximal femoral nailing or cemented bipolar hemiarthroplasty according to the allocated treatment group. Fractures were classified using the AO/OTA and Evans classification systems.

Follow-up and Outcome Assessment

Patients were evaluated clinically and radiologically at **3 months, 6 months, and final follow-up.**

Functional outcome was assessed using:

- Harris Hip Score (HHS)
- Oxford Hip Score (OHS)
- Visual Analogue Scale (VAS)
- Activities of Daily Living (ADL) Scale

Radiological evaluation included fracture reduction quality, fracture union, implant-related complications, limb length discrepancy, prosthetic stability, stem subsidence, heterotopic ossification, acetabular erosion, and radiolucent lines where applicable.

Statistical Analysis: Data were analyzed using SPSS version 25.0. Continuous variables were expressed as mean $\pm$ standard deviation, while categorical variables were presented as frequencies and percentages. Independent Student's *t*-test was used to compare continuous variables, and the Chi-square test was used for categorical variables. A *p*-value <0.05 was considered statistically significant.

RESULTS

A total of 60 elderly patients with unstable intertrochanteric fractures were included and randomized equally into the proximal femoral nail group and cemented bipolar hemiarthroplasty group, with 30 patients in each group. The mean follow-up duration was 14.2 months, ranging from 12 to 19 months.

Table 1: Baseline Demographic and Fracture Characteristics

Parameter	PFN group (n=30)	Hemiarthroplasty group (n=30)	p-value
Mean age, years	69 $\pm$ 5.6	71 $\pm$ 6.0	0.182
Age range, years	65–90	65–89	
Male	12 (40.0%)	13 (43.3%)	0.790
Female	18 (60.0%)	17 (56.7%)	
Mean BMI, kg/m ²	25.2	23.8	0.310
AO/OTA classification			0.550
31-A2	23 (76.7%)	21 (70.0%)	
31-A3	7 (23.3%)	9 (30.0%)	
Evans classification			0.110
Type III	10 (33.3%)	10 (33.3%)	
Type IV	14 (46.7%)	13 (43.3%)	

Type V	6 (20.0%)	7 (23.3%)	
Trivial fall	24 (80.0%)	25 (83.3%)	>0.05
Road traffic accident	6 (20.0%)	5 (16.7%)	
Right-sided fracture	14 (46.7%)	18 (60.0%)	0.300
Left-sided fracture	16 (53.3%)	12 (40.0%)	

The two groups were comparable regarding age, sex, BMI, fracture classification, mechanism of injury, and side of involvement. Females constituted the majority in both

groups, while trivial falls were the most common mechanism of injury. AO/OTA type 31-A2 and Evans type IV were the predominant fracture patterns.

Table 2: Comparison of Intraoperative Parameters and Early Postoperative Complications

Parameter	PFN group (n=30)	Hemiarthroplasty group (n=30)	p-value
Mean operative time, minutes	85	110	<0.01
Mean blood loss, mL	155	340	<0.01
Patients requiring transfusion	18 (60.0%)	29 (96.7%)	<0.01
Mean units transfused	0.7	1.7	<0.01
Respiratory complications	5 (16.7%)	1 (3.3%)	<0.01
Cardiovascular complications	2 (6.7%)	2 (6.7%)	>0.05
Urinary tract infection	1 (3.3%)	1 (3.3%)	>0.05
Bed sores	6 (20.0%)	1 (3.3%)	<0.01
Deep-vein thrombosis	2 (6.7%)	1 (3.3%)	>0.05
Superficial wound infection	1 (3.3%)	2 (6.7%)	>0.05
Deep wound infection	0	1 (3.3%)	>0.05
Total postoperative complications	17 (56.7%)	9 (30.0%)	<0.01

PFN was associated with significantly shorter operative time, lower blood loss, and reduced transfusion requirements. However, early postoperative complications were more frequent in the PFN group, particularly respiratory

complications and bed sores, likely because of delayed mobilization. Wound complications and deep-vein thrombosis were comparable between the groups.

