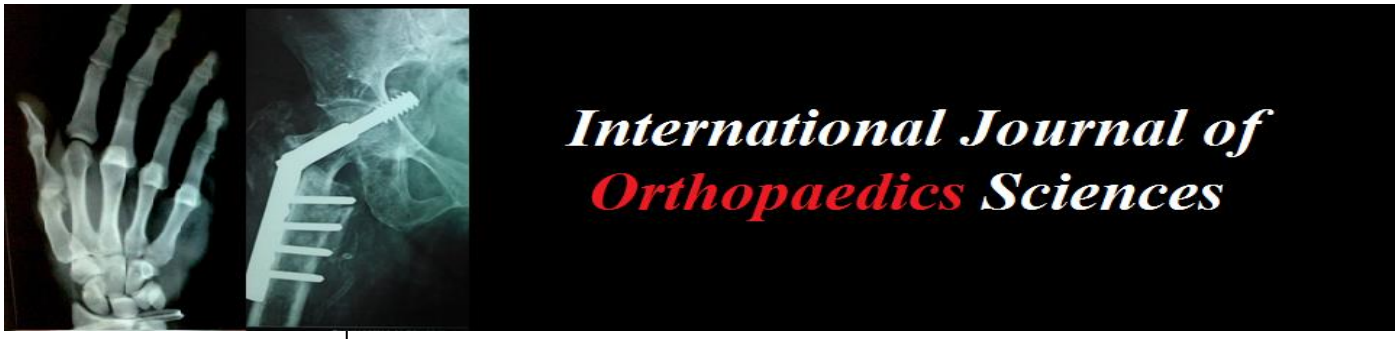

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A comparative study on the functional outcome of bipolar hip arthroplasty and total hip replacement in elderly patients with displaced femoral neck fractures

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Abstract
Background: Fractures of the femoral neck present a significant global public health challenge, particularly affecting elderly individuals and leading to high mortality rates. As the aging population continues to grow, the incidence of these fractures is also increasing steadily. When it comes to treating neck of femur fractures in the elderly age group, options include hemiarthroplasty (HA) and total hip replacement (THR). The choice of treatment depends on various factors, including the type of fracture, the patient's overall condition, functional requirements, and their medical and mental capacity to undergo surgery. This study aims to compare the outcomes of bipolar hemiarthroplasty (BHA) and total hip replacement (THR) in elderly patients with neck of femur fractures.
Materials and Methods: This was a prospective study of 30 patients of age more than 60 years with closed displaced femoral neck fractures and the patients were randomized into two groups (THR and BHA) of 15 patients each and their outcomes were compared. The study was conducted between May 2022 and December 2022 with a follow up of 2 years.
Results: At 24-month follow-up, the total modified Harris Hip scores ranged from 78 to 96.Three (20%) patients in BHA group and 6 (40%) patients in THR group had hip scores from 91 to 100 (excellent), 10 (67%) patients in BHA and nine patients (60%) in THR had hip scores 81–90 (fair) and 2 (13%) patients in BHA group and 1 (7%) patients in THR group were rated 71–80 (good) and none was found in poor category. The mean blood loss during BHA was 235 ml, whereas in THR it was 329 ml. The average duration of surgery was significantly shorter at 50 minutes compared to 119 minutes in the total hip replacement (THR) group. All patients were happy with the procedure and the functional outcome.
Conclusion: BHA demonstrates comparable functional outcomes to total hip replacement (THR) when assessed by Modified Harris Hip Score (MHHS). Furthermore, BHA offers several advantages such as significantly reduced blood loss during surgery, shorter surgical duration, and improved cost-effectiveness. Therefore, BHA can be recommended as the primary surgical management option for elderly patients with displaced femoral neck fractures in developing countries.

