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COMPARATIVE STUDY OF FIXATION AND REPLACEMENT OF INTRACAPSULAR FEMORAL NECK FRACTURES IN ELDERLY PATIENTS

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ABSTRACT

Introduction: Femoral neck fractures are the most common type of fracture in the elderly osteoporotic population. The treatment options include internal fixation (IF), total hip replacement (THR) and hemiarthroplasty (HA). **Methods:** The medical records of 150 elderly patients treated at orthopedic clinics in Jordanian Royal Medical Services hospitals between January 2016 and January 2019 were retrospectively analyzed. The inclusion criteria were elderly patients aged >65 years, intracapsular femoral neck fracture (Garden types I–IV), and the ability to walk independently prior to surgery with or without aids. Patients were treated with either THR (group A), HR (group B) or IF (group C) using cannulated screws, dynamic hip screws or both. The mean follow-up period was 24 months. All patients were alive at January 2019. **Results:** Most patients were female (101/150, 67%). The length of hospitalization of group A was significantly shorter than groups B and C (5, 7 and 6 days, respectively; P =0.03). Patients in group A also had a significantly better functional score than those in groups B and C (P = 0.025, P = 0.034 and P = 0.04 respectively), along with the lowest rate of postoperative complications (18%, nine patients) and the lowest reoperation rate (2%, one dislocation). Group B had an overall complication rate of 33.3%, with three patients requiring reoperation (5%). Group C had the highest overall complication rate of 47.5% (15 patients), but this difference did not reach statistical significance (P = 0.39). Group C also had a significantly higher reoperation rate (17.5%, P = 0.045) due to nonunion in five patients and avascular necrosis in two patients. **Conclusion:** Treatment of the femoral neck fracture with THA was associated with a significantly shorter length of hospitalization, better functional scores and lower complication and reoperation rates. On the other hand, IF had a significantly shorter operation time but the highest rate of reoperation. The HA group had more medical complications, but this was not statistically significant.

KEYWORDS: Intracapsular neck of femur fracture; Treatment comparative.

INTRODUCTION

The femur, the longest bone in humans, consists of a body (shaft or diaphysis) with proximal and distal ends (Fig. 1). Femoral neck fracture is the most common fracture in the elderly osteoporotic population.[1] In 1990, there were 1.66 million femoral neck fractures worldwide, and the incidence is expected to increase over the next few decades, estimated to affect up to 6.25 million people by 2050.[1,2] The mortality rate within 1 year of suffering a femoral neck fracture has been reported to range between 20% and 35%.[4] Performance indicators for such fractures are evaluated based on mortality following hospital admission. However, the only measure of mortality in routine hospital statistics is death during the initial admission for the fracture (in-hospital mortality).[5]

These fractures are classified as either nondisplaced fractures or displaced fractures. Femoral neck fracture is associated with negative consequences for the blood supply of the femoral head, which can lead to nonunion of this fracture or femoral head necrosis. Nondisplaced fractures can be treated by internal fixation (IF), although several studies have reported that open or closed reduction with internal fixation is a less than optimal treatment in the elderly population.[3,5] In very old or chronically ill patients, surgeons prefer to proceed with a hemiarthroplasty (HA). On the other hand, total hip arthroplasty (THA) is usually preferred for physiologically younger, active patients and for patients with a history of hip osteoarthritis.[3-7]

Over the last six decades, this type of fracture was designated as "the unresolved fracture". Many studies have demonstrated that the functional outcomes after

THA are superior to HA, while others have shown that arthroplasty is better than IF, and some have reported different conclusions again[5-9] . In this research, we focused on three treatment modalities for intracapsular femoral neck fracture in elderly patients: THR (group A), HR (group B), and IF (group C). We compared the outcomes between these three treatment modalities, including postoperative surgical complications, medical complications and functional outcomes.

MATERIALS AND METHODS

The medical records of 150 elderly patients treated at orthopedic clinics in Jordanian Royal Medical Services hospitals were retrospectively analyzed. These patients had been admitted for femoral neck fracture in the time period from January 2016 to January 2019. There were 101 females and 49 males with a mean age of 75 years and body mass index (BMI) of 25 kg/m^2 (Table 1). All patients signed an informed consent form for inclusion in the study. Approval for this study was obtained from the ethical committee of the Royal Medical Services.

