

Assessment of Surgical Treatment Results of Femoral Neck Fracture

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1. Abstract

1.1. Background & Aim: Femoral neck fracture (FNF) is one of the most common that, causing problems and complications for them. The purpose of the present study is to investigate of surgical treatment results of femoral neck fracture.

1.2. Methods & Materials: This cross-sectional study was performed on 53 patients aged 15-60 with FNF who were referred to Firoozgar hospital, between January 2013- December 2017. In this study, all patients with FNF diagnosis were visited and the recovery and postoperative complications were evaluated by Harris Hip Score (HHS) questionnaire and recorded.

1.3. Results: In this study, of the 53 eligible patients examined, 42 (79.2%) of the participants were male. The mean age of the all patients was 42.1±12.5 years. The mean HHS for all patients was 82.7 ± 6.9 point. Results showed that 52.8% patients had complication such as: 10 patients (18.9%) avascular necrosis (AVN), 9 patients (17.0%) malunion, 1 patient (1.9%) nonunion and 8 patients (15.1%) needed a re-surgical procedure.

Also, the results of logistic regression model showed that delayed surgery, type of reduction, and type of fracture could significantly increase the incidence of complication of FNF surgery. Thus, the result of the treatment was influenced by delayed surgery for more than 6 hours [OR = 1.823], non-anatomical reduction [OR = 1.532], and type of fracture [OR = 2.305].

1.4. Conclusion: With reducing the amount of delay in surgery and increasing the anatomical reduction method, leads to fewer

complication and more effective treatment for patients.

2. Introduction

Femoral neck fracture (fracture of the short and intensive femoral shaft that located between the femur head and trochanter) contains nearly half the total hip fracture that can occur with high prevalence in elderly patients even after falling from a simple height [1-2]. FNF fractures, looking for a snap and a simple fall, are very common and costly when compared to older people [3]. Patients with these fractures occupy about 20 percent of the orthopedic beds in England. It is estimated that the number of these fractures in the world is 1.2 million cases per year and is expected to reach 2.5 million in 2025 and reach 4.5 million in 2050 [1]. In most cases, FNF occurs in older patients after a low-energy traumatic event (falling) and in young patients occurs usually following a high-energy trauma [1-3]. In the elderly patients, gliding or falling leads to a direct trauma to the lateral side of hip as the most common mechanism of this fracture [4]. Today traumatic injury is a common cause of death and disability in the world. The occurrence of fractures, especially in the elderly, is associated with multiple clinical complications and excessive costs to the health system [1]. It seems that young people who usually have femoral fractures due to severe trauma, usually associated with other injuries, is a worse prognosis for femoral insufficiency in middle-aged people [4-5].

FNF in the elderly is usually a sub capital and the most common fracture pattern is horizontally. However, in young people, accord-

ing to the mechanism of trauma, the pattern of fracture tends to be vertical and therefore biomechanical is more unstable. Few patients with hip fracture can return to the level of pre-injury activity and act independently in their daily activities [6]. Half of hip fracture patients are dependent on day-to-day activities, and about 25% of them need long-term care and treatment [7]. The most important symptoms of this fracture are limitation of motion in the affected leg and the rotational state of the exterior and abduction in it. In suspicious case of FNF fracture, full-length radiography of femur is taken [7-8].

The goal of FNF treatment varies among elderly and younger people. Although internal fixation and femoral head restoration are considered as preferred therapeutic goals, there are still no definitive results for choosing the perfect treatment method [9-10]. These differences are lower in older patients with lower activity levels. Femoral neck fractures are described in older patients using the Garden classification. In this age group, treatment is selected based on the type of fracture in the Garden classification. It is divided into two groups without displacement (Garden I and II) and with displacement (Garden III and IV) [11-12]. Garden grouping is not suitable for describing femoral neck fractures in young people. Paul's classification may be more useful in describing fractures because it is based on the fracture pattern and is associated with the achievement of stable fixation in the femoral neck fracture in young people [13].

Many orthopedists believe that treatment should be based on individual characteristics and fracture patterns, the presence of displacement in the fracture site, the level of pre-injury activity, mental status, the quality of bone and joints, the degree of daily activities and the condition of public health [14-16]. Fixation methods are still under discussion. The reduction during open surgery and internal fixation through the Watson-Jones method is introduced as a proposed method. Definite fixation can be combined with three conical screw or non-conical screws. Also, performing a capsulotomy in a femoral neck fracture is still discussed and depends on the patient's condition [17]. Biomechanical challenges of femoral neck fixation and vascular plexus vulnerability, was caused a high prevalence of nonunion and osteonecrosis of the femoral head is displaced after internal fixation in the femoral neck fracture with displacement [18].

