

Proximal Femoral Nail Versus Bipolar Hemiarthroplasty for Comminuted Unstable Intertrochanteric Femur Fractures in Elderly Patients: A Prospective Comparative Study

Shivakumar Bingi¹, J. Gowtham²

¹Assistant Professor, Department of Orthopaedics, Prathima Relief Institute of Medical Sciences, Hanamkonda, Telangana, India

²Assistant Professor, Department of Orthopaedics, Prathima Institute of Medical Sciences, Karimnagar, Telangana, India

Received: 01-09-2022 / Revised: 10-10-2022 / Accepted: 20-10-2022

Corresponding Author: Dr. J. Gowtham

Conflict of interest: Nil

Abstract

Background: Unstable intertrochanteric fractures of the femur are common among elderly individuals and are associated with substantial morbidity, mortality, and loss of independence. The optimal surgical treatment remains controversial, particularly in osteoporotic patients with comminuted fracture patterns. This study compared the outcomes of osteosynthesis using Proximal Femoral Nail (PFN) and coxofemoral bypass using Bipolar Hemiarthroplasty in elderly patients with unstable intertrochanteric fractures.

Methods: A total of 56 patients aged 60 years and above with comminuted unstable intertrochanteric fractures (Evans Type III-V) were recruited. Patients were randomized into two groups: Group A underwent PFN fixation (n=28), while Group B underwent Bipolar Hemiarthroplasty (n=28). Perioperative variables, complications, mobilization status, and functional outcomes were evaluated over 12 months follow-up period using the Harris Hip Score (HHS).

Results: The majority of patients were females, and trivial falls were the predominant mechanism of injury. PFN was associated with significantly shorter operative duration and lower intraoperative blood loss. Conversely, Bipolar Hemiarthroplasty enabled earlier mobilization and full weight-bearing. Harris Hip Scores were significantly better in the hemiarthroplasty group during early follow-up; however, no statistically significant difference was observed between the groups at one year. Implant-related complications were more common in the PFN group, whereas prosthesis-related complications occurred infrequently in the hemiarthroplasty group.

Conclusion: Both PFN and Bipolar Hemiarthroplasty provide satisfactory long-term outcomes in elderly patients with unstable intertrochanteric fractures. Bipolar Hemiarthroplasty offers the advantage of early rehabilitation, while PFN minimizes operative trauma. Treatment selection should be individualized according to fracture characteristics, bone quality, patient comorbidities, and surgeon expertise.

Keywords: Intertrochanteric fracture; Proximal femoral nail; Bipolar hemiarthroplasty; Elderly; Harris Hip Score; Functional outcome..

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>) and the Budapest Open Access Initiative (<http://www.budapestopenaccessinitiative.org/read>), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction

Intertrochanteric fractures of the femur are among the most common fragility fractures encountered in orthopaedic practice and constitute a major public health concern owing to the ageing population worldwide. These fractures occur between the greater and lesser trochanters of the proximal femur and account for approximately 45-50% of all hip fractures in elderly individuals. The incidence of intertrochanteric fractures is expected to rise substantially over the coming decades because of increased life expectancy and the growing prevalence of osteoporosis among older adults. Elderly patients sustaining these injuries often

present with multiple medical comorbidities, making their management particularly challenging and contributing to significant morbidity, mortality, functional dependence, and healthcare expenditure [1, 2]. The primary goals in the treatment of unstable intertrochanteric fractures are restoration of pre-injury mobility, achievement of stable fixation, early mobilization, and minimization of complications associated with prolonged recumbency. Traditionally, internal fixation has been considered the standard treatment modality. Among contemporary fixation devices, the Proximal Femoral Nail has gained widespread

acceptance because of its biomechanical advantages, including a shorter lever arm, loadsharing characteristics, minimal soft tissue disruption, and improved rotational stability. PFN has demonstrated satisfactory union rates and functional outcomes in many studies involving unstable fracture patterns [3, 4].

However, fixation failure remains a concern in elderly patients with severe osteoporosis and comminuted fractures involving posteromedial cortical deficiency. Complications such as screw cut-out, varus collapse, implant breakage, and the need for delayed weight-bearing may compromise postoperative recovery and increase the risk of medical complications [5].

