Outcome of Bipolar Hip Arthroplasty in Femoral-Neck Fracture (Medium-Term Result)

Abstract

Introduction: Arthroplasty as a treatment option for femoral neck fracture in elderly people has been widely supported although the type of arthroplasty is debatable. This study was conducted to evaluate the functional outcome of bipolar hemiarthroplasty (BHA).

Materials & Methods: 49 patients with femoral neck fracture who were operated with BHA within 5 years were included in the study. The clinical, radiographic, and functional results, using modified Harris-Hip score (HHS), were evaluated with a follow-up of 47 months.

Results & Discussion: 49 patients, - 66.7% men and 33.3% women, with 9 patients (18.4%) below 60 and 40 (81.6%) over 60 years old were studied. The average follow-up period was 48.66 months in people below 60 years and 46.60 months in over 60 years patients. The difference in the average HHS between the two groups was marginally significant (p=0.06). In the performance section of HHS, 55.6% showed poor performance, 33.3% relatively good performance and 11.1% good performance in people below 60- years group. These scores for over 60- years group were 85%, 7.5% and 7.5% in respectively.

Conclusion: The present study could not observe a satisfactory functional outcome after BHA in below or over 60-years population in this medium-term study. Therefore, evaluating the hip function after BHA in the long term and the cause for poor function is needed to be investigated. Slow erosion of the acetabulum following BHA can be a possible reason, lowering performance which requires in-depth investigation in long term studies.

Keywords: Femoral neck fractures, Hemiarthroplasty, Outcome assessment.

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Introduction

Femoral neck fractures are disabling injuries that usually affect the elderly people due to poor bone quality[1–3] and this is considered a challenge for healthcare systems and society[4–6]. Effective treatment has led to increased life expectancy, which has risen every decade[7]. Osteoporosis is more common in the elderly female. Despite the nature of these fractures, there remain surprising differences in treatment outcomes for these patients. These fractures have always posed major challenges for orthopedic surgeons.

These patients also commonly suffer from multiple comorbidities such as hypertension, heart problems, diabetes, and dementia. Along with prolonged immobility due to the fracture, this leads to increased complications and mortality. Therefore, timely surgery for these fractures is essential[8]. Rehabilitation and returning the patient to normal life after surgery also require a structured and targeted program. Hence, evaluating joint replacement outcomes according to international standards is felt to be necessary[9].

The choice of type and size of implants may also be influenced by hereditary and racial characteristics of bones and joints, which may subsequently affect long-term joint replacement outcomes. On the other hand, better understanding of strengths and weaknesses as well as the potential complications helps us provide better care and perform more successful surgeries[10]. Therefore, evaluating joint replacement outcomes and localizing them according to international standards is regarded as a necessity[11].

Arthroplasty is a standard treatment method for femoral neck fractures in over 60 years old patients for early mobilization and can reduce secondary diseases after hospitalization[12]. The successful long-term results after total hip arthroplasty (THA) have led to an increase in the number of THA procedures over the past three decades[13] Surgeons should always consider THA for active, young patients, when planning surgery. Many efforts have been made to improve and facilitate THA[14].

Nevertheless, the choice of procedure as hip arthroplasty remains unresolved and has specific advantages and disadvantages in different clinical trials[15–21]. The current generation of bipolar arthroplasties has a lower incidence of protrusio acetabuli compared to previous methods. However, some researchers have found that the inner bearing surface cannot be durable, and bipolar arthroplasties finally functionally convert to unipolar types[22].

The aim of this study was to investigate the clinical effect of bipolar arthroplasty after fracture of femoral neck on hip joint function and evaluated the effect of this surgical method on pain relief and activity improvement and daily quality of life. On the other hand, it assessed postoperative complications and follow-up over five years after surgery.

Materials & Methods

This study was a cohort study conducted to evaluate the outcomes of bipolar hip arthroplasty surgeries. This study was performed both retrospectively (by collecting data from patient records) and prospectively through assessing patient function and arthroplasty results. All patients who had undergone primary bipolar hip arthroplasty surgery from the beginning of the year 1395 (March 2016) up to the present, at the orthopedic departments of two teaching hospitals affiliated with Babol and Mazandaran Universities of Medical Sciences were included in this study.

