

ASSESSMENT OF CLINICAL OUTCOMES FOLLOWING CEMENTED BIPOLAR PROSTHESIS AND PROXIMAL FEMORAL NAIL IN THE TREATMENT OF UNSTABLE INTERTROCHANTERIC FRACTURES AMONG OLDER ADULTS

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Abstract

Background: Unstable intertrochanteric fractures are common in the elderly and are associated with significant morbidity, mortality and functional impairment. The goal of surgical treatment is stable fixation, early mobilisation and return to the functional status before the injury. Cemented bipolar hemiarthroplasty and proximal femoral nailing (PFN) are the two widely used modes of treatment with their respective merits.

Aim: To evaluate and compare the clinical and functional results of cemented bipolar hemiarthroplasty and proximal femoral nail fixation in the treatment of unstable intertrochanteric fractures in elderly patients.

Materials and Methods: This prospective observational study was carried out in the Department of Orthopaedics, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu from June 2025 to February 2026. Total 60 patients of age 60 years and above with acute closed unstable intertrochanteric fracture (Boyd and Griffin Type II, III and IV) were included. Patients were divided into two equal groups: cemented bipolar hemiarthroplasty (n = 30) and proximal femoral nail fixation (n = 30). Demographic characteristics, duration of operation, intra-operative blood loss, hospital stay, limb length discrepancy, post-operative complications, radiological and functional outcomes (Harris Hip Score [HHS]) were assessed and compared between the two groups.

Results: The mean age of the study population was 68.35 ± 9.33 years. 55% of the cases were females. The left side was involved in 56.67 % of patients and trivial trauma (70 %) was the commonest mechanism of injury. Boyd and Griffin Type III fractures were identified in 58.33% of the cases. The operative time and intraoperative blood loss were significantly higher in the bipolar hemiarthroplasty group (91.93 ± 8.62 minutes and 294.33 ± 55.50 mL) compared with the PFN group (68.80 ± 9.67 minutes and 125.50 ± 23.21 mL) ($p < 0.0001$). The bipolar hemiarthroplasty group also had a significantly longer length of hospital stay ($p = 0.025$), but there was no significant difference in limb length discrepancy between the groups ($p = 0.156$). Good clinical results were obtained with both treatment modalities, with bipolar hemiarthroplasty allowing earlier weight bearing, and PFN showing perioperative advantages.

Conclusion: Cemented bipolar hemiarthroplasty and proximal femoral nail fixation are effective treatment options in the management of unstable intertrochanteric fractures in elderly patients. PFN has the advantages of shorter operation time, less blood loss and shorter hospital stay, while cemented bipolar hemiarthroplasty allows early mobilisation and immediate weight bearing. Careful patient selection and individualised treatment planning are key to optimise surgical results.

Keywords: Unstable intertrochanteric fracture, Proximal femoral nail, Cemented bipolar hemiarthroplasty, Elderly, Harris Hip Score, Hip fracture, Functional outcome.

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Introduction:

Intertrochanteric fractures of the femur are one of the

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commonest fragility fractures in orthopaedic practice and are an important cause of morbidity, mortality and loss of independence in the elderly. With population ageing, increased life expectancy and the increasing prevalence of osteoporosis, the incidence of these fractures has increased significantly. Intertrochanteric fractures constitute a large part of proximal femoral fractures and are associated with a significant socioeconomic burden, prolonged hospital stay, reduced mobility and a one year mortality rate of almost 20–30% in the elderly population. (1,2)

The main aim of the treatment of unstable intertrochanteric fractures is to provide stable fixation which allows early mobilisation, reduces the complications of immobilisation and to regain the pre injury functional status of the patient. Now, conservative treatment is reserved for patients who are not medically fit for surgery or those with very limited functional demands. Prolonged bed rest is associated with complications such as pressure sores, pneumonia, deep vein thrombosis, urinary tract infections and muscle wasting. Therefore, early surgical intervention has become the standard of care for most elderly patients with unstable intertrochanteric fractures. (3,4)

Among the available surgical options, Proximal Femoral Nailing (PFN) has gained popularity because of its minimally invasive intramedullary fixation technique with excellent biomechanical stability. The intramedullary position of the implant reduces the bending moment, preserves the biology of the fracture, reduces the dissection of soft tissue and facilitates early rehabilitation. However, despite these advantages, PFN is associated with complications such as screw cut-out, implant failure, varus collapse, fracture shortening and delayed weight bearing especially in severely osteoporotic bone and highly unstable fracture patterns. PFN success is highly dependent on accurate fracture reduction, appropriate implant placement and bone quality. (5–7)

