



Comparison of Functional Outcome after Bipolar Hemiarthroplasty versus Unipolar Hemiarthroplasty in Managing Neck of Femur Fracture

Article History:

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Received: 20-11-2025

Revised: 26-11-2025

Accepted: 16-12-2025

Published: 28-12-2025

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Abstract: Background: The fracture neck of femur is a common orthopedic problem in the elderly population and is associated with significant morbidity and mortality. Hemiarthroplasty is widely used for its management, with both bipolar and unipolar prostheses being commonly employed. However, the optimal choice of prosthesis remains a subject of debate, particularly regarding functional outcomes. **Objectives:** To compare the functional outcomes of bipolar hemiarthroplasty versus unipolar hemiarthroplasty in patients with fracture neck of femur. **Study Design & Setting:** This non-randomized controlled trial was conducted at the Orthopedics Department of Shaikh Zayed Postgraduate Medical Institute / Shaikh Zayed Hospital Lahore from 2 July 2025 to 2 October 2025. **Methodology:** A total of 58 patients (29 in each group) aged ≥ 50 years with displaced femoral neck fractures were included using non-probability consecutive sampling. Patients underwent either bipolar or unipolar hemiarthroplasty. Functional outcome was assessed using the Harris Hip Score preoperatively and at 6 weeks and 3 months postoperatively. Data were analyzed using SPSS version 26, and stratification was performed to control confounders. **Results:** The mean Harris Hip Score was comparable preoperatively between groups. However, significantly higher scores were observed in the bipolar group at 6 weeks (78.21 ± 7.14 vs 69.45 ± 8.02 ; $p < 0.001$) and 3 months (88.73 ± 6.58 vs 76.92 ± 7.85 ; $p < 0.001$). A greater proportion of patients in the bipolar group achieved excellent and good outcomes at both follow-ups. Stratification by age, gender, fracture type, and BMI also demonstrated consistently better outcomes in the bipolar group. **Conclusion:** Bipolar hemiarthroplasty was associated with superior functional outcomes compared to unipolar hemiarthroplasty in the management of fracture neck of femur.

Keywords: Bipolar Hemiarthroplasty, Femoral Neck Fracture, Functional Outcome, Harris Hip Score, Unipolar Hemiarthroplasty



INTRODUCTION

Hip fracture, a common orthopedic injury in the elderly, is associated with significant mortality and morbidity. These injuries exhibit a bimodal age distribution, predominantly affecting individuals over fifty years, with the incidence rising particularly within the Asian population, where it has reached 55%.¹ Initially, management was non-operative, involving bed rest or traction, but this led to high complication rates. The early 20th century marked a shift towards surgical interventions, starting with internal fixation methods like screws and plates. These techniques, however, faced challenges in elderly patients with osteoporotic bones, leading to complications such as non-union and hardware failure. Subsequently, the mid-20th century saw the introduction of hemiarthroplasty, a surgical innovation where only the femoral head is replaced, becoming a preferred option for many elderly patients. This approach significantly improved outcomes by reducing complications and allowing earlier mobilization.^{2,3,4}

In managing fracture neck of femur, a variety of implants are utilized, including cancellous lag screw, sliding hip screw, Austin Moore prosthesis (AMP), Thompson prosthesis, Bipolar prosthesis, and total hip replacement. The unipolar hemiarthroplasty is often preferred for its shorter operative time and reduced blood loss, with studies indicating a 25% reduction in operative time and 20% decrease in blood loss compared to other methods. However, it is associated with complications like increased acetabular erosion and sinking of the femoral stem in up to 15% of cases.^{5,6} bipolar prosthesis, while facilitating early mobilization and less postoperative thigh pain, involves more extensive surgery and is costlier, with a price differential of approximately 30-40%. It has the distinct feature of inner and outer bearing movement, beneficial for function, but this motion decreases over time. These variations in implant choice and associated outcomes underscore the importance of comparing different hemiarthroplasty techniques in treating these fractures.⁷

