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Evaluation of Cemented Bipolar Hemiarthroplasty to Assess Functional Outcome of Displaced Femoral Neck Fractures in Elderly Osteoporotic Patients

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Abstract

Background: Hip fractures are the most frequent injury among elderly patients. The incidence is increasingly prevalent worldwide, particularly in the older age group as one common risk factor for both sexes is osteoporosis. Cemented hemiarthroplasty is one of several surgical treatment options for displaced femoral neck fractures, and it is promising for elderly osteoporotic patients.

Objective: This study was aimed to evaluate the functional outcomes of cemented bipolar hemiarthroplasty in treating displaced femoral neck fractures among elderly osteoporotic patients.

Methods: This quasi-experimental study was conducted at the Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, from March 2022 to March 2024. We evaluated the functional outcomes of cemented bipolar hemiarthroplasty in the treatment of displaced femoral neck fractures among 15 elderly osteoporotic patients. All study patients were assessed pre-operatively and followed up post-operatively at 1, 3, 6, and 12 months accordingly. Data were analyzed and compared by statistical tests.

Results: The mean(±SD) age of the study patients was 67.93±8.03 years, most (60%) of them was aged between 61-70 years. Females constituted 70% of the total participants, with a male-to-female ratio was 1:2. Co-morbidities included hypertension (26.67%), diabetes mellitus (33.33%), and both conditions (20%). Right-sided injuries were more common (53.33%). Garden type IV fractures were predominant (60%), and 86.67% of cases was Dorr type C. The mean hospital stay was 6.93±1.44 days, mean blood loss was 216±34.6 ml and mean duration of surgery was 96.67±15.43 minutes. The Harris Hip Score improved significantly from 62.87±2.39 at 1 month to 89.40±1.97 at 12 months ($p<0.001$). Superficial infection and wound hematoma were found in 6.7% of patients each.

Conclusion: Cemented bipolar hemiarthroplasty for displaced femoral neck fractures among elderly osteoporotic patients provides a good functional outcome, pain relief, and a quick return to independent activity with a manageable risk of complications.

Keywords: Elderly osteoporotic patients; Cemented bipolar hemiarthroplasty; Femoral neck fracture; Functional outcomes

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Introduction

Femoral neck fractures are frequent injuries, particularly in the elderly patients. Femoral neck and inter-trochanteric fractures are occurring in approximately equal proportions, account for over 90% of hip fractures [1]. According to demographic projections, the frequency of femoral neck fractures will continue to increase in the future. The intracapsular femoral neck is the site of around half of all hip fractures; women have a 40–50% lifetime chance of hip fractures, whereas men have a 13-22% risk [2]. Hip fractures will increase from 1.66 million in 1990 to 6.26 million in 2050 globally as life expectancy rises [2]. Particularly in elderly individuals, these fractures have a high morbidity and mortality rate and are burden for the healthcare system [2]. The elderly population is at risk for femoral neck fractures due to a number of predisposing factors such as- osteoporosis, malnutrition, decreased physical activity, visual impairment, neurological disorders, poor balance, and muscle atrophy [3]. The main risk factor, osteoporosis, affects both men and women, with women having a 2-3 times higher risk of fractures [4]. These fractures frequently lead to decreased mobility, increased morbidity and mortality, and a loss of independence, all of which are further complicated by co-morbid conditions including diabetes and hypertension [5]. The usual treatment for older patients with displaced femoral neck fractures is surgery, mainly hemiarthroplasty. Compared to internal fixation, cemented bipolar hemiarthroplasty is recommended due to its lower risk of complications and better functional outcomes [6]. For elderly osteoporotic patients, cemented implants are the best option because this modality provides better fixation and allow for early mobilization [7]. The posterior and lateral procedures are common surgical approaches; each has unique benefits, such as a decreased risk of muscle damage or dislocation [8]. Avascular necrosis (AVN) and non-union are common complications associated to femoral neck fractures because of exposure of synovial fluid and disturbed blood flow. Delayed treatment often worsens these complications [9]. Rapid functional restoration with an emphasis on pain management, mobility, and independence is the goal of effective treatment. After surgery, the Harris Hip Score (HHS) is frequently used to assess functional outcomes and patient satisfaction [10-11]. Although hip replacement surgery has advanced, there is still little information available on the results of cemented bipolar hemiarthroplasty in Bangladesh. In order to fill-up this knowledge gap and support better clinical practices and patient care, this study attempts to offer evidence-based insights on the procedure's safety, effectiveness, and outcomes.

