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Comparison of hemiarthroplasty and total hip arthroplasty in elderly patients with displaced femoral neck fractures

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Abstract

Objective: This study was performed to compare the clinical and radiological outcomes of displaced femoral neck fractures (FNFs) treated with either hemiarthroplasty or total hip arthroplasty (THA) in elderly patients. Morbidity and mortality were also evaluated.

Methods: Twenty-two patients who underwent hemiarthroplasty and 16 patients who underwent THA for treatment of Garden type 3–4 FNFs from 2012 to 2015 were enrolled in this study. All patients were >65 years of age. Cox regression analysis was performed for mortality evaluation.

Results: The postoperative blood loss volume, decrease in the hemoglobin level, and transfusion rate were significantly higher in the THA group. The univariate mortality risk was higher in patients with a Charlson comorbidity score of >4, American Society of Anesthesiologists score of >2, Singh index of <3, and postoperative hospitalization of >1 week.

Conclusion: This study revealed no significant difference in the short-term clinical and radiological results between cementless hemiarthroplasty and THA in elderly patients with displaced FNFs. However, morbidity and mortality were associated with the presence of additional systemic diseases. THA is the preferred surgical technique in patients with displaced FNFs and low comorbidities.

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Introduction

The average lifespan worldwide is increasing, resulting in growth of the elderly population and an increase in the incidence of osteoporotic hip fractures. The worldwide frequency of hip fractures was 1.6 million in the year 2000, and this number is estimated to reach 6 million in the year 2050.[1] Among proximal femoral fractures, displaced femoral neck fractures (FNFs) are the most common (37% frequency), while two-thirds of total FNFs are displaced fractures.[2] Hemiarthroplasty (HA) and total hip arthroplasty (THA) are the main surgical techniques used to treat displaced FNFs in elderly patients (>65 years of age). Both of these methods have advantages and disadvantages. THA is reportedly associated with a longer length of surgery, increased blood loss, and higher rate of dislocation in the postoperative period, while HA is associated with a greater need for revision surgery because of increased acetabular erosion.[3]

Elderly patients often have additional diseases that can affect the mortality rate. However, the effect of surgery type on the mortality rate is not clear.[4] Conflicting results have been obtained regarding whether preoperative general health, activity level, presence/severity of additional diseases, and type of surgery affect mortality rates and other outcomes.[5]

This study was performed to compare the clinical and radiological results of displaced FNFs in elderly patients who underwent HA or THA. We also evaluated the effect of the selected surgery type on the morbidity and mortality rates.

Materials and methods

Patients

This study was approved by the local ethics committee of Uludağ University Research Ethics Committee (26 July 2016; approval no. 2016-14/9). Information was collected from all participants after obtaining written informed consent in accordance with the Declaration of Helsinki and ethical board approval. We retrospectively evaluated elderly patients (>65 years of age) with displaced FNFs (Garden type 3–4) who underwent HA or THA in a single center from 2012 to 2015. Patients were included in the study if they had pre-fracture mobilization capacity, had not previously undergone an operation in the same hip, and had been previously treated with cementless surgery. Patients were excluded from the study if they had pathologic fractures, had a non-displaced fracture (Garden type 1–2), had impaired cognitive function in the terminal period, or became bedridden.

Procedures

THA was performed in patients with degenerative arthritis (stage 3–4) defined according to the coxarthrosis classification by Kellgren and Lawrence. Patients in Group I underwent HA in the supine position with a lateral approach, and those in Group II underwent THA in the lateral decubitus

position with a posterolateral approach. All patients in both groups underwent cementless arthroplasty.

Clinical evaluation parameters

The American Society of Anesthesiologists (ASA) score was used to evaluate the patients' preoperative general health condition, and the Charlson comorbidity index was used to determine the effect of additional diseases on the results.[6]

The surgical time was defined as the time from the initial skin incision to wound closure, and the amount of blood loss was defined as the sum of the intraoperative and postoperative operative bleeding. The total length of hospital stay was defined as the time from admission to discharge, while the total hospitalization time was defined as the time from admission to the operation.

The modified Harris hip score and Barthel activity score were used for clinical assessments at each postoperative follow-up.[7]

We also evaluated each patient for complications such as infection, dislocation, heterotopic ossification, periprosthetic fracture, and femoral stem fracture; in patients who underwent THA, we also evaluated changes in the acetabular cup angle of $>2^\circ$ as well as vertical and horizontal migration.[8,9] The mortality rate was calculated at both the 1-year follow-up and at the last follow-up.

Surgery-related complications were classified as either general or hip-related complications, and their severities were graded.[10]

Radiologic evaluation parameters

Each patient underwent a radiological evaluation of his or her bone structure as assessed by the Singh index, and each patient was evaluated for osteoporosis.[11]

At each postoperative radiological follow-up, migration and radiolucency development were evaluated to determine the femoral stem angle, extremity length difference, and stem stability.[12]

When evaluating acetabular erosion, the amount of acetabular wear of the prosthesis was calculated in millimeters as described by Phillips.[13]

Statistical methods

The mean, standard deviation, median, lowest value, highest value, frequency, and ratio were used as descriptive statistics of the data. The Kolmogorov–Smirnov test was used to evaluate the distribution of the variables, and the Mann–Whitney U test was used to analyze quantitative, independent, non-parametric data. The chi-square test was used to analyze qualitative independent data, and Fisher's test was used when conditions for the chi-square test were not met. All analyses were performed using IBM SPSS Statistics, version 22.0 (IBM Corp., Armonk, NY, USA).