Thus, the sample size included all operated patients. For patients from previous years, data were necessarily obtained from their medical records. The Harris Hip Score forms were completed for these patients either during outpatient visits or after contacting and inviting them back to the clinic for evaluation. Due to concerns about prosthesis subsidence, pelvic radiographs were performed, and the results were compared with initial radiographs.

The present study was conducted in accordance with the Helsinki Declaration guidelines. The informed consent was obtained from all patients. The study protocol was approved by the Ethics Committee of Mazandaran University of Medical Sciences with the code 8749.1400.IR.MAZUMS.IMAMHOSPITAL.REC.

Individuals whose surgery had been performed at least one year prior and exclusively at the two aforementioned centers were included in the study. Patients who underwent a second or multiple surgeries for any reason, as well as those whose evaluations were incomplete for any reason, were excluded from the study.

Study Tool

In this study, the Harris Hip Score (HHS) system was used as the study tool. The HHS is a measure for assessing functional impairment and the higher score shows the better outcome. The maximum score is 100. The results can be interpreted as follows:

- ≤ 70 = poor result
- 70–80 = fair
- 80–90 = good
- 90–100 = excellent

In the Harris assessment method, several components are evaluated, including:

1. Pain level after surgery
2. Degree of limping
3. Walking distance
4. Ability to climb stairs
5. Ability to put on socks and shoes
6. Amount and type of support or use of walking aids

In addition, the range of hip motion was also measured as part of the surgeon-focused section.

Each criterion is scored individually, and the total sum is used as the Harris Hip Score in statistical analysis. In this study, the Persian version of the Harris Hip Score, adapted by the Iranian Orthopedic Association, was used. The score of each question was recorded and subjected to statistical analysis.

Statistical Analysis

After extracting the necessary information from patients' medical records, demographic classification was performed regarding age distribution, gender, operated side, disease cause, and possible complications during hospitalization and up to one-year post-surgery. Ultimately, patient satisfaction was measured using the Harris criteria, recorded via

data collected in the specially designed Persian Harris questionnaire forms. The data were analyzed using SPSS software version 20. For data analysis, the independent t-test statistical method was used and evaluated accordingly.

Results

The present study, conducted to evaluate the outcomes of bipolar hip arthroplasty, included a total of 50 patients. During the follow-up period, one patient was lost, so the final analysis was performed on 49 patients. Among them, 24 patients (49%) were male and 25 (51%) were female. In 21 patients (42.9%), the fracture occurred in the right hip, and in 28 patients (57.1%), the fracture was on the left side. The mean age of patients was 68.73 ± 11.88 years (40- 98 years), and the average follow-up duration was 46.97 ± 21.25 months (9- 93 months). Patients were categorized into four groups: under 60 years, 60–69 years, 70–79 years, and over 80 years. The majority of fractures in this study were observed in the 60–69 years and 70–79 years old groups (Table 1). Table 2 shows a comparison of age, affected side, and follow-up duration between the two sexes. Although the incidence of fractures and the age at which they occurred were higher in women, this difference was not statistically significant. Eleven patients (22.45%) had underlying medical conditions. One patient (2.04%) had asthma; one patient (2.04%) had hypertension (HTN) and rheumatoid arthritis (RA); one patient (2.04%) had diabetes mellitus (DM) and hypertension (HTN); two patients (4.08%) had hypertension alone; one patient (2.04%) had DM alone; one patient (2.04%) had dyslipidemia (DLP) and HTN; one patient had HTN, DM, DLP, and ischemic heart disease (IHD); one patient (2.04%) had only IHD; and two patients (4.08%) had HTN, DM, and Sacrofemoral Distance (SFD).

No cases of mortality, deep surgical site infection, or prosthetic dislocation were observed among the participants in this study. There were two cases (4.08%) of superficial surgical site infection, both of which were successfully treated with timely antibiotic therapy based on culture results and sensitivity testing, along with repeated wound dressing changes.

The mean Harris Hip Score (HHS) was 50.51 ± 18.59 (range: 18.45–87.55). No patient demonstrated excellent function according to the HHS evaluation. Only 4 patients (8.2%) had good function (HHS score 80–90), 6 patients (12.2%) had fair function (HHS score 70–80), and 39 patients (79.6%) showed poor functional improvement (HHS score <70).

Tables 3 and 4 show the mean total Harris Hip Score and its subcomponents in the study population.