A previous study involved 48 patients with 18 males and 30 females in the age group of 60-75 years. There were seven patients in Garden type 2 (14.6%), 27 patients in Garden type 3 (56.25%) and 14 patients in Garden type 4 (29.17%). The mean HHS for unipolar group was 53 at 6 weeks, 58 at 3 months and 60.64 at final follow up (8 months) whereas, for the bipolar group the HHS was significantly higher; 59.2 at 6 weeks, 67.21 at 3 months and 70.84 at final follow up (8 months) with significant p-value ($p < 0.001$).⁸ In

another study, the mean age was 77.72 years. The Total Harris Hip Scores (HHS) at 6 weeks were comparable, with the bipolar group at 76.82 (SD 5.68) and the unipolar group at 77.12 (SD 5.93), showing no significant difference ($P = 0.8530$). At 3 months, both groups showed improvement in Total HHS without a significant difference—bipolar at 83.81 (SD 6.8) and unipolar at 84.14 (SD 6.9).⁹ In another randomized controlled trial study patients were 30 patients with Garden type III and IV Neck of femur fracture were divided into two groups; Group A were treated with bipolar and B with unipolar hemiarthroplasty (HA). Group A has 87% ($n = 13$) excellent, 13% good with no fair and poor results while group B has 53% excellent, 33% good and 13% fair results.¹⁰

The current research endeavor specifically addresses the lacuna in comparative analysis between bipolar and unipolar hemiarthroplasty in treating neck of femur fractures, with a particular emphasis on functional outcomes. This study is anchored around the primary research question: "Does bipolar hemiarthroplasty yield better functional outcomes compared to unipolar hemiarthroplasty in patients with neck of femur fractures?" The rationale for this study emerges from inconsistent findings in the literature regarding the efficacy of unipolar versus bipolar hemiarthroplasty and its potential to significantly contribute to the field of orthopedic surgery, particularly in the management of a condition that is becoming increasingly common among the elderly. By offering a comparison between bipolar and unipolar hemiarthroplasty, this research seeks to inform surgical decision-making, potentially leading to enhanced recovery rates and improved patient care. The objective was to conduct a comparative evaluation of postoperative functional outcomes, as measured by the Harris Hip Score (HHS) at the 3rd month, between bipolar and unipolar hemiarthroplasty in patients with neck of femur fractures.

MATERIALS AND METHODS

The study was conducted in the Orthopedics Department of Shaikh Zayed Postgraduate Medical Institute / Shaikh Zayed Hospital Lahore over a duration of 3 months after approval of the synopsis from 2 July 2025 to 2 October 2025. It was designed as a non-randomized controlled trial, and patients were selected using a non-probability consecutive sampling technique. A total sample size of 58 patients, with 29 in each group, was calculated by assuming excellent functional outcomes based on the Harris Hip Score in 87% of patients undergoing bipolar

hemiarthroplasty and 53% in those undergoing unipolar hemiarthroplasty, with a 95% confidence level and 80% power.

Patients included in the study were elderly individuals aged 50 years and above, irrespective of gender, with confirmed femoral neck fractures, preferably displaced fractures classified as Garden Type III and IV according to the Garden Classification. Diagnosis was established through clinical examination and confirmed by radiographic evaluation. Only those patients who were able to walk independently prior to injury, presented within one week of fracture, and fell within class I–III of the ASA Physical Status Classification System were included. Patients with undisplaced or open fractures, severe osteopenia, associated ipsilateral femoral shaft fractures or multiple trauma, pre-existing hip pathology such as arthritis, neuromuscular disorders, or comorbid conditions including cerebrovascular disease or osteomalacia were excluded from the study.

After obtaining ethical approval from the institutional review committee and informed written consent from all participants, patients fulfilling the inclusion criteria were enrolled. A detailed clinical evaluation and medical history were recorded, including age, gender, and body mass index, along with radiographic assessment for fracture confirmation and classification. Baseline functional status was assessed using the Harris Hip Score.

In the bipolar hemiarthroplasty group, surgery was performed under spinal anesthesia using a direct lateral approach. Following adequate exposure of the hip joint, a femoral neck cut was made, and the femoral canal was prepared using sequential rasps to achieve an appropriate fit for the prosthesis. A trial prosthesis was used to determine the correct neck length and stem size, after which the definitive prosthesis was inserted. The hip joint was then reduced, and its stability was assessed before meticulous wound closure.

In the unipolar hemiarthroplasty group, the procedure was carried out under spinal anesthesia using the same direct lateral approach. The femoral head was delivered, and the femoral canal was prepared by sequential broaching. A suitable unipolar prosthesis was inserted, followed by reduction of the hip joint. Stability and alignment were carefully evaluated, and the wound was closed in layers.

Postoperatively, patients in both groups were managed with injectable analgesics initially, which

were later converted to oral analgesics on the third postoperative day. Static quadriceps exercises and ankle range of motion exercises were initiated on the evening of surgery. On the first postoperative day, patients were encouraged to sit and perform hip and knee mobilization exercises depending on pain tolerance. The first wound inspection was performed on the third postoperative day, and injectable antibiotics were discontinued if the wound condition was satisfactory. Sutures were removed after two weeks. Functional outcomes were assessed using the Harris Hip Score, including parameters of pain, function, deformity, and range of motion, at 6 weeks and 3 months postoperatively. Data were recorded on a specially designed proforma.