Results

In total, 38 patients aged >65 years were included in this study. A flowchart of the patients, including their demographics, is shown in Figure 1. HA was performed in 22 patients (57.9%, Group I) and THA was performed in 16 patients (42.1%, Group II). The mean postoperative follow-up in Group I was 26.2 ± 14.3 months (range, 2–47 months), and that in Group II was 24.2 ± 14.2 months (range, 1–48 months). The mean follow-up time in patients who survived in Group I was 31 ± 10.7 months (range, 16–47 months), and that in Group II was 30.5 ± 10.1 months (range, 16–48 months). Four patients from each group died (Figure 1).

In Group I, 3 (13.6%), 16 (72.8%), and 3 (13.6%) patients had an ASA score of 1, 2, and 3, respectively; these numbers in Group II were 2 (12.5%), 11 (68.8%), and 3 (18.7%), respectively. No patients in either

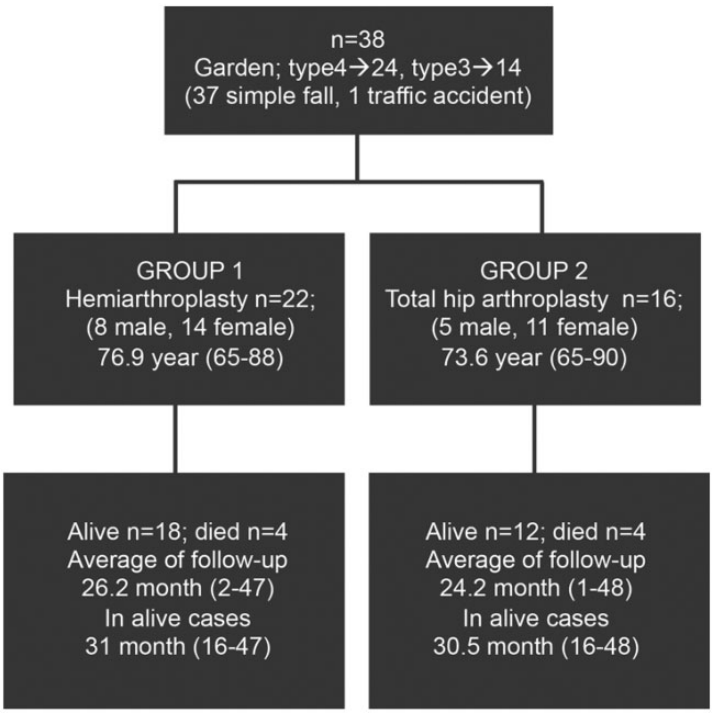

Figure 1. Flowchart of patients.

group had an ASA score of 4 or the addition of "E" to their score (indicating an emergency case). The mean Charlson comorbidity index in Groups I and II was 1.8 ± 0.9 (range, 0–3) and 2.2 ± 2.0 (range, 0–8), respectively. Between both groups, 12 (31.6%) patients had diabetes mellitus, 7 (18.4%) had coronary artery disease, 28 (73.7%) had hypertension, 4 (10.5%) had cerebrovascular disease, 1 (2.6%) had systemic lupus erythematosus, 10 (26.3%) had chronic obstructive pulmonary disease, 5 (13.2%) had congestive heart failure, and 1 (2.6%) had chronic hepatitis (Table 1).

The fracture type and Singh index were similar between the groups.

The mean length of operation in Groups I and II was 80.7 ± 20.4 minutes (range, 45–120 minutes) and 93.1 ± 18.8 minutes (range, 60–120 minutes), respectively.

The mean intraoperative/postoperative blood loss volume in Group I was 234 ± 128 mL (range, 100–500 mL), which was significantly higher than that in Group II (393 ± 165 mL; range, 100–700 mL) ($p < 0.05$). The mean postoperative decrease in the hemoglobin level in Group was 1.2 ± 0.9 (range, 0.1–2.7), which was significantly higher than that in Group II (1.9 ± 1.1; range, 0.5–3.9) ($p < 0.05$).

The mean postoperative transfusion amount in Group I was 0.9 ± 0.9 units (range, 0–3 units; $n = 14$), which was significantly lower than that in Group II (2 ± 1 units; range, 0–3 units; $n = 15$) ($p < 0.05$).

The mean hospitalization time in Groups I and II was 13.2 ± 10.3 days (range, 3–42 days) and 13.6 ± 10.2 days (range, 4–33), respectively. The mean duration of time from the initial admission to the operation in Groups I and II was 2.6 ± 1.3 days (range, 1–6 days) and 2.7 ± 1.5 days (range, 1–6 days), respectively.

