DOI: 10.7860/JCDR/2025/79793.21300

Original Article

Orthopaedics Section

Comparison of Cemented Bipolar Hemiarthroplasty versus Proximal Femoral Nail Antirotation in Patients with Unstable Intertrochanteric Femur Fractures: A Prospective Interventional Study

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ABSTRACT

Introduction: Unstable intertrochanteric femur fractures in the elderly present treatment challenges due to high complication and mortality rates. While Intramedullary Fixation (IMF) with Proximal Femoral Nail Antirotation (PFNA) is the standard for stable fractures, its effectiveness in unstable fractures is limited. Cemented Bipolar Hemiarthroplasty (BH) has emerged as an alternative, potentially reducing implant-related complications.

Aim: To compare clinical and functional outcomes of cemented BH versus PFNA in elderly patients with unstable intertrochanteric femur fractures.

Materials and Methods: A prospective interventional study was conducted at Department of Orthopaedics, Government Doon Medical College and Associated Hospital, Dehradun, Uttarakhand, India, from July 2023 to December 2024. A total of 100 patients aged ≥65 years with AO type A2 unstable intertrochanteric fractures were allocated to hemiarthroplasty (Group I, n=50) or PFNA (Group II, n=50). Outcomes assessed included Harris Hip Score (HHS), pain using the Visual Analogue Scale (VAS), operative time, blood loss, time to weight-bearing, hospital stay and complications. Data were analysed using appropriate statistical tests, with significance set at p-value<0.05.

Results: Group I participants had a slightly higher average age (78.2 years) compared to Group II (76.7 years). The groups were comparable demographically. Group I had longer operative times (96.2±12.5 min vs. 65.3±12.5 min, p=0.001) and greater blood loss (280.2±50.0 mL vs. 150.3±45.0 mL, p=0.001). Hospital stay was similar for both groups. HHS was higher in Group I at one and three months (p=0.001) but comparable at six months and one year. VAS scores indicated less pain in Group I at one month. Complications were low and similar; one reoperation occurred in Group II.

Conclusion: Cemented BH yields functional outcomes comparable to PFNA but involves longer surgery and more blood loss. It may facilitate earlier mobilisation and reduce implant complications. The treatment choice should be individualised.

Keywords: Elderly, Functional outcome, Implant complications, Unstable intertrochanteric fracture

INTRODUCTION

Hip fractures, along with the increasing morbidity associated with intertrochanteric femur fractures, pose a significant financial burden on the healthcare system. Conservative therapy for unstable intertrochanteric femur fractures in the elderly can lead to consequences such as pneumonia, Deep Vein Thrombosis (DVT), bedsores and even death [1]. Clinical trials have shown that surgical treatment is preferable to conservative options because it provides solid fixation and allows patients to get out of bed sooner [2].

Hip replacement and internal fixation are the two primary surgical procedures. Internal fixation methods include compression hip screws, dynamic hip screws, gamma nails, cephalomedullary nails and proximal femoral nail antirotation. Trochanteric femur fractures have traditionally been treated with extramedullary fixations [3]. However, this approach has significant biomechanical disadvantages, particularly for unstable fractures, when compared to intramedullary implants [4]. For intertrochanteric femur fractures, Intramedullary Fixation (IMF) is therefore the most commonly utilised internal device [4]. Internal fixation, however, is prone to failure, especially in fragile and unstable fractures. Consequently, several surgeons are now considering hip arthroplasty as the main treatment option for intertrochanteric hip fractures.

Hemiarthroplasty and total hip arthroplasty are two commonly employed surgical methods for hip replacement. Hemiarthroplasty involves replacing only the femoral head, whereas total hip arthroplasty replaces both the acetabulum and the femoral head, offering a more comprehensive joint reconstruction [5]. Several previous studies have compared the outcomes of these two procedures, with some suggesting that total hip arthroplasty may lead to better long-term function and lower revision rates, particularly in active or elderly patients, whereas hemiarthroplasty may be preferred in cases with limited life expectancy or lower functional demand [4-6].

