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Assessment of Surgical Treatment Results of Adult Traumatic Femoral Neck Fracture

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Abstract

Background & aim: Femoral Neck Fracture (FNF) is one of the most common that, causing problems and complications for patients. The purpose of the present study is to investigate surgical treatment results of traumatic femoral neck fracture in adults under 60 years.

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 and 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.

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 re-operation.

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 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].

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.

Keywords: Femoral neck fracture; Complications; Treatment results.

Introduction

Femoral neck fracture contains nearly half of the total hip surgery 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 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 and 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, according to the mechanism of trauma, the pattern of fracture tends to be vertical and therefore biomechanical is more un-

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stable. 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 preservation 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 for these fractures description because it is based on the fracture pattern and is associated with achievement of stable fixation of 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 during femoral neck fracture fixation is still controversial [17]. Biomechanical challenges of femoral neck fixation and vascular plexus vulnerability, may cause high prevalence of nonunion and osteonecrosis of the femoral head after internal fixation of femoral neck fractures with displacement [18].

Internal fixation of FNF is generally associated with high rate of complications and poor results in hip function but usually this surgical procedure is the preferred method. Important reasons for selection of this method as choice method includes 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 fixations used in internal fixation of femoral neck fractures [20].

This study was conducted aimed to surgical treatment results of FNF in patients aged 15 to 60 years referrals to Firoozgar Hospital in Tehran from 2013 to 2017.

Materials & methods

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

Inclusive criteria consisted of: Ability to be present in follow up visits for a period of time (at least six months), and patients' agreement to participate in this research. Exclusive criteria were mental or physical disability, underlying disease that is effective in the process of repair and pathologic fractures.

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 all patients. HHS standard questionnaire, in addition to patient's demographic information, includes: pain measurement, limping, use of a cane and supportive tools, distance that the patient can walk, the comfort of sitting on the chair, ability to use public transport, ability to climb stairs, comfort in wearing of socks and shoes is a measure of deformity and joint range of motion [21]. In the HHS questionnaire, the range of points is between zero and 100 points. Based on HHS, surgical outcome is divided into four categories: Excellent (90-100), Good (80-90), Fair (70-80) and Poor (<69) (11,12). The X-ray and, if necessary, more advanced methods such as MRI, were used to examine malunion, non-union and 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.

Results

In this study, 53 eligible patients examined, 42(79.2%) of the participants were male and the rest were female. The mean age of 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 (30 cases, 56.6%). Also, in 44 patients, (83%) 3 parallel cannulated screws were used for fixation. 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. Malunion, 11 cases (20.8%) were the most common complication of FNF surgery in our cases.

As shown in Table 3, older age ($p=0.43$), lower mean HHS scores ($p=0.004$), non-anatomical reduction ($p=0.034$), time to fixation more than 6 hours ($p=0.01$) and Garden III and IV ($p=0.001$) were significantly more in complicated cases. 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, quality of reduction, and type of fracture could significantly increase the incidence of complication of FNF surgery. Thus, the result 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 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

Discussion

This study showed that the frequency of FNF surgery complications were significantly higher in patients with a delay of more than 6 hours for fixation, non-anatomical reduction, and the Garden III and IV fractures. 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 and non-anatomical reduction can significantly correlated with complications.

Treatment goals differ among elderly and young patients. In older patient's goals include early surgery and patient ambulation with weight bearing for reducing complications [22]. Several surgical choices are considered including open reduction and internal fixation, hemi arthroplasty or total hip arthroplasty. In younger adults, there is only one treatment option that is open or close reduction and internal fixation. In young patients, the main goals include maintaining femoral head, preventing osteonecrosis and preventing nonunion. Therefore, anatomical

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				0.097
Screw removal	20(80.0)	21(75.0)	41(77.4)	
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 20 to 40 years More than 40 years	1.000 0.905 1.129	1.055-0.0832 1.208-0.0912	0.061 0.052
Sex	Male Female	1.000 0.951	1.083-0.525	0.085
Type of reduction	Anatomical reduction Non-anatomical reduction	1.000 1.532	1.848-1.311	0.029
Delay in starting surgery	Less than 6 hours Equal to more than 6 hours	1.000 1.823	2.235-1.512	0.001
Type of fracture	Garden I Garden II Garden III Garden IV	1.000 1.127 1.851 2.305	1.256-0.908 2.197-1.483 2.638-2.171	0.087 0.011 0.001
HHS points	More than 80 points Equal to less than 80	1.000 1.166	1.342-0.809	0.053

reduction and stable internal fixation is the best method with acceptable results. Surgery is usually done via Watson-Jones approach [23,24]. Definitive fixation can be done with three cannulated or non-cannulated screws. Capsulotomy or aspiration can be used to reduce intra articular pressure. 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 Fontanesi et al. evaluated the results of femoral neck fracture surgery in patients younger than 60 years of age and showed that femoral neck fracture surgery in young people, has relatively high complications such as malunion, AVN and re-operation. According to the results of our study, 52.8% of the patients had at least one type of complication [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 [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 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, the surgical technique and the sample size [29].

In a study by Hartford et al. which aimed to investigate complications of FNF, 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 treatment methods and surgeons' skills [30-33].

The results of this study showed that postoperative complications have a significantly related with the patient's age, type of fracture and reduction quality.

Conclusion

The results of this study showed that 52.8% patients had complications following femoral neck fracture surgery. Surgery as soon as possible and anatomical reduction leads to fewer complications and more effective treatment.

Limitations: We had several limitations in the present study such as relatively small sample size especially of female cases, so the evaluation of gender distribution is not possible. Also, failure to follow the patients for longer time.

Declarations

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Informed consent: Informed consent was obtained from all individual participants included in the study.

Conflict of interests: The authors declared that they have no conflict of interest.

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