Table 1. ASA scores, numbers of additional systemic diseases, and Charlson comorbidity index scores in each group.

		ASA score						Number of additional systemic diseases	Charlson comorbidity score
		1		2		3			
	N	n	%	n	%	n	%	Mean ± SD (med)	Mean ± SD (med)
Group I	22	3	13.6	16	72.8	3	13.6	1.6 ± 0.8 (2.0)	1.8 ± 0.9 (2.0)
Group II	16	2	12.5	11	68.8	3	18.7	2.1 ± 1.2 (2.0)	2.2 ± 2.0 (2.0)
Total	38	5	13.2	27	71.0	6	15.8	1.8 ± 1.0 (2.0)	2.1 ± 1.5 (2.0)
p		0.919**						0.157*	0.190*

Group I, hemiarthroplasty; Group II, total hip arthroplasty; ASA, American Society of Anesthesiologists; SD, standard deviation; med, median.
*Mann–Whitney U test, **chi-square test.

Clinical evaluation parameters in postoperative follow-up

At the last follow-up, the mean Harris hip score in Groups I and II was 83.9 ± 5 (range, 75–97) and 83.3 ± 6.7 (range, 71–93), respectively. The mean Barthel activity score in Groups I and II was 14.3 ± 1.3 (range, 12–17; n = 18) and 14.8 ± 0.9 (range, 13–16; n = 12), respectively.

Radiological evaluation parameters in postoperative follow-up

The femoral stem angle and extremity length discrepancy were similar between the two groups.

Stem migration of ≤2 mm was detected in two patients (9.1%) in Group I and in one patient (6.3%) in Group II. A 1-mm-long radiolucent line in femoral stem zone 7 was observed in one patient (4.5%) in Group I, but this was not detected in Group II.

Acetabular erosion of ≤2 mm in length was detected in two patients (9.1%) in Group I; no patients in Group II had acetabular cup wear. However, two patients (12.6%) in Group II had a 1-mm radiolucency in zone 2. The mean acetabular component angle in Group II was 37.9° (range, 30°–50°), while the vertical displacement of the component was 2 mm, even in the two patients (12.6%) that had an angle change of 2° (12.6%). Horizontal displacement was not observed in any patients. Heterotopic ossification developed in both groups. In Group I, grade 1, 2, and 3 heterotopic ossification was found in four (19.0%), one (4.8%), and three (14.2%) patients, respectively. In Group II, however, grade 3 and 4 heterotopic ossification was found in five patients (38.5%) and one patient (7.7%), respectively. The rate of heterotopic ossification was similar between the groups.

A grade 2 sciatic nerve injury developed in one patient (4.5%) in Group I. Conservative treatment was performed, and the patient recovered after 3 months of follow-up. Also in Group I, two patients (9.1%) developed grade 2 superficial exudates, and one patient (4.5%) developed a urinary tract infection; all of these patients underwent medical treatment. In Group II, grade 3 complications occurred in two patients (12.6%; pneumonia in one patient (6.3%) and gastrointestinal bleeding in the other patient (6.3%)); both were treated with hospitalization.

Postoperative dislocation developed in 1 patient (6.3%) in Group II. No patients in

Table 2. Distribution of types and grades of complications in each group.

	Group I (n = 22)			Group II (n = 16)				
Postoperative complications	n		%	N		%	P*	
Absent	13		72.7	7		43.8	0.350	
Present	9		27.3	9		56.3		
Complication type							Total	
During hospitalization	n	%	Grade	n	%	Grade	n	%
General								
Minor								
Urinary tract infection	1	4.5	1				1	2.6
Major								
Pulmonary embolism	1	4.5	5	1	6.3	5	2	5.3
Acute renal failure				1	6.3	5	1	2.6
Related to hip								
Superficial surgical site infection	2	9.1	1				2	5.3
Sciatic nerve damage	1	4.5	2				1	2.6
Total (During hospitalization)	5			2			7	
At follow-up								
General								
Pulmonary embolism	1	4.5	5	1	6.3	5	2	5.3
Acute renal failure	1	4.5	5	1	6.3	3	2	5.3
Acute myocardial infarction	1	4.5	5	1	6.3	5	2	5.3
Gastrointestinal bleeding				1	6.3	3	1	2.6
Pneumonia				1	6.3	3	1	2.6
Related to hip								
Dislocation				1	6.3	2	1	2.6
Acetabular erosion	2	9.1	1				2	5.3
Acetabular radiolucency				2	12.6	1	2	5.3
Cup angle change				2	12.6	1	2	5.3
Vertical cup migration				2	12.6	1	2	5.3
Stem migration	2	9.1	1	1	6.3	1	3	7.9
Stem radiolucency	1	4.5	1				1	2.6
Heterotopic ossification (>2)	3	13.6	1	6	37.5	1	9	23.7
Total (at follow-up)	11			19			30	
General total	16			21			37	

Group I, hemiarthroplasty; Group II, total hip arthroplasty
*Chi-square test

the current study developed a periprosthetic fracture or prosthetic infection; therefore, no additional surgical intervention was needed (Table 2).