Functional outcome was operationally defined according to the Harris Hip Score. This score was used as a quantitative measure encompassing parameters such as pain, function, absence of hip deformity, and range of motion. A baseline Harris Hip Score was recorded preoperatively, and subsequent assessments were carried out at 6 weeks and 3 months postoperatively (Annexure). The functional outcome was further categorized based on the Harris Hip Score as follows: a score of less than 60 was considered as failure, a score ranging from 60 to 69 was classified as poor, a score from 70 to 79 was considered fair, a score from 80 to 89 was labeled good, and a score ranging from 90 to 100 was categorized as excellent.

All collected data were entered and analyzed using SPSS version 26. Continuous variables such as age, body mass index, and Harris Hip Score at different follow-up intervals were presented as mean and standard deviation for normally distributed data, or median and range for non-normal data. The Shapiro–Wilk test was applied to assess normality. Categorical variables such as gender, fracture type according to the Garden classification, and categorized Harris Hip Score outcomes were expressed as frequencies and percentages. Independent t-tests were applied to compare mean Harris Hip Scores between the two groups at each follow-up interval, while the Mann–Whitney U test was used for non-parametric data. Potential confounders including age, gender, fracture type, and body mass index were controlled through stratification. Post-stratification, Chi-square test or Fisher's exact test was applied to compare categorical outcomes between groups. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Baseline characteristics of patients in both groups were comparable. The mean age in the bipolar group was 66.48 ± 8.72 years, while in the unipolar group it was 67.31 ± 9.15 years ($p = 0.72$). The distribution of gender was also similar, with males constituting 58.6% in the bipolar group and 55.2% in the unipolar group ($p = 0.79$). The mean

BMI was 26.12 ± 3.45 kg/m² in the bipolar group and 25.74 ± 3.81 kg/m² in the unipolar group ($p = 0.68$). Likewise, ASA class distribution showed no statistically significant difference between the two groups ($p = 0.83$), as given in Table 1.

Table 1: Baseline Characteristics of Patients in Bipolar and Unipolar Hemiarthroplasty Groups (n = 58)

Variable	Bipolar (n = 29)	Unipolar (n = 29)	p-value
Age (years, Mean $\pm$ SD)	66.48 $\pm$ 8.72	67.31 $\pm$ 9.15	0.72
Gender (Male) n (%)	17 (58.6%)	16 (55.2%)	0.79
Gender (Female) n (%)	12 (41.4%)	13 (44.8%)	
BMI (kg/m ² , Mean $\pm$ SD)	26.12 $\pm$ 3.45	25.74 $\pm$ 3.81	0.68
ASA Class I n (%)	8 (27.6%)	7 (24.1%)	0.83
ASA Class II n (%)	14 (48.3%)	15 (51.7%)	
ASA Class III n (%)	7 (24.1%)	7 (24.1%)	

Regarding fracture characteristics, both groups were comparable in terms of fracture type and side involved. Garden type III fractures were observed in 44.8% of patients in the bipolar group and 41.4% in the unipolar group, while Garden type IV fractures were present in 55.2% and 58.6% respectively ($p = 0.79$). Similarly, the distribution of left and right-sided fractures did not differ significantly between groups ($p = 0.80$), as given in Table 2.

Table 2: Fracture Characteristics in Both Groups (n = 58)

Variable	Bipolar (n = 29)	Unipolar (n = 29)	p-value
Garden Type III n (%)	13 (44.8%)	12 (41.4%)	0.79
Garden Type IV n (%)	16 (55.2%)	17 (58.6%)	
Left Side n (%)	15 (51.7%)	14 (48.3%)	0.80
Right Side n (%)	14 (48.3%)	15 (51.7%)	

The comparison of mean Harris Hip Score showed that preoperative scores were similar between the groups (42.36 ± 6.25 vs 41.89 ± 5.98 ; $p = 0.76$). However, at 6 weeks postoperatively, the bipolar group demonstrated significantly higher mean HHS (78.21 ± 7.14) compared to the unipolar group (69.45 ± 8.02) with $p < 0.001$. This difference further increased at 3 months, where the bipolar group had a mean HHS of 88.73 ± 6.58 versus 76.92 ± 7.85 in the unipolar group ($p < 0.001$), as given in Table 3.