Methodology

This was a quasi-experimental study, conducted at the Department of Orthopaedic Surgery, Bangabandhu Sheikh Mujib Medical University (BSMMU), Dhaka, Bangladesh, from March 2022 to March 2024. A toral of 15 elderly (age >60 years) osteoporotic patients with displaced fracture neck of femur were enrolled following purposive non-randomized sampling technique. Patients of both genders with displaced femoral neck fractures, ambulatory before injury were included. On the other hand, patients with associated fractures, extracapsular fractures, pathological fractures, or patients having cerebrovascular disease and neuromuscular disorders were excluded from the study. Data were collected on demographic variables (age, sex, and occupation), clinical variables (mode and duration of injury, side of involved, and fracture type), and surgical variables (operative duration, perioperative blood loss, and hospital stay). Outcomes were assessed using the Visual Analog Scale (VAS) for pain and the Harris Hip Score (HHS) for functional status, along with perioperative and post-operative complications. This study was approved by Institutional Review Board (IRB) of BSMMU, Dhaka, Bangladesh (IRB No. BSMMU/2023/1080, dated 15/01/23).

Clinical evaluation: After selection, a through clinical assessment of all study patients was done which included assessing general features such as the velocity and duration of trauma, pain in the hip region, and difficulty in standing or walking. Local features were examined that included-limb attitude, muscle wasting in the lower limb, limb length discrepancy, joint tenderness, and the range of hip joint movement. Relevant laboratory investigations were done accordingly to ensure anesthetic fitness, diagnose co-morbid conditions, and confirm the disease; including complete blood count (CBC), C-reactive protein (CRP), random blood sugar (RBS), blood urea, serum creatinine, HBsAg, anti-HCV, blood grouping with Rh- typing, electrocardiogram (ECG), and echocardiography. Radiological evaluations included chest X-rays (P/A view) and pelvic X-rays (A/P view) covering both hips and upper thighs, as well as lateral X-rays of the affected hip joint were performed accordingly.

Study procedure: Elderly patients underwent replacement hemiarthroplasty, were selected on specific selection criteria. Prior to enrollment the aims, procedures, risks, and benefits of the study were explained to all patients and their families, followed by obtaining an informed written consent. The patients were encouraged for voluntary participation in this study. Participants were assured regarding the confidentiality of all data. The objectives, procedures, risks and benefits of the operation were explained to all selected patients. Data were collected pre-operatively and post-operatively using a structured form, with follow-ups at 1, 3, 6, and 12 months after surgery. Functional outcomes were assessed using the Harris Hip Score.

Statistical analysis of data

Data were collected, organized, and calculated based on key variables and functional evaluation scores. Data

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were analyzed using a windows-based soft-ware Statistical Package for Social Sciences (SPSS) version 26, All qualitative data were expressed as frequencies with percentages, while quantitative data as mean with standard deviation (±SD). For comparison of variables paired t-test was performed. A p-value <0.05 was considered as statistically significant.

Results and Observation

A toral of 15 elderly osteoporotic patients with displaced fracture neck of femur underwent cemented bipolar hemiarthroplasty were included on the basis of selection criteria. All the patients were operated by direct lateral approach. They were evaluated pre-operatively and then followed up at 1st, 3rd, 6th and 12th month post-operatively.

The baseline characteristics of the study participants (N= 15) showed that, mean age was 67.93±8.03 years, that was ranged between 61 to 90 years. Females were predominant (66.67%), while males accounted for 33.33%, with a male-to-female ratio was 1:2. Regarding comorbidities; 33.33% had diabetes mellitus (DM), 26.67% had hypertension (HTN), 20% had both HTN and DM, while 20% had no comorbid condition. The mean duration of injury before treatment was 9.47±3.35 days, with 66.67% presenting within 8-14 days, 26.67% within 7 days, and 6.67% after 14 days (Table 1).

The majority (60%) of study patients aged between 61-70 years, followed by 26.67% aged 71-80 years, and 13.33% aged 81-90 years (Figure 1). Fractures were slightly more common on the right side (53.33%) than the left (46.67%) (Figure 2).

Table 1: Baseline characteristics of the study population (N= 15).

Variables	Frequency (n)	Percentage (%)
Age (years)		
Mean±SD	67.93±8.03 years	
Range (minimum-maximum)	61-90	
Gender		
Male	5	33.33
Female	10	66.67
Male to female ratio	1:2	
Comorbidities		
Hypertension (HTN)	4	26.67
DM	5	33.33
Both (HTN and DM)	3	20
None	3	20
Duration of injury (days)		
≤7	4	26.67
8-14	10	66.67
>14	1	6.67
Mean±SD	9.47±3.35 days	

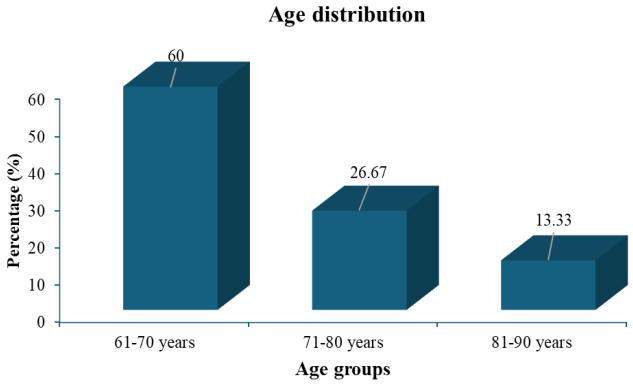

Figure 1: Age groups of the participants (N= 15).