One patient (4.5%) in Group I developed a fatal pulmonary thromboembolism in the first postoperative month during hospitalization. One patient (4.5%) in Group I developed pulmonary thromboembolism in the second postoperative month and died on day 12 of rehospitalization. Pulmonary thromboembolism developed in two patients in Group II (12.6%; one during hospitalization and the other during the 16-month follow-up); both of these patients died.

Table 3. Distribution of causes and times of deaths in each group.

Cause of death	Postoperative death (time point, mos)	Number of patients	Dead		Alive		p*
			n	%	n	%	
Group I							
Acute renal failure	3	1	4	18.2	18	81.8	0.611
Acute myocardial infarction	11	1					
PTE	1 and 2	2					
Group II							
Acute renal failure	2	1	4	25.0	12	75.0	
Acute myocardial infarction	3	1					
PTE	1 and 16	2					

Group I, hemiarthroplasty; Group II, total hip arthroplasty; PTE, pulmonary thromboembolism.
*Chi-square test.

Mortality assessment

One patient (4.5%) in Group I and one patient (6.3%) in Group II died of pulmonary thromboembolism in the short-term postoperative period (first 30 days after surgery). Four patients (18.2%) in Group I and three patients (18.7%) in Group II died during the first year of follow-up. The mortality rate at the last follow-up in Group I was 18.2% (four patients; mean follow-up, 26.2 months), and that in Group II was 25.0% (four patients; mean follow-up, 24.2 months) (Table 3).

The results of the Cox regression analyses are summarized in Table 4. According to these analyses, the univariate mortality risk increased when the Charlson comorbidity score was >4, ASA score was >2, Singh index was <3, and length of hospitalization was >1 week. The Charlson comorbidity score and postoperative length of hospitalization were independent factors affecting the survival rate.

Discussion

Analysis of our data revealed no significant differences in the clinical and radiological results between cementless THA and HA for the treatment of FNFs in elderly patients at the end of the short-term follow-up. However, the amount of intraoperative/postoperative blood loss and the number of transfusions were greater in the THA group. Both techniques have similar morbidity and mortality rates. Our analyses revealed that the mortality risk increased when the Charlson comorbidity score was >4, ASA score was >2, Singh index was <3, and length of hospitalization was >1 week. We also found that the Charlson comorbidity score and length of hospital stay were independent risk factors for survival.

Generally, the most widely accepted surgical technique for the treatment of displaced FNFs in elderly patients is arthroplasty, and the clinical results of performing this type of surgery as THA or HA have been reported in the literature.[2,5,14–16] Hedbeck et al.[17] conducted a prospective randomized clinical trial examining the results of arthroplasty (HA, n = 41; THA, n = 42) performed in 83 patients aged >65 years (mean age, 80 years). The authors found that while the results of both techniques were similar in the short-term period, the first-year follow-up results in the THA group were significantly better. Macaulay et al.[18] compared the results of arthroplasty for FNFs in 40 patients aged >50 years (HA, n = 23; mean age, 77 years and

Table 4. Cox regression analyses.

	Univariate model			Reduced multivariate model		
	HR	95% CI	p	HR	95% CI	p
Age	1.02	0.93–1.12	0.619			
Sex	0.24	0.03–1.96	0.183			
Side	1.23	0.31–4.91	0.772			
Waiting time for surgery	0.84	0.48–1.47	0.533			
ASA score of >2	4.62	1.24–17.15	**0.022**			
Charlson comorbidity index of >4	8.02	1.56–41.20	**0.013**	22.1	1.86–263	**0.014**
Garden type	1.83	0.37–9.07	0.459			
Singh Index of <3	0.27	0.06–0.97	**0.042**			
Anesthesia type	2.05	0.49–8.58	0.326			
Intraoperative/postoperative blood loss	1.00	1.00–1.00	0.907			
Decrease in hemoglobin level	0.72	1.34–1.52	0.383			
Length of postoperative stay >1 week	1.13	1.06–1.20	**0.000**	21.6	1.97–2.36	**0.012**
Femoral stem angle	1.51	0.55–4.13	0.42			
Femoral stem migration	0.04	0.00 to >100	0.57			
Femoral stem radiolucency	0.05	0.00 to >100	0.746			
Charnley zone	0.05	0.00 to >100	0.645			
Acetabular erosion	0.05	0.00 to >100	0.645			
Change in acetabular cup angle	0.05	0.00 to >100	0.645			
Heterotopic ossification grade	0.74	0.34–1.65	0.466			
	Cox regression					

HR, hazard ratio; CI, confidence interval; ASA, American Society of Anesthesiologists.
Boldface p values indicate statistical significance.

