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Original Article

Effects of Hardinge versus Moore approach on postoperative outcomes in elderly patients with hip fracture

Fırat Ozan[1], Eyyüp Sabri Öncel[1], Şemmi Koyuncu[2], Kaan Gürbüz[1], Fatih Doğar[1], Fatih Vatansever[1], Fuat Duygulu[1]

[1]Department of Orthopedics and Traumatology, Kayseri Training and Research Hospital, Kayseri, Turkey; [2]Department of Orthopedics and Traumatology, Bayburt State Hospital, Bayburt, Turkey

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Abstract: Objective: With increasing age, minor traumas may result in multipart and unstable fractures of the proximal femur. The treatment aims to return patients to their prefracture functional levels. In elderly patients with proximal femoral fractures, hip replacement with hemiarthroplasty (HA) is common performed. This study aims to evaluate the efficiency of treatment, mortality-morbidity relationship, and postoperative complications in elderly patients with proximal femoral fractures who underwent HA with a Hardinge or Moore approach. Materials and methods: We retrospectively evaluated 233 patients who underwent cement-less bipolar HA for proximal femoral fracture with either a Hardinge approach (Group 1; n = 86; 29 males, 57 females; mean age 78.3 years; range 67-91 years) or a Moore approach (Group 2; n = 147; 68 males, 79 females; mean age 78.7 years; range 65-102 years). Patients in both groups were compared with respect to gender, type of fracture, age, American Society of Anesthesiologist (ASA) score, time from fracture to operation, comorbid factors, postoperative mortality, and postoperative complications. Postoperative functional results evaluated using the University of California, Los Angeles (UCLA) hip scoring assessment. Results: Mean UCLA scores were 12.02 and 11.77 in Groups 1 and 2, respectively ($P > 0.05$), and mean time from fracture to operation was 2.8 days and 1.7 days, respectively ($P < 0.05$). Eight (9.3%) and 18 (12.2%) patients died in Groups 1 and 2, respectively ($P > 0.05$). For both groups, mortality rate of patients with ASA scores of 3-4 was non-significantly higher than that of patients with ASA scores of 1-2 ($P > 0.05$). In Group 1, but not Group 2, mortality increased significantly with increasing number of comorbidities. Three (3.4%) and 11 (7.4%) patients developed an infection in Groups 1 and 2, respectively ($P > 0.05$), and postoperative dislocation occurred in four (4.6%) and 17 (11.5%) patients, respectively ($P > 0.05$). Conclusion: Detecting factors that affect outcomes and taking protective measures are essential in elderly patient groups with low postoperative success levels. The surgical approach is also a factor affecting the outcomes of HA for proximal femoral fracture.

Keywords: Hip fractures, hemiarthroplasty, Hardinge approach, Moore approach, comorbidity, mortality, risk factors

Introduction

Hip fracture is a common health problem, particularly in the elderly [1-3]. Due to decreased visual and hearing capabilities, as well as balance control and emerging gait disorders, elderly people fall more frequently. This, in addition to an increased prevalence of osteoporosis, leads to multipart and unstable fractures of the proximal femur [1, 3, 4]. Hip fracture is a leading cause of death in the elderly population [1, 3]. Surgical procedures for hip fractures are associated with high morbidity and mortality, depending on the general preoperative condition of the patient [2, 3], as well as other preoperative systemic comorbidities [1-3].

The treatment options for proximal femoral fractures, nondisplaced or displaced, are osteosynthesis, hemiarthroplasty (HA), and total joint arthroplasty [4, 5]. The goal of treatment is to return patients to their prefracture functional levels without mortality and long-term disability [3]. Femoral head replacement is preferred over internal fixation due to high rates of non-