Keywords: Hemiarthroplasty, total hip replacement, elderly, harris hip score

Introduction
Hip fractures pose significant challenges to the healthcare system and society at large, particularly affecting the elderly population due to their diminished bone quality [1-3]. With the steady increase in life expectancy, the incidence of hip fractures has shown a corresponding upward trend [4]. In order to facilitate early mobilization and weight bearing, arthroplasty has become the preferred treatment approach for femoral neck fractures in older patients (aged >60 years) instead of osteosynthesis. This shift aims to mitigate the complications associated with prolonged immobilization [5]. However, the choice between hemiarthroplasty and total hip arthroplasty remains a perplexing dilemma, as both procedures have their own advantages and disadvantages, as observed in various clinical trials [6-12]. To shed light on this matter, this clinical study focuses on presenting the short-term outcomes of a prospective randomized trial that compares bipolar hemiarthroplasty (BHA) and total hip replacement (THR) for the management of displaced femoral neck fractures in the elderly population. The evaluation will primarily utilize the modified Harris hip score (MHHs) as a measure of functional outcome [13].

Materials and Methods

This was a prospective study that included 30 patients who presented with displaced femoral neck fractures between May 2022 and December 2022 at our Department of Orthopaedics. The inclusion criteria for this study consisted of patients aged 60 or above with closed intracapsular femoral neck fractures, while those with ipsilateral lower limb fractures, psychiatric or neurological disorders, and those who did not provide informed consent were excluded.

To ensure statistical significance, a sample size of 15 patients per intervention (THR vs BHA) was determined, assuming an alpha error of 0.05 and a power of 80%. Upon hospital admission, relevant data were collected from the patients, and they were advised to regularly visit the outpatient department for follow-up. The selection of patients for follow-up involved a combination of simple random technique and alternate systemic random sampling. All cases were monitored for a period of 24 months. The clearance had been obtained from ethical committee. The surgeries were performed on an elective basis, employing standard aseptic precautions, under spinal anesthesia with the patient in a lateral decubitus position on the unaffected side using either lateral or posterior approach. Skin incision made posterior to the lateral side of the greater trochanter extending 5cm proximally towards PSIS and 5cm distally along femoral axis. Following skin incision, fascia lata and gluteal muscles along with short external rotators were cut. The short external rotators were reflected to expose the capsule. Capsulotomy was done parallel to femoral neck in a T-fashion. Femoral head was extracted and femoral stem was prepared for prosthesis insertion. Standard 130 mm cementless porous coated femoral stems were used. Dual mobility cups were made up of titanium alloy with hydroxyapatite coating fixed by uncemented press fit technique. Femoral head was made up of standard stainless steel. The femoral stem and acetabular component was anteverted by 15° with an inclination of 40°.

Post operatively the patients were mobilised using a walker for 2–4 weeks. Quadriceps muscle strengthening exercises were started from day one after surgery. Low molecular weight heparin was administered to all patients as DVT prophylaxis. Patients were discharged on fifth post-operative day and followed in clinic after one week. Suture removal was done after 2 weeks. Functional outcome was ana ysed using Modified Harris Hip Score (MHHs) at 24 months.

The collected data were analyzed using various computer statistical software tools such as Microsoft Excel, SPSS 20, and primer. Descriptive statistics (mean, standard deviation, and proportions) were employed to summarize the study variables, while the 95% confidence intervals for mean differences were calculated. The association between qualitative study variables and outcomes was examined using the chi-square test, and the unpaired t-test was used for quantitative data analysis. A P-value of less than 0.05 was considered statistically significant.

Results

A total of 30 elderly patients with displaced neck of femur fracture treated with bipolar hip arthroplasty (BHA) and total hip replacement (THR) were studied in this study, which took place between May 2022 and December 2022. The group consisted of 9 males and 21 females, with a higher incidence of fractures on the left side affecting 16 patients (Figure 1). The average age of the patients was 71.3 years, ranging from 62 to 80 years. Slip and fall incidents were the most common mode of injury, followed by fall from a height. According to Gardens classification, type 4 fractures were observed more frequently, accounting for 19 patients (Table 2). In the group undergoing bipolar hip arthroplasty (BHA), the average duration of surgery was significantly shorter at 50 minutes compared to 119 minutes in the total hip replacement (THR) group. The mean blood loss during BHA was 235 ml, whereas in THR it was 329 ml (Table 1). At the end of two years, the total modified Harris Hip scores ranged from 78 to 96. In the BHA group, three patients (20%) achieved excellent scores (91-100), while six patients (40%) in the THR group achieved the same. Additionally, 10 patients (67%) in the BHA group and eight patients (60%) in the THR group had fair scores (81-90), while two patients (13%) in the BHA group and one patient (7%) in the THR group achieved good scores (71-80) (Figure 2). None of the patients fell into the poor category. No significant deformities were observed in either group, although four patients showed minor limb length discrepancy that did not require heel or sole rise. Two patients developed bed sores, but they were successfully treated with antibiotics. All patients were able to return to their preinjury status and resume their daily activities within 14 weeks. None of the patients experienced complications such as periprosthetic femur fractures, prosthetic dislocations, or implant failures. None of our patients were lost to follow up.

