

Original Research Article

Evaluation of functional outcome of cemented bipolar prosthesis in femoral neck fracture in old age patients

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ABSTRACT

Background: Older adults are at a higher risk of proximal femur fractures, particularly femoral neck and intertrochanteric fractures, often due to falls, trauma, or osteoporosis. Managing these fractures in osteoporotic bones is challenging, as they are associated with complications such as pressure sores, deep vein thrombosis, and hypostatic pneumonia. This study aimed to evaluate the outcomes of treating femoral neck fractures in elderly patients using cemented bipolar prosthesis.

Methods: A quasi-experimental study was conducted on 40 patients aged 60 to 84 years who underwent cemented bipolar hemiarthroplasty within 21 days of fracture from January 2019 to December 2019. Post-operative functional outcomes were assessed using the Harris hip score (HHS) at 3, 12, and 24 weeks, both clinically and radiologically.

Results: Of the 40 patients, 65% were female, and 52.5% had left-sided fractures. The majority (55%) experienced trivial falls. The HHS improved significantly from a mean of 43.73 ± 6.78 at 3 weeks to 82.56 ± 9.13 at 6 months. Garden type 3 fractures were the most common (70%). Functional outcomes were graded as good in 72.5% of patients, excellent in 17.5%, and fair in 5%, while 2.5% had a poor outcome. One patient (2.5%) died due to pulmonary embolism.

Conclusions: Cemented bipolar hemiarthroplasty in elderly patients with femoral neck fractures is a safe and effective treatment, promoting early mobilization and reducing the risk of complications such as bed sores, deep vein thrombosis, and hypostatic pneumonia.

Keywords: Femoral neck fracture, Elderly, Cemented bipolar prosthesis, HHS, Hemiarthroplasty

INTRODUCTION

The hip joint is one of the body's most significant weight-bearing joints, crucial in maintaining mobility and overall quality of life.¹ It is subjected to considerable stress during daily activities, making it susceptible to injury, particularly

in the elderly. Among the various injuries affecting the hip, post-traumatic fractures of the femoral neck are notably more common in older adults, primarily due to osteoporosis. This condition, characterized by decreased bone density and strength, makes the bones more fragile and prone to fractures from minor falls or trivial trauma.² According to the world health organization, individuals

over the age of 60 are classified as elderly, a demographic that is increasingly vulnerable to such injuries. Globally, the burden of osteoporotic fractures is substantial. In 2000, it was estimated that nearly 9 million osteoporotic fractures occurred annually, with approximately 1.6 million of these involving the hip.³ The prevalence of femoral neck fractures is significant in various regions. For instance, an analysis of the Nationwide Inpatient Sample database in the USA from 2003 to 2013 identified 808,940 femoral neck fractures in patients aged 60 years and older, averaging 57,781 cases per year.⁴ In Europe, the incidence of hip fractures is even higher. In Poland, for example, the incidence of hip fractures increased by 19.4% in women and 14.2% in men between 2008 and 2015. During this period, 289,230 proximal femur fractures were recorded, with femoral neck fractures being slightly more prevalent.

The primary objective of treating a femoral neck fracture is to restore the patient to their pre-fracture functional status. However, this goal is often complicated by the physiological challenges associated with bone healing in elderly patients, such as osteoporosis and the intra-capsular nature of these fractures. Internal fixation, a standard treatment method, is fraught with uncertainty regarding fracture union. Even when union occurs, there is a significant risk of avascular necrosis of the femoral head, secondary osteoarthritis, varus deformity, and limb shortening, particularly in older people.⁵ Given these challenges, many surgeons advocate for primary prosthetic replacement in elderly ambulatory patients. Prosthetic replacement allows for immediate weight-bearing and early return to activity, reducing the risk of complications associated with prolonged immobility, such as pressure sores, deep vein thrombosis, and hypostatic pneumonia.⁶ In Western Europe and the USA, arthroplasty has become the standard surgical treatment for intracapsular femoral neck fractures in patients over 60 years old who are still active.⁷ Various types of bipolar hemiarthroplasty prostheses are used in clinical practice for treating displaced femoral neck fractures in elderly patients. These prostheses can be categorized into cemented and uncemented types based on the method of implant fixation. Cemented bipolar prostheses are associated with good short- and long-term outcomes, while uncemented bipolar hemiarthroplasty also demonstrates good mid-term outcomes in elderly patients.⁸

