



FUNCTIONAL RECOVERY FOLLOWING CEMENTED BIPOLAR HEMIARTHROPLASTY IN GERIATRIC FEMORAL NECK FRACTURES: A PROSPECTIVE ANALYSIS

Orthopaedics

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ABSTRACT

Background: Fracture neck of femur is a common and debilitating injury in the elderly, often resulting from low-energy falls in osteoporotic bone. Displaced intracapsular fractures pose treatment challenges due to compromised blood supply and high rates of non-union and avascular necrosis. Cemented bipolar hemiarthroplasty offers immediate stability and early mobilization. This study evaluates clinical and functional outcomes of cemented bipolar hemiarthroplasty in elderly patients with femoral neck fractures. **Methods:** A prospective observational study was conducted on 65 elderly patients (aged ≥ 60 years) with displaced femoral neck fractures treated with cemented bipolar hemiarthroplasty. Patients were followed up at 4, 8, 12, and 24 weeks postoperatively. Outcomes were assessed using the Modified Harris Hip Score (MHHS), pain scores, weight-bearing status, and radiological evaluation. Statistical analysis was performed using paired t-test and chi-square test. **Results:** Mean age was 72.4 ± 7.2 years; 56.9% were female. Trivial falls accounted for 86.2% of injuries. Mean MHHS improved significantly from 66.54 ± 2.62 at 4 weeks to 85.78 ± 8.81 at 24 weeks ($p < 0.001$). Pain scores decreased from 41.29 ± 1.89 to 26.23 ± 2.68 ($p < 0.001$). By 12 weeks, 95.4% achieved full weight-bearing. Postoperative complications occurred in 20% (limb length discrepancy 9.2%, superficial infection 7.7%, dislocation 3.1%). No significant association was found between radiological outcome and functional outcome ($p = 0.372$). **Conclusion:** Cemented bipolar hemiarthroplasty provides reliable pain relief, early mobilization, and satisfactory functional outcomes with a low complication profile in elderly patients with displaced femoral neck fractures.

KEYWORDS

Femoral neck fracture, cemented bipolar hemiarthroplasty, elderly, Harris Hip Score, functional outcome.

INTRODUCTION

Fracture neck of femur is one of the most common and devastating injuries affecting the elderly population, representing a major public health concern worldwide. With increasing life expectancy, the incidence of hip fractures has risen substantially, particularly in individuals above 60 years of age. These fractures typically result from low-energy trauma, such as trivial falls, occurring against a background of osteoporosis, sarcopenia, and impaired balance. The consequences extend beyond the skeletal injury, often leading to significant morbidity, loss of independence, reduced quality of life, and increased mortality. Nearly half of affected elderly patients fail to regain their pre-injury level of mobility, and a considerable proportion require long-term institutional care [1].

The anatomical location and precarious blood supply of the femoral neck make these fractures particularly challenging to manage. The intracapsular nature compromises the retinacular blood supply to the femoral head, predisposing to avascular necrosis and non-union, especially in displaced fractures. While internal fixation remains viable in younger patients with good bone quality, its success in the elderly is limited due to osteoporotic bone, higher fixation failure rates, and prolonged immobilization requirements [2].

Hemiarthroplasty has emerged as the preferred surgical option for elderly patients with displaced femoral neck fractures, enabling early mobilization, rapid pain relief, and predictable functional outcomes. Bipolar prostheses were developed to address limitations of unipolar implants by reducing acetabular cartilage wear and improving hip biomechanics through dual articulation [3]. The bipolar design incorporates two articulating surfaces, theoretically decreasing acetabular erosion and enhancing range of motion.

Cemented fixation offers distinct advantages in elderly patients with osteoporotic bone, providing immediate implant stability, better load distribution, and reduced risk of periprosthetic fractures. Cemented stems have been associated with improved postoperative pain control, enhanced mobility, and superior functional outcomes compared to uncemented stems in this population [4,5]. Cemented bipolar hemiarthroplasty thus combines the biomechanical advantages of bipolar articulation with the stability of cemented fixation.