THA, n = 17; mean age, 82 years). The authors found that at the end of a 1-year follow-up, the Harris hip scores were 80 and 84, respectively, without a significant difference. Cadossi et al.[19] performed a study of patients with FNFs aged >70 years, 49 of whom underwent HA and 47 of whom underwent THA; at the 3-year follow-up, their Harris hip scores were 78 and 71, respectively, and this difference was significant. Liao et al.[20] conducted a meta-analysis evaluating HA and THA for the treatment of FNFs in 983 elderly patients in a total of 8 publications. The results indicated that patients who underwent THA had higher Harris hip scores at the 1-year postoperative follow-up, and this good outcome was still present at the 2-year follow-up. Although the clinical differences obtained after arthroplastic surgery for the treatment of FNFs are reportedly due to patient-specific and surgeon-specific factors, additional studies with larger sample sizes and longer follow-up periods are needed to make more accurate assessments.[20–22] In the current study, the clinical outcomes of our elderly patients with a diagnosis of a displaced FNF treated with HA or THA were similar in both the short-term and final follow-ups. However, we believe that the short-term follow-up findings may be an indicator of longer-term outcomes; therefore, long-term clinical outcomes should always be assessed.

In the treatment of displaced FNFs in elderly patients, radiological results have been shown to vary according to the selected treatment modality and the patient's characteristics. One of the most significant characteristics affecting outcomes is acetabular erosion, which is the most important cause of pain and reoperation–revision in elderly patients treated with HA.[3,22–25] Previous studies have shown that 9% to 66% of patients develop acetabular erosion; however, it is observed more frequently at the long-term follow-ups of overweight mobile patients.[22,25–34] In a study by Baker et al.,[23] acetabular erosion developed in 21 (66%) of 32 patients who underwent HA (mean age, 75 years; range, 63–86 years), and after 36 months of follow-up, a revision surgery (THA) was required for one of these patients. Likewise, Avery et al.[35] evaluated the 8.6-year follow-up results of 41 patients treated with HA and found that three of eight patients with acetabular erosion required revision surgery. A 2016 systematic review by Rogmark and Leonardsson[32] revealed that acetabular erosion more commonly develops after HA in older patients, patients with higher activity levels, the use of a bipolar prosthesis, patients with a large femoral head, and during a prolonged follow-up time. In the current study, acetabular erosion developed in two of the elderly patients treated with bipolar HA prostheses; both of these patients had grade 1 severity and did not require a reoperation during the follow-up. However, we believe that the poor clinical outcomes of these two patients (Harris hip scores of 75 and 77) may have been due to the effects of acetabular erosion because their clinical outcomes were worse than those of the other patients who underwent HA in our study (average Harris hip score of 83).

Osteoporosis is defined as bone quality deterioration and increased brittleness, and it is an important public health problem that is frequently seen in the elderly population.[33] Patients with both an FNF and osteoporosis may need modifications in their surgical treatments. The most fundamental change is the preference of bone cement for the purpose of sufficient implant stability. In their prospective study, Seo et al.[33] stated that of 70 patients with a mean age of 75 years, 36 underwent HA and 34 underwent cementless THA; no revisions were required until the end of the last follow-up. In their 3866-patient case series, Jameson et al.[30] found no significant difference in revision rates when comparing the short- to mid-term results of cemented THA and HA surgeries. In the current study, no problems were observed in the femoral component detection of patients treated with cementless arthroplasty during the follow-up period. We believe that the surgical technique is also a determining factor regarding whether adequate femoral component stability will be achieved at the last follow-up; notably, the Singh index is not affected by variability in bone quality. We also believe that during the surgical procedure, it is of utmost importance to use the largest possible component; this should provide adequate press-fit detection without creating a fracture. Furthermore, postoperative antiresorptive treatment should positively affect the patient's bone quality as well as the implant–bone fusion. In our experience, cementless arthroplasty performed with the correct technique and supplemented with additional postoperative medical treatments is one of the best surgical options for elderly patients with additional systemic diseases because complications can often be prevented.

Independent of the type of arthroplasty technique used, complications in elderly patients with hip fractures are typically more frequent and catastrophic than those observed after primary arthroplasty. Complications in elderly patients after

surgical treatment of FNFs often lead to prolonged hospitalization, increased treatment costs, loss of function and independence, and the need for long-term care, which results in a loss of productivity for their family members. Additional health problems increase the general complication rates among elderly patients. Therefore, it is important to identify comorbidity factors in these patients.[25,29] Multiple systemic diseases, a high ASA score, and an increased length of postoperative hospital stay are known to increase major complications after surgery.[11,13,14,16,22,25,31,36,37] Liodakis et al.[31] stated that complications (both major and minor) were more frequently observed in patients who underwent HA for the treatment of FNFs (HA, 10.3% and THA, 6.6% for minor complications; HA, 12.4% and THA, 9.1% for major complications). The study by Liodakis et al.[31] also revealed that the presence of either congestive heart failure or chronic obstructive pulmonary disease was an important comorbidity factor for predicting complications. The authors also found that ASA scores were higher in the HA than THA group; 81% of patients in the HA group and 64.9% of patients in the THA group had an ASA score of >2; therefore, an ASA score of >2 was defined as the threshold value for developing complications. Further, Miller et al.[25] stated that diabetes and disseminated cancer are comorbidity factors for the development of complications, and they emphasized the importance of the ASA score as well. In the current study, an ASA score of >2, Charlson comorbidity index of >4, and Singh index of <3 were found to be independent predictors of the development of comorbidities for the administered treatments.

