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Proximal femur fracture, analysis of epidemiology, complications, and mortality: A cohort with 380 patients

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Ethics Committee Approval
The study was approved by the Keçiören Health Practice and Research Hospital Ethics Committee (date: 15.05.2020, number: 43278876-929). All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

Conflict of Interest
No conflict of interest was declared by the authors.

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Abstract

Background/Aim: Among all orthopedic injuries, hip fractures continue to have high morbidity and mortality. While the epidemiological features of proximal femoral fractures (PFF) have often been defined, there are studies which examine the relationship between the complications of the types of PFF and mortality. The aim of this study was to determine the frequency of PFF types and investigate the relationship between complications of subtypes and mortality.

Methods: This study included 380 patients aged >40 years who underwent surgery for a PFF. The fractures were classified according to localization as intertrochanteric femur fracture (ITFF), femoral neck fracture (FNF) and subtrochanteric fracture (STF). Patient demographic data (age, gender, comorbidities) were recorded, and modified Charlson comorbidity scores were calculated. Major surgical complications (infection, dislocation, implant failure) were defined as those requiring additional surgery, and minor surgical complications (cellulitis, wound site problems, pressure sores, deep vein thrombosis) as those not requiring surgery. Mortality rates were examined at 1, 3 and 12 months postoperatively. The fracture subtypes were compared with respect to surgical complications (major and minor), non-surgical complications and mortality rates. Mortality risk factors were determined according to final mortality status.

Results: The patients included 235 females and 136 males (F/M=2/1) with a mean age of 78.5 (12.1) years. Three hundred and thirty (86.5%) patients were aged >65 years and 50 (13.5%) were aged <65 years. The fractures were classified as 225 (60%) ITFF, 120 (32%) FNF, and 26 (7%) STF. Surgical complications and complications not related to surgery were seen in 35 (9.2%) and 25 (6%) patients, respectively. Mortality occurred within one month in 17 (4.6%) patients, in three months in 32 (8.6%) and within the first year in 97 (26%). No significant difference was found between fracture types with respect to mortality in 1, 3, and 12 months (P=0.51, P=0.641, P=0.2 respectively). The mortality rates of ITFF and FNF were highly similar (1, 3, 12-month mortality: P=0.943, P=0.939, P=0.946 respectively). In the comparison between the surviving and non-surviving groups, age, Charlson comorbidity index, prolonged stay in intensive care, and non-surgical complications were significantly increased in the non-surviving group (P<0.001, P<0.001, P=0.03, P=0.005 respectively).

Conclusion: ITFF is common among PFF. While there was no relationship between fracture types in PFF, complication and mortality, a correlation was found between mortality and age, Charlson comorbidity score, prolonged stay in intensive care, and non-surgical complications.

Keywords: Hip fracture, Proximal femur fracture, Epidemiology, Mortality, Complication

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Introduction

Hip fractures are common in orthopedic surgery and constitute 20% of the orthopedic workload [1]. Approximately 90% of hip fractures occur in patients aged >65 years and are often the result of a low-energy fall from the same level [2]. In 1999, there were 1.66 million hip fractures worldwide and in parallel with increasing life expectancy, this is expected to surpass 6.26 million by 2050 [3].

Hip fractures are classified as intracapsular (femur neck fracture) and extracapsular (intertrochanteric and subtrochanteric femur fracture). This classification directs surgical treatment so that while osteoporotic femoral neck fractures (>65 years of age) are treated with arthroplasty, in young femoral neck fractures where union is expected and in intertrochanteric and subtrochanteric femoral fractures, the aim of treatment is to obtain osteosynthesis [4]. Despite all the advances in treatment approaches there has been no change in mortality rates over the years, and 1-year mortality rates have been reported as 20%-40%, and in-hospital mortality as 5% [5,6].