The present study aimed to compare functional outcomes, complication rates and early mobilisation potential between cemented Bipolar Hemiarthroplasty (BH) and intramedullary implants in the management of unstable intertrochanteric femur fractures in elderly patients. The significance of this study lies in its focus on early postoperative recovery, mobility and complication trends within a specific high-risk population, providing updated clinical insights that could guide the choice of surgical method in resource-limited settings or in patients with specific co-morbid profiles.

MATERIALS AND METHODS

A prospective interventional study was conducted in the Department of Orthopaedics, Government Doon Medical College and Associated Hospital, Dehradun, Uttarakhand, India, from July 2023 to December 2024, following approval from the Institutional Ethics Committee (GDMC/IEC/2023/81). Written informed consent was obtained from all participating patients.

Inclusion criteria:

- Patients having intertrochanteric femur fractures AO type A2.1, A2.2 and A2.3;
- Patients older than 65 years;
- Fractures caused by a low-energy injury;
- No contraindications to anaesthesia.

Exclusion criteria:

- Patients having intertrochanteric femur fractures AO type A1.1, A1.2, A1.3, A3.1, A3.2 and A3.3;
- Loss to follow-up within the postoperative period of one year;
- Pathological fractures, significant senile dementia, or osteoarthritis/rheumatoid arthritis in the fractured hip;
- Fractures associated with polytrauma, immobility, or walking difficulties prior to the fracture.

Sample size calculation: The sample size was calculated based on the formula for comparing two means. A minimum of 47 patients per group was needed. To accommodate potential dropouts and loss to follow-up, we rounded up and included 50 patients per group, resulting in a total of 100 patients.

Study Procedure

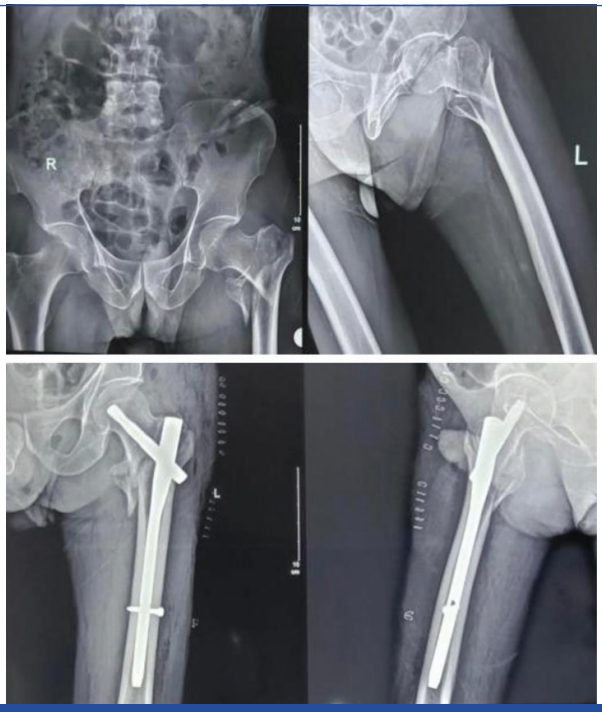
Using computer-generated random numbers, the 100 patients were divided into two treatment groups. The final treatment allocation was influenced by the preference of the chief surgeon based on clinical judgement and patient-specific factors. None of the patients declined to participate in the trial. In Group I, 50 patients received treatment with BH, while an intramedullary nail (PFNA) was applied to 50 individuals in Group II. Both trial arms underwent surgery by the same surgeon. The follow-up period averaged 12 months. In both groups, the use of prophylactic antibiotics was consistent.