Discussion

Hip fractures present a significant global health challenge, and their incidence continues to rise. The rehabilitation of patients from rural areas is greatly influenced by factors such as poverty, ignorance, illiteracy, and life expectancy [13]. Therefore, it is preferable to opt for a comprehensive approach that addresses all these aspects at once. In the case of fractures in the neck of the femur, the use of osteosynthesis has been decreasing worldwide due to its high rates of non-union and implant failure, particularly among the elderly [14-16]. Patients and surgeons tend to favor alternative options such as unipolar hemiarthroplasty, bipolar hemiarthroplasty, and total hip arthroplasty, as they better cater to the specific needs of the individuals involved. The optimal treatment for displaced fractures of the femoral neck in elderly patients remains a topic of debate. Previous studies have indicated that bipolar hemiarthroplasty (BHA) is typically favored for older patients with limited life expectancy and lower functional demands, while total hip replacements (THRs) require more precision and time, offering improved functional outcomes and better suitability for younger patients with higher life expectancies and greater functional demands.

Dislocation is a primary cause for reoperation following total hip replacement (THR), and the risk of dislocation is higher in THA compared to bipolar hemiarthroplasty (BHA). The risk of dislocation is often a concern for orthopedic surgeons when considering total hip replacement (THR) for active elderly patients. Several factors contribute to the occurrence of dislocation, including the surgical approach and the size of the prosthetic head. Specifically, the posterolateral approach and the use of a smaller prosthetic head have been associated with an increased rate of dislocation. This trend is observed in both THA and BHA procedures, highlighting the importance of selecting optimal hardware and improving the surgical access route to mitigate complications associated with this commonly performed surgery. The findings of the present study suggest that well-trained general orthopedic surgeons, using an anterolateral approach and carefully selecting suitable patients, can achieve favorable outcomes and low

dislocation rates with primary THR.

In our study, we observed that the BHA group exhibited shorter surgery duration, reduced blood loss, and fewer blood transfusions compared to the THR group. This difference can be attributed to the additional preparation required for the acetabular component in THR procedures [6, 17-21]. In elderly patients, the treatment outcome is significantly influenced by surgery duration and blood loss, as prolonged surgery and increased blood loss make patients more susceptible to infections. Interestingly, the total duration of hospital stay did not show consistency between the two groups in our study, thus lacking reliability as a determining factor.

The functional outcome of total hip replacement (THR) is influenced by various factors, including patient characteristics, surgical technique, and the choice of implants. These factors collectively contribute to the overall quality of life that patients can achieve after the procedure. To assess the functional outcomes of THR, several hip scoring systems have been developed, such as the Western Ontario and McMaster Universities Arthritis Index (WOMAC score), the Oxford 12-item questionnaire, and the standard Harris Hip Score (HHS). However, it has been observed that the HHS has limitations, including a high ceiling effect, which means it may not accurately capture improvements in patients with higher preoperative functional scores. Additionally, the HHS is prone to inter-observer bias due to the subjective nature of the clinical evaluation component. To address these issues, the Modified Harris Hip Score (MHHS) was introduced, which eliminates the clinical evaluation part in order to minimize inter-observer bias and provide a more objective assessment of hip function after THR.

Hence, we employed the Modified Harris hip score, which showed significantly higher scores in the THR group compared to other arthroplasty methods. The MHHS ranges from 0 to 100 points and encompasses pain, deformity, function, and range of motion as subdomains. Our findings align with a study by Vanden *et al*., who reported that BHA was comparative with THR in terms of functional outcome calculated by MHHS at the end of 2 years [16]. Giannini *et al*. also noted that duration of surgery and blood loss were significantly higher in THR group than in BHA group, consistent with our study's results. BHA has demonstrated higher revision rates due to acetabular erosion, implant loosening, and heterotopic ossification [17]. Kasetti *et al*. reported a revision rate of 20.8% in the BHA group due to such complications. However, our study did not observe such findings [18]. Patients who underwent total hip arthroplasty (THA) demonstrated superior hip function compared to those treated with hemiarthroplasty. One significant factor contributing to this difference is acetabular erosion.