Inclusion criteria were elderly patients aged >65 years, intracapsular femoral neck fracture (Garden types I–IV), and the ability to walk independently prior surgery with or without aids. The exclusion criteria were age less than 65 years, pathologic hip fracture due to malignancy or infection, extracapsular hip fracture, bilateral hip fractures, previous hip surgery, inability to walk prior to injury, and death prior to the end of the study.

The included patients were treated by THR, HR or IF with cannulated screws, dynamic hip screws or both. The surgical decisions were based on the patients' age and medical and physical condition. Group (A) patients, treated by THR, had a good medical status and a good preinjury activity level. Group (B) patients, treated by HA, were aged >79 years, had a poor medical status and a poor preinjury activity level. Group (C) patients, treated by IF, had a Garden type I fracture, a good medical status and good preinjury activity level. All patients received preoperative first-generation cephalosporin antibiotic treatment and anticoagulant prophylaxis with low-molecular-weight heparin. The postoperative physiotherapy protocol usually started on the second day after surgery according to the patient's condition and group. Postoperative evaluation was performed at the clinic at regular intervals (3, 6, 12, 24 and 36 months.) The mean follow-up period was 24 months (range 12–36 months). All patients were alive in January 2019. The functional evaluation was performed using the Harris Hip Score, which considers the presence of pain, walking distance, use of walking aids, and the ability to perform personal and household activities.

The primary outcomes of interest were function and postoperative complications, including pneumonia, reoperation, deep vein thrombosis (DVT) and surgical site infections.

All statistical analyses were performed using SPSS version 25. Trends in the demographic variables and frequency of THA, HA and IF were analyzed.

RESULTS

Summary statistics of surgical and demographic factors according to procedure are presented in Table 1. The mean BMI of patients was similar between the three surgical techniques, despite differing group sizes. Most of the patients were female (101/150, 67%), 33% had diabetes, and 36% were smokers. The surgical duration of group (C) was significantly shorter than that of groups A and B (70, 100 and 80 min, respectively; P = 0.02). The mean hospitalization length of group A was significantly shorter than groups B and C (5, 7 and 6 days, respectively; P = 0.03; Table 1).

The functional outcomes, assessed using the Harris Hip Score, showed that group A had significantly better functioning than groups B and C during the entire follow-up period, (P = 0.025, P = 0.034 and P = 0.04, respectively). However, after 12 months of follow up, group C (IF) achieved a better function score than group B (HA) (Table 2).

The complications observed from 2016 to 2019 were evaluated, and the mean and standard deviation for each type of complication were calculated. Medical complications and surgical complications are shown in Table 3.

Postoperative complication rates according to procedure type are presented in Table (4). Patients who underwent THA (group A) had the lowest rate of postoperative complications (18%, nine patients), with deep incisional surgical site infection and pneumonia observed in one patient (2%), superficial incisional surgical site infection in three patients (6%), DVT in three patients (6%), pulmonary embolism occurred in one patient (2%) and reoperation was performed in one patient due to dislocation (2%). The overall complication rate in group B (HA) was 33.3% (20 patients). Three patients underwent reoperation (5%), with one patient converted to THR due to acetabular erosion, one patient reoperated due to dislocation, and one patient treated by resection arthroplasty due to a resistant infection. In addition, the rate of pneumonia in group B was 5%, superficial infection 8.33%, deep infection 3.3%, DVT 6.6% and pulmonary embolism 5%. The overall complication rate in group C was 47.5% (15 patients), which was much higher than the other groups, but this increase was not statistically significant (P = 0.39). In this group, deep incisional surgical site infection and pneumonia occurred in one patient (2.5%), superficial incisional surgical site infection (7.5%), DVT (7.5%) and pulmonary embolism occurred in one patient 2.5%. Patients who underwent internal fixation (group C) had the highest rate of reoperation (17.5%) compared to the other groups, which was due to nonunion in five patients and avascular necrosis in two patients (six patients were converted to

THR and one patient to HA), and this difference was statistically significant (P = 0.045).