Operative technique:

- **Proximal Femoral Nail Antirotation (PFNA):** In the PFNA group of patients, closed reduction and internal fixation were performed with the patient on a traction table, using short or standard length proximal femur nails under fluoroscopic guidance, as shown in [Table/Fig-1-3].
- **Bipolar Hemiarthroplasty (BH):** All patients were operated on using the direct lateral approach via coxofemoral bypass. A longitudinal incision was made, starting approximately 5 cm above the tip of the greater trochanter, passing centrally over it and extending about 8 cm distally along the line of the femoral shaft. The subcutaneous fat and deep fascia were incised in line with the skin incision to allow retraction of the tensor fascia lata anteriorly and the gluteus maximus posteriorly. The fracture line of the greater trochanter was palpated and a surgical plane was developed to gain entry through the fracture site. A T-shaped incision was made over the superior aspect of the capsule. The femoral head, along with the neck, was extracted using a head extractor. The acetabulum was then cleared of all soft tissue remnants. Broaches were inserted at an angle of 10-15 degrees of anteversion relative to the axis of the flexed tibia to remove cancellous bone from the proximal femoral shaft. A trial reduction was performed using trial stems. Limb length was assessed, as well as the range of motion and the stability of the arthroplasty, using trial components. The depth of insertion of the definitive prosthesis was determined at the point where the limb lengths became equal and a bony landmark was marked as a guide for final implantation. An 18 Gauge (1 mm) stainless steel wire was passed through a drill hole created just below the lesser trochanter to fix the greater trochanter in a figure-of-eight configuration after prosthesis insertion and joint reduction. A cement gun was used to deliver bone cement for prosthesis fixation. The desired anteversion and mediolateral positioning

[Table/Fig-1]: Showing intraoperative set-up for PFNA.

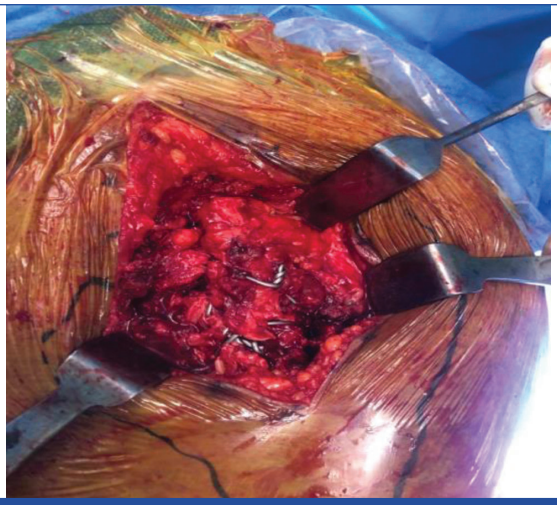
[Table/Fig-2]: Preoperative skin marking for PFNA.



[Table/Fig-3]: Radioimaging of PFNA.

of the femoral stem were confirmed prior to final insertion. Limb length and prosthesis stability were reconfirmed. Soft tissue and skin closure were performed after placing a suction drain. Postoperatively, the limb was maintained in abduction with a pillow placed between the legs to prevent adduction and internal rotation, as illustrated in [Table/Fig-4-6].

[Table/Fig-4]: Preoperative limb preparation with surgical markings for BH.



[Table/Fig-5]: Intraoperative view showing exposed surgical site.

[Table/Fig-6]: Radioimaging of BH.

Clinical evaluation included the HHS and the VAS to assess functional outcomes and pain intensity pre- and postoperatively [7,8]. The HHS quantifies hip function based on pain, function, deformity and range of motion, with scores ranging from 0 (worst) to 100 (best). The Singh index was used to assess the degree of osteoporosis in the femoral neck, which can influence fracture healing and outcomes [9]. Additionally, the VAS is a 10-point scale used to measure subjective pain levels, where 0 represents no pain and 10 indicates the worst possible pain.