Traditional hemiarthroplasty using the Austin Moore prosthesis is now considered obsolete due to associated complications such as pain, reduced range of motion, acetabular erosion, loosening of the femoral stem, and the risk of prosthesis intrusion into the pelvis.⁹ In contrast, bipolar hemiarthroplasty is widely accepted as a more effective treatment option. This procedure offers several advantages, including earlier ambulation, a lower probability of reoperation, and better functional outcomes. However, the effectiveness of cementless implants depends on bone ingrowth and biological stabilization, which are slower processes in elderly patients due to their limited physiological reserves. Additionally, older patients

often have a wider diaphyseal diameter, necessitating a larger stem size and an adequate cement mantle for stability.

In cemented bipolar hemiarthroplasty, polymethyl-methacrylate (PMMA) bone cement is utilized during surgery to establish a solid bone-implant interface. One potential advantage of cement is reduced post-operative anterior thigh pain and improved stem fixation within the medullary cavity.¹⁰ Christ et al justified using cemented prostheses in elderly patients, particularly those with wide medullary canals and thin, brittle femoral cortices.¹¹ The improved cementing technique has significantly enhanced the long-term survival of femoral stem implants in older patients. Moreover, the cemented technique is complex when achieving a satisfactory fit with an uncemented implant. The remarkable durability of cemented Charnley total hip arthroplasty was highlighted, noting that aseptic loosening of components is the most common long-term complication. However, improved cementing techniques have reduced the incidence of this complication to as low as 3% over 11 years.

Hemiarthroplasty offers reliable pain relief and predictable outcomes with lower reoperation rates than internal fixation. Cementation of the prosthesis provides good initial fixation in osteoporotic bone. However, it carries risks such as bone marrow and fat embolization, which can lead to intraoperative hypotension and an increased incidence of deep vein thrombosis. Modular prostheses offer the advantage of later conversion to total hip arthroplasty without needing stem revision.¹² Total hip arthroplasty, while providing the best long-term clinical outcomes, is associated with longer and more complex operative procedures, increased blood loss, higher mortality rates, and more significant costs compared to bipolar prostheses.

This study is a prospective quasi-experimental analysis of the short-term results of hemiarthroplasty using cemented bipolar prostheses. Outcomes at three weeks, twelve weeks, and twenty-four weeks post-surgery were evaluated and compared using the modified HHS and radiographic assessments.

Objectives

General objectives

General objective was to evaluate the outcome of treatment of femoral neck fracture by cemented Bipolar Prosthesis in old aged patients.

Specific objectives

Specific objective was to assess the functional outcome of treatment of femoral neck fracture by cemented bipolar prosthesis in old aged patients using HHS and to identify the complications per and post-operative, both clinically and pertinent investigation.

METHODS

Study design

This study was a prospective quasi-experimental design conducted over one year, from January 2019 to December 2019, at the national institute of traumatology and orthopedic rehabilitation (NITOR) in Sher-E-Bangla Nagar, Dhaka. The research aimed to evaluate the short-term outcomes of cemented bipolar hemiarthroplasty in elderly patients with femoral neck fractures. Patients meeting specific inclusion criteria underwent the surgical procedure within 21 days of injury. Data were collected at defined intervals to assess functional outcomes using the modified HHS, allowing for a systematic evaluation of treatment effectiveness in a specialized clinical setting.

Inclusion criteria

Patients with intracapsular fracture neck of femur in patients of age 60 years and above, both male and female patients will be enrolled and any site of involvement were included.