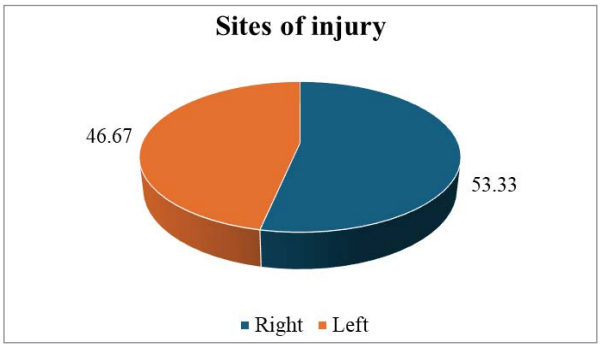

Figure 2: Affected sites of injury among the study patients (N= 15).

Among the study subjects, 60% had Garden type IV fractures, while the remaining 40% had Garden type III fractures. In terms of Dorr classification, the majority (86.67%) were categorized as Dorr type C, indicating poor bone quality, while 13.33% were Dorr type B. There was no patient identified as having Dorr type A (Table 2).

Table 2: Distribution of fracture types and Dorr classification among study subjects (N= 15).

Variables	Frequency (n)	Percentage (%)
Type of fracture (Garden type)		
III	6	40.0
IV	9	60.0
Dorr type		
A	0	0
B	2	13.33
C	13	86.67

In this study, the mean post-operative hospital stay was 6.93±1.44 days, ranging from 5 to 10 days. The mean post-operative blood loss was 216±34.6 ml, with a range of 170 ml to 280 ml. The mean duration of surgery was 96.7±15.4 minutes, varying between 70 and 120 minutes (Table 3).

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Table 3: Postoperative hospital stay, blood loss, and surgery duration among study subjects (N= 15).

Variables	Mean±SD	Range (minimum-maximum)
Post-operative hospital stays (days)	6.93±1.44	(5-10) days
Postoperative blood loss (ml)	216±34.6	(170-280) ml
Duration of surgery (minutes)	96.7±15.4	(70-120) minutes

The mean Visual Analog Scale (VAS) score showed a significant reduction from 8.0±0.85 preoperatively to 4.47±0.74 at 1 month, 2.6±0.63 at 3 months, 1.13±0.52 at 6 months, and 0.47±0.52 at 12 months post-operatively ($p<0.001$ for all instances) (Table 4).

Table 4: Comparison of VAS score over time among the study population (N= 15).

Time interval	VAS score (Mean±SD)	p-value
Preoperative	8.0±0.85	versus
At 1 month after surgery	4.47±0.74	<0.001*
At 3 months after surgery	2.6±0.63	<0.001*
At 6 months after surgery	1.13±0.52	<0.001*
At 12 months after surgery	0.47±0.52	<0.001*

The Harris Hip Score (HHS) demonstrated a steady and significant improvement over time, increasing from 62.87±2.39 at 1 month to 72.93±1.43 at 3 months, 81.93±1.62 at 6 months, and 89.40±1.92 at 12 months post-operatively ($p<0.001$ for all comparisons). This indicates substantial functional recovery and improved hip performance following cemented bipolar hemiarthroplasty (Table 5).

Among the study patients, superficial infection was observed in 1 (6.7%) patient and wound hematoma was found in another 1 (6.7%) patient. Most of the patients 13 (86.67%) did not have any complications (Table 6).

Table 5: Changes in Harris Hip Score over time among study patients (N= 15).

Time interval	HHS score (Mean±SD)	p-value
At 1 month	62.87±2.39	versus
At 3 months	72.93±1.43	<0.001*
At 6 months	81.93±1.62	<0.001*
At 12 months	89.40±1.92	<0.001*

p-value obtained by Paired t-test, *significant

Table 6: Distribution of the study subjects according to post-operative complication (N= 15).

Post-operative complication	Frequency (n)	Percentage (%)
Superficial infection	1	6.7
Wound hematoma	1	6.7

Discussion

The number of elderly people is increasing globally. The incidence of osteoporosis and related fractures are increasingly prevalent among elderly people because they often face challenges related to balance issues, sensory impairments and gait disturbances. Management of displaced femoral neck fractures among elderly osteoporotic patients is always challenging as they are vulnerable to fracture associated complications like- non-union, pressure sore, pneumonia and deep vein thrombosis. The purpose of this study was to ascertain the results of cemented modular bipolar hemiarthroplasty for treating displaced femoral neck fractures among elderly osteoporotic patients.