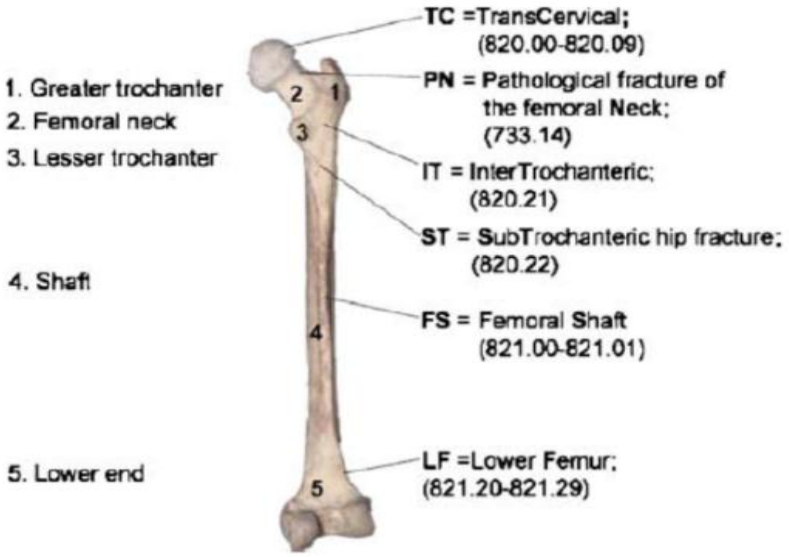

Figure 1 Anatomy of the femur and fracture sited with corresponding ICD-9 code.

Table 1: Summary statistics of surgical and demographic factors according to procedure.

Variables	Mean ± SD or frequency (proportion)			
	Overall	THA (group A)	HA (group B)	IF (group C)
Number of patients (%)	150	50 (33.3)	60 (40.0)	40 (26.7)
Age at surgery (years)	75	70 ± 4	85.5 ± 5	68 ± 3
Male, n (%)	49 (32.7)	20 (40.0)	26 (43.3)	3 (7.5)
Female, n (%)	101 (67.3)	30 (60.0)	34 (56.7)	37 (92.5)
BMI (kg/m^2)	25.8$^+$	25.7	25.9	25.7
Surgical time (min)	84	100 (70–150)	80 (53–106)	70 (49–90)
Current smoker (within 1 year), n (%)	55 (36.7)	26 (52.0)	26 (43.3)	3 (7.5)
Diabetes mellitus, n (%)	50 (33.3)	17 (34.0)	26 (43.3)	7 (17.5)
Length of hospitalization (days)	6	5 (3–7)	7 (5–9)	6 (5–9)
SD, standard deviation; THA, total hip arthroplasty; HA, hemiarthroplasty; IF, internal fixation; BMI, body mass index.				

Table 2: Harris Hip Scores at follow up.

	3 months	6 months	12 months	24 months
Group A, THR	80 (47–96)	85 (50–99)	94 (57–99)	95 (57–99)
Group B, HA	74 (45–90)	79 (47–94)	84 (52–94)	86 (52–96)
Group C, IF	72 (43–95)	75 (48–96)	87 (51–97)	91 (53–99)
THA, total hip arthroplasty; HA, hemiarthroplasty; IF, internal fixation.				

Table 3: Medical and surgical complications.

Year	2016	2017	2018	2019
Total number of patients	11	63	74	2
Medical complications				
Pneumonia	0	2	3	0
Surgical complications				
Return to operating room	1	5	5	0
Superficial incisional surgical site infection	1	5	4	1
Deep incisional surgical site infection	0	2	2	0
Deep vein thrombosis	0	4	4	1
Pulmonary embolism	1	2	2	0

Table 4: Summary statistics of postoperative complications according to procedure.

Complication	Overall	THA	HA	IF
Total number of patients	150	50	60	40
Medical complications				
Pneumonia	5	1	3	1
Surgical complications				
Return to operating room	11	1	3	7
Superficial incisional surgical site infection	11	3	5	3
Deep incisional surgical site infection	4	1	2	1
Deep vein thrombosis	10	3	4	3
Pulmonary embolism	5	1	3	1
THA, total hip arthroplasty; HA, hemiarthroplasty; IF, internal fixation.				