Exclusion criteria

Patients with the following characteristics were excluded from the study-patients below 60 years, avascular necrosis of femoral head with acetabular changes, pathological fractures of the neck of the femur, patients are medically unfit for surgery, any other major psychiatric illness, such as schizophrenia or mental retardation and inability or unwillingness to give written informed consent were excluded.

Data collection technique

Data from the patients were collected through face-to-face interviews until the desired sample size was attained. Clinical motion, radiographic alignment, subsequent procedures, and complications (LLD, superficial wound infection, weakness in walking) were recorded. All fractures were classified according to Garden's classification. The patients were encouraged to participate. Then, written informed consent taken from each patient.

Data analysis

The data collected from the patients were analyzed. After completion of data collection, to maintain consistency, the data were checked and edited manually and verified before tabulation. Data were coded, entered, and analyzed in a computer. The statistical analysis was conducted using SPSS (Statistical package for social science) version 25.0 statistical software. The study's findings were presented by frequency and percentage in tables and graphs. Means and standard deviations for continuous variables and frequency distributions for categorical variables were used to describe the characteristics of the total sample. Clinically, the outcome was considered excellent when the final HHS

was within 90-100, good when within 80-89, and fair when 70-79. Radiological follow-up was done to see any prosthesis-related complications. Associations of data were assessed using the Fisher exact test. Here, $p < 0.05$ was considered significant. Here, all p values were two-sided.

Ethical consideration

In the beginning, approval was obtained from the protocol approval committee. Also, written permission was obtained from the patients. A complete assurance was given to patients and their attendants that all information would be kept confidential. The patients were given the right not to participate and to discontinue participation at any time in the study with consideration/without penalty. Informed consent was appropriately documented.

RESULTS

During this study, 40 patients with femoral neck fractures who fulfilled the inclusion criteria for this thesis were selected. But as one patient died at home before follow-up, 39 cases were taken. Patients were treated operatively from January 2019 to December 2019. All patients were followed up for 6 months. In this series, the following results were obtained.

Table 1: Age distribution of patients.

Age group (in years)	N	Percentage (%)	P value
60-64	11	27.5	-
65-69	9	22.5	-
70-74	7	17.5	-
75-79	11	27.5	-
80-84	2	5.0	-
Mean±SD	70.73±15.73		0.134

The age distribution table shows that most patients were in the 60-64 and 75-79 age groups, each comprising 27.5% of the sample. The mean age was 70.73 ± 15.73 years, reflecting the typical age range for femoral neck fractures. The $p=0.134$ indicates no significant age-related differences within the study population.

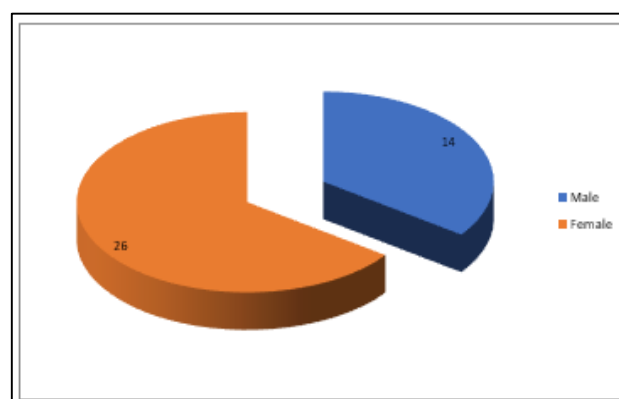


Figure 1: Distribution of patients by gender, (n=40)

The above figure shows that among 40 patients, 26 (65%) were female and 14 (35%) were male. The male-to-female ratio was 1:1.85.

