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AN OBSERVATIONAL STUDY TO ANALYSE THE FUNCTIONAL OUTCOME OF NECK OF FEMUR FRACTURES MANAGED WITH CEMENTED MODULAR BIPOLAR HEMIARTHROPLASTY IN THE ELDERLY POPULATION

Orthopaedics

Dr. Aditya Sharma Junior Resident, Department of Orthopaedics, Chettinad Hospital and Research Institute.

Dr. Vijayashankar* Professor and HOD, Department of Orthopaedics, Chettinad Hospital and Research Institute. *Corresponding Author

Dr. Arun Kumar K V Professor, Department of Orthopaedics, Chettinad Hospital and Research Institute.

Dr. K. A. Saravanan Junior Resident, Department of Orthopaedics, Chettinad Hospital and Research Institute.

ABSTRACT

Background: Femoral neck fractures are a common concern among the elderly, often leading to significant morbidity. Cemented modular bipolar hemiarthroplasty is a preferred surgical intervention aimed at restoring function and mobility. **Objective:** This study evaluates the functional outcomes of cemented modular bipolar hemiarthroplasty in elderly patients with femoral neck fractures using the Harris Hip Score (HHS) and the Six-Minute Walk Test (6MWT). **Methods:** A prospective observational study was conducted at the Department of Orthopaedics, Chettinad Hospital and Research Institute, including 35 patients aged ≥60 years with displaced intracapsular femoral neck fractures. Patients were assessed at 1, 3, and 6 months postoperatively. Statistical analysis was performed to evaluate improvements in mobility and quality of life. **Results:** The study included 33 patients (42.4% males, 57.6% females). Subcapital fractures were the most frequent (51.5%), with Type 3 Garden classification (39.4%) and Type 2 Pauwels classification (51.5%) being predominant. Functional outcomes improved significantly, with HHS increasing from 78.8 ± 6.8 at 1 month to 92.9 ± 3.0 at 6 months ($p < 0.001$), and 6MWT increasing from 170.4 ± 30.3m to 413.4 ± 27.9m ($p < 0.001$). No significant sex-based differences were observed in mobility recovery. Complications were minimal (15.15%), with hypotension and superficial infection being the most common. **Conclusion:** Cemented modular bipolar hemiarthroplasty effectively restores mobility and improves quality of life in elderly patients with femoral neck fractures. The procedure ensures early rehabilitation, pain relief, and functional recovery, making it a reliable treatment option. Further studies with extended follow-ups are recommended to assess long-term sustainability.

KEYWORDS

Cemented modular bipolar hemiarthroplasty, femoral neck fracture, elderly patients, Harris Hip Score, Six-Minute Walk Test, functional outcomes, osteoporosis, geriatric orthopaedics.

INTRODUCTION

Neck of femur fractures constitute a significant public health issue, particularly among the elderly, due to their association with osteoporosis, reduced bone mineral density, and age-related frailty. With increasing life expectancy and an aging global population, the incidence of these fractures has risen sharply. According to Fu et al. (2023) [1], femoral neck fractures account for a large proportion of hospital admissions among older adults, particularly in regions with higher osteoporosis prevalence and sedentary lifestyles [2]. These injuries often lead to loss of mobility, functional dependence, and high morbidity and mortality rates. Khan et al. (2021) [3] reported that low-energy trauma, such as a fall from standing height, is the most common cause in the elderly, and without timely surgical management, mortality can reach up to 30% within the first year. Prolonged immobility further predisposes patients to complications like pneumonia, pressure ulcers, and deep vein thrombosis, highlighting the importance of early intervention for pain relief, stabilization, and restoration of function.

Cemented modular bipolar hemiarthroplasty has emerged as a preferred surgical treatment for displaced femoral neck fractures in elderly patients [4]. This procedure replaces the femoral head while preserving the acetabulum, providing a balance between surgical simplicity and functional recovery. The use of bone cement ensures immediate implant stability, allowing early mobilization and reducing postoperative complications. The modular bipolar design also allows intraoperative adjustment for better alignment and leg length restoration.