To overcome these limitations, primary bipolar hemiarthroplasty has emerged as an alternative treatment option for selected elderly patients with unstable intertrochanteric fractures. Coxafemoral bypass using bipolar hemiarthroplasty permits immediate or early full weight-bearing, thereby facilitating rapid rehabilitation and reducing the incidence of complications related to prolonged immobilization. Several investigators have reported encouraging functional outcomes with hemiarthroplasty, although concerns regarding increased operative time, blood loss, and prosthesis-related complications persist [6-8]. Despite numerous studies comparing internal fixation and arthroplasty, the optimal treatment strategy for comminuted unstable intertrochanteric fractures in elderly patients remains controversial. Therefore, the present study was undertaken to compare osteosynthesis using Proximal Femoral Nail with coxafemoral bypass using bipolar hemiarthroplasty in terms of perioperative parameters, complications, and functional outcomes in elderly patients with comminuted intertrochanteric fractures of the femur.

Materials and Methods

This prospective interventional comparative study was conducted in the Department of Orthopaedics at Prathima Institute of Medical Sciences, Karimnagar and Pratima Relief Institute of Medical Sciences, Hanamkonda, Telangana from July 2021 to September 2022. A total of 56 elderly patients presenting with comminuted unstable intertrochanteric fractures of the femur were recruited.

Inclusion Criteria

Patients aged 60 years and above, irrespective of gender, acute closed comminuted or unstable intertrochanteric fractures of the femur, Evans Type III, IV, or V fractures, patients who were ambulatory before sustaining the fracture, patients medically fit to undergo surgery and willing to participate and provide written informed consent.

Exclusion Criteria

Patients with Evans Type I or II intertrochanteric fractures, open fractures, pathological fractures secondary to malignancy or metabolic bone disease, neglected fractures presenting more than three weeks after injury, polytrauma requiring alternative treatment priorities, previous surgery involving the ipsilateral hip, patients unwilling to participate and unable to comply with follow-up. The written informed consent was obtained from all the participants and study protocol was approved by the institutional ethics committee. Study participants (n=56) were randomly allocated equally into two treatment groups. Group A (n = 28) managed with osteosynthesis using Proximal Femoral Nail and group B (n = 28) treated with coxafemoral bypass using Bipolar Hemiarthroplasty.

Detailed demographic and clinical history regarding mechanism of injury, associated comorbidities, and pre-injury ambulatory status were recorded. General physical and systemic examination, local examination of the affected limb and necessary routine laboratory investigation were conducted. standard radiographic evaluation including AP X-ray of the pelvis with both hips and lateral radiograph of the affected hip. Fracture classification was done using Evans classification and assessment of osteoporosis using the Singh Index, wherever applicable.

Patients allocated to group A underwent fixation using a standard proximal femoral nail under spinal or combined spinal epidural anaesthesia. Patients in group B underwent coxafemoral bypass using bipolar hemiarthroplasty under regional anaesthesia.

Postoperative rehabilitation

Group A: Quadriceps strengthening exercises initiated on postoperative day one. Non-weight-bearing or toe-touch ambulation with walker support commenced according to fracture stability and progression to partial and full weight-bearing based on radiological evidence of fracture healing.

Group B: Bedside mobilization and sitting initiated within 24-48 hours, full weightbearing ambulation with walker support encouraged as tolerated from the second postoperative day and hip precautions were explained to prevent dislocation.

Follow-up: Patients were postoperatively evaluated clinically and radiologically at 3 weeks, 6 weeks, 3 months, 6 months, 9 months, and 12 months. At each follow-up visit, patients underwent clinical examination, radiological assessment, pain and ambulatory status, limb length discrepancy, and associated complications.

Statistical Analysis: The collected data was extracted to Microsoft Excel sheet and analyzed using SPSS v.26.0. Continuous variables were expressed as mean and standard deviation, whereas categorical variables were presented as frequencies and percentages. Comparisons between the two

groups were performed using independent Student's *t*-test for continuous variables, Chi-square test for categorical variables. A *p*-value <0.05 was considered statistically significant.

Results

Table 1: Distribution of Patients According to Age

Parameter	Group A (n=28)		Group B (n=28)	
	Frequency	Percentage	Frequency	Percentage
Age group (In years)				
60-69	8	28.6%	7	25%
70-79	14	50%	15	53.6%
≥80	6	21.4%	6	21.4%
Gender				
Male	11	39.3%	10	35.7%
Female	17	60.7%	18	64.3%
Mode of Injury				
Trivial fall	23	82.1%	24	85.7%
Road traffic accident	5	17.9%	4	14.3%
Evans classification				
Type III	12	42.9%	11	39.3%
Type IV	10	35.7%	11	39.3%
Type V	6	21.4%	6	21.4%

The majority of patients belonged to the 70–79 years age group (51.8%). The mean age in the PFN group was 73.6 ± 7.4 years, while that in the Bipolar group was 74.2 ± 6.8 years, with no statistically significant difference between the groups ($p > 0.05$). Females constituted the majority

of cases (62.5%), reflecting the increased prevalence of osteoporosis in elderly women. Most fractures resulted from low-energy trivial falls (83.9%). Evans Type III fractures were the most common unstable fracture pattern encountered (Table 1).