There were an increased number of hip complications in the total hip arthroplasty group, although the difference was not significant. Immediate complications include infection, deep vein thrombosis, and delayed mobilization, while late complications encompass implant failure, dislocation, periprosthetic fractures, and implant loosening. However, two of these complications - periprosthetic fracture and late hematogenous infection, cannot be directly attributed to the surgical method itself. Wound infections were the most common complication in both BHA and THR groups, with one case of deep wound infection in the BHA group, successfully treated with wound debridement and antibiotics. In the THR group, one case of superficial wound infection occurred, managed with oral antibiotics and dressings. Dislocation risk is higher in total hip arthroplasty, but our study did not report any dislocations in either group. The absence of dislocations can be attributed to another significant factor: the exclusion of patients with severe cognitive dysfunction from the study. Total hip arthroplasty is not recommended for individuals with cognitive dysfunction due to several reasons [18-24]. Firstly, there is an elevated risk of dislocation following the procedure. Additionally, these patients are more prone to experiencing complications. Moreover, their life expectancy tends to be shorter, further influencing the decision against performing total hip arthroplasty in this particular population [25, 26, 27]. Chronic hip pain was observed in three BHA patients, likely due to cartilage damage and acetabular surface erosion.

The observed lower values in the function dimension of the MHHS in our study, compared to studies involving patients who underwent total hip replacement (THR) for degenerative joint disease, can likely be attributed to the older age and higher prevalence of comorbidities among our patient population [28-34]. Even prior to the fracture, many of our patients relied on walking aids. Over time, there is a progressive decline in function and health-related quality of life, which is likely influenced by the natural aging process, the increased occurrence of comorbidities, and the occurrence of new fractures in the lower limb [35].

Bipolar arthroplasty is associated with a higher revision rate compared to THR in the literature, primarily due to acetabular erosion; however, our study did not record any cases requiring revision surgery. The study's limitation was the relatively short duration of follow-up.

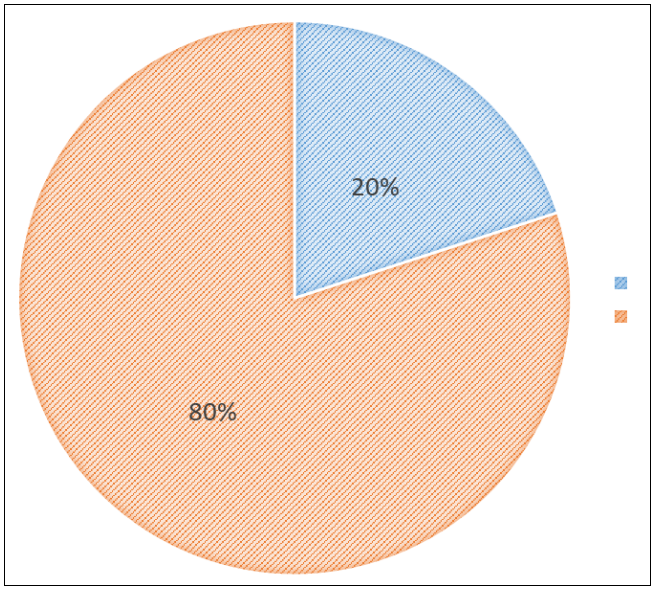

Fig 1: Distribution of gender among participants

Table 1: Blood loss and duration of surgery

	THR	BHA
Blood Loss during surgery (in ml)	329	235
Duration of surgery (in mins)	119	50