Table 1. Patients' demographic characteristics and clinical outcomes

	Group 1 (n = 86)	Group 2 (n = 147)	*P*-value
Age (years), mean (range)	78.3 (67-91)	78.7 (65-102)	P = 0.6879
Sex, n (%)			
Female	57 (66.2)	79 (53.7)	χ^2 = 0.055 P = 0.815
Male	29 (33.7)	68 (46.2)	
Time from fracture to operation (days)	2.8 (1-9)	1.7 (0-17)	P = 0.0001
ASA score, n (%)			
ASA 1-2	26 (30.2)	45 (30.6)	χ^2 = 86.00 P = 0.000
ASA 3-4	60 (69.8)	102 (69.4)	
UCLA score	12.02	11.77	P = 0.423
Dislocation, n (%)	4 (4.6)	17 (11.5)	χ^2 = 0.680 P = 0.409
Infections, n (%)	3 (3.4)	11 (7.4)	χ^2 = 0.112 P = 0.737
Mortality, n (%)	8 (9.3)	18 (12.2)	χ^2 = 0.039 P = 0.843

Abbreviations: ASA, American Society of Anesthesiologists; UCLA, University of California, Los Angeles.

union, avascular necrosis, and reoperation after osteosynthesis in elderly patients [5, 6]. Some authors reported that HAs yield better outcomes than osteosynthesis for the treatment of unstable intertrochanteric hip fractures [7, 8].

Many different surgical approaches to the hip joint have been described [5, 9, 10]. The two main surgical approaches are lateral and posterior [11, 12]. The posterior (Moore) approach is generally considered to be easy to perform and has less tissue dissection, which leads to shorter operation times and less blood loss [5, 9, 10, 12]. The advantage of a lateral (Hardinge) approach is that it can provide generous exposure of the acetabulum, which facilitates cup positioning. Appropriate cup positioning may decrease rates of hip dislocation [5, 9-11].

In this study, we evaluated the efficiency of treatment, mortality-morbidity relationship, and postoperative complications in elderly patients with proximal femoral fractures who underwent HA with a Hardinge or Moore approach.

Material and methods

We retrospectively evaluated 233 patients (97 males, 136 females) aged 65 and over, who underwent cement-less bipolar HA due to proximal femoral fracture between 2011 and 2014 with a follow-up duration of at least 6 months. Patients separated into two groups according to surgical approach. Eighty-six patients (29 males, 57 females; 42 right, 44 left; mean age 78.3 years; range 67-91 years) were included in the Group 1 in which hip joint capsules were exposed anteriorly with a lateral approach (Hardinge), whereas 147 patients (68 males, 79 females; 81 right, 66 left; mean age 78.7 years; range 65-102 years) were included in the Group 2 in which hip joint capsules were exposed posteriorly with a posterior approach (Moore). Mean follow-up duration of patients in Group 1 and Group 2 were 17.4 months (range 6-34 months) and 16.9 months (range 6-39 months), respectively (**Table 1**).

All patients had spinal anesthesia. Patients were required to ambulate on the first day after surgery with partial-weight bearing according to their pain tolerance levels.

Both groups compared with respect to gender, type of fracture, age, American Society of Anesthesiologists (ASA) scores, time from fracture to operation, comorbid factors, postoperative mortality, and postoperative complications [13]. The University of California, Los Angeles (UCLA) hip scoring assessment used to evaluate patients' postoperative functional results. Patient also classified into two groups based on their ages as 65-74 years and ≥ 75 years.

Time from fracture to operation was compared by grouping patients into three categories of time (1-3, 4-6, and ≥ 7 days), and death ratios of patients in these groups were evaluated.

The presence of associated comorbidities, including neurologic, cardiac, pulmonary, endocrine, and renal diseases, identified. Patients were assigned into four groups according to the number of comorbidities present at the time of