STATISTICAL ANALYSIS

Statistical analysis was performed using Statistical Package for Social Sciences (SPSS) version 0.27. Continuous variables were tested for normality using the Shapiro-Wilk test. Normally distributed data were presented as mean±Standard Deviation (SD), while non normally distributed data were expressed as median and range. Categorical variables were summarised as frequencies and percentages. An independent samples t-test was used for comparing normally distributed continuous variables between the two groups, while categorical variables were analysed using the Chi-square test. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Group I participants had a slightly higher average age (78.2 years) compared to Group II (76.7 years). Both groups had similar distributions in terms of gender (female) and Body Mass Index (BMI), with Group I showing a slightly higher BMI range [Table/Fig-7].

Parameters	Group I (n=50)	Group II (n=50)	p-value
Age (years)*	78.2 (73-86)	76.7 (70-84)	0.021
Singh index			0.030
2	19	20	
3	17	18	
4	14	12	
Gender, female	42	40	0.001
BMI (kg/m^2)*	23.1 (15.5-34.1)	22.1 (15.2-36.3)	0.033

[Table/Fig-7]: Baseline characteristics of participants.
*The values are given as the mean and range

Regarding the amount of blood loss during surgery, patients in Group I lost an average of 280.2 mL (range, 200-400 mL), while those in Group II lost 150.3 mL (range, 70-250 mL), which differed significantly between the groups (p-value=0.001; [Table/Fig-8]).

Parameters	Group I (n=50)	Group II (n=50)	p-value
Operative time (min)	96.2±12.5 (70-120)	65.3±12.5 (40-90)	0.001
Blood loss (mL)	280.2±50.0 (200-400)	150.3±45.0 (70-250)	0.001
Hospital days	14.8±4.0 (10-26)	10.4±2.0 (8-16)	0.365

[Table/Fig-8]: Intraoperative findings and outcomes.
The values are given as the mean±SD and range; Independent t-test was used

Group I patients were able to walk with a walker at a mean of 8.2 days (range, 4-12 days) postoperatively, while Group II patients were able to do so at a mean of 9.8 days (range, 5-18 days) (p-value=0.069).

Group I demonstrated better functional outcomes using the HHS during the first three months (p-value <0.05) compared to Group II. However, both groups had similar scores at six months and one year (p-value >0.05) [Table/Fig-9].

VAS scores indicated less pain in Group I at one month [Table/Fig-10].

Complications and Reoperation

Reoperation was performed in one case in Group II due to non union of the fracture, which required surgical intervention. No patients in Group I required reoperation. Additionally, three patients in Group II

Parameters	Group I (n=50)	Group II (n=50)	p-value
Harris Hip Score (HHS) at 1 month	61.2±3.65	52.2±2.04	0.001
Harris Hip Score (HHS) at 3 month	70.20±2.15	64.04±2.61	0.001
Harris Hip Score (HHS) at 6 month	79.94±1.82	78.64±1.5	0.573
Harris Hip Score (HHS) at 1 year	84.35±2.58	85.9±2.31	0.053

[Table/Fig-9]: Outcomes according to Harris Hip Score.
The values are given as the mean±SD; Independent t-test

Parameters	Group I (n=50)	Group II (n=50)	p-value
VAS score at 1 month	27.7±2.01	33.5±2.65	0.043
VAS score at 3 month	21.8±2.41	22.2±2.25	0.546
VAS score at 6 month	18.9±2.5	16.8±1.72	0.436
VAS score at 1 year	24.1±2.11	15.9±2.38	0.001

[Table/Fig-10]: Outcomes according to VAS score.
The values are given as the mean and SD; Independent t-test

experienced non union. In Group I, one patient developed DVT and was treated with low-molecular-weight heparin and warfarin. Each group had one case of superficial infection, which was successfully managed with regular dressing changes and antibiotics. No anaesthesia-related complications were reported.

The p-values were determined using an independent t-test for continuous variables (age and BMI) and a Chi-square test for categorical variables (gender and Singh index).

