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A review of proximal femur fracture patterns, etiologies and sociodemographic features

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Abstract

Objectives: To identify the frequency and patterns of proximal femur fractures in a tertiary center in Jordan to aid in the identification of the requirement of the orthopedic department and assist in the future planning for founding country-based preventive and treatment guidelines.

Methods: This retrospective study reviewed 706 proximal femur fractures admitted from July 2018 to December 2021 at King Hussein Medical City in Amman, the capital of Jordan. Fractures were assessed concerning age, gender, mechanism of injury and variation over the years.

Results: Proximal femoral fractures account for one-fifth of all orthopedic hospital admissions. Females represented most patients (60.9%) and the left side was most affected (52.1%). Intertrochanteric fractures were the most common, followed by intracapsular fractures of the femoral neck; both accounted for about 90% of all fractures. Patients with femoral neck fractures are ten years younger than the intertrochanteric group. Falling from the floor was the most common cause. Fractures of the proximal femur occur in elderly patients with a mean age of 70.81 years (± 18.97). However, femoral head and hip dislocation occur in young patients. We notice an annual increase in the number of admissions.

Conclusions: Proximal femur fractures are the leading cause of hospitalizations in the orthopedic department. This study provides information on proximal femur fractures in Jordan. However, multicenter studies are needed to evaluate proximal femur fractures adequately, provide guidelines for treating and preventing these injuries and determine our institute's supply needs.

Keywords: Femur, intertrochanteric, femur neck, fractures, Jordan, trauma

Introduction

Proximal femur fractures are the leading cause of hospital admission and are associated with significant mortality and morbidity [1]. Although proximal femur fractures are more common in older patients and can occur with simple falls, they are caused by high-energy injury in young individuals [2]. However, they have adverse functional outcomes and a significant socioeconomic impact [3,4].

The proximal femur includes the femoral head, neck, intertrochanteric and sub-trochanteric regions [5]. However, each fracture pattern varies in its prognosis and treatment. Treatment of the proximal fractures varies according to the fracture pattern, anatomical location, presence of pathology, age of the patients and physical activity level [6]. The same fracture pattern might be treated in different methods according to previous parameters and the bioavailability of orthopedic implants [7]. The proximal femur is a common site for metastasis and might result in pathological fractures, which may require different treatment from non-pathological fractures [8,9].

In this review, we evaluated proximal femur fractures regarding their frequency, etiology, age distribution and gender. Therefore, we can identify the orthopedic department's requirements and assist in the future planning for founding country-based preventive and treatment guidelines.

Materials and Methods

This retrospective study reviewed the clinical and radiological records of all proximal femur fractures admitted to the Royal Rehabilitation Center at King Hussein Medical City (KHMC)

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in Amman, capital of Jordan, from July 2018 to December 2021. KHMC is an integrated hospital in Jordanian Royal Medical Services and is a referral center for all districts and health sectors in the kingdom. A 706 proximal femur fractures data were extracted from 3387 hospitalized orthopedic patients in the orthopedic department, their sociodemographic data were extracted from patients' records, and their radiographs were reviewed using Picture Archiving and Communication System (PACS) to analyze fractures locations and patterns.

The patients' age, gender, mechanism of injury, type of fracture, and associated injuries were obtained. Fractures in the femoral head, neck, intertrochanteric, greater trochanter and subtrochanteric areas were defined as proximal femur fractures. Hip dislocation, whether simple or complex, was counted with the proximal femur injuries. Mechanism of injury was classified into simple falls (from ground level), falls from height, road traffic accidents and others. Age groups were classified into younger than 40 years (41-64), (65-79) and older than 80.

Statistical analysis

Descriptive statistics (mean, frequency, and percentages) were used to describe study population characteristics in terms of gender, age, fracture location and mechanism. All statistical tests are two-tailed and the significance level is $p < 0.05$. Comparison between categorical variables is performed with a chi-square test and Yates continuity correction was used for a 2x2 contingency table order to avoid type I error. The statistical analysis was performed using the Statistical Package for Social Sciences (version 23.0, SPSS Inc., Chicago, IL, USA).

Results

Out of 3387 hospitalized patients in the orthopedic ward over 3.5 years, 706 patients were admitted for proximal femur fractures, representing 20.9% of all admissions. The mean age for patients was 70.81 years (± 18.97). Females represented most patients (60.9%) and the left side was affected more frequently (52.1%), table 1.

Table 1: Sociodemographic characteristics of proximal femur fractured patients, N= 706

	Number	Percentage
Gender		
Male	276	39.1
Female	430	60.9
Extremity		
Right	338	47.9
Left	368	52.1
Anatomical sites		
Intertrochanteric fracture	394	55.8
Femoral neck fracture	235	33.2
Subtrochanteric fracture	47	6.7
Greater trochanteric fracture	11	1.6
Femoral head fracture	3	0.4
Hip dislocation	16	2.3
Mechanism of injury		
Simple Falls	656	92.9
Falls from height	16	2.3
Road traffic accidents	22	3.1
Other injuries	12	1.7
Associated injuries		
Pathological fractures	12	1.7
Open fractures	2	0.3
Vascular injuries	1	0.1
Neurological injuries	4	0.6

Intertrochanteric fractures were the most frequent, followed by the intra-capsular neck of femur fractures; both represented around 90% of all fractures. Subtrochanteric fractures represented 6.7%, while the femoral head fractures were the least frequent and represented 0.4%. Falling from the ground level induces proximal femur fracture in more than 90% of cases, while all other mechanisms were responsible for less than 10%. Pathological fractures were identified in 1.7% and associated vascular and neurological injuries were identified in 1 and 4 patients, respectively.