Table 2. Clinical characteristics of the patients according to mortality

Patient characteristics	Group 1 (n = 8/86)			Group 2 (n = 18/147)		
	No Mortality	Mortality	*P*-value	No Mortality	Mortality	*P*-value
Age (years),						
65-74	23 (29.5)	3 (37.5)	$\chi^2 = 0.22$	36 (27.9)	3 (16.7)	$\chi^2 = 1.02$
≥ 75	55 (70.5)	5 (62.5)	P = 0.638	93 (72.1)	15 (83.3)	P = 0.312
Time from fracture to operation (days), n (%)						
1-3	33 (42.3)	4 (50)	$\chi^2 = 0.76$	111 (86)	17 (94.4)	$\chi^2 = 2.82$
4-6	40 (51.3)	3 (37.5)		15 (11.6)	0 (0)	P = 0.243
≥ 7	5 (6.4)	1 (12.5)	P = 0.683	3 (2.3)	1 (5.6)	
ASA score, n (%)						
ASA 1-2	22 (28.2)	4 (50)	$\chi^2 = 1.63$	40 (31.0)	5 (27.8)	$\chi^2 = 0.07$
ASA 3-4	56 (71.8)	4 (50)	P = 0.201	89 (69.0)	13 (72.2)	P = 0.781
Dislocation, n (%)						
Absent	74 (94.9)	8 (100)	$\chi^2 = 0.51$	117 (90.7)	13 (72.2)	$\chi^2 = 5.27$
Present	4 (5.1)	0 (0)	P = 0.430	12 (9.3)	5 (27.8)	P = 0.022
Infections, n (%)						
Absent	78 (100)	5 (62.5)	$\chi^2 = 30.30$	118 (86.8)	18 (100)	$\chi^2 = 1.65$
Present	0 (0)	3 (37.5)	P = 0.000	11 (8.5)	0 (0)	P = 0.198
Number of comorbidities, n (%)						
0	11 (14.1)	0	$\chi^2 = 12.33$	22 (17.1)	3 (16.7)	$\chi^2 = 1.12$
1	26 (33.3)	0	P = 0.006	46 (35.7)	5 (27.8)	P = 0.771
2	25 (32.1)	2 (25)		49 (38)	7 (38.9)	
≥ 3	16 (20.5)	6 (75)		12 (9.3)	3 (16.7)	

Abbreviations: ASA, American Society of Anesthesiologists.

surgery-zero, one, two, and three or more comorbid factors. This study conducted in accordance with the ethical guidelines of the Declaration of Helsinki and informed consent obtained from all patients.

Statistical analyses

Statistical analysis was performed using PASW version 18.0 software (SPSS Inc., Chicago, IL, USA). Frequency analysis was performed for categorical variables. The data were expressed in numbers and percentages. Paired Student's t-test and Pearson chi-square test were used to compare categorical data groups. A *p* value of < 0.05 was considered statistically significant.

Results

Fracture distributions of patients were classified according to the American Orthopedic/American Orthopedic Trauma Association (AO/OTA) classification as follows. Group 1: A1 in 10 patients (11.6%), A2 in 21 (24.4%), A3 in four (4.6%), B1 in 24 (27.9%), B2 in 18 (20.9%), and B3 in nine (10.4%). Group 2: A1 in 31 patients (21%), A2 in 38 (25.8%), A3 in six (4%), B1 in 10 (6.8%), B2 in 45 (30.6%), and B3 in 17 (11.5%).

No significant difference detected between Group 1 and Group 2 in terms of patient age and fracture type (P > 0.05). Mean UCLA scores were 12.02 (range 3-28) and 11.77 (range 3-30) in Group 1 and Group 2, respectively (P = 0.423). No periprosthetic fracture, neurologic deficit, or heterotopic ossification detected in any of the groups.

Mean time from fracture to operation was 2.8 days (range 1-9 days) and 1.7 days (range 0-17 days) in Group 1 and Group 2, respectively (P = 0.0001). An evaluation of the relationship between elapsed time until operation and mortality revealed that length of elapsed time until operation did not increase mortality significantly in either group (Group 1, $\chi^2 = 0.761$, P = 0.683; Group 2, $\chi^2 = 2.827$, P = 0.243).

Postoperatively, an infection developed in three (3.4%) and 11 patients (7.4%) in Group 1 and Group 2, respectively ($\chi^2 = 0.112$, P = 0.737), and hip dislocation in four (4.6%) and 17

patients (11.5%), respectively (χ^2 = 0.680, P = 0.409).