In this study, the mean age of the study patients was 67.93±8.03 years (range: 61-85 years), with majority (60%) of them aged between 61-70 years. A similar result was observed in a previous study, that reported a mean age of 65.2 years in patients with femoral neck fractures treated with cemented bipolar hemiarthroplasty [6]. Similarly, Sharoff L et al. [12] also found all patients underwent cemented bipolar hemiarthroplasty were above 55 years. Females predominated was found in this present study, comprising 66.67% of the participants, with a male-to-female ratio was 1:2. In accordance, Sharoff L et al. [12] reported a male-to-female ratio was 1:1.6; however, Mayi SC et al. [5] found this ratio was 6:13.

It was observed that injuries predominantly affected the right side (53.33%), that was consistent with a related study [6]; which reported 12 right-sided and 8 left-sided cases, and other studies showing right-sided predominance [13]. The most common comorbidities in this study were diabetes mellitus (33.33%) followed by hypertension (26.67%), however both conditions were observed in 20% patients. In this context, Sharoff L et al. [12] documented

that hypertension was in 22 patients and diabetes was in 21 patients, along with other conditions such as coronary artery disease, dementia, and Parkinson's disease.

In this current study, most cases (66.67%) presented within 8-14 days of injury, with a mean injury duration was 9.47±3.35 days (range: 3-15 days). Badavath RR et al. [14] reported that 55% of patients presented within 24 hours, while Khan M et al. [15] found that 75% presented within 3 weeks. Analyzing the fracture variety (Garden type) revealed that, majority (60%) of fractures in this current study was Garden type IV, this finding was supported by one previous study [14], which reported 60% of fractures was Garden type IV. However, Kazley JM et al. [16] found Garden type III fractures in 43.4% of study cases, with 30% was Garden type IV.

Regarding Dorr classification, 86.67% of the cases were Dorr type C, and 13.33% were type B, reflecting the use of cemented prostheses. Similarly, Shekhar A et al. [17] reported 72.7% type C and 27.3% type B cases in a related study. The mean hospital stay in this study was 6.93±1.44 days (range: 5-10 days); aligning with a related previous study, reported an average hospital stay of 6.8 days [6]. In contrast, Mayi SC et al. [14] reported a longer average stay of 11.31 days [5], and Badavath RR et al. [14] observed a range of hospital stay was 10-32 days.

The mean blood loss during surgery in this study was 216±34.6 ml (range: 170-280 ml), similar to the 190 ml reported by Raam BPJ et al. [6]. However, Badavath RR et al. [14] reported a higher average blood loss of 500 ml. In this study, the mean duration of surgery (skin incision to closure) was 96.67±15.43 minutes (range: 70-120 minutes); which was comparable with a couple of related studies [5,6,14].

Among the study patients, pain relief as assessed by the Visual Analog Scale (VAS) showed significant improvement. The mean preoperative VAS score was 8.00±0.85 (range: 7-9) decreased to 0.47±0.52 at the 12th- month follow-up ($p<0.001$). Similar pain relief trends were observed by a couple of previous study [18-19]. In this present study, the mean Harris Hip Score (HHS) was 62.87±2.39 at 1 month, improving significantly to 89.40±1.92 at 12th- month ($p<0.001$). This finding was aligned with similar previous studies as reported that, mean HHS values were 91.4, 85, and 83.1 respectively, at 12th- month [15, 20]. Aparajit P et al. [21] found an average HHS of 83.40 at 1 year, and Badavath RR et al. [14] observed a rise in HHS from 83 at 3 months to 87.2 at 6 months.

In terms of complications, one (6.7%) of our study patients experienced a superficial infection, and another one (6.7%) developed a wound hematoma. But most of our study patients (86.67%) had no complications. Superficial infections were managed with dressings and antibiotics, while the hematoma was treated with aspiration and pressure dressing. Mayi SC et al. [5] reported similar complications, including Grade-1 pressure sores, deep vein thrombosis, and urinary tract infections. Overall, this study demonstrated significant functional improvement and a low rate of complications following cemented bipolar hemiarthroplasty. However, limitations in our study include- small sample size with single-center design, a short follow-up period, potential selection bias and lack of supervised physiotherapy in some cases.

Conclusion

This study concluded that cemented bipolar hemiarthroplasty for displaced femoral neck fractures among elderly osteoporotic patients provides excellent functional outcomes, pain relief, and rapid recovery with minimal complications. This method is safe and effective, but further multicenter studies with larger samples and longer follow-ups are recommended to validate long-term outcomes.

Conflicts of interest

All authors stated that there is no conflict of interest in this publication.

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