Alternative surgical options include cemented bipolar hemiarthroplasty, which has been increasingly used for the treatment of unstable intertrochanteric fractures in elderly patients with poor bone quality. Internal fixation requires fracture healing. Hemiarthroplasty replaces the femoral head and neck, so there is no need for fracture healing and full weight bearing can begin immediately or early. Early mobilisation after hemiarthroplasty reduces complications of prolonged recumbency, reduces length of hospital stay and allows faster functional recovery. However, hemiarthroplasty is associated with longer operative time, more blood loss, cement-related complications and potential complications of joint replacement surgery. (8–10)

There are several comparative studies which have compared the relative benefits of cemented bipolar hemiarthroplasty and proximal femoral nailing. While hemiarthroplasty has shown better immediate functional outcomes and earlier weight bearing, PFN has been associated with shorter operative time, lower intraoperative blood loss, preservation of native hip anatomy, and better long term functional performance. Although there have been many published studies, the best treatment modality for unstable intertrochanteric fractures still remains controversial, especially for elderly patients with osteoporosis and multiple medical comorbidities. (11–14)

There is a need for more comparative clinical evidence given the ongoing controversy on optimal surgical treatment of unstable intertrochanteric fracture in the geriatric population. So, the present prospective observational study was conducted to compare the clinical and functional outcome between cemented bipolar hemiarthroplasty and proximal femoral nail fixation in elderly with unstable intertrochanteric femur fractures. The aim of the study is to evaluate functional recovery, postoperative complications and overall clinical outcomes to establish the most suitable treatment strategy for this difficult group of patients.

Materials and Method

This was a prospective observational study carried out in the Department of Orthopaedics, Saveetha Institute of Medical and Technical Sciences, Chennai, Tamil Nadu for a period of nine months from June 2025 to February 2026. The study was approved by the Institutional Ethics Committee and written informed consent was taken from all the participants before inclusion.

Patients over 60 years of age with an acute closed unstable intertrochanteric femur fracture Boyd and Griffin type II, III or IV were included in this study. Only patients who were independently ambulant prior to the fracture and medically fit for surgery were included. Patients younger than 60 years, with open fractures, pathological fractures, polytrauma, associated neurovascular deficits in the affected limb, previous ipsilateral hip surgery, medically unfit patients, and individuals requiring ambulatory support or who were non-ambulatory before injury were excluded from the study.

All patients had thorough clinical examination at the time of admission. Haemodynamic stability and vital signs were assessed. Demographic data, mechanism of injury, associated comorbidities such as diabetes

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mellitus, hypertension, chronic obstructive pulmonary disease, osteoporosis, prior fractures, smoking history and other relevant medical conditions were documented. Local examination of the affected hip was done to assess the deformity, swelling, skin condition, limb shortening and distal neurovascular status. Standard pelvic radiographs of both hips (anteroposterior view) and a lateral view of the affected hip were taken. Fractures were categorised based on AO/OTA classification and Boyd and Griffin classification. They were temporarily immobilised with a Thomas splint or a skin traction and given adequate analgesia until definitive surgery.

Routine preoperative investigations like complete blood count, renal and liver function tests, blood glucose, serum electrolytes, coagulation profile, electrocardiography, chest radiography and physician/anesthesiologist evaluation were done to assess the fitness for surgery. Radiographs were reviewed independently by senior orthopaedic consultants to confirm eligibility and determine the appropriate surgical procedure.

Patients who met the inclusion criteria were split into two equal treatment groups based on the operating surgeon's clinical judgement and fracture characteristics. One group was treated with cemented bipolar hemiarthroplasty and the second group was treated with proximal femoral nail (PFN) fixation. All operations were performed by standard operative techniques under spinal or general anaesthesia. Immediate postoperative anteroposterior pelvis and lateral hip radiographs were taken to assess fracture reduction, implant position, and restoration of limb alignment.

All patients were treated with intravenous antibiotics for 5 postoperative days and then received oral third-generation cephalosporins for 10 days after discharge. Analgesics, thromboprophylaxis and routine wound care were given as per institutional protocol. Ankle pump exercises, toe movements, quadriceps strengthening exercises and limb elevation were advised immediately after the surgery. Depending on the stability of fixation and type of surgical procedure, mobilisation with walker support and progressive weight bearing was started. Clinical and radiological follow-up was performed at 6 weeks, 3 months, 6 months and 12 months after the surgery. The functional outcome was evaluated by Harris hip score (HHS). Radiographic assessment included union of the fracture, position of the implant, limb length, stability of the prosthesis and postoperative complications such as infection, dislocation, implant failure, deep vein thrombosis and mortality.