In addition to general complication rates, hip-related problems are common in elderly patients and may vary with surgical technique (e.g., acetabular erosion for HA and acetabular component problems for THA). Dislocation is a problem that may require reoperation and reportedly occurs in up to 19% of patients after HA procedures and in up to 22% of patients after THA procedures.[3,14,16,18–20,22,23,25,26,28,30–32,34,35,38,39] Baker et al.[23] reported that seven patients with FNFs underwent THA and developed dislocation, and all of them required reoperation. Hedbeck et al.[17] evaluated the results of arthroplasty performed in 83 patients (HA, n = 41; THA, n = 42; mean age, 80 years) and reported no dislocations in either group after 48 months of follow-up. Avery et al.[35] stated that in a 7- to 10-year follow-up of 81 patients (THA, n = 40; HA, n = 41), 3 patients in the THA group developed dislocation, but the overall complication rates did not differ between the two groups. Zi-Sheng et al.[22] performed a meta-analysis of 1122 patients from 8 randomized controlled trials and found that 27 (4.5%) of 604 patients who underwent HA developed dislocations, while this rate was 17% (89 patients) among those who underwent THA. In the current study, dislocation was observed in one patient (6.3%) who underwent THA, and a closed reduction technique was performed. None of the other patients developed similar problems; the affected patient had no recurrence during follow-up and did not require a reoperation. Because the number of patients in our study was low, we cannot make a general inference. However, we believe that these problems can be minimized with good preoperative planning and successful surgical techniques, reducing the risk of dislocation in elderly patients undergoing THA with poor bone quality to within acceptable limits.

One of the greatest concerns regarding hip fracture in elderly patients is mortality, which depends both on the general health of the patient and the type of surgery performed. Studies have shown that the ASA score impacts the mortality rate.[4,24–26,28,40,41] In 243 elderly patients

with FNFs (mean age, 75.9 years), Lim et al.[41] found that the mortality rates were 11.2% and 19.5% at the first and third years of follow up, respectively, and the authors defined significant comorbidity factors for postoperative mortality as an ASA score of $\geq$3, wait time for surgery of $>$6 days, and patient age of $>$75 years. In a study by Avery et al.[35] including 81 patients (THA, n = 40; HA, n = 41), the long-term follow-up mortality rate was 51.2% and 32.5% for HA and THA, respectively. No deaths were detected in the THA group in the early postoperative period, while two deaths occurred in the HA group in the short-term period (one intraoperatively and one 1 week postoperatively). None of the long-term deaths were related to the THA or HA procedures, and the authors provided no specific information regarding the causes of the long-term deaths. Hopley et al.[42] evaluated 15 randomized controlled trials involving 1980 patients, including elderly patients with FNFs, and found that the surgical technique did not significant affect the risk of mortality at the 1-year follow-up. Maceroli et al.[39] conducted a study of 45,749 patients with FNFs (mean age: HA, 79 years; THA, 83 years) and reported that the 30-day mortality rates were 8.4% and 5.7% in the HA and THA groups, respectively; further, they reported that the mortality rate at the 1-year follow-up was higher in the HA group. By analyzing comorbidity variables, the authors of that study concluded that THA surgeries in centers offering multiple arthroplasty treatments were associated with a reduced risk of mortality. Ginsel et al.[28] treated 283 patients with FNFs (HA, 232; THA, 52; mean age, 83.4 years) with a cemented femoral stem; the mean length of hospital stay was 9.2 days, and the length of hospital stay of the patients with an ASA score of $\geq$3 cases was the most important risk factor for mortality. Thromboembolism is known to be the most frequent cause of early mortality. Prophylactic treatments are important in reducing this problem, and to that end, many different guidelines have been defined. Recent studies have shown that these approaches may also be effective in lowering early mortality rates. In the current study, one patient in each group died in the early period, and a total of four patients died between both groups. We believe that prolonged prophylactic treatments as well as immediate mobilization are effective for lowering the short-term mortality rate. We urge physicians to consider using guidelines recommending prolonged prophylaxis for elderly patients who have additional diseases and an increased susceptibility to thromboembolic events.

Our study has some limitations. First, this was a retrospective study that included a low number of patients and had a relatively short-term follow-up. In addition, the way in which we defined the criteria when forming groups inhibited randomization in the selection of surgery type. However, randomization in elderly patients with comorbidities can lead to possible ethical problems. Furthermore, the treatment of patients in tertiary referral hospitals may not reflect the actual results in the general population, especially when assessing morbidity and mortality. The main strength of this study is that we included groups of patients with homogeneous demographics who underwent the same surgical techniques and implants. The effectiveness and reliability of both surgical methods can be evaluated in follow-up studies, and a cost analysis should be performed with well-designed, prospective, multicenter studies with a sufficient number of patients and adequately long follow-up time.