Internal fixation of FNF is generally associated with high rates of complications and poor results in hip function but usually this surgical procedure is the preferred method. Of the most important reasons for this method, is noted to the maintenance of hip joint anatomy, improvement of motor status after recovery and prevention of complications of arthroplasty [19]. With regard to the above, it cannot be concluded that the method of treatment preferences is clear. Currently, Sliding Hip Screws (SHS) and Multiple Cannulated Screws (MCS) are two common types of methods used in internal fixation of femoral neck fractures [20].

Due to the lack of precision in determining the rate of femoral neck fracture in young and old patients and the lack of surgical unit for this type of fracture, this study was conducted aimed to surgical treatment results of FNF in patients aged 15 to 60 years referrals to Firoozgar Hospital in Tehran in 2013 until 2017.

3. Materials & Methods

This study was carried out as a descriptive-analytic study with a review of patients with FNF those were referred to the Firoozgar Hospital in Tehran and under took internal fixation in order to compare the surgical treatment results between January 2013 and December 2017.

Inclusive criteria consisted of: the ability to be present in the follow up visits for a period of time (at least six months), and satisfaction in the research. Exclusive criteria were mental or physical disability, underlying disease that is effective in the process of repair, fracture due to underlying disease or malignancy and dissatisfaction in the research.

In this study, eligible previous patients were selected by archives of medical records and re-evaluated. New patients were also examined at 2, 6, 12, and 6 months after surgery. A standard Harris Hip Score (HHS) questionnaire was used to re-evaluate the all patients. HHS standard questionnaire, in addition to the patient's demographic information, includes: pain measurement, limping, the use of a cane and supportive tools, the distance that the patient can walk, the comfort of sitting on the chair, the ability to use public transport, the ability to climb stairs, comfort in the wearing of socks and shoes is a measure of deformity and joint motion range [21]. The score for each of these questions is specified and, by summarizing, the final score of each patient is determined. In the HHS questionnaire, the range of points is between zero and 100 points. Based on HHS, the surgical outcome is divided into four categories: Excellent (90-100), Good (80-90), Fair (70-80) and Poor (<69) [11-12]. After completing HHS questionnaire, patients underwent evaluation of bone regeneration in pelvic X-ray. The X-ray and, if necessary more advanced methods like MRI, was used to examine malunion, non-union and the appearance of avascular necrosis (AVN).

Descriptive statistics including mean and standard deviation, as well as relative frequency were used to describe the data. To examine the relationships and comparisons between quantitative variables was performed by t-test and in case of abnormal distribution by Mann-Whitney U test. The comparison of qualitative variables was done by Chi-square test or Fisher's exact test. Also, multivariate logistic regression was used to evaluate the odds of each of the variables. All analyzes were performed using SPSS software version 16 and significant level ($p < 0.05$). This study has an ethics code number (IR. IUMS. FMD.REC. 1397.199) from research deputy of Iran University of Medical Sciences. The essential information and the objectives of the study were explained to the

patients, and written consent was obtained for participation in the plan.

4. Results

In this study, of the 53 eligible patients examined, 42 (79.2%) of the participants were male and the rest were female. The mean age of the all patients was 42.1±12.5 years (15-60 years). Average rating of HHS was 82.7±6.9 points (58-96 point). The most common type of fracture was Garden III in 30 cases (56.6%). Also, in these patients, were treated 44 patients (83%) with parallel conical screw. The demographic and clinical information of patients are presented in Table 1.

Complications of surgery and bone repair problems for all patients, are shown in Table 2. As can be seen, malunion with 11 cases (20.8%) was the most common complication of FNF surgery.

As shown in Table 3, increasing age ($p=0.43$), decreasing mean

HHS scores ($p=0.004$), non-anatomical reduction ($p=0.034$), delaying of more than 6 hours at the start of surgery ($p=0.01$) and the type of fracture of the Garden III and IV ($p=0.001$) were significantly more in complicated.

In this study independent variables with complication of FNF surgery were investigated in multivariate regression model. The results of logistic regression model showed that delayed surgery, type of reduction, and type of fracture could significantly increase the incidence of complication of FNF surgery. Thus, the result of the treatment was influenced by delayed surgery for more than 6 hours [OR = 1.823 (95% Confidence: 2.235-1.512)], non-anatomical reduction [OR = 1.532 (95% Confidence: 11.848-1.311)], and type of fracture [OR = 2.305 (95% Confidence: 2.638-2.171)]. The results of the multivariate logistic regression model are presented in Table 4.