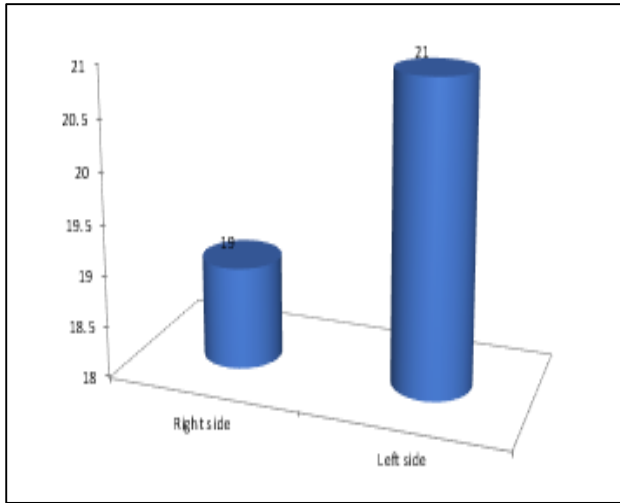


Figure 2: Distribution of the patients by affected side, (n=40).

The above figure shows that 52.5% (n=21) patients had fractures on the left side, and the rests (47.5%, n=19) had on the right side.

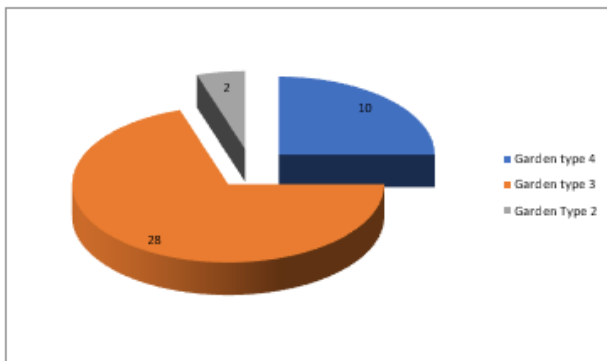


Figure 3: Distribution of patients according to the garden type of fracture, (n=40).

Above figure shows that out of 40 patients, 28 (70%) had garden type 3 fractures, 10 (25%) had garden type 4 fracture and only 2 (5%) had garden type 2 fracture.

The distribution of patients by co-morbid conditions shows that 32.5% had no significant medical problems. In comparison, the rest had various conditions, such as diabetes mellitus (17.5%), hypertension with ischemic heart disease (12.5%), and chronic obstructive pulmonary disease (12.5%). A notable finding is that myocardial infarction (7.5%) had a statistically significant $p=0.041$, indicating its potential impact on patient outcomes. These co-morbid conditions are crucial in influencing the management and recovery of hip surgery patients. The distribution of patients by mechanism of injury reveals that

the most common cause was a trivial fall, accounting for 55.0% of cases, followed by falls from height (25.0%). Road traffic accidents (RTA) contributed to 7.5% of injuries, with a $p=0.29$, indicating no significant difference compared to other injury mechanisms. This data highlights the vulnerability of elderly patients to hip fractures from minor trauma, particularly trivial falls.

Table 2: Distribution of patients by co-morbid conditions with mechanism of injury.

Variables	N	Percentage (%)	P value
Co-morbid conditions			
No medical problems	13	32.5	-
MI	3	7.5	0.041
HTN with IHD	5	12.5	-
HTN with DM	4	10.0	-
DM (only)	7	17.5	-
CKD	3	7.5	-
COPD	5	12.5	-
Mechanism of injury			
RTA	3	7.5	0.29
FFH	10	25.0	-
Trivial fall	22	55.0	-
Fall on ground	4	10.0	-
Others	1	2.5	-

Table 3: Post-operative hospital stay with range of motion.