DISCUSSION

Femoral neck fractures in the elderly population are common injuries that are treated by orthopedic surgeons. Due to the aging population, the absolute number of femur neck fractures is expected to increase over the coming years. In the next 20 years, it is estimated that the number of these fracture in the USA will exceed half a million annually, with an estimated cost of over 10 billion dollars.[1-4] Historically, the treatment of this type of fracture is over 400 years old. Nowadays, the available treatment options include IF, THA and HA.[3] The purpose of our study was to analyze the patient demographics and medical conditions that affect the surgical treatment of elderly patients, as well as to compare the postoperative functional outcomes and complication rates between these three surgical techniques in this patient population. The strengths of this study include the number of patients, the long follow-up period, the scoring systems used, the strict inclusion and exclusion criteria, and that the study was conducted across multiple centers. However, this study also has some limitations, including the retrospective design, lack of randomization methods, surgical decision affected by the patient's age and medical conditions, the combination of cementless and cemented fixation techniques, and the combination of monopolar and bipolar hemiarthroplasty. Despite decades of research, there is still no consensus on the use of monopolar over bipolar hemiarthroplasty. A Cochrane review published in 2004 including seven randomized controlled trials (RCTs) with 857 patients found no difference between monopolar and bipolar hemiarthroplasty techniques with regard to dislocation, infection, reoperation, acetabular erosion, DVT or mortality rates.[10] In 2011, the Australian National Joint Replacement Registry reported a higher reoperation rate following monopolar than bipolar techniques in elderly patients.[11] In addition, there is also no consensus on the use of cementless versus cemented prostheses. A 2008 meta-analysis by Ahn et al. including 11 studies of cemented versus uncemented HA showed no differences in terms of pain, mortality rates or overall complications.[12] Another more recent meta-analysis by Veldman et al. (2017) of five RCT trials with 950 patients revealed that HA using cemented stems resulted in fewer implant-related complications and a similar mortality rate when compared to cementless stems, but the operating time was shorter for cementless prostheses.[13]

In our study, HA was the most common procedure for the treatment of femoral neck fractures in the elderly, with THA ranking second and IF being the least common. Regarding differences between techniques, THA was associated with a significantly shorter length of hospitalization, better functional scores and lower complication and reoperation rates. On the other hand, IF had significantly shorter operation times but the highest reoperation rates. The HA group had the highest complication rates for pneumonia, surgical site infections, DVT and pulmonary embolisms, but this finding was not statistically significant.

The results of this study are similar to those of other studies published over previous decades. Rogmark et al. (2002) performed an RCT comparing IF to arthroplasty in 450 elderly patients with fractures, and found that the failure rate in the IF group was 43% versus 6% in the arthroplasty group.[14] Consistent with this, Keating et al. (2006) compared IF with THR and HA in elderly patients with fractures, and also found that the IF group presented the worst functional outcome, quality of life and reoperation rate (39%), as well as having the highest cost.[15]

In contrast, Vassilios Nicolaides et al. published an article in 2009 that showed different results; however, it should be taken into consideration that the comparison between the IF and arthroplasty groups did not consider the prosthesis type. These authors concluded that the IF group had a shorter length of hospitalization (4.8 days) compared to the arthroplasty group (5.9 days), a lower complication rate and better functional scores at 1 year. However, the arthroplasty group had a lower reoperation rate (1.4%) than the IF group (11.4%), and both groups had very similar functional outcomes at 2 years.[16]

A recent meta-analysis by Bin-Fei Zhang et al. including 40 RCT studies containing 6131 elderly patients with femoral neck fractures found that although IF had the highest reoperation rate, there were no differences in mortality among the treatment options.[17] Another recent meta-analysis by Freng-Jen Tseng et al. including 26 studies of different types of treatment for elderly patients

with femur neck fractures concluded that osteosynthesis had a higher revision rate than THR and HA, but there were no significant difference in mortality rates between IF, THR and HA.[18]

CONCLUSION

In our study, THA was associated with a significantly shorter length of hospitalization, better functional scores, fewer complications and a lower reoperation rate than the other treatments. IF had a significantly shorter operation time but the highest reoperation rate of the three groups. The HA group had higher complication rates for pneumonia, surgical site infections, DVT and pulmonary embolisms, but this was not statistically significant.

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