A significant negative correlation based on Pearson's correlation test was observed between age and the Harris Hip Score ($r = -0.379$, $p = 0.007$). In other words, the younger the patient, the higher the Harris Hip Score after surgery and the better the functional recovery. This correlation remained significant even after controlling for the effect of follow-up duration in a multivariable linear regression analysis ($B = -0.353$, $p = 0.015$). For further analysis, patients were categorized in two groups: under 60 years and over 60 years. Nine patients (18.4%) were under 60 years old, and 40 (81.6%) were above 60 years.

Table 1: Frequency of Femoral Neck Fracture Across Different Age Groups

Age Group	Frequency	Percentage (%)
< 60	9	18.4
60–69	17	34.7
70–80	17	34.7
> 80	6	12.2

Table 2: Comparison of Age, Affected Side, and Follow-up Duration Between Males and Females

Parameter	Unit	Men (n=24)	Women (n=25)	Total (n=49)	p-value
Affected Side					
— Right (count, %)		13 (54.2%)	8 (32%)	21 (42.9%)	0.117
— Left (count, %)		11 (45.8%)	17 (68%)	28 (57.1%)	
Age	Year	66.4 ± 12.06	71.32 ± 11.35	68.73 ± 11.88	0.121
Follow-up Duration	Month	49.87 ± 24.71	44.20 ± 25.87	46.97 ± 25.21	0.437

Table 3: Harris Hip Score and Its Subcomponents in the Study Population			
Variable	Mean ± SD	Minimum	Maximum
Pain	22.53 ± 10.06	10	44
Limping	6.32 ± 0.30	0	11
Need for Assistance	6.38 ± 2.02	2	11
Function:			
— Walking Distance Capable	89.21 ± 3.21	0	11
— Climbing Stairs	1.32 ± 0.71	0	4
— Putting on Socks and Shoes	2.00 ± 1.41	0	4
— Sitting	2.44 ± 1.96	0	5
— Using Public Transport	0.30 ± 0.46	0	1
Total Functional Score	6.08 ± 3.87	0	12
Absence of Deformity	0.40 ± 1.22	0	4
Range of Motion (ROM):			
— Hip Flexion	41.24 ± 10.05	30	54
— Abduction	8.85 ± 2.85	4	12
— Adduction	2.44 ± 0.70	1	3
— External Rotation	5.02 ± 1.42	2	6
Total ROM Score	2.87 ± 0.48	2.05	3.75
Total Harris Hip Score	50.51 ± 18.95	11.45	87.55

Table 4: Comparison of Mean Total Harris Hip Score and Its Subcomponents Between the Two Age Groups: Under 60 and 60 Years or Older			
Variable	Under 60 years (Mean ± SD)	60 years and older (Mean ± SD)	p-value
Pain	26.66 ± 8.66	21.10 ± 10.22	0.147
Limping	8.34 ± 2.33	5.98 ± 2.87	0.023*
Need for assistance	6.66 ± 0.77	6.22 ± 3.30	0.301
Function:			
— Walking distance capable	8.78 ± 3.33	5.07 ± 5.35	0.016*
— Climbing stairs	1.66 ± 0.05	1.25 ± 0.74	0.045*
— Putting on socks and shoes	2.00 ± 0.01	1.45 ± 1.85	0.118
— Sitting	3.12 ± 4.44	1.88 ± 2.22	0.071
— Use of public transport	0.55 ± 0.52	0.25 ± 0.43	0.075
Total functional score	8.42 ± 3.33	5.38 ± 5.57	0.043*
Absence of deformity	0	1.33 ± 0.50	0.268
Range of Motion:			
— Hip Flexion	38.33 ± 10.47	41.90 ± 9.97	0.614
— Abduction	9.84 ± 2.11	8.89 ± 2.80	0.827
— Adduction	2.77 ± 0.44	2.37 ± 0.74	0.133
— External Rotation	5.55 ± 0.88	4.90 ± 1.49	0.251
Total ROM score	2.78 ± 0.05	4.19 ± 0.00	0.559
Total Harris Hip Score	61.23 ± 15.39	29.48 ± 20.89	0.06

6 patients (66.7%) were men and 3 (33.3%) were women in patients under 60 years while 18 patients (45%) were men and 22 (55%) were women in over 60 years. There was no statistically significant difference between the two groups in terms of gender distribution (p = 0.289).