This study aims to evaluate the clinical and functional outcomes of cemented bipolar hemiarthroplasty in elderly patients with fracture neck of femur treated at a tertiary care center in Tumkur, India, contributing region-specific data on the effectiveness of this procedure.

MATERIALS AND METHODS:

Study Design and Setting

This prospective observational study was conducted in the Department of Orthopaedics at Sri Siddhartha Medical College and Hospital, Tumkur, a tertiary care teaching hospital. The study was approved by the Institutional Ethics Committee (Ref No: SSMC/MED/IEC-028/Feb-2024). Written informed consent was obtained from all participants.

Study Duration

Patient enrollment occurred between February 2024 and August 2025. Postoperative follow-up assessments were conducted at 4 weeks, 8 weeks, 12 weeks, and 24 weeks after surgery.

Participants

Inclusion Criteria:

- Age ≥ 60 years
- Diagnosed with fracture neck of femur
- Willing to undergo cemented bipolar hemiarthroplasty
- Provided informed consent

Exclusion Criteria:

- Ipsilateral fractures or associated hip fractures
- Pre-existing arthritis of the hip
- Head injury, hemiplegia, or hemiparesis
- Polytrauma
- Unwilling to undergo surgical intervention

Sample Size

Sample size was calculated using the formula: $n = Z^2(1-\alpha/2) \times p(1-p)/d^2$, where proportion of excellent outcome (p) = 42.5%, absolute precision (d) = 10%, and Z value for 90% confidence interval = 1.64. The minimum required sample size was 65 participants.

Surgical Technique

All patients underwent cemented bipolar hemiarthroplasty under spinal or general anesthesia. The posterior (Moore's) approach was used. After dislocation and femoral head resection, the femoral canal was prepared sequentially. A distal cement restrictor was placed, and polymethylmethacrylate (PMMA) bone cement was introduced retrograde with pressurization. The definitive femoral stem was inserted in correct alignment (10-15° anteversion). After cement polymerization, the bipolar head was assembled and reduced. Stability, limb length, and range of motion were assessed before layered closure.

Postoperative Management

Intravenous antibiotics were continued for 48-72 hours. Deep vein thrombosis prophylaxis was initiated. Early mobilization with weight-bearing as tolerated was encouraged, with physiotherapy starting on the first postoperative day.

Outcome Assessment

Clinical and functional outcomes were assessed using:

- Modified Harris Hip Score (MHHS): Evaluated at 4, 8, 12, and 24 weeks postoperatively. Scores >90 = excellent, 80-89 = good, 70-79 = fair, <70 = poor.
- Pain Score: Assessed using the pain component of MHHS at each follow-up.
- Weight-bearing Status: Recorded as full, partial, or assisted ambulation.
- Radiological Evaluation: X-ray pelvis with both hips assessed implant position, stability, loosening, and subsidence.
- Complications: Intraoperative and postoperative complications were documented.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using Epi Info software. Quantitative variables were expressed as mean $\pm$ standard deviation, and qualitative variables as frequencies and percentages. Paired sample t-test was used to compare pre- and post-intervention outcomes. Chi-square test was used for association between categorical variables. Pearson correlation analyzed relationships between continuous variables. A p-value < 0.05 was considered statistically significant.

RESULTS

Demographic Characteristics

A total of 65 elderly patients with displaced femoral neck fractures were included. The mean age was 72.4 ± 7.2 years. The largest age group was 70-79 years (43.1%), followed by 60-69 years (36.9%), while 20.0% were aged ≥ 80 years. Female patients constituted 56.9% (n=37) and males 43.1% (n=28). Right-sided fractures were slightly more common (52.3%) than left-sided (47.7%).

Mode of Injury and Surgical Parameters

Trivial falls accounted for 86.2% of injuries, while road traffic accidents contributed to 13.8%. Surgery was performed within 7 days of injury in 78.5% of patients. Spinal anesthesia was used in 84.6% of cases. The mean duration of surgery was 79.9 ± 6.5 minutes, with no significant difference between functional outcome groups (p = 0.979).