Conclusions

In conclusion, the short-term clinical and radiological results were similar for elderly

patients with FNFs who underwent cementless HA and THA. Depending on the preparation of the acetabulum, which is an additional surgical procedure in THA, the length of surgery, amount of blood loss, and blood transfusion rates were higher in THA than in HA. Additionally, the development of acetabular problems should be taken into consideration, even in the short-term follow-up period, in patients undergoing HA. Other factors, including bone quality and osteoporosis, should also be considered. Morbidity and mortality were found to be associated with the presence of additional systemic diseases. In conclusion, our study indicates that THA is the preferred surgical technique in elderly patients with displaced FNFs and low comorbidities.

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References

1. Cooper C, Campion G and Melton LJ, 3rd. Hip fractures in the elderly: a world-wide projection. *Osteoporos Int* 1992; 2: 285–289.
2. Thorngren KG, Hommel A, Norrman PO, et al. Epidemiology of femoral neck fractures. *Injury* 2002; 33(Suppl 3): 1–7.
3. Jonas SC, Shah R, Al-Hadithy N, et al. Displaced intracapsular neck of femur fractures in the elderly: bipolar hemiarthroplasty may be the treatment of choice; a case control study. *Injury* 2015; 46: 1988–1991.
4. Hossain M and Andrew JG. Is there a difference in perioperative mortality between cemented and uncemented implants in hip fracture surgery? *Injury* 2012; 43: 2161–2164.
5. Nather A, Seow CS, Iau P, et al. Morbidity and mortality for elderly patients with fractured neck of femur treated by hemiarthroplasty. *Injury* 1995; 26: 187–190.
6. Charlson ME, Pompei P, Ales KL, et al. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis* 1987; 40: 373–383.
7. Frihagen F, Grotle M, Madsen JE, et al. Outcome after femoral neck fractures: a comparison of Harris Hip Score, Eq-5d and Barthel Index. *Injury* 2008; 39: 1147–1156.
8. Brooker AF, Bowerman JW, Robinson RA, et al. Ectopic ossification following total hip replacement. Incidence and a method of classification. *J Bone Joint Surg Am* 1973; 55: 1629–1632.
9. Wroblewski BM. Clinical and radiographic evaluation of total hip replacement. A standard system of terminology for reporting results. *J Bone Joint Surg Am* 1991; 73: 948.
10. Healy WL, Iorio R, Clair AJ, et al. Complications of Total Hip Arthroplasty: Standardized List, Definitions, and Stratification Developed by The Hip Society. *Clin Orthop Relat Res* 2016; 474: 357–364.
11. Singh M, Nagrath AR and Maini PS. Changes in trabecular pattern of the upper end of the femur as an index of osteoporosis. *J Bone Joint Surg Am* 1970; 52: 457–467.
12. Gruen TA, McNeice GM and Amstutz HC. "Modes of failure" of cemented stem-type femoral components: a radiographic analysis of loosening. *Clin Orthop Relat Res* 1979: 17–27.
13. Phillips TW. Thompson hemiarthroplasty and acetabular erosion. *J Bone Joint Surg Am* 1989; 71: 913–917.