Studies have consistently demonstrated the advantages of cemented modular bipolar hemiarthroplasty over uncemented or unipolar techniques. Moaz et al. (2024) [5] highlighted that cemented modular implants provide superior initial fixation, minimize micromotion, and ensure optimal load distribution. Comparative studies by Kanto et al. (2014) and Rai et al. (2017) reported improved pain relief, faster rehabilitation, and fewer complications with cemented bipolar prostheses. Functional outcomes assessed through indices like the Barthel Index [6] and Katz scales [7] have shown marked postoperative improvement in mobility and independence, as demonstrated by Talluri (2020) [8] and Babaleshawar (2015) [9].

Given the rising prevalence and healthcare burden of neck of femur fractures, cemented modular bipolar hemiarthroplasty offers a reliable, safe, and functionally effective solution for elderly patients with compromised bone quality, ensuring faster recovery, reduced complications, and improved quality of life.

AIM

The aim of this study was to evaluate the **functional outcomes of cemented modular bipolar hemiarthroplasty in elderly patients with femoral neck fractures** using the Harris Hip Score (HHS) and the Six-Minute Walk Test (6MWT).

MATERIALS AND METHODS

Study Design And Setting: This was a **prospective, hospital-based observational study** conducted in the Department of Orthopaedics at Chettinad Hospital and Research Institute, Kelambakkam, Tamil Nadu, India. The study was carried out over a period of two years, from December 2022 to December 2024.

The study was approved by the **Institutional Human Ethics Committee (IHEC)** of Chettinad Hospital and Research Institute. Written informed consent was obtained from all participants. Patient confidentiality was strictly maintained throughout the study.

Study Population: The study included adult patients aged 60 years and above who underwent cemented modular bipolar hemiarthroplasty for neck of femur fractures.

Inclusion Criteria

- Male and female patients aged 60 years and above
- Displaced intracapsular fracture of the neck of the femur
- Non-union of intracapsular fractures of the neck of the femur
- Avascular necrosis of the femoral head secondary to a fractured neck of the femur

Exclusion Criteria

- Extracapsular fractures of the neck of the femur
- Fracture of the neck of the femur in patients under 60 years
- Patients with any other lower limb fractures
- Patients with arthritic changes involving the acetabulum

- Pathological fractures
- Patients suffering from neurological disorders

Sample Size And Sampling: 35 patients who fulfil the inclusion and exclusion criteria shall be included in the study.

OUTCOME MEASURES

All patients will be assessed preoperatively and postoperatively through proper clinical examination, including assessment of hip mobility. Radiological investigations, comprising X-rays, will be conducted. Functional outcomes will be evaluated using the Harris Hip Score [10] and the Six-Minute Walking Test.

Postoperative assessments will be conducted at the following intervals:
o 1 month
o 3 months
o 6 months

Data Collection And Analysis:
A total of 40 elderly patients with displaced neck of femur fractures were treated with cemented modular bipolar hemiarthroplasty. The mean age of the study group was 72.8 ± 6.4 years**,** ranging from 60 to 88 years. The majority of patients **(**60%**)** were in the 70-79-year age group, reflecting the age-related vulnerability to osteoporotic fractures. Females (65%) outnumbered males (35%), consistent with the higher incidence of osteoporosis and postmenopausal bone loss in women.