Table 3: Comparison of Functional Outcomes During Follow-up

Outcome measure	Follow-up	PFN group	Hemiarthroplasty group	p-value
Harris Hip Score	3 months	57	70	<0.01
	6 months	71	72	0.210
	Final follow-up	76.0	76.4	0.560
Oxford Hip Score	3 months	20	28	<0.01
	6 months	31.0	30.2	0.070
	Final follow-up	37	35	0.700
VAS pain score	3 months	35	26	<0.01
	6 months	20.0	19.5	0.080
	Final follow-up	16.6	16.0	0.150
Activities of Daily Living score	3 months	4	5	0.300
	6 months	5	6	0.007*
	Final follow-up	6	6	0.700

*The supplied data reported p=0.007 for the six-month ADL comparison; this value indicates statistical significance, although the original interpretation labelled it non-significant. Hemiarthroplasty produced significantly better Harris Hip

and Oxford Hip scores and lower pain at three months. By six months and final follow-up, the functional outcomes and pain scores were comparable between the two groups. Activities of daily living improved progressively in both groups.

Table 4: Radiological Outcomes and Late Complications

Outcome	PFN group (n=30)	Hemiarthroplasty group (n=30)
Fracture union	30 (100%)	Not applicable
Mean time to union	15 weeks (12–19)	Not applicable
Anatomical reduction at immediate postoperative assessment	24 (80.0%)	Not applicable
Anatomical reduction at final follow-up	19 (63.3%)	Not applicable
Z-effect	6 (20.0%)	—
Reverse Z-effect	3 (10.0%)	—
Screw cut-out	1 (3.3%)	—
Optimal femoral stem fixation	—	30 (100%)
Heterotopic ossification	—	2 (6.7%)
Stem subsidence	—	0
Acetabular erosion	—	0
Osteolysis	—	0

Implant irritation	10 (33.3%)	3 (10.0%)
Limb shortening	4 (13.3%)	2 (6.7%)
Limb lengthening	0	3 (10.0%)
Reoperation	1 (3.3%)	0

All fractures in the PFN group united at a mean of 15 weeks. Implant-related complications included Z-effect, reverse Z-effect, and screw cut-out. All hemiarthroplasty patients achieved optimal stem fixation, with no stem subsidence, acetabular erosion, or osteolysis. Implant irritation was significantly more frequent following PFN, whereas limb-length discrepancy was comparable between the groups. Overall, PFN offered shorter surgery, less blood loss, and lower transfusion requirements. Hemiarthroplasty enabled better early functional recovery, less pain, and fewer immobilization-related complications. At six months and final follow-up, both procedures provided comparable functional outcomes.

DISCUSSION

The present randomized controlled study compared proximal femoral nailing and cemented bipolar hemiarthroplasty in 60 elderly patients with unstable intertrochanteric fractures. The two groups were comparable with respect to age, sex, body mass index, fracture classification, mechanism of injury, side involved, and associated comorbidities. Proximal femoral nailing was associated with shorter operative time, lower blood loss, and reduced transfusion requirements, whereas hemiarthroplasty provided better early functional recovery, lower pain, and fewer immobilization-related complications. At six months and final follow-up, functional outcomes were comparable between the two groups.