Table 1: The demographic & clinical information of patients.

Demographic & clinical information (n=53)	Mean or Number (%)
Age (year)	42.1±12.5
Sex	
Male	42 (79.2)
Female	11 (20.8)
BMI	
< 18 kg/m ²	7 (13.2)
18-25 kg/m ²	37 (69.8)
> 25 kg/m ²	9 (17.0)
Type of fracture	
Garden I	5 (9.4)
Garden II	4 (7.5)
Garden III	30 (56.6)
Garden IV	14 (26.4)
Type of treatment	
parallel conical screw	44 (83)
Triangular screw	8 (15.1)
DHS	1 (1.9)
Type of reduction	
Anatomical reduction	18 (34.0)
Non-anatomical reduction	35 (66.0)
Average delay in starting surgery (hours)	25.7±21.9
Type of surgery	
Screw removal	41 (77.4)
THA	9 (17.0)
Bipolar	3 (5.6)
Average HHS (point)	82.7±6.9

Table 2: Complication of FNF surgery in patients.

Side effects	Number (%)
Without complication	25 (47.2)
malunion	10 (18.9)
nonunion	1 (1.9)
Avascular necrosis	9 (17.0)
Failure and need to re-surgery	8 (15.1)
Total	53 (100)

Table 3: The Comparison of effective factors in complication of patients.

Demographic & clinical information	Without complication Mean or Number (%) n=25	With complication Mean or Number (%) n=28	Total Mean or Number (%) n=53	p-value
Mean age (year)	41.9±16.6	44.7±15.3	42.7±16.2	0.043
Sex				
Male	20 (80.0)	22 (78.6)	42 (79.2)	0.103
Female	5 (20.0)	6 (21.4)	11 (20.8)	
Mean of HHS points	86.9±8.3	72.5±6.3	82.7±6.9	0.004
Type of treatment				
parallel conical screw	20 (80.0)	24 (85.7)	44 (83)	0.127
Triangular screw	5 (20.0)	3 (10.7)	8 (15.1)	
DHS	0 (0.0)	1 (3.6)	1 (1.9)	
Type of reduction				
Anatomical reduction	11 (44.0)	7 (25.0)	18 (34.0)	0.034
Non-anatomical reduction	14 (56.0)	21 (75.0)	35 (66.0)	
Delay in starting surgery (hours)				
Less than 6 hours	12 (48.0)	7 (25.0)	19 (46.4)	0.01
Equal to more than 6 hours	13 (52.0)	21 (75.0)	34 (53.6)	
Type of fracture				
Garden I	4 (16.0)	1 (3.6)	5 (9.4)	0.001
Garden II	3 (12.0)	1 (3.6)	4 (7.5)	
Garden III	12 (48.0)	18 (64.3)	30 (56.6)	
Garden IV	6 (24.0)	8 (28.6)	14 (26.4)	
Type of surgery				
Screw removal	20 (80.0)	21 (75.0)	41 (77.4)	0.097
THA	4 (16.0)	5 (17.9)	9 (17.0)	
Bipolar	1 (4.0)	2 (5.1)	3 (5.6)	

Table 4.: Relationship between independent variables with complication in multivariate logistic regression model.

Independent variables		Odds Ratio	95% Confidence	P- Value
Age category	Less than 20 years	1.000		
	20 to 40 years	0.905	1.055-0.0832	0.061
	More than 40 years	1.129	1.208-0.0912	0.052
Sex	Male	1.000		
	Female	0.951	1.083-0.525	0.085
Type of reduction	Anatomical reduction	1.000		
	Non-anatomical reduction	1.532	1.848-1.311	0.029
Delay in starting surgery	Less than 6 hours	1.000		
	Equal to more than 6 hours	1.823	2.235-1.512	0.001
Type of fracture	Garden I	1.000		
	Garden II	1.127	1.256-0.908	0.087
	Garden III	1.851	2.197-1.483	0.011
	Garden IV	2.305	2.638-2.171	0.001
HHS points	More than 80 points	1.000		
	Equal to less than 80	1.166	1.342-0.809	0.053

5. Discussion

The results of this study showed that the frequency of FNF surgical complications was significantly higher in patients with a delay of more than 6 hours in surgery, had a non-anatomical reduction, and the Garden III and IV type of fracture was more than other patients.