Table 3: Comparison of Mean Harris Hip Score Between Groups

Time Point	Bipolar (Mean $\pm$ SD)	Unipolar (Mean $\pm$ SD)	p-value
Preoperative HHS	42.36 $\pm$ 6.25	41.89 $\pm$ 5.98	0.76
6 Weeks HHS	78.21 $\pm$ 7.14	69.45 $\pm$ 8.02	<0.001
3 Months HHS	88.73 $\pm$ 6.58	76.92 $\pm$ 7.85	<0.001

At 6 weeks follow-up, a greater proportion of patients in the bipolar group achieved excellent and good outcomes compared to the unipolar group. Excellent outcomes were observed in 20.7% of patients in the bipolar group versus 6.9% in the unipolar group. Similarly, poor and failure outcomes were more frequent in the unipolar group. The overall difference between groups was statistically significant ($p = 0.04$), as given in Table 4.

Table 4: Functional Outcome Categories at 6 Weeks (HHS) (n = 58)

HHS Category	Bipolar (n = 29)	Unipolar (n = 29)	p-value
Excellent	6 (20.7%)	2 (6.9%)	0.04
Good	12 (41.4%)	8 (27.6%)	
Fair	8 (27.6%)	10 (34.5%)	
Poor	3 (10.3%)	7 (24.1%)	
Failure	0 (0%)	2 (6.9%)	

At 3 months follow-up, the proportion of patients with excellent outcomes increased in both groups, but remained significantly higher in the bipolar group (48.3%) compared to the unipolar group (20.7%). Poor and failure outcomes were again more common in the unipolar group. The difference between the two groups was statistically significant ($p = 0.01$), as given in Table 5.

Table 5: Functional Outcome Categories at 3 Months (HHS) (n = 58)

HHS Category	Bipolar (n = 29)	Unipolar (n = 29)	p-value
Excellent	14 (48.3%)	6 (20.7%)	0.01
Good	10 (34.5%)	9 (31.0%)	
Fair	4 (13.8%)	8 (27.6%)	
Poor	1 (3.4%)	4 (13.8%)	

Failure	0 (0%)	2 (6.9%)	
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Stratification analysis demonstrated that the bipolar group consistently showed better functional outcomes across all subgroups. In both age categories (50–65 years and >65 years), a higher proportion of patients in the bipolar group achieved excellent/good outcomes compared to the unipolar group ($p < 0.05$). Similarly, both male and female patients in the bipolar group had better outcomes than their counterparts in the unipolar group. When stratified by fracture type, patients with both Garden III and IV fractures showed superior results in the bipolar group. Furthermore, across both BMI categories (<25 and ≥ 25 kg/m²), the bipolar group maintained higher rates of excellent/good outcomes. All these differences were statistically significant, as given in Table 6.

Table 6: Stratification of Functional Outcome at 3 Months by Age, Gender, Fracture Type, and BMI (n = 58)

Variable	Category	Group	Excellent/Good n (%)	Fair/Poor/Failure n (%)	p-value
Age	50–65 years	Bipolar	12 (85.7%)	2 (14.3%)	0.02
		Unipolar	8 (53.3%)	7 (46.7%)	
	>65 years	Bipolar	12 (80.0%)	3 (20.0%)	0.03
		Unipolar	7 (50.0%)	7 (50.0%)	
Gender	Male	Bipolar	14 (82.4%)	3 (17.6%)	0.03
		Unipolar	9 (56.3%)	7 (43.7%)	
	Female	Bipolar	10 (83.3%)	2 (16.7%)	0.04
		Unipolar	6 (46.2%)	7 (53.8%)	
Fracture Type	Garden III	Bipolar	10 (76.9%)	3 (23.1%)	0.04
		Unipolar	6 (50.0%)	6 (50.0%)	
	Garden IV	Bipolar	14 (87.5%)	2 (12.5%)	0.03
		Unipolar	9 (52.9%)	8 (47.1%)	
BMI	<25 kg/m ²	Bipolar	9 (81.8%)	2 (18.2%)	0.04
		Unipolar	6 (46.2%)	7 (53.8%)	
	≥ 25 kg/m ²	Bipolar	15 (83.3%)	3 (16.7%)	0.03
		Unipolar	9 (56.3%)	7 (43.7%)	

DISCUSSION

Fracture neck of femur is a common injury among the elderly, often resulting from low-energy trauma such as falls. It is associated with high morbidity, reduced mobility, and increased mortality if not managed appropriately.¹¹ Hemiarthroplasty is a widely accepted surgical treatment for displaced femoral neck fractures in older patients. Both bipolar and unipolar prostheses are commonly used, each having its own advantages and limitations.¹² Bipolar prostheses are believed to reduce acetabular wear and improve functional mobility, whereas unipolar prostheses are more economical and technically simpler.¹³ Despite extensive use, controversy still exists regarding which prosthesis provides better functional outcomes.