14. Burgers PT, Van Geene AR, Van den Bekerom MP, et al. Total hip arthroplasty versus hemiarthroplasty for displaced femoral neck fractures in the healthy elderly: a meta-analysis and systematic review of randomized trials. *Int Orthop* 2012; 36: 1549–1560.
15. Lu-Yao GL, Keller RB, Littenberg B, et al. Outcomes after displaced fractures of the femoral neck. A meta-analysis of one hundred and six published reports. *J Bone Joint Surg Am* 1994; 76: 15–25.
16. Yu L, Wang Y and Chen J. Total hip arthroplasty versus hemiarthroplasty for displaced femoral neck fractures: meta-analysis of randomized trials. *Clin Orthop Relat Res* 2012; 470: 2235–2243.
17. Hedbeck CJ, Enocson A, Lapidus G, et al. Comparison of bipolar hemiarthroplasty with total hip arthroplasty for displaced femoral neck fractures: a concise four-year follow-up of a randomized trial. *J Bone Joint Surg Am* 2011; 93: 445–450.
18. Macaulay W, Nellans KW, Iorio R, et al. Total hip arthroplasty is less painful at 12 months compared with hemiarthroplasty in treatment of displaced femoral neck fracture. *HSS J* 2008; 4: 48–54.
19. Cadossi M, Chiarello E, Savarino L, et al. A comparison of hemiarthroplasty with a novel polycarbonate-urethane acetabular component for displaced intracapsular fractures of the femoral neck: a randomised controlled trial in elderly patients. *Bone Joint J* 2013; 95-B: 609–615.
20. Liao L, Zhao J, Su W, et al. A meta-analysis of total hip arthroplasty and hemiarthroplasty outcomes for displaced femoral neck fractures. *Arch Orthop Trauma Surg* 2012; 132: 1021–1029.
21. Tol MC, van den Bekerom MP, Sierevelt IN, et al. Hemiarthroplasty or total hip arthroplasty for the treatment of a displaced intracapsular fracture in active elderly patients: 12-year follow-up of randomised trial. *Bone Joint J* 2017; 99-B: 250–254.
22. Zi-Sheng A, You-Shui G, Zhi-Zhen J, et al. Hemiarthroplasty vs primary total hip arthroplasty for displaced fractures of the femoral neck in the elderly: a meta-analysis. *J Arthroplasty* 2012; 27: 583–590.
23. Baker RP, Squires B, Gargan MF, et al. Total hip arthroplasty and hemiarthroplasty in mobile, independent patients with a displaced intracapsular fracture of the femoral neck. A randomized, controlled trial. *J Bone Joint Surg Am* 2006; 88: 2583–2589.
24. Emery RJ, Broughton NS, Desai K, et al. Bipolar hemiarthroplasty for subcapital fracture of the femoral neck. A prospective randomised trial of cemented Thompson and uncemented Moore stems. *J Bone Joint Surg Br* 1991; 73: 322–324.
25. Miller CP, Buerba RA and Leslie MP. Preoperative factors and early complications associated with hemiarthroplasty and total hip arthroplasty for displaced femoral neck fractures. *Geriatr Orthop Surg Rehabil* 2014; 5: 73–81.
26. Andersen MF, Jakobsen T, Bensen AS, et al. Lower reoperation rate for cemented femoral stem than for uncemented femoral stem in primary total hip arthroplasty following a displaced femoral neck fracture. *SICOT J* 2015; 1: 26.
27. Eiskjaer S, Boll K and Gelineck J. Component motion in bipolar cemented hemiarthroplasty. *J Orthop Trauma* 1989; 3: 313–316.
28. Ginsel BL, Taher A, Ottley MC, et al. Hospital mortality after arthroplasty using a cemented stem for displaced femoral neck fractures. *J Orthop Surg (Hong Kong)* 2014; 22: 279–281.
29. Horriat S, Hamilton PD and Sott AH. Financial aspects of arthroplasty options for intra-capsular neck of femur fractures: a cost analysis study to review the financial impacts of implementing NICE guidelines in the NHS organisations. *Injury* 2015; 46: 363–365.
30. Jameson SS, Lees D, James P, et al. Cemented hemiarthroplasty or hip replacement for intracapsular neck of femur fracture? A comparison of 7732 matched patients using national data. *Injury* 2013; 44: 1940–1944.
31. Liodakis E, Antoniou J, Zukor DJ, et al. Major Complications and Transfusion Rates After Hemiarthroplasty and Total Hip Arthroplasty for Femoral Neck

Fractures. *J Arthroplasty* 2016; 31: 2008–2012.
32. Rogmark C and Leonardsson O. Hip arthroplasty for the treatment of displaced fractures of the femoral neck in elderly patients. *Bone Joint J* 2016; 98-B: 291–297.
33. Seo JS, Shin SK, Jun SH, et al. The Early Result of Cementless Arthroplasty for Femur Neck Fracture in Elderly Patients with Severe Osteoporosis. *Hip Pelvis* 2014; 26: 256–262.
34. Tidermark J, Zethraeus N, Svensson O, et al. Femoral neck fractures in the elderly: functional outcome and quality of life according to EuroQol. *Qual Life Res* 2002; 11: 473–481.
35. Avery PP, Baker RP, Walton MJ, et al. Total hip replacement and hemiarthroplasty in mobile, independent patients with a displaced intracapsular fracture of the femoral neck: a seven- to ten-year follow-up report of a prospective randomised controlled trial. *J Bone Joint Surg Br* 2011; 93: 1045–1048.
36. Mariconda M, Costa G, Misasi M, et al. Ambulatory Ability and Personal Independence After Hemiarthroplasty and Total Arthroplasty for Intracapsular Hip Fracture: A Prospective Comparative Study. *J Arthroplasty* 2017; 32: 447–452.
37. Johnson DJ, Greenberg SE, Sathiyakumar V, et al. Relationship between the Charlson Comorbidity Index and cost of treating hip fractures: implications for bundled payment. *J Orthop Traumatol* 2015; 16: 209–213.
38. Fisher MA, Matthei JD, Obirieze A, et al. Open reduction internal fixation versus hemiarthroplasty versus total hip arthroplasty in the elderly: a review of the National Surgical Quality Improvement Program database. *J Surg Res* 2013; 181: 193–198.
39. Maceroli MA, Nikkel LE, Mahmood B, et al. Operative Mortality After Arthroplasty for Femoral Neck Fracture and Hospital Volume. *Geriatr Orthop Surg Rehabil* 2015; 6: 239–245.
40. Gjertsen JE, Lie SA, Vinje T, et al. More reoperations after uncemented than cemented hemiarthroplasty used in the treatment of displaced fractures of the femoral neck: an observational study of 11,116 hemiarthroplasties from a national register. *J Bone Joint Surg Br* 2012; 94: 1113–1119.
41. Lim YW, Kwon SY, Han SK, et al. Postoperative mortality and factors related to mortality after bipolar hemiarthroplasty in patients with femoral neck fractures. *J Arthroplasty* 2009; 24: 1277–1280.
42. Hopley C, Stengel D, Ekkernkamp A, et al. Primary total hip arthroplasty versus hemiarthroplasty for displaced intracapsular hip fractures in older patients: systematic review. *BMJ* 2010; 340: c2332.