Data were collected and analysed using Statistical Package for the Social Sciences (SPSS) version 26.0 (IBM Corp., Armonk, NY, USA) and Microsoft Excel. Continuous variables were expressed as mean $\pm$ standard deviation (SD) and categorical variables as frequencies and percentages. Comparison between bipolar hemiarthroplasty and PFN groups was done by independent Student's t test for continuous variables and Chi-square test or Fisher's exact test for categorical variables. A P value <0.05 was considered statistically significant.

Result:

Table 1: Demographic and clinical characteristics

Characteristics	n = 60
Age, years, mean $\pm$ SD	68.35 $\pm$ 9.33
Gender, n (%)	
Female	33 (55.00%)
Male	27 (45.00%)
Side of injury, n (%)	
Right	26 (43.33%)
Left	34 (56.67%)
Mechanism of injury, n (%)	
Trivial trauma	42 (70.00%)
RTA	18 (30.00%)
Type of fracture	
BG Type 2	24 (40.00%)

Table 2: Intra- and post-operative characteristics

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Characteristics	Treatment group		p
	Bipolar prosthesis (n=30)	PFN (n=30)	
Surgery time, min	91.93 (8.62)	68.80 (9.67)	<0.0001
Blood loss, ml	294.33 (55.50)	125.50 (23.21)	<0.0001

In both the bipolar prosthesis and the PFN groups, HHS score increased significantly at 12- and 24-weeks compared to 6-weeks (all $p < 0.0001$). However, at 6-, 12-, and 24-weeks, the HHS score was significantly greater in the bipolar prosthesis group than the PFN group (all $p < 0.0001$) (Table 3).

Table 3: Functional outcomes (HHS)

HHS	Treatment group		p
	Bipolar prosthesis (n=30)	PFN (n=30)	
6-weeks	62.77 (3.77)	53.57 (3.27)	< 0.0001
12-weeks	74.27 (3.32)	65.67 (2.66)	< 0.0001
24-weeks	87.07 (1.39)	82.80 (1.92)	< 0.0001
p	< 0.0001	< 0.0001	

HHS: Harris hip score, PFN: Proximal femoral nail
A total of 60 patients with femoral neck fractures were included in the study, with a mean age of 68.35 ± 9.33 years, reflecting the predominance of fractures among the elderly population. Females constituted a slightly higher proportion of patients (55%) than males (45%),

consistent with the increased prevalence of osteoporotic fractures in women. Left-sided injuries (56.67%) were marginally more common than right-sided injuries (43.33%). The majority of fractures occurred following trivial trauma (70%), while 30% resulted from road traffic accidents, indicating that low-energy trauma was the principal mechanism of injury. Among the fracture patterns, Garden (BG) Type II fractures accounted for 40% of cases.

Comparison of intraoperative parameters demonstrated that proximal femoral nailing (PFN) was associated with a significantly shorter operative duration than bipolar prosthesis implantation (68.80 ± 9.67 vs. 91.93 ± 8.62 minutes; $p < 0.0001$). Similarly, intraoperative blood loss was substantially lower in the PFN group (125.50 ± 23.21 mL) compared with the bipolar prosthesis group (294.33 ± 55.50 mL; $p < 0.0001$), suggesting that PFN is a less invasive surgical procedure. Although the bipolar prosthesis group had a slightly longer mean hospital stay (5.63 ± 1.29 vs. 5.07 ± 0.37 days), the difference was statistically significant ($p = 0.025$) but relatively small in magnitude. Limb length discrepancy (LLD) was minimal in both groups (0.38 ± 0.58 mm vs. 0.20 ± 0.39 mm) and did not differ significantly ($p = 0.156$), indicating comparable restoration of limb length following both procedures.

Functional recovery, assessed using the Harris Hip Score (HHS), improved significantly over time in both treatment groups ($p < 0.0001$), demonstrating progressive rehabilitation after surgery. However, patients treated with bipolar prosthesis consistently achieved significantly higher HHS scores than those treated with PFN at every follow-up interval. At 6 weeks, the bipolar prosthesis group had a mean HHS of 62.77 ± 3.77 compared with 53.57 ± 3.27 in the PFN group ($p < 0.0001$). This advantage persisted at 12 weeks (74.27 ± 3.32 vs. 65.67 ± 2.66 ; $p < 0.0001$) and 24 weeks (87.07 ± 1.39 vs. 82.80 ± 1.92 ; $p < 0.0001$). These findings indicate that although PFN offers operative advantages, including shorter surgical time and reduced blood loss, bipolar prosthesis provides superior postoperative functional outcomes and faster recovery of hip function during the first six months after surgery. Overall, the results suggest that the choice of procedure should balance the benefits of minimally invasive surgery with the goal of achieving optimal functional recovery.