In this study, also with the help of multivariate logistic regression model, it was determined that factors such as delay of more than 6 hours in beginning of surgery, non-anatomical reduction and non-anatomical reduction can significantly correlate with the increase in patients' complications.

Due to the very diverse age range of patients, therapeutic goals differ among the elderly and younger age groups. In older patients, therapeutic goals include rapid pacing and patient compliance, with weight bearing and reducing complications as a result of long-term admission [22]. Several surgical choices are considered including internal reduction and internal fixation, hemi arthroplasty or total hip arthroplasty. In younger adults, there is only one therapeutic option, and it is done by opening or closing firm fixing and is fracture fixation. In young people, the main goals include maintaining femoral head, preventing osteonecrosis and preventing nonunion. Therefore, anatomical reduction and stable internal fixation is the

best method with acceptable yield. Surgery is usually done using the Watson-Jones method [23-24]. Definitive fixation can be done with three cannule screws or non-cannule screws. Capsulotomy or aspiration can be used to reduce hip hypotension. This reduction in intra-articular pressure improves blood flow to the femoral head and reduces the risk of femoral head ischemia [25-26].

In a study by Fontanesi et al. who evaluated the results of femoral neck fracture surgery in patients younger than 60 years of age, was showed that the evaluation of clinical outcomes related to femoral neck fracture surgery in young people, has relatively high complications such as malunion, AVN and need to re-operation that according to the results of this study, 52.8% of the patients undergoing surgery had at least one type of complication, is consistent [27].

Marti et al. in their study showed that the average HHS score of their patients with FNF was 85.6 ± 6.8 and complications after surgery were 18% that is largely the same as the result of the present study, and there is a slight difference in the difference in the age group of the patients in the two studies [28].

The results of this study showed that the delay of more than 6 hours for initiation of FNF surgery could significantly increase postoperative complications and increase the chance of complications by approximately 2 times (OR=1.83). In study of Schoenfeld et al. which was conducted with the aim of examining the results of femoral neck fracture surgery in 2015, the average HHS was 83.5. Seventy two percent of patients returned to the level of preoperative activity. There was also no significant relationship between delayed surgery and postoperative complications, this finding is not consistent with the results of our study, which may be due to the difference between the age of the patients under study, the surgical technique and the sample size examined [29].

In a study by Hartford et al. which aimed to investigate the complications of FNF, the prevalence of AVN was 14.3%, nonunion: 9.3%, malunion: 7.1%, and failure rate was 9.7%. However, in the present study, the rate of these complications was significantly lower, which may be due to differences in the conditions of the patients in both groups, the therapies methods and surgeons' skills [30].

The results of this study showed that postoperative complications have a significant relationship with the patient's age and type of fracture and reduction, and with increasing age, displacement and non and non-anatomical reduction, the complications will also increase. In a study by Kalra et al. with the aim of examining the therapeutic effect of internal fixation on femoral neck fracture along with displacement in middle aged patients, the results showed that in the middle aged group with displaced FNF, the complications were higher in patients without displacement and the younger age group, and more care should be taken to use the internal fixation of the patients that these results are in line with our findings [31].

The results of our study showed that there is a significant relationship between type of reduction and fracture with displacement and the frequency of postoperative complications, and these factors can increase the chance of postoperative complications. In a study by Anglen et al. Which aimed to determine the results of FNF therapy and to determine the association of AVN in this type of injury, there were one nonunion case, one patient delayed union and three of the patients also found AVN [32]. There was no relationship between the time of fixation, the type of reduction, and the presence of displacement in fracture as predictive factors of AVN. The differences between the results of the two studies can be attributed to the duration of post-fracture surgery, surgical techniques, and the sample size of the two studies [33].

6. Conclusions

Conclusion the results of this study showed that 52.8% patients had complications following the postoperative of FNF and with reducing the amount of delay in surgery and increasing the anatomical reduction method, leads to fewer complication and more effective treatment for patients.

7. Limitations

A limitation of the present study comes from a relatively small number of female samples, so the evaluation of gender distribution is not possible. Also, failure to follow the patients for future visits and the inability to complete the Harris questionnaire by the patients were among the other limitations of the study.

8. Funding

This study received funding from the research deputy of Iran University of Medical Sciences.

9. Ethical Standards

This study has an ethics code number (IR. IUMS. FMD. REC. 1397.199) from research deputy of Iran University of Medical Sciences.

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