DISCUSSION

In the present prospective, randomised study conducted by a single surgeon, the authors found no statistically significant differences between the PFNA and hemiarthroplasty groups in terms of the HHS, length of hospital stay, or overall complication rates. However, significant differences were observed in operative time and intraoperative blood loss, with the hemiarthroplasty group exhibiting longer surgeries and higher blood loss.

The present findings are consistent with recent literature. For instance, Singh J et al., reported similar clinical outcomes between primary cemented BH and PFNA for unstable intertrochanteric fractures in elderly patients, though hemiarthroplasty was associated with longer operative times and greater blood loss [9]. Likewise, Ju JB et al., in their systematic review and meta-analysis, demonstrated no significant difference in functional outcomes or complications between internal fixation and hemiarthroplasty but noted that hemiarthroplasty incurred longer surgical durations and increased intraoperative bleeding [10].

Jolly A et al., prospectively analysed 20 patients with unstable intertrochanteric fractures treated by BH, reporting average HHS values of 75 and an average hospital stay of 13.3 days, which aligns closely with our results. Their complication profile, including cases of superficial and deep infections, also resembles those encountered in our study, though we did not observe statistically significant differences in overall complication rates between the groups [11].

Song QC et al., found a significant difference in operating times, with hemiarthroplasty averaging 52.33 minutes compared to 28.19 minutes in the PFNA group (p-value <0.001). However, they observed no significant difference in postoperative hospital stays between the two groups. These results corroborate the present findings regarding surgical duration and hospital stay [12].

Xu H et al., comparing clinical outcomes among patients treated with PFNA, BH and compression hip screw fixation, reported no significant differences in functional scores, pain, or mobility measures across the three groups. Their average HHS values (BH: 73±17, CHS: 71±19, PFNA: 74±15) were also consistent with the present findings, reinforcing that functional recovery does not significantly differ between fixation and replacement techniques in this population [13].

Despite the similar functional outcomes, hemiarthroplasty was associated with increased surgical invasiveness, as indicated by longer operative times, greater intraoperative blood loss, higher transfusion requirements and increased drainage volume. These factors may contribute to increased perioperative morbidity and healthcare costs, which must be balanced against the potential benefits of earlier mobilisation [14].

A notable advantage of hemiarthroplasty, as observed in several studies [9-14], including authors, is the ability for earlier partial weight-bearing. The present hemiarthroplasty group initiated partial weight-bearing at a median of four days postoperatively, significantly earlier than the 10-day full weight-bearing observed in the PFNA group (p-value <0.001), potentially reducing immobilisation-related complications.

Future research should focus on longer-term, multicentre studies with larger patient populations to better define the durability and cost-effectiveness of hemiarthroplasty versus PFNA in unstable intertrochanteric fractures.

Limitation(s)

First, a considerable number of patients were excluded, which may affect the generalisability of the present results. Second, the relatively short duration of follow-up limits the assessment of long-term complications, such as stem loosening, acetabular erosion, or late dislocation after hemiarthroplasty. Such late complications might influence the choice of surgical technique, particularly in the elderly population with a limited life expectancy.

CONCLUSION(S)

Both PFNA and hemiarthroplasty offer comparable functional outcomes and complication rates; however, PFNA is associated with shorter operative times and reduced blood loss. Conversely, hemiarthroplasty may facilitate earlier mobilisation but at the cost of increased surgical morbidity. These findings should guide individualised treatment decisions based on patient health status, fracture characteristics and surgeon expertise.

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PLAGIARISM CHECKING METHODS: [Jain H et al.]
- Plagiarism X-checker: Apr 13, 2025
- Manual Googling: Jun 03, 2025
- iThenticate Software: Jun 05, 2025 (11%)

ETYMOLOGY: Author Origin

EMENDATIONS: 6

AUTHOR DECLARATION:
- Financial or Other Competing Interests: None
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

Date of Submission: **Apr 10, 2025**
Date of Peer Review: **May 02, 2025**
Date of Acceptance: **Jun 07, 2025**
Date of Publishing: **Aug 01, 2025**