Table 2: Intraoperative Variables

Intraoperative variable	Group A	Group B	p-value
Duration of surgery (min)	69.4 ± 12.6	97.8 ± 14.9	<0.001
Blood loss (mL)	138.5 ± 41.2	302.7 ± 65.8	<0.001
Hospital stay (days)	10.8 ± 2.9	9.2 ± 2.5	0.028

Bipolar hemiarthroplasty required significantly longer operative time and resulted in greater intraoperative blood loss, whereas the duration of hospital stay was significantly shorter (Table 2).

Table 3: Details of postoperative profile and Harris Hip Score during follow-up

Parameter	Group A	Group B	p-value
Time to mobilization (days)	4.8 ± 1.6	2.1 ± 0.8	<0.001
Full weight-bearing (days)	43.6 ± 8.4	3.6 ± 1.4	<0.001
Harris Hip Score during follow-up			
6 weeks	67.2 ± 8.6	73.5 ± 7.9	0.014
3 months	74.8 ± 7.3	79.6 ± 6.8	0.026
6 months	81.3 ± 6.7	83.2 ± 6.1	0.284
12 months	86.5 ± 6.3	88.1 ± 5.8	0.337

Patients treated with bipolar hemiarthroplasty achieved significantly earlier mobilization and full weight-bearing. Bipolar hemiarthroplasty demonstrated superior early functional recovery; however, no statistically significant difference was

observed in Harris Hip Scores at final follow-up (Table 3). At one year, 76.8% of PFN patients and 78.6% of Bipolar patients achieved excellent-to-good outcomes, with comparable long-term functional results (Graph 1).

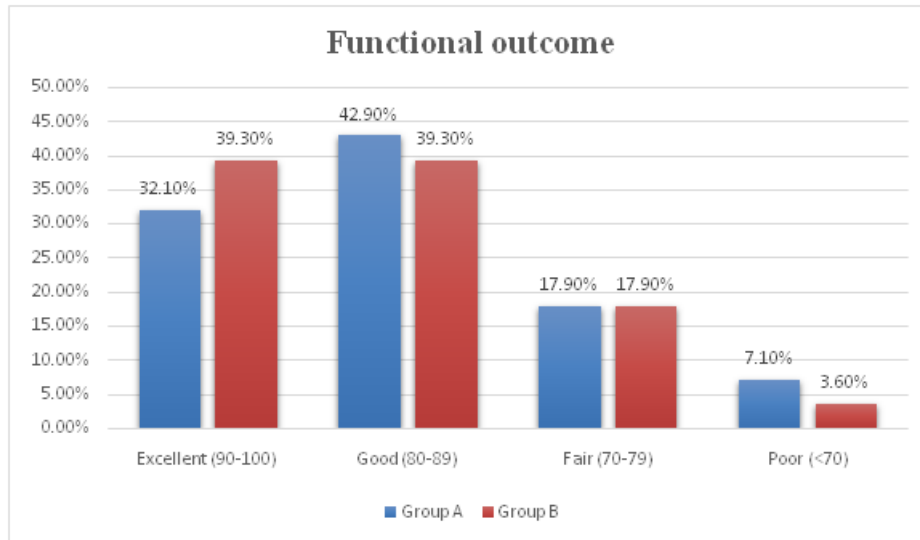


Figure 1: Functional outcome at one year assessed by Harris Hip Score

Table 4: Postoperative complications

Complication	Group A		Group B	
	Frequency	Percentage	Frequency	Percentage
Superficial infection	01	3.6%	01	3.6%
Bed sore	02	7.14%	-	-
Pulmonary infection	02	7.14%	01	3.6%
Implant failure/cut-out	01	3.6%	-	-
Prosthetic dislocation	-	-	01	3.6%
Deep vein thrombosis	01	3.6%	01	3.6%
Limb shortening (>1 cm)	02	7.14%	01	3.6%
Reoperation	01	3.6%	01	3.6%