Discussion:

We performed a prospective observational study to compare cemented bipolar hemiarthroplasty and proximal femoral nailing (PFN) for treatment of unstable intertrochanteric fractures in elderly patients. Both treatment modalities resulted in satisfactory

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fracture management but significant differences were observed in the perioperative parameters. PFN was associated with shorter operative time, less intra-operative blood loss and shorter hospital stay. Bipolar hemiarthroplasty had the advantage of immediate stability and earlier weight bearing. These results are consistent with earlier comparative studies. (15,16)

The mean age of the study population was 68.35 ± 9.33 years with a predominance of female patients (55%). Demographic distribution is consistent with increasing incidence of osteoporotic hip fractures in elderly women secondary to decreased bone mineral density after menopause. Gullberg et al. and Kannus et al. also reported similar epidemiological findings and identified advancing age and osteoporosis as the main reasons for the increasing incidence of intertrochanteric fractures around the world. (17,18)

Most of the fractures were on the left side (56.67%) and trivial trauma was responsible for 70% of injuries. This indicates that low-energy falls remain the dominant mechanism of injury in elderly individuals. Baumgaertner (Boyd and Griffin) Type III fractures, which are unstable fracture patterns and frequently require surgical management, comprised the majority of the fractures (58.33%). Fracture patterns similar to those reported in earlier clinical series evaluating unstable intertrochanteric fractures were seen. (19)

The main result of the present study was that the operative time was significantly longer in the bipolar prosthesis group than in the PFN group (91.93 ± 8.62 min vs. 68.80 ± 9.67 min; $p < 0.0001$). Similarly, intra-operative blood loss was significantly higher in patients undergoing bipolar hemiarthroplasty. Such findings might be expected as PFN is performed through minimally invasive incisions with limited soft tissue dissection while hemiarthroplasty requires wider surgical exposure, femoral canal preparation, cementation and prosthesis implantation. Kim et al. and Tang et al. reported similar findings, concluding that PFN significantly reduces operative time and blood loss compared with hemiarthroplasty. (15,20)

The length of the hospital stay was significantly higher in the bipolar prosthesis group ($p = 0.025$) possibly due to increased surgical trauma and post-operative recovery needs. The limb length discrepancy was a little larger after bipolar hemiarthroplasty but the difference between the two groups was not statistically significant. These data suggest that both procedures can restore an acceptable limb alignment if appropriate surgical techniques are used. (21)

Cemented bipolar hemiarthroplasty, although

technically more demanding, has significant benefits in elderly patients with severe osteoporosis and very unstable fractures, as it permits immediate or early full weight bearing. Early mobilisation prevents the complications of prolonged recumbency: deep vein thrombosis, pulmonary complications, pressure sores, muscle wastage. In contrast, PFN preserves the native hip joint, requires less operative exposure and provides superior biomechanical fixation while reducing perioperative morbidity. The choice between the two procedures should be individualised to the patient's age, bone quality, fracture pattern, pre-injury functional status and associated medical comorbidities. (16,22)

In conclusion, the results of the present study suggest that both cemented bipolar hemiarthroplasty and proximal femoral nailing are effective treatment options for unstable intertrochanteric fractures in elderly patients. Earlier weight bearing is permitted by bipolar hemiarthroplasty but PFN has considerable advantages with respect to operative time, blood loss and length of hospital stay. Larger randomised multicenter studies with longer follow-up are necessary to determine long-term functional outcomes, implant survival, complication rates and quality of life after both procedures.

Conclusion

Both cemented bipolar hemiarthroplasty and proximal femoral nailing (PFN) are effective surgical options for the treatment of unstable intertrochanteric fractures in elderly patients. PFN had significant benefits in terms of operative time, blood loss during surgery and length of hospital stay compared with cemented bipolar hemiarthroplasty in the present study. Bipolar hemiarthroplasty however, has the advantage of providing immediate post-operative stability and allowing early full weight bearing, and thus is a good option in the elderly patient with severe osteoporosis and highly unstable fracture patterns. The surgical technique should be individualised to the patient according to age, quality of bone, pattern of fracture, functional status and associated comorbidities. The clinical results of both treatments were satisfactory when performed with adequate surgical technique and a structured postoperative rehabilitation. Further randomised multicenter studies with larger sample size and longer follow up are recommended to evaluate long term functional outcome, implant survival, complication rates and quality of life.

Conflicts of Interest

The authors declare that they have no conflicts of interest related to this study. The authors alone are responsible for the content and writing of this manuscript.

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