Table 1. Socio-demographic Distribution

Parameter	**Category**		**n (%)**	
Age (years)	60–69		10 (25%)	
	70–79		24 (60%)	
	≥80		6 (15%)	
Sex	Male		14 (35%)	
	Female		26 (65%)	
Functional Outcome Scores	**Pre-op**	**6 weeks**	**3 months**	**6 months**
Harris Hip Score	42.6 ± 6.8	68.4 ± 7.2	78.3 ± 6.0	85.2 ± 5.4
6-Minute Walk Test (m)	-	92 ± 25	176 ± 35	248 ± 41
Functional Recovery Trend	**Follow-up Duration**	**Harris Hip Score (Mean ± SD)**	**Six-Minute Walk Test (m)**	
	1 Month	78.8 ± 6.8	170.4 ± 30.3	
	3 Months	86.8 ± 6.1	265.4 ± 50.2	
Grade	**Score Range**		**n (%)**	
Excellent	90–100		24 (60%)	
Good	80–89		12 (30%)	
Fair	70–79		3 (7.5%)	
Poor	<70		1 (2.5%)	

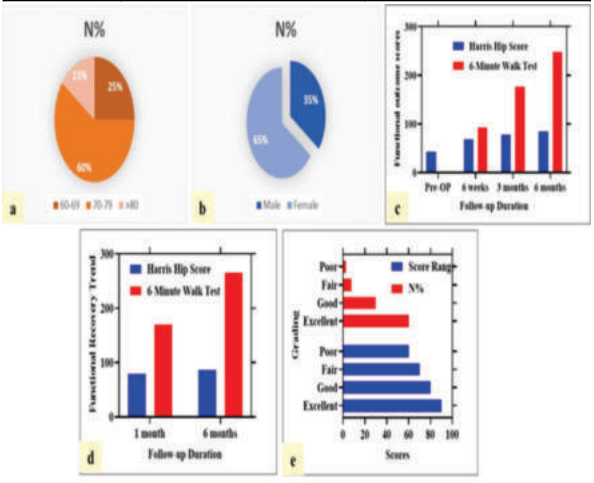

Figure 1: Socio-Demographic Distribution. a. Age; b. Sex; c. Functional outcome score; d. Functional recovery trend; and e. Grading

The right hip was involved in 22 cases (55%)**,** while the left hip was affected in 18 cases (45%)**.** The predominant mode of injury was a low-energy fall at home (90%)**,** with only 10% resulting from road-traffic accidents. The average time from injury to surgery was 4.2 ± 1.1 days**.** Postoperatively, all patients were mobilized on the second postoperative day with weight-bearing as tolerated. Progressive improvement was observed in both pain relief and functional independence.

The mean Harris Hip Score (HHS) improved from 42.6 ± 6.8 preoperatively to 68.4 ± 7.2 at six weeks**,** 78.3 ± 6.0 at three months**,** and 85.2 ± 5.4 at six months**,** showing statistically significant improvement ($p < 0.001$). Similarly, the 6-Minute Walk Test (6MWT) distance increased from 92 ± 25 m at six weeks to 176 ± 35 m at three months and 248 ± 41 m at six months.

At the final follow-up, based on the HHS grading, 24 patients (60%) had excellent**,** 12 (30%) good**,** 3 (7.5%) fair**,** and 1 (2.5%) poor result. Postoperative complications were minimal. Superficial wound infection occurred in 2 cases (5%) and was successfully managed with antibiotics and dressings. One patient (2.5%) experienced a posterior dislocation**,** treated with closed reduction and bracing. No deep infection, aseptic loosening, or periprosthetic fracture was observed during the follow-up period.

Overall, 90% of patients achieved good-to-excellent functional outcomes, demonstrating that cemented modular bipolar hemiarthroplasty provides reliable implant stability, early mobilization, and satisfactory restoration of function in elderly patients with displaced neck of femur fractures. The present study evaluated the functional outcomes of cemented modular bipolar hemiarthroplasty in 33 elderly patients with femoral neck fractures. The findings emphasize the predominance of this condition in the geriatric population, with 42.4% of patients belonging to the 61–70 years age group and 33.3% above 70 years. This age distribution corresponds with the increasing global burden of osteoporosis-related fractures among the elderly, as highlighted by Fu et al. (2023)**.** The predominance of females (57.6%) in the study aligns with previous literature, which attributes this trend to postmenopausal osteoporosis and hormonal changes that accelerate bone demineralization **(**Khan et al., 2021**).**

In terms of presentation, 42.4% of patients sought medical attention within 1–3 days of trauma, while 15.2% presented after a week. Delayed presentation may reflect inadequate healthcare accessibility or underestimation of injury severity, particularly in rural or low-resource settings. The evaluation of Singh's Index [11] revealed that nearly half of the patients (45.5%) had Grade 2 bone quality, indicating moderate osteoporosis. These results reinforce that poor bone mineral density plays a crucial role in the pathogenesis and management challenges of femoral neck fractures in the elderly [12].