Discussion

Unstable intertrochanteric fractures of the femur in elderly patients continue to represent a major therapeutic challenge because of osteoporosis, fracture comminution, multiple comorbidities, and the need for rapid postoperative rehabilitation. The present study compared Proximal Femoral Nail fixation and coxafemoral bypass using Bipolar Hemiarthroplasty (BHA) in 56 elderly patients with comminuted unstable intertrochanteric fractures. In the present study, females constituted the majority of patients, and most fractures occurred following trivial falls. These findings are consistent with the epidemiological observations of hip fractures among elderly osteoporotic women reported worldwide. The increasing prevalence of osteoporosis and longevity has contributed significantly to the growing burden of unstable intertrochanteric fractures in geriatric populations. PFN demonstrated advantages with respect to operative parameters. The mean duration of surgery and intraoperative blood loss were significantly lower in the PFN group compared with the bipolar hemiarthroplasty group. Similar findings were reported by Görmeli et al., who observed that PFN involved less surgical trauma and lower perioperative blood loss than bipolar

hemiarthroplasty in elderly patients with intertrochanteric fractures [8]. Zhou et al. also reported significantly shorter operative time and reduced blood loss with PFNA compared with cementless bipolar hemiarthroplasty [9]. Ozkayın et al., in their prospective randomized study, similarly found that internal fixation procedures were associated with less operative morbidity than arthroplasty [12]. Despite these perioperative advantages, PFN-treated patients experienced delayed mobilization because fracture healing and implant protection necessitated restricted weight-bearing. In contrast, bipolar hemiarthroplasty enabled immediate or early full weight-bearing.

Early mobilization is particularly important in elderly individuals because prolonged recumbency predisposes them to pressure sores, respiratory infections, venous thromboembolism, muscle wasting, and loss of independence. Green et al. first emphasized the benefits of prosthetic replacement in unstable intertrochanteric fractures by facilitating early rehabilitation and reducing immobilization-related complications [6]. Subsequently, Roy S et al. and Jalaluddeen MV and Sandeep Set al. reported superior early postoperative functional recovery among patients treated with hemiarthroplasty [7, 10].

In our study, Harris Hip Scores were significantly better in the bipolar group during the early follow-up period. However, by one year, both treatment modalities yielded comparable functional outcomes. Similar findings have been reported by Song et al., who demonstrated superior early function after hemiarthroplasty but no significant difference in final Harris Hip Scores [13]. Zhou et al. also observed equivalent one-year functional outcomes despite earlier ambulation among arthroplasty patients [9]. Ozkayın et al. noted that although hemiarthroplasty patients initially regained mobility more rapidly, PFN-treated patients eventually achieved similar and, in some cases, superior activity levels during long-term follow-up [12].

Complication profiles differed between the two treatment groups. Implant-related complications such as screw cut-out, fixation failure, and varus collapse occurred predominantly in the PFN group. These complications have been attributed to osteoporotic bone, inadequate fracture reduction, and severe posteromedial comminution. Desteli et al. reported comparable observations, emphasizing that fixation failure remains a concern in unstable osteoporotic fractures treated with intramedullary devices [11]. Conversely, prosthesis-related complications, particularly dislocation and periprosthetic fractures, were unique to hemiarthroplasty. Nevertheless, these complications were relatively infrequent and manageable.

Kumar et al. conducted a systematic review and meta-analysis including studies published between 2005 and 2017 and concluded that PFN was associated with lower blood loss, shorter operative duration, reduced hospital stay, and lower mortality rates compared with bipolar hemiarthroplasty [14]. Similarly, Chen et al., in a 2021 systematic review and meta-analysis, reported that while arthroplasty facilitated earlier weight-bearing, PFN offered favourable perioperative outcomes and comparable long-term function, without establishing clear superiority of either modality [15] which supports present study findings. The limitations of this study include the relatively small sample size and 12 months follow-up period. Longer follow-up studies incorporating quality of life assessments and economic analyses are warranted.

Conclusion

Both Proximal Femoral Nail fixation and Bipolar Hemiarthroplasty are effective treatment options for comminuted unstable intertrochanteric fractures in elderly patients. PFN offers the advantages of shorter operative duration, reduced intraoperative blood loss, and preservation of native hip anatomy.

In contrast, Bipolar Hemiarthroplasty facilitates earlier mobilization and immediate weight-bearing, thereby reducing complications associated with

prolonged immobilization. Although bipolar hemiarthroplasty demonstrated superior early functional recovery, both procedures yielded comparable long-term functional outcomes at one year. Therefore, treatment should be individualized based on fracture pattern, bone quality, patient comorbidities, pre-injury functional status, and surgeon expertise.