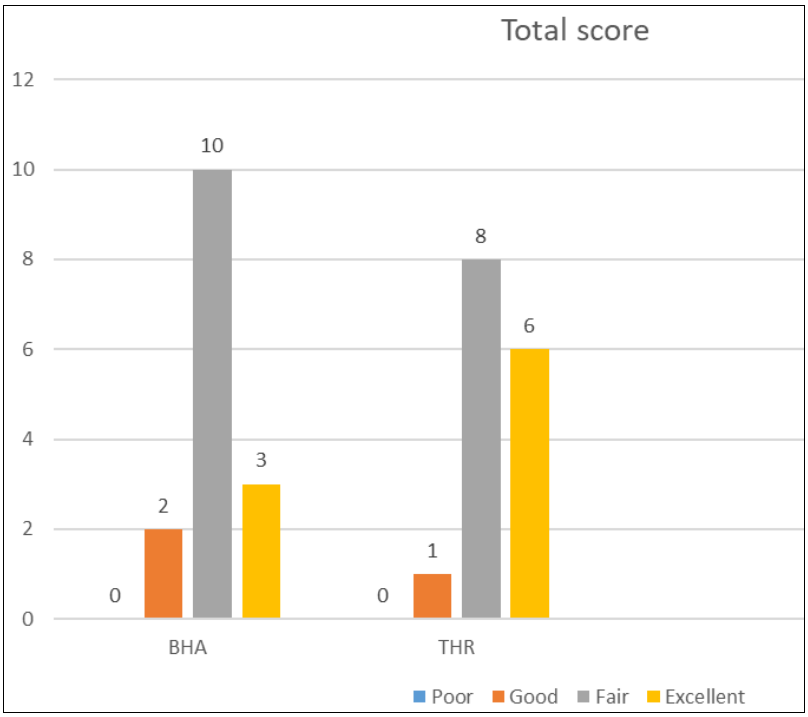

Fig 2: Distribution of cases by functional results based on MHHs at end of 2 years

Table 2: Patient demographics and data

BHA vs THR									
S. No	**Age**	**Sex**	**Side**	**Mode of injury**	**Garden type**	**Blood loss (ml)**	**Duration of surgery (mins)**	**Surgery performed**	**MHHs (2 years)**
1	66	M	R	RTA	4	220	45	BHA	78
2	68	F	L	SAF	3	330	120	THR	80
3	72	F	L	FFH	4	320	110	THR	94
4	64	M	L	RTA	4	340	120	THR	88
5	78	F	R	SAF	3	210	50	BHA	92
6	62	M	L	RTA	4	310	130	THR	90
7	68	F	L	FFH	3	220	45	BHA	82
8	74	F	R	SAF	3	230	55	BHA	92
9	80	F	L	SAF	4	220	45	BHA	82
10	72	M	R	FFH	4	250	55	BHA	86
11	70	F	R	SAF	3	340	110	THR	88
12	68	F	L	FFH	4	330	115	THR	92
13	76	F	L	SAF	3	260	50	BHA	80
14	78	F	R	FFH	4	240	55	BHA	82
15	74	M	L	FFH	4	220	55	BHA	94
16	76	F	R	SAF	4	250	50	BHA	84
17	72	F	R	SAF	3	320	125	THR	88
18	68	M	R	FFH	3	330	130	THR	92
19	66	F	L	RTA	4	310	115	THR	92
20	70	F	R	FFH	4	340	125	THR	90
21	68	F	L	FFH	3	260	45	BHA	86
22	72	F	R	SAF	4	350	110	THR	90
23	78	F	L	SAF	4	240	55	BHA	82
24	80	F	L	SAF	4	220	50	BHA	84
25	78	M	R	SAF	3	250	50	BHA	84
26	68	F	R	FFH	4	330	105	THR	96
27	64	M	L	RTA	4	310	135	THR	88
28	70	F	R	FFH	4	340	110	THR	90
29	62	M	L	RTA	4	330	120	THR	96
30	76	F	L	SAF	3	240	45	BHA	86

Conclusion

BHA demonstrates comparable functional outcomes to total hip replacement (THR) when assessed by Modified Harris Hip Score (MHHS). Furthermore, BHA offers several advantages such as significantly reduced blood loss during surgery, shorter surgical duration, and improved cost-effectiveness. Therefore, BHA can be recommended as the primary surgical management option for elderly patients with displaced femoral neck fractures in developing countries.

Declarations

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Conflict of Interest: None declared
Ethical Approval: Not required

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