A review of postoperative mortality revealed that eight (9.3%) and 18 patients (12.2%) died in Group 1 and Group 2, respectively (χ^2 = 0.039, P = 0.843). In both groups, mortality rate of patients with ASA scores of 3-4 was not significantly higher than that of patients with ASA scores of 1-2 (Group 1, χ^2 = 1.634, P = 0.201; Group 2, χ^2 = 0.078, P = 0.781).

Group 1 included 26 patients (30.2%) aged 65-74 and 60 (69.7%) aged ≥ 75, while Group 2 included 39 (26.5%) aged 65-74 and 108 (73.4%) aged ≥ 75. A review of the relationship between age and mortality did not reveal any significant difference for both groups (Group 1, χ^2 = 0.221, P = 0.638; Group 2, χ^2 = 1.024, P = 0.312).

A significantly increased mortality rate was found with increase in the number of comorbidities in Group 1 (χ^2 = 12.791, P = 0.012), whereas no significant increase was detected in Group 2 (χ^2 = 1.254, P = 0.869) (**Table 2**).

Discussion

Hip replacement with HA is a common surgical procedure performed in elderly patients with proximal femoral fracture [4, 10]. Dislocation of a hip prosthesis is relatively rare and clinically important complication after total or partial hip arthroplasty, in terms of morbidity implications and cost [15]. The mortality rate after dislocation is 65% at 6 months [15]. In a systematic review of the literature, Varley and Parker reported a higher dislocation rate with the posterior approach (5.1%), compared to the anterior approach (2.4%) [16]. Unwin and Thomas reported a significantly higher dislocation rate with the posterior approach when compared to the lateral approach [17]. In the study of Bush et al, nine (4.5%) dislocations were detected in the posterior approach group (n = 199) and none in the anterior approach group (n = 186) [5]. Several studies have reported higher dislocation rate with the posterior approach than with the lateral approach [14, 18, 19].

However, Wood reported increased dislocation rates with the posterior approach compared to the anterior approach, though this difference was not significant [20]. Downing et al. also did not find a significant difference in the dislocation rate between the two approaches [21]. Consistent with their results, our study also revealed a non-significantly higher number of dislocations in the posterior approach group (Group 2; 11.5%) than in the anterior approach group (Group 1; 4.6%).

The annual mortality rate in elderly patients with hip fractures is reported to be between 14 and 36% [3, 22, 23]. Death in patients with a hip fracture occurs more often in the first post-fracture year compared to their peers [3, 22]. Schneider et al. reported the annual mortality rate to be 36% in their study of HA with an anterior approach [23]. Bush et al. reported four deaths (2.1%) out of 186 patients who underwent HA with an anterior approach and eight deaths (4.2%) out of 199 patients who underwent HA with a posterior approach [5]. Enocson et al. reported there was no statistical difference in postoperative complications or death within the first 6 weeks in their comparison of patients who had an anterolateral or posterolateral approach [14]. In our study, postoperative mortality rates were 9.3% and 12.2% in Groups 1 and 2, respectively. We determined that a great number of patients died during the course of the first postoperative year-six in Group 1 and 13 in Group 2, and the difference was not significant.

Another complication observed in patients with hip prosthesis is infection. Prevalence of infection after HA was reported to be between 1.7% and 7.2% [24]. Jalovaara et al. reported a deep infection rate of 4% in their study with a posterior approach [25]. Alternatively, Keene and Parker reported that operative time, blood loss, and infection increased after an anterior approach [19]. In their HA study with an anterior approach, Schneider et al. detected a superficial wound site infection in one patient (1%) [23]. Sikorski and Barrington concluded that the anterolateral approach was the safest operation when performing HA in patients with fractures of the femoral neck [26]. They indicated that mortality increased in the posterolateral approach and that the anterolateral approach had lower mortality and systemic complication rates. Furthermore, they detected more wound site infections with the anterior approach than with the posterior approach [26]. In our study, three (3.4%) and 11 (7.4%) patients developed

an infection in Groups 1 and 2, respectively, and the difference was not significant. A calculation of the relationship between infection and mortality revealed a statistically significant relationship in Group 1; no such relationship found in Group 2.