The average follow-up period was 48.66 ± 22.18 months for the under-60 group and 46.60 ± 26.08 months for over 60 years group. This difference was not statistically significant (p = 0.827). The mean age in the under-60 group was 52.33 ± 6.08 years, and in the 60-and-over group, it was 72.45 ± 9.50 years.

The difference of the total Harris Hip Score between the two age groups was marginally significant (P = 0.06). This was mainly related to the functional subcomponents of the score, while no statistically significant differences were observed between the groups in terms of pain, range of motion, deformity (Table 4). Table 5 shows the classification of Harris Hip Scores in terms of functional outcome for individuals under 60 years and those over 60 years. Among those over 60 years, 44.4% achieved moderate to good functional improvement, whereas only 15% of individuals under 60 years reached this level. The majority of patients over 60 years showed poor functional improvement. Patients over 60 years old were divided into five follow-up duration groups: 6–12 months, 12–24 months, 25–36 months, 37–48 months, and 49–60 months. According to ANOVA statistical testing, the mean Harris Hip Score among these five subgroups showed no statistically significant difference (P = 0.612).

Discussion

The goal of surgical treatment of displaced femoral neck fractures in elderly patients is to bring them back to their pre-injury functional status as soon as possible, while minimizing the risk of dislocation or the need for revision surgery. Arthroplasty is widely supported for treatment of hip fracture in elderly patients; however, but choosing the hemiarthroplasty or total hip arthroplasty, remains a topic of debate[23].

In the present study, of the 49 participating, the difference in Harris Hip Scores between the two groups was marginally significant (P = 0.06). Based on Harris Hip Score classifications, 55.6% of patients under 60 had poor function, 33.3% had fair function, and 11.1% had good function. These proportions in the 60-and-over group were 85%, 7.5%, and 7.5%, respectively. None of the patients achieved an excellent functional outcome. Therefore, this study couldn't find any satisfactory functional outcome following bipolar hemiarthroplasty in patients that was studied. Chhabra et al. in 2020, followed 30 patients over 60 years old with bipolar hemiarthroplasty after intracapsular femoral neck fractures and used the modified Harris Hip Score over 6 months. Among these 30 patients, 14 had excellent results, 12 had good results, 1 had fair results, and 1 had poor results[24]. Several reasons may explain the differences observed between the present study and the study by Chhabra et al.

Table 5: Classification of Harris Hip Scores by Functional Outcome in Individuals Under 60 Years and Those Over 60 Years

Performance Classification	Under 60 years (n=9)	60 years and older (n=40)	p-value
Poor	5 (55.6%)	34 (85%)	0.085
Fair	3 (33.3%)	3 (7.5%)	
Good	1 (11.1%)	3 (7.5%)	
Excellent	0	0	

Table 6: Mean Harris Hip Score in Five Patient Groups with Different Follow-up Durations

Follow-up Duration (months)	Number of Patients (n)	Total Harris Hip Score (mean ± SD)	95% Confidence Interval (%)	p-value
6–12	8	43.00 ± 10.13	32.05 – 53.96	
12–24	1	31.5	—	
25–36	5	51.45 ± 20.38	26.13 – 76.76	0.612
37–48	4	58.80 ± 44.54	14.50 – 67.45	
49–60	22	48.01 ± 21.95	28.38 – 57.75	

The first reason for the difference between the two studies was the variation in age, 72.42 years in our study and 67.2 years in Chhabra et al. study[24]. As observed in the present study, the Harris Hip Score has a significant negative correlation with age. Therefore, one reason for the higher functional scores in Chhabra et al.'s study may be related to the younger age of their study population.

Another difference between the two studies was the maximum follow-up duration: Chhabra et al. followed patients for 6 months[24], while in the present study, patients were followed for an average of approximately 4 years (ranging from 9 to 93 months). The Harris Hip Score is one of the most important tools for assessing the quality of life after femoral neck fracture surgery, but it changes over time. Therefore, the timing of assessment is particularly important, especially in hemiarthroplasty cases. For example, Zhao et al., in their meta-analysis comparing three independent studies, concluded that hip function peaks about one year after surgery[23].

Cadossi et al. noted that between 3 months and 3 years postoperatively, the Harris Hip Score tends to shift in favor of total hip arthroplasty compared to hemiarthroplasty, and the dominance of total hip arthroplasty becomes increasingly evident[25]. Similar results were reported by Hedbeck et al. with comparable follow-up duration[26]. The present study had the same results of Cadossi et al. and Hedbeck et al., confirming a decline in Harris Hip Scores in patients undergoing bipolar hemiarthroplasty over the long term.