Complications

Intraoperative complications occurred in only one patient (1.5%)—a greater trochanter fracture. Postoperative complications were observed in 20% of patients: limb length discrepancy (9.2%), superficial infection (7.7%), and dislocation (3.1%). No cases of deep infection, periprosthetic fracture, or thromboembolic events were reported.

Weight-Bearing Status

By 12 weeks postoperatively, 95.4% of patients achieved full weight-bearing, while 4.6% required assisted ambulation. There was no significant association between weight-bearing status at 4 and 12 weeks (p = 0.219). However, postoperative complications significantly delayed full weight-bearing (p = 0.039).

Pain Outcomes

Mean pain scores progressively decreased from 41.29 ± 1.89 at 4 weeks to 26.23 ± 2.68 at 24 weeks, a statistically significant reduction (p < 0.001). A weak positive correlation was observed between duration of surgery and pain score at 24 weeks (r = 0.259, p = 0.037).

Functional Outcomes

The mean Modified Harris Hip Score improved significantly from 66.54 ± 2.62 at 4 weeks to 85.78 ± 8.81 at 24 weeks (p < 0.001). At final follow-up, 83.1% of patients achieved excellent or good functional outcomes (excellent: 40.0%, good: 43.1%, fair: 10.8%, poor: 6.2%).

Radiological Outcomes

Radiological evaluation at 24 weeks showed stable prosthesis positioning in 93.8% of patients. Loosening and subsidence were each observed in 3.1% of cases. No significant association was found between radiological outcome and final functional outcome (p = 0.372).

Table 1: Demographic and Clinical Characteristics

Characteristic	Category	Frequency (n)	Percentage (%)
Age group (years)	60–69	24	36.9
	70–79	28	43.1
	≥ 80	13	20.0
Gender	Female	37	56.9
	Male	28	43.1
Side of fracture	Right	34	52.3
	Left	31	47.7
Mode of injury	Trivial fall	56	86.2
	RTA	9	13.8
Time to surgery	<7 days	51	78.5
	>7 days	14	21.5
Anaesthesia	Spinal	55	84.6
	General	10	15.4

Table 2: Functional Outcomes - Modified Harris Hip Score

Follow-up Period	Mean MHHS $\pm$ SD	Improvement from Previous
4 weeks	66.54 ± 2.62	–
8 weeks	75.98 ± 2.48	+9.44
12 weeks	83.51 ± 2.48	+7.53
24 weeks	85.78 ± 8.81	+2.27

Paired t-test: 4 weeks vs 24 weeks, t = -16.41, df = 64, p < 0.001

Table 3: Pain Score Trend

Follow-up Period	Mean Pain Score $\pm$ SD
4 weeks	41.29 ± 1.89
8 weeks	37.35 ± 1.62
12 weeks	33.03 ± 2.00
24 weeks	26.23 ± 2.68

Paired t-test: 4 weeks vs 24 weeks, t = 39.09, df = 64, p < 0.001

Table 4: Postoperative Complications

Complication	Frequency (n)	Percentage (%)
None	52	80.0
Limb length discrepancy	6	9.2
Superficial infection	5	7.7
Dislocation	2	3.1

Table 5: Final Functional Outcome Distribution

Outcome Category	Frequency (n)	Percentage (%)
Excellent (>90)	26	40.0
Good (80–89)	28	43.1
Fair (70–79)	7	10.8
Poor (<70)	4	6.2

DISCUSSION

This prospective study evaluated the clinical and functional outcomes of cemented bipolar hemiarthroplasty in 65 elderly patients with displaced femoral neck fractures. Our findings demonstrate that this procedure provides significant pain relief, early functional recovery, and acceptable complication rates.

Demographic Profile: The predominance of patients in the 70-79 years age group (43.1%) and female preponderance (56.9%) aligns with the known epidemiology of femoral neck fractures, reflecting the impact of postmenopausal osteoporosis and age-related bone fragility. Similar demographic patterns were reported by Rahim et al. (2025) with mean age 67.93 years and female predominance (70%) [6], and Kumar et al. (2025) with mean age 75 years [7].