Whether the elapsed time until operation has an effect on mortality is unclear [22, 27]. Usually, it has reported that surgical outcomes were superior in patients who underwent an operation in the early post-fracture compared to those who underwent an operation in the later post-fracture period [28-30]. Casaletto and Gatt demonstrated that shorter time from fracture to surgery significantly decreases annual mortality rates in patients over 80 years of age [22]. In addition, Zuckerman et al. showed that delays of > 2 days until operation significantly increased the mortality rate in the first postoperative year [28]. Also, Sexson and Lehner reported increased mortality with longer time from fracture to surgery [29]. Kenzora et al. revealed significantly higher mortality rates in patients operated on first day compared to patients who underwent the operation between the second and fifth days [30].

However, Keene and Parker did not detect a significant difference between the duration of hospital stay and mortality [19]. Moreover, Karaman et al. and Öztürk et al. reported that time to operation has no effect on mortality [31, 32]. Similarly, in our study, we showed there was not a significant increase in mortality, in either Group 1 or 2, with increased time from hip fracture to operation.

Reviews on the effects of comorbid factors on postoperative mortality indicate increased mortality with increasing number of comorbid factors. Meyer et al. reported a three-fold increase in the mortality rate in patients with hip fracture having more than two chronic diseases [33]. Svensson et al. associated annual death rates with the number of preoperative accompanying health issues and demonstrated mortality rates of 0%, 14%, and 24% for patients with 0, 1-2, and 3-4 comorbidities, respectively [34]. As the number of patients' associated comorbidities increase, returning to daily activities becomes challenging. In our study, we found the relationship between the number of comorbid factors and mortality significant in Group 1, but not in Group 2.

A useful risk assessment system for patients with hip fractures is the ASA classification system [13]. Independent of ASA, medicals, and surgical assessments used worldwide, the general health status of the patient is assessed by an anesthesiologist [31, 32]. Mortality risk and ASA scores increase with age [22, 27]. In their study, Bombacı et al. demonstrated a significantly higher death rate in patients classified as ASA 4 compared to groups classified as ASA 3 or lower [27]. However, in our study, mortality rate of patients with ASA scores of 3-4 in both groups was not significantly higher than that of patients with ASA scores of 1-2.

There are studies indicating that the incidence of hip fracture increases with increasing age and that a higher age at the time of hip fracture significantly increases mortality [4, 30, 35]. Hedlund at al reported that hip fractures have age-specific incidence [36]. Authors reported that the incidence of hip fracture increases two-fold every 5-6 years in females over 30 years old. In our study, an evaluation of the relationship between age and gender associated with mortality did not reveal a significant difference for both groups. A review of the totality of patients in both groups, in terms of gender, revealed 136 female patients compared to 97 male patients, indicating that hip fracture is more common in females than males.

Our retrospective study has some limitations. Implants used in HA operations due to hip fracture were not monotype and various implants owned by different companies were used the procedures. Another limitation of our study is that HA operations performed by multiple surgeons.

Only a limited number of elderly patients with hip fracture are able to return to their preoperative functional status. Many indicators have reported to affect the return to preoperative functional status and mortality rate. These include male gender, age greater than 80 years, an increased number of comorbid diseases, increased length of time prior to operation, experience of the surgeon, long duration of hospital stay, patient's hemodynamic parameters, and poor living conditions. We believe that the surgical approach in HA exposures is also one of these factors. Detecting the factors that affect the outcomes and taking protective measures are essential in elderly patient groups with rather low postoperative success levels.

Disclosure of conflict of interest

None.

Address correspondence to: Dr. Fırat Ozan, Department of Orthopedics and Traumatology, Kayseri Training and Research Hospital, Sanayi Mah., Atatürk Bulvarı Hastane Cad., Kocasinan, Kayseri 38010, Turkey. Tel: +90 352 336 88 84; Fax: +90 352 320 73 13; E-mail: firatozan9@gmail.com

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