Avery et al. also reported a decrease in hip functional scores in both hemiarthroplasty and total hip arthroplasty groups between 3 and 9 years after surgery[27].

Shukla et al. has compared the functional outcomes of bipolar prosthesis versus total hip replacement in the treatment of femoral neck fractures in elderly patients, all participants were over 60 years old with a mean age of 68.3 years. The modified Harris Hip Score in the bipolar hemiarthroplasty group was 74.68, 78.24, and 81.40 at 6, 12, and 24 months postoperatively, respectively[28].

In a study by Sharma et al. aimed at evaluating the results of bipolar hemiarthroplasty and total hip arthroplasty in femoral neck fracture in patients over 60 years old, 40 patients underwent bipolar hemiarthroplasty and were followed for one year. Similar to the present study, where the majority of fractures in the over-60 group were in elderly women with a prevalence of 55%, Sharma et al. also reported that 55% of femoral neck fractures occurred in elderly women. The mean age was similar to ours at 73 years and the Harris Hip Score was 80 (67–85) after one year follow-up[29].

In a study by Sonaje et al. comparing bipolar arthroplasty and total hip arthroplasty, after a 24-month follow-up, the mean modified Harris Hip Score in the bipolar hemiarthroplasty group was 83.85 ± 6.62. In this group, 7 patients (35%) achieved scores of 91 to 100 (excellent), 9 patients (45%) had scores between 81 and 90 (fairly good), and 4 patients (20%) had scores between 71 and 80 (good). No patient was classified in the poor category[30].

Regarding the differences of results between this study and those by Sharma et al.[29] and Sonaje et al.[30], apart from differences in follow-up duration, the prevalence of comorbidities in the studied populations can be considered another reason. In the present study, 22.4% of patients had comorbid conditions, whereas Sharma et al.[29] and Sonaje et al.[30] did not evaluate this aspect.

The extent to which the presence of comorbidities affects the success rate of arthroplasty surgery was investigated by Macaulay et al., who found that for each additional comorbidity, the risk of mortality increased by 4.2 times[31].

The nutritional status and mobility level of patients before surgery are also important factors. In the studies by Sharma et al.[29], Shukla et al.[28], and Chhabra et al.[24], all patients were in good ambulatory condition and were independently performing activities of daily living prior to trauma, which by itself may lead to higher Harris Hip Scores postoperatively.

The study by Shah Fahad et al. compared the functional outcomes, dislocation rates, complications, and mortality rate between bipolar hemiarthroplasty and total hip arthroplasty with a dual mobility cup for displaced femoral neck fractures in patients over 60 years old during a one-year follow-up, 77 patients underwent bipolar hemiarthroplasty. The mean Harris Hip Score before surgery was 71.01 (poor), which improved to 68.82 after surgery[32].

Therefore, factors to consider when selecting a treatment method for femoral neck fracture in elderly patient will be age, medical status and comorbidities, nutritional and life status, ambulatory and cognitive function, available surgical facilities, and socio-economic condition[29].

Although hemiarthroplasty has shown advantages in previous studies, such as shorter surgical time and less blood loss, it may have complications like polyethylene liner dislocation and acetabular erosion, which in the long term may necessitate conversion to total hip arthroplasty[33,34]. Evaluating hip function during follow-up after bipolar hemiarthroplasty is an important aspect and requires attention. Erosion of acetabulum after hemiarthroplasty could be a reason for poor long-term functional outcomes in these patients[29].

Conclusion

In the present study, the majority of individuals over 60 years old with fractures were elderly women with a prevalence of 55%. Based on the Harris Hip Score classification, 55.6% of individuals over 60 years old had poor function, 33.3% had relatively good function, and 11.1% had good function. These ratios were 85%, 7.5%, and 7.5%, respectively, in individuals aged 60 years or younger. None of the patients were able to achieve an excellent functional score. Therefore, the present study could not observe a satisfactory functional outcome after bipolar hemiarthroplasty among the population under investigation in the long term. Therefore, evaluating hip function in patients undergoing bipolar hemiarthroplasty in the long term is an important issue that requires further investigation. Wear of the acetabular component following hemiarthroplasty may be a potential cause of relatively poor long-term outcomes in patients undergoing hemiarthroplasty.

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