Variables	N	Percentage (%)	P value
Post-operative hospital stay (days)			
1 to 3 days	32	80.0	0.021
4 to 6 days	7	17.5	-
7 to 10 days	1	2.5	-
Mean±SD	4.06±2.19	-	-
Range of motion			
Full range of motion	18	46.16	0.03
Partial range of motion	21	53.84	-
Restricted motion	0	0	-
Mean±SD	3.92±1.01	-	-

The table on post-operative hospital stay indicates that most patients (80.0%) were discharged within 1 to 3 days, with a statistically significant $p=0.021$. A smaller proportion of patients (17.5%) stayed 4 to 6 days, and only 2.5% stayed 7 to 10 days. The mean hospital stay was 4.06 ± 2.19 days, reflecting a generally short recovery period following the procedure. The HHS for the range of motion shows that 46.16% of patients achieved a full range of motion postoperatively, while 53.84% had a partial range of motion. No patients experienced restricted motion. The mean score was 3.92 ± 1.01 , with a significant

$p=0.03$, indicating that the range of motion post-surgery improvement was statistically significant. This result suggests that most patients regained substantial hip mobility following their procedure. The mean HHS distribution during follow-up indicates a progressive improvement in hip function over time. The mean score increased from 43.73 ± 6.78 in the immediate post-operative period to 82.56 ± 9.13 at 6 months. The p values at 3 weeks (0.001), 3 months (0.002), and 6 months (0.003) all show statistically significant improvements in the HHS, demonstrating a substantial and consistent recovery in hip function as time progresses following the procedure.

Table 4: Final outcome: HHS.

Functional outcome	N	Score	Percentage (%)	P value
Excellent (90-100)	7	661	17.5	0.01
Good (80-89)	29	2521	72.5	-
Fair (70-79)	2	150	5.0	-
Poor (<70)	1	28	2.5	-
Not evaluated (Death)	1	-	2.5	-
Mean $\pm$ SD	84 $\pm$ 14.58			-

The final outcome based on the HHS reveals that 72.5% of patients achieved a "good" functional outcome (80-89), while 17.5% had an "excellent" outcome (90-100), with a significant $p=0.01$ indicating statistical significance. A smaller percentage of patients had "fair" (5.0%) and "poor" (2.5%) outcomes. One patient (2.5%) was not evaluated due to death. The mean HHS across the cohort was 84 ± 14.58 , indicating generally favorable results from the treatment.

DISCUSSION

The optimal management of displaced intracapsular femoral neck fractures, particularly in elderly patients, remains a subject of ongoing debate despite the high frequency with which these injuries occur.^{13,14} While there is consensus that surgical intervention is essential, the choice between internal fixation and hemiarthroplasty and between cemented and uncemented hemiarthroplasty continue to generate discussion among orthopedic surgeons. In this study, we evaluated the outcomes of 40 patients with femoral neck fractures who underwent cemented bipolar hemiarthroplasty at the NITOR, Dhaka, from January 2019 to December 2019. The mean age of patients in this study was 70.73 ± 15.73 years, with no significant age difference between the groups ($p=0.134$). This aligns with findings from Hasan et al who reported similar mean ages in both cemented and uncemented groups in their study of femoral neck fractures.¹⁵ This consistency suggests that age distribution in femoral neck fracture studies tends to be similar across different

populations, supporting the generalizability of our findings. Another study in Kerala, India, further corroborates this age range, indicating that patients in their 60s and 70s are most commonly affected by femoral neck fractures.

In terms of gender distribution, the present study found that 65% of the patients were female, a finding that is consistent with previous studies such as the one by, which reported that women constituted 60% of the cases in their cemented prosthesis group. This higher prevalence in females can be attributed to the higher incidence of osteoporosis among older women, which increases their susceptibility to fractures from minor traumas, such as trivial falls—a common cause in our study, accounting for 55% of cases. This pattern of injury mechanism is also reflected in the work of Digga et al who observed similar causes of femoral neck fractures in their study population.¹⁶