Proximal Femoral Nail fixation and Bipolar Hemiarthroplasty are effective treatment options for comminuted unstable intertrochanteric fractures in elderly patients. PFN offers the advantages of shorter operative duration, reduced intraoperative blood loss, and preservation of native hip anatomy. In contrast, Bipolar Hemiarthroplasty facilitates earlier mobilization and immediate weight-bearing, thereby reducing complications associated with prolonged immobilization. Although bipolar hemiarthroplasty demonstrated superior early functional recovery, both procedures yielded comparable long-term functional outcomes at one year. Therefore, treatment should be individualized based on fracture pattern, bone quality, patient comorbidities, pre-injury functional status, and surgeon expertise.

References

1. Kannus P, Parkkari J, Sievänen H, Heinonen A, Vuori I, Järvinen M. Epidemiology of hip fractures. *Bone*. 1996;18(1 Suppl):57S-63S.
2. Gullberg B, Johnell O, Kanis JA. World-wide projections for hip fracture. *Osteoporos Int*. 1997;7(5):407-13.
3. Simmermacher RK, Bosch AM, Van der Werken C. The AO/ASIF-proximal femoral nail (PFN): a new device for the treatment of unstable proximal femoral fractures. *Injury*. 1999;30(5):327-332.
4. Saudan M, Lübbecke A, Sadowski C, Riand N, Stern R, Hoffmeyer P. Pertrochanteric fractures: is there an advantage to an intramedullary nail?: a randomized, prospective study of 206 patients comparing the dynamic hip screw and proximal femoral nail. *J Orthop Trauma*. 2002;16(6):386-393.
5. Parker MJ, Handoll HH. Gamma and other cephalocondylic intramedullary nails versus extramedullary implants for extracapsular hip fractures in adults. *Cochrane Database Syst Rev*. 2010;(9):CD000093.
6. Green S, Moore T, Proano F. Bipolar prosthetic replacement for the management of unstable intertrochanteric hip fractures in the elderly. *Clin Orthop Relat Res*. 1987;(224):169-177.
7. Nandanwar AY, Konde S, Patil AG, Borkar S, Yadav SR, Kamath PS. A comparative study between osteosynthesis by proximal femoral nail (PFN) and Coxafemoral bypass with bipolar hemiarthroplasty in comminuted inter-

- trochanteric fractures of femur in elderly patients. *International Journal of Health Sciences*. 2022; 6(S7): 282-292.
8. Görmeli G, Görmeli CA, Uğurlar M, Karakaplan M, Sariyilmaz K, Adanas C, Karata T, Simsek SA. Comparison of femur intertrochanteric fracture fixation with hemiarthroplasty and proximal femoral nail systems. *Ulus Travma Acil Cerrahi Derg*. 2015;21(6):503-508.
 9. Zhou S, Liu J, Zhen P, et al. Proximal femoral nail anti-rotation versus cementless bipolar hemiarthroplasty for unstable femoral intertrochanteric fracture in the elderly: a retrospective study. *BMC Musculoskelet Disord*. 2019;20(1):500.
 10. Jalaluddeen MV, Sandeep S. Osteosynthesis by Proximal Femoral Nail (PFN) Vs coxofemoral bypass with bipolar hemiarthroplasty in comminuted inter-trochanteric fractures of femur. *International Journal of Orthopaedics Sciences* 2019; 5(4): 209-211.
 11. Desteli EE, İmren Y, Erdoğan M, Aydagün Ö. Quality of Life Following Treatment of Trochanteric Fractures with Proximal Femoral Nail versus Cementless Bipolar Hemiarthroplasty in Elderly. *Clin Invest Med*. 2015;38(2):E63-E72.
 12. Özkayın N, Okçu G, Aktuğlu K. Intertrochanteric femur fractures in the elderly treated with either proximal femur nailing or hemiarthroplasty: A prospective randomised clinical study. *Injury*. 2015;46(Suppl 2):S3–S8.
 13. Song QC, Dang SJ, Zhao Y, Wei L, Duan DP, Wei WB. Comparison of clinical outcomes with proximal femoral nail anti-rotation versus bipolar hemiarthroplasty for the treatment of elderly unstable comminuted intertrochanteric fractures. *BMC Musculoskelet Disord*. 2022; 23(1): 628.
 14. Kumar P, Rajnish RK, Sharma S, Dhillon MS. Proximal femoral nailing is superior to hemiarthroplasty in AO/OTA A2 and A3 intertrochanteric femur fractures in the elderly: a systematic literature review and meta-analysis. *Int Orthop*. 2020;44(4):623-633.
 15. Chen WH, Guo WX, Gao SH, Wei QS, Li ZQ, He W. Arthroplasty vs proximal femoral nails for unstable intertrochanteric femoral fractures in elderly patients: A systematic review and meta-analysis. *World J Clin Cases*. 2021; 9(32): 9878-9888.