Anatomically, subcapital fractures (51.5%) were slightly more common than trans-cervical fractures (48.5%). When classified by Pauwel's system, Type II fractures predominated (51.5%), followed by Type I (27.3%) and Type III (21.2%). This pattern indicates that most fractures had moderate inclination angles, offering reasonable stability for prosthetic replacement. Similarly, based on the Garden classification, the majority (66.6%) of patients presented with displaced Type III and IV fractures, emphasizing the need for operative management. The higher frequency of displaced fractures is consistent with other studies, including Rai et al. (2017)[13] and Talluri (2020)**,** which reported that hemiarthroplasty remains the preferred treatment in such cases for early mobilization and pain relief.

The functional recovery outcomes in this study were highly encouraging. The Harris Hip Score (HHS) demonstrated a statistically significant improvement from 78.8 ± 6.8 at 1 month to 92.9 ± 3.0 at 6 months ($p < 0.001$). Similarly, the Six-Minute Walk Test (6MWT) distance improved markedly from 170.4 ± 30.3 meters at 1 month to 413.4 ± 27.9 meters at 6 months**,** reflecting enhanced endurance and gait stability over time. These findings are comparable to those of Shashidhara (2024) and Moaz et al. (2024)[14]**,** who observed significant improvements in functional mobility and pain reduction following cemented modular hemiarthroplasty.

The postoperative complication rate was low-84.8% of patients experienced no adverse events. Minor complications included

hypotension (6.1%), superficial infection (6.1%), and one case of peri-prosthetic fracture with foot drop (3%). The low complication rate corroborates earlier findings by Kanto et al. (2014) and Khan et al. (2021), which demonstrated the safety and effectiveness of cemented bipolar prostheses in elderly patients.

Gender-based analysis revealed that males had a higher early HHS at 1 month (81.5 vs. 76.9, p = 0.034). Still, females showed greater improvement at 6 months (p = 0.010), suggesting a better long-term adaptation and rehabilitation response among female patients.

Overall, this study supports the growing evidence that cemented modular bipolar hemiarthroplasty [15] offers stable fixation, facilitates early mobilization, minimizes complications, and leads to excellent functional recovery in elderly patients with displaced femoral neck fractures. These outcomes reinforce its role as a preferred surgical option in osteoporotic patients, especially when rapid postoperative rehabilitation is desired.

Figure 2: a. Pre- and Post-Operative X-rays of Displaced Femoral Neck Fractures; b. Pre OP X-ray; c. Traction and IR view; follow-up d. Post OP X-ray; e. 6-month follow up; and f. Functional outcome

CONCLUSION

The study aimed to assess outcomes of modular bipolar hemiarthroplasty for femoral neck fractures in the elderly. Results revealed notable improvements in mobility and quality of life post-surgery, evident in increased Harris Hip Scores and 6MWT distances. Most of the patients had recovered well by six months, attaining almost normal functional levels; no significant differences were found between male and female subjects for mobility outcomes.

The results reaffirm the value of cemented modular bipolar hemiarthroplasty with geriatric patients suffering from femoral neck fractures as a treatment option. The procedure offers pain relief, early mobilization, and rehabilitation of weight-bearing functions, thereby lowering the risk of post-operative complications. Because these patients suffer from high osteoporosis prevalence, prompt detection and structured rehabilitation programs remain essential determinants of the optimization of long-term outcome. Further studies with longer follow-ups are needed to assess the sustainability of these functional improvements and to identify complementary strategies for older patients recovering after hip fracture surgery.

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