Mode of Injury: Trivial falls accounted for 86.2% of injuries, emphasizing the fragility nature of these fractures in elderly

osteoporotic bone. This finding is consistent with Kumar et al. (2025) who reported 75% of fractures following minor trauma [7], reinforcing the importance of fall prevention strategies.

Complication Profile: The low intraoperative complication rate (1.5%) and absence of major complications such as deep infection, periprosthetic fracture, or thromboembolic events support the procedural safety of cemented bipolar hemiarthroplasty. Our findings align with Fu et al. (2023), who reported significantly lower rates of intraoperative and periprosthetic fractures with cemented compared to uncemented techniques [8].

Functional Recovery: The significant improvement in MHHS from 66.54 at 4 weeks to 85.78 at 24 weeks ($p < 0.001$) demonstrates progressive functional recovery. Our results compare favorably with Shashidhara et al. (2024), who reported mean MHHS of 85.4 at one year with 79% achieving excellent/good outcomes [9], and Ramasamy et al. (2022), who reported 85% excellent/good outcomes [10].

Pain Relief: The progressive and statistically significant reduction in pain scores ($p < 0.001$) confirms the effectiveness of cemented bipolar hemiarthroplasty in providing sustained postoperative analgesia. Yurdakul et al. (2015) similarly reported superior pain scores with cemented hemiarthroplasty during early follow-up [11].

Weight-Bearing: Achievement of full weight-bearing by 95.4% of patients at 12 weeks highlights the procedure's role in facilitating early mobilization. The significant association between postoperative complications and delayed weight-bearing ($p = 0.039$) underscores the importance of meticulous perioperative care.

Radiological Outcomes: The absence of significant association between radiological findings and functional outcomes ($p = 0.372$) suggests that early clinical recovery may not be compromised by minor radiographic changes, consistent with Ramasamy et al. (2022) [10].

Comparison with Literature: Our findings are consistent with Kanto et al. (2014), who reported comparable functional outcomes between unipolar and bipolar hemiarthroplasty with low revision rates [12]. Khan et al. (2021) reported similar functional improvement with bipolar hemiarthroplasty [13], while Yoo et al. (2019) demonstrated favorable outcomes with cemented fixation [14].

LIMITATIONS

This study has certain limitations, including a relatively small sample size ($n=65$) and a short follow-up period of 24 weeks, which restrict the assessment of long-term outcomes and implant survival. Its single-center design may limit generalizability, and the absence of a comparison group (such as uncemented or total hip arthroplasty) prevents comparative analysis. Additionally, potential selection bias due to institutional protocols and reliance mainly on MHHS may not fully reflect patient-reported quality of life.

CONCLUSIONS

Cemented bipolar hemiarthroplasty is a reliable and effective treatment modality for displaced fracture neck of femur in elderly patients. The procedure provides predictable pain relief, facilitates early mobilization, and results in satisfactory clinical and functional outcomes with a low complication profile. The significant improvement in Modified Harris Hip Scores, progressive pain reduction, and high rate of full weight-bearing at 12 weeks demonstrate the effectiveness of this procedure in restoring hip function and facilitating early return to mobility. Given these favorable outcomes, cemented bipolar hemiarthroplasty can be recommended as a preferred treatment option for elderly patients with displaced femoral neck fractures. Further multicentric studies with larger sample sizes and longer follow-up are recommended to evaluate long-term outcomes and prosthesis survivorship.

ABBREVIATIONS

Abbreviation	Full Form
MHHS	Modified Harris Hip Score
FNF	Femoral Neck Fracture
BHA	Bipolar Hemiarthroplasty
CBH	Cemented Bipolar Hemiarthroplasty
PMMA	Polymethyl Methacrylate

THA	Total Hip Arthroplasty
BCIS	Bone Cement Implantation Syndrome
RTA	Road Traffic Accident

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