Regarding the laterality of the fractures, our study noted a slightly higher incidence of left-sided fractures (52.5%) than right-sided ones (47.5%). This observation is in line with findings by those who also reported a higher prevalence of left-sided femoral neck fractures. While the reasons for this asymmetry are unclear, it could be related to dominant leg use or variations in fall mechanics among older people. Pain management and functional recovery are critical outcomes in treating femoral neck fractures. In our study, 84.62% of patients reported no or slight pain postoperatively, with a mean pain score of 39.07 ± 5.96 , which was statistically significant ($p=0.027$). This outcome compares favorably with the study by ZD. Lucas et al who found that post-operative thigh pain was significantly higher in patients who underwent uncemented hemiarthroplasty.¹⁷ Similarly, reported a higher incidence of residual thigh pain in uncemented groups, further supporting the advantages of cemented bipolar prosthesis in terms of pain relief. Limping, another critical functional parameter, was minimal in our study, with 97.44% of patients exhibiting no or slight limping. The mean limping score in the cemented group was 9.54 ± 2.14 , with a significant $p=0.03$. This result is consistent with the findings of Liu et al who reported similar outcomes in their study of patients treated with cemented hemiarthroplasty.^{18,19} The ability to walk without significant limitations is a crucial factor in the overall recovery and quality of life of elderly patients following hip surgery. In our study, 17 out of 39 patients could walk unlimited distances, with a statistically significant mean walking distance score of 8.69 ± 2.15 ($p=0.019$).

Stair climbing ability, another important aspect of post-operative recovery, was normal in 41.03% of our patients, with a mean score of 2.64 ± 1.08 , also statistically significant ($p=0.043$). This finding aligns with the retrospective study by Senthilnathan et al which reported similar outcomes in a comparable patient population.²⁰ Additionally, 51.28% of our patients could use public

transport independently, highlighting the significant functional independence regained by these patients postoperatively. Range of motion, critical in the hip joint's overall functionality post-surgery, was found to be good in 90% of our patients, with a mean score of 3.92 ± 1.01 and a significant $p=0.03$. This outcome mirrors his study at Mansoura University, Egypt, where a good range of motion was reported in patients who received cemented prostheses. The overall functional outcome in our study, as measured by the HHS showed that 17.5% of patients achieved excellent outcomes, 72.5% had good outcomes, 5% had fair outcomes, and 2.5% had poor outcomes. One patient (2.5%) expired due to medical comorbidities before follow-up. The average HHS in the cemented group was 84 ± 14.58 , with a statistically significant $p=0.01$. These results are comparable to those found in other studies, such as H, where the HHS in the cemented group was 74.7 points, and similar findings were reported by Fenelon et al.

Regarding post-operative complications, the rate in our study was 10%, which is relatively low compared to the 34.3% complication rate reported.²¹ This difference could be attributed to variations in surgical techniques, patient management protocols, or patient populations between the studies. In the study, replacement hemiarthroplasty using a cemented bipolar prosthesis for displaced femoral neck fractures in older adults appears to be a rational and practical treatment option. It facilitates faster mobilization, reduces morbidity, and improves overall functional outcomes. With appropriate surgical expertise, supportive care, prophylactic antibiotics, and adequate physical therapy cemented bipolar hemiarthroplasty provides a reliable solution for managing these complex fractures in elderly patients, leading to favorable outcomes and enhanced quality of life.^{22,23}

The study has several limitations. First, the small sample size of 40 patients may limit the generalizability of the findings to the broader population. Second, the follow-up period of 24 weeks may be insufficient to fully assess long-term outcomes, complications, or prosthesis durability. Additionally, the study was conducted at a single center, which may introduce selection bias. Future research with larger, multi-center cohorts and extended follow-up periods is needed to validate and expand upon these results.

CONCLUSION

Cemented bipolar hemiarthroplasty is a safe and effective treatment for femoral neck fractures in elderly patients, promoting early mobilization and reducing complications such as avascular necrosis, bed sores, deep vein thrombosis, and hypostatic pneumonia. This approach offers favorable functional outcomes and enhances the quality of life in geriatric patients.

Recommendations

A similar study can be performed on a large sample size with a prolonged follow-up period. The same surgeons would operate all operations. A separate study can be done to evaluate the outcome of the uncemented bipolar prosthesis in patients with wide medullary cavities.

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