Table 2 revealed the fracture patterns distribution between gender and extremities. Intertrochanteric fracture is the most common fracture among both genders. However, females are more likely to develop such fractures compared to males. The intracapsular neck of femur fractures demonstrated slight female preference, and the hip dislocation was more frequent among males. However, other fracture patterns had no sex nor extremity dominance.

Table 2: Proximal femur fracture distribution across gender and extremities

Fracture pattern	Gender		Extremity		Total
	Female	Male	Left	Right	
Intertrochanteric fracture	263, (61.2)	131, (47.4)	218, (59.2)	176, (52.1)	394, (55.8)
Femoral neck fracture	129, (30)	106, (38.4)	116, (31.5)	119, (35.2)	235, (33.3)
Subtrochanteric fracture	30, (7)	17, (6.2)	19, (5.2)	28, (8.2)	47, (6.7)
Greater trochanteric fracture	5, (1.2)	6, (2.2)	4, (1.1)	7, (2.1)	11, (1.5)
Femoral head fracture	1, (0.2)	2, (0.7)	2, (0.5)	1, (0.3)	3, (0.4)
Hip dislocation	2, (0.4)	14, (5.1)	9, (2.4)	7, (2.1)	16, (2.3)
Total	430, (60.9)	276, (39.1)	368, (52.1)	338, (47.9)	706, (100)
Test statistics	$X^2 = 27.213$, P-value <0.000		$X^2 = 7.526$, P-value = 0.275		

*Numbers within the brackets represents percentage within the same category (gender, extremity)

Three-quarters of proximal femur fractures occur in patients over 65, particularly intertrochanteric, femoral neck, and subtrochanteric fractures. However, femoral head fractures and hip dislocations occur primarily in young patients under 40 years of age, table 3.

Table 3: Proximal femur fracture distribution across age groups

Fracture pattern	≤ 40	41 to 65	66 to 79	≥ 80
Intertrochanteric fracture	6, (9.5)	53, (49.1)	166, (58)	169, (67.9)
Femoral neck fracture	33, (52.4)	42, (38.9)	107, (37.4)	53, (21.3)
Subtrochanteric fracture	6, (9.5)	8, (7.4)	9, (3.1)	24, (9.6)
Greater trochanteric fracture	---	4, (3.7)	4, (1.4)	3, (1.2)
Femoral head fracture	3, (4.8)	---	---	---
Hip dislocation	15, (23.8)	1, (0.9)	---	---
Total	63, (8.9)	108, (15.3)	286, (40.5)	249, (35.3)

*Numbers within the brackets represents percentage within the same age group.
**Test statistics: $X^2 = 239.352$, P-value <0.000.

The mean age for all patients with proximal femur fractures was 70.8 (± 18.9). However, females are older than males who sustained those fractures by 2.6 years. Most fractures' mean age is above 65 years except for femoral head fractures and

hip dislocation, which affect young patients with a mean age of 20.33 (± 10.2) and 31.9 (± 8.3), respectively, secondary to high energy mechanisms that cause such injuries, table 4.

Table 4: Mean age for patients for different fracture patterns (mean age, Standard deviation)

Fracture pattern	Both gender	Female	Male
Intertrochanteric fracture	75.7 (13.4)	76.3 (12.9)	74.5 (14.5)
Femoral neck fracture	65.80 (22.1)	67.5 (21.1)	63.4 (23.6)
Subtrochanteric fracture	70.9 (20.5)	72.7 (18.1)	67.9 (24.6)
Greater trochanteric fracture	70.3 (14.5)	69.6 (8)	70.8 (19.2)
Femoral head fracture	20.33 (10.2)	13	24 (11.3)
Hip dislocation	31.9 (8.3)	45.5 (12)	29.8 (5.7)
Total	70.8 (18.9)	70 (16.9)	67.4 (21.4)

Falling from ground level was the most responsible mechanism and accounted for 92.9%. Road traffic accidents caused higher energy injuries, femoral head fracture and hip

dislocation. Falls from height cause femoral neck fractures mainly, table 5.

Table 5: Proximal femur fracture distribution according to the mechanism of injury

Fracture pattern	Simple falls	Falls from height	RTA	Other mechanisms
Intertrochanteric fracture	390, (59.4)	2, (12.5)	2, (9.1)	---
Femoral neck fracture	211, (32.1)	10, (62.5)	4, (18.1)	10, (83.4)
Subtrochanteric fracture	43, (6.5)	2, (12.5)	1, (4.6)	1, (8.3)
Greater trochanteric fracture	9, (1.4)	2, (12.5)	---	---
Femoral head fracture	1, (0.2)	---	2, (9.1)	---
Hip dislocation	2, (0.4)	---	13, (59.1)	1, (8.3)
Total	656, (92.9)	16, (2.3)	22, (3.1)	12, (1.7)

*Numbers within the brackets represents percentage within the same mechanism of injury.
 **Test statistics: $\chi^2 = 446.023$, P-value > 0.000.