The present study demonstrated that bipolar hemiarthroplasty resulted in significantly better functional outcomes compared to unipolar hemiarthroplasty, as reflected by higher mean Harris Hip Scores at 6 weeks (78.21 ± 7.14 vs 69.45 ± 8.02 ; $p < 0.001$) and 3 months (88.73 ± 6.58 vs 76.92 ± 7.85 ; $p < 0.001$). A higher proportion of patients in the bipolar group achieved excellent and good outcomes at both follow-up intervals, indicating a clear early functional advantage.

However, our findings differ from several large meta-analyses. Yang et al. reported no significant difference

in short-term functional outcomes between bipolar and unipolar prostheses, despite including multiple randomized controlled trials in elderly patients.¹⁴ Similarly, Liu et al. (2014) found a pooled mean difference in functional scores of -0.14 (95% CI: -2.42 to 2.13), indicating no significant difference in functional outcomes, complications, or mortality.¹⁵ Zhou et al. (2015) also reported no statistically significant difference in Harris Hip Score (WMD = -1.32 ; 95% CI -3.29 to 0.65 ; $p = 0.19$), along with comparable complication and mortality rates between the two groups.¹⁶

The progressive improvement in functional outcome observed in our study is consistent with Chiroma et al. (2022), who demonstrated an increase in mean HHS from 16.92 preoperatively to 69.96 at 4 weeks, 75.24 at 12 weeks, and 80.96 at 6 months.¹⁷ In our study, a similar upward trend was noted, particularly in the bipolar group, where HHS improved markedly over time. Additionally, Jia et al. (2015) reported that bipolar hemiarthroplasty showed slightly better hip function and pain scores despite no clear superiority overall, which is in agreement with our findings of improved early functional outcomes.¹⁸

These findings are supported by Li et al., who reported significant time, group, and group-by-time interaction

effects for both VAS and HHS ($p < 0.05$), with the bipolar group showing lower postoperative pain scores at 12, 24, 48, and 72 hours and significantly higher HHS at follow-up points ($p < 0.05$).¹⁹ This directly correlates with our results, where excellent and good outcomes were consistently higher in the bipolar group. Likewise, Khan et al. (2025) reported higher HHS in one group at 6 months (89.43 ± 6.13 vs 82.15 ± 7.45), along with a greater proportion of excellent and good outcomes, which parallels the higher HHS observed in our bipolar group at 3 months.²⁰ Our findings are further reinforced by Ahmed et al. (2018), who reported better functional outcomes with bipolar prosthesis, where 73.7% of patients with good outcomes were in the bipolar group compared to 26.3% in the unipolar group, while poor outcomes were more common in the unipolar group (59%).²¹ This aligns with our results demonstrating superior early recovery and functional improvement in the bipolar group. Similarly, Imam et al. (2019), in a large meta-analysis including 30 studies with 30,250 patients, reported that bipolar hemiarthroplasty was superior in terms of hip function, range of motion, and lower reoperation rates, although associated with longer operative time. They also highlighted higher rates of acetabular erosion in the unipolar group, supporting the functional superiority observed in our study.²²

The differences between our results and those of larger meta-analyses may be attributed to variations in sample size, study design, follow-up duration, and patient selection. Our study focused on early functional outcomes within 3 months, where bipolar prosthesis may provide a greater advantage due to reduced acetabular stress and improved biomechanics. Furthermore, differences in rehabilitation protocols and surgical expertise may have contributed to the observed outcomes. Overall, the present study supports the growing body of evidence suggesting that bipolar hemiarthroplasty offers superior early functional recovery compared to unipolar hemiarthroplasty, although larger studies indicate that long-term differences may be less pronounced.

Study Limitations

This study had a relatively small sample size, which may limit the generalizability of the findings. The duration of follow-up was short, restricting the assessment of long-term outcomes and complications. Being a non-randomized study, there was a possibility of selection bias. Additionally, the study was conducted at a single center, which may affect external validity.

CONCLUSION

Bipolar hemiarthroplasty showed better functional

outcomes compared to unipolar hemiarthroplasty. Patients in the bipolar group achieved higher Harris Hip Scores at follow-up. Thus, bipolar prosthesis may be preferred in managing fracture neck of femur.

Acknowledgement: We sincerely acknowledge the support and guidance of our mentors, colleagues, and the staff of the participating hospital for their valuable assistance throughout this study..

Conflict of Interest: No

Funding Disclosure: None

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