Tang et al. reported that proximal femoral nailing preserves the native hip and is associated with less operative trauma, while hemiarthroplasty permits earlier weight-bearing and functional recovery in elderly patients with unstable intertrochanteric fractures.^[8] These findings are consistent with the present study, in which the PFN group had shorter surgery and less blood loss, while the hemiarthroplasty group demonstrated better early Harris Hip and Oxford Hip scores. Özkayın et al., in a prospective randomized study, observed that hemiarthroplasty allowed earlier mobilization and better short-term function, although long-term outcomes were comparable with proximal femoral nailing.^[9] Similarly, Luo et al. noted that hemiarthroplasty may be particularly useful in elderly patients with severe osteoporosis and unstable fracture patterns because it reduces the risk of fixation failure and allows early rehabilitation.^[10]

In the present study, the mean operative time and blood loss were significantly lower in the PFN group. Kumar et al., in a systematic review and meta-analysis, reported that proximal femoral nailing was associated with shorter operative duration, reduced blood loss, and lower transfusion requirements compared with hemiarthroplasty.^[11] These advantages are important in elderly patients with multiple comorbidities and limited physiological reserve.

Despite better intraoperative parameters, early postoperative complications were more frequent in the PFN group, particularly respiratory complications and bed sores. This

may be attributed to delayed full weight-bearing and prolonged immobilization. Ekinici et al. reported that hemiarthroplasty facilitates early mobilization and may reduce complications related to prolonged recumbency, although it involves greater operative blood loss and surgical trauma.^[12]

At three months, the hemiarthroplasty group had significantly better Harris Hip and Oxford Hip scores and lower pain scores. Agar et al. similarly found that hemiarthroplasty provided better early function and pain relief, while later functional outcomes became comparable between the two treatment methods.^[13] Şişman et al. also reported that hemiarthroplasty may offer advantages in early mobilization among very elderly patients, whereas proximal femoral nailing remains less invasive and preserves the native joint.^[14]

By six months and final follow-up, no significant differences were observed in most functional outcomes. Chen et al., in a meta-analysis, concluded that arthroplasty provides earlier weight-bearing and better short-term function, whereas proximal femoral nailing offers lower surgical morbidity; long-term functional results are generally similar.^[15] Hongku et al. also reported that both fixation and hemiarthroplasty are effective options for unstable intertrochanteric fractures, with treatment selection depending on patient characteristics, bone quality, fracture complexity, and surgical risk.^[16]

All patients in the PFN group achieved fracture union at an average of 15 weeks. However, implant-related complications such as Z-effect, reverse Z-effect, screw cut-out, and implant irritation were observed. Martinho and Stoffel highlighted that unstable fracture morphology, poor bone quality, and inadequate reduction increase the risk of fixation-related complications, whereas arthroplasty avoids fracture-healing dependence but may introduce prosthesis-related risks.^[17] In the present study, all patients undergoing hemiarthroplasty achieved optimal stem fixation, with no stem subsidence, acetabular erosion, or osteolysis, although heterotopic ossification occurred in a small proportion.

Functional assessment using the Oxford Hip Score provided a standardized measure of pain and disability. Murray et al. emphasized that the Oxford Hip Score is a valid and reliable patient-reported outcome measure for assessing hip function after surgical treatment.^[18] The progressive improvement in Oxford Hip Scores in both groups indicates satisfactory long-term recovery irrespective of the selected procedure.

Overall, proximal femoral nailing offered clear intraoperative advantages, while hemiarthroplasty provided better early mobility, pain relief, and fewer immobilization-related complications. The comparable functional outcomes at final follow-up suggest that both procedures are effective when selected according to patient condition, bone quality, fracture pattern, and expected rehabilitation potential.

CONCLUSION

Both proximal femoral nailing and cemented bipolar hemiarthroplasty were effective for unstable intertrochanteric

fractures in elderly patients. Proximal femoral nailing resulted in shorter operative time, less blood loss, and reduced transfusion requirements. Hemiarthroplasty provided better early functional recovery, lower pain, earlier mobilization, and fewer complications related to prolonged immobilization. At six months and final follow-up, functional outcomes were comparable. Therefore, hemiarthroplasty may be preferred in elderly patients with severe osteoporosis and a need for immediate mobilization, while PFN remains suitable for medically fit patients in whom preservation of the native hip is desirable.

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Conflicts of interest

There are no conflicts of interest.

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