Table 6 shows the variation from one year to another; most admissions for proximal femur fractures occurred in 2021. Data collection started in June 2018, explaining the lower

admissions frequency. Intertrochanteric and femoral neck fractures showed an annual increase for four consecutive years.

Table 6: Proximal femur fracture distribution across years

Fracture pattern	2018	2019	2020	2021
Intertrochanteric fracture	27, (47.4)	84, (60.9)	130, (64.6)	153, (49.4)
Femoral neck fracture	21, (36.8)	40, (29.0)	60, (29.9)	114, (36.8)
Subtrochanteric fracture	3, (5.3)	14, (10.1)	8, (4)	22, (7.1)
Greater trochanteric fracture	2, (3.5)	---	---	9, (2.9)
Femoral head fracture	---	---	2, (1)	1, (0.3)
Hip dislocation	4, (7.0)	---	1, (0.5)	11, (3.5)
Total	57 (8.1)	138 (19.5)	201 (28.5)	310 (43.9)

*Numbers within the brackets represents percentage within the same year.
 ** Test statistics: $\chi^2 = 53.395$, P-value > 0.000.

Discussion

Proximal femur fractures are the leading cause of orthopedic department hospitalization, representing a fifth of all admissions to our institute. Proximal femur fractures are increasingly common due to the aging population and carry significant health and socioeconomic impact. However, proper management and early rehabilitation improve outcomes^[10, 11]. Understanding the frequency and patterns of fracture aids in the identification of the requirement of the orthopedic department and assists in the future planning for founding country-based preventive and treatment guidelines. In this study, we reviewed 706 patients with proximal femur fractures. Females represent most admitted patients due to their higher osteoporotic risk^[12]. Most fractures occur in the intertrochanteric and neck of femur regions. Two-thirds of intertrochanteric and subtrochanteric fractures occurred in females. However, females were more likely to develop intracapsular neck of femur fractures than males, while hip

dislocation was most frequent in males because high-energy mechanisms caused those injuries; in our study, 81.3% of hip dislocations occurred due to road traffic accidents, and males were usually involved more frequently in traffic accidents.

Intertrochanteric fractures occur in older patients with a mean age of 75.7 (± 13.4), while patients with neck of femur fractures are younger by around ten years. Consequently, the decision to fix or replace the fractures in this age group is not straightforward, and many other factors such as physical activity and comorbidities weigh a decision over others. Similarly, Subtrochanteric and isolated greater trochanters fractures occur in the old age group with a mean age of around 70. However, hip dislocation and femoral head fracture are caused by high energy and consequently occur in young adults.

Proximal femur fractures are primarily fragility fractures in elderly patients secondary to simple falls from ground level. Identification of the preceding events is essential as many

patients fall due to medical conditions such as cerebrovascular accidents, hypoglycemia, cognitive impairment and medication effect^[13]. Therefore, it is crucial not to miss these injuries because fractures are usually distracting and may delay the treatment for medical conditions and increase mortality and morbidity.

We noticed an annual increment in the frequency of proximal femur fractures over four consecutive years. In 2021 there were around 44% of all admissions. In 2020, after the announcement of the COVID-19 pandemic, the world implemented many measures and restrictions to control the spread of the virus; these measures reduce overall fractures due to a significant reduction in road traffic accidents and work-related injuries. However, proximal femurs are caused by simple falls and should not be affected by the measures related to COVID-19; nevertheless, in a study by Al-Rousan *et al.* which was conducted at our institute to measure the impact of social distancing on geriatric hip fractures among the Jordanian population during the COVID-19 pandemic^[14]. The study demonstrated an increase in the proportion of geriatric hip fractures during the complete lockdown period, which might be explained by the inability of the caregiver of the family members to reach those elderly dependent patients and help them do their daily activities and check their compliance with medication. Additionally, elderly patients were left alone to protect them from infection. Therefore, this increases their dependence on fulfilling their needs, increasing falling risk and injuries. In our study, there was a yearly increase in the total number of proximal femur fractures. In 2021, many restrictions were eliminated; this explains an increase in the total number of trauma patients but not proximal femur fracture incidence.

Our study has some limitations. First, it is a retrospective study, and second, the lack of adequate documentation on the mechanism of injury precludes a detailed analysis of the etiology; for example, falling from ground level is grouped as one category of simple falls which prevent founding detailed preventive measures.

Conclusions

Proximal femur fractures are the leading cause of hospitalization in the orthopedic department and count for a fifth of all admissions. This study provides insight into proximal femur fractures in Jordan. However, multicenter studies are needed to assess proximal femur fractures adequately, provide guidelines for treating and preventing these injuries and identify our institute's supply requirements.

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