In addition to mortality, another problem for these patients is not regaining the pre-fracture quality of life [7]. To be able to reduce the high mortality rates of hip fractures, this subject has often been investigated in literature to be able to determine the risk factors and develop healthcare services. Numerous studies report that non-surgical and unchangeable risk factors are predominant in mortality, such as age, more than one comorbidity, dementia, and the preoperative independence score [8-10].

Most hip fractures are intertrochanteric fractures, while subtrochanteric fractures account for the lowest percentage [11]. Trochanteric fractures increase with age because of the decrease in bone density in the trochanteric region with ageing, and reduced resistance to shear forces. In epidemiological studies that have examined proximal femoral fractures (PFF), subtrochanteric fractures have been reported in a young patient group [12]. Despite the determination of epidemiological features of PFF, there have been limited comparisons of the complications of PFF types and mortality. The aim of this study was to determine the frequency of PFF types and investigate the relationship between complications and mortality for the prediction of prognosis.

Materials and methods

Patients

The design and protocol of this retrospective cohort study were approved by the Keçiören Health Practice and Research Hospital Ethics Committee (date: 15.05.2020, number: 43278876-929). The study procedures followed the principles of the Helsinki Declaration.

The records of 392 patients who were treated for proximal femoral fracture (PFF) in the department of Orthopedics and Traumatology at Keçiören Health Practice and Research Hospital between 2015-2018 were examined. Patient data were retrieved from the hospital electronic data system and patient records. A total of 12 patients were excluded from the study, 2 because of poor general condition, 3 did not wish to be included, 2 had femoral head fractures, and 5 were aged <40 years. Thus, the study included 380 patients aged > 40 years, who were operated for PFF. Three hundred and eighty patients with PFF constituted 22% of the 1710 patients treated surgically because of trauma in our clinic in the designated study period.

The fractures were classified according to localization as intertrochanteric femur fracture (ITFF), femoral neck fracture (FNF) and subtrochanteric fracture (SFF). Patient demographic data (age, gender, comorbidities) were recorded, and modified Charlson comorbidity scores were calculated. Differences were examined according to the frequency of fracture type and demographic data. Changes and the relationship with fracture subtype were examined according to the years.

Variables

Examinations were made of the postoperative length of stay in hospital, postoperative stay in the Intensive Care Unit (ICU) and surgical (major and minor) and non-surgical complications. Non-surgical complications were limited to complications determined during hospitalization. Major surgical complications (infection, dislocation, implant failure) were defined as those requiring additional surgery, and minor surgical complications (cellulitis, wound site problems, pressure sores, DVT) as those not requiring surgery. The mortality data of patients were retrieved from the hospital system and the official national registration system. Mortality rates were examined at 1, 3 and 12 months postoperatively. The fracture subtypes were compared in terms of length of hospital stay, requirement for postoperative ICU, surgical complications (major and minor), non-surgical complications and mortality rates. The relationship between fracture types and mortality was evaluated with the 1, 3, and 12-month mortality rates.

In the examination of the risk factors for mortality, the patients were grouped as survivors and non-survivors. Age, gender, Charlson comorbidity score, stay in ICU, surgical complications (major and minor) and non-surgical complications were evaluated with respect to mortality.

Clinical treatment and surgery

Immediately after admittance of the patients, mechanical and medical DVT prophylaxis was started. Internal treatments were applied to patients before the operation. After the necessary workup for anesthesia, surgery was performed as soon as the general medical status of the patient allowed. Infection prophylaxis was administered to all patients preoperatively. Proximal femoral nail (PFN) was performed to patients with ITFF and STF. For patients with FNF, internal fixation with cannulated screw was used in those <60 years of age and bipolar endoprosthesis to those aged >60 years.

Postoperative follow-up

All patients were mobilized on postoperative day 1 or 2 with a walker. Weight-bearing was allowed as tolerated postoperatively. The patients were called for follow-up examinations at 2-week intervals and the joint range of movement (ROM) was checked. In the follow-up examinations, patients with fixation were assessed with respect to union and implant failure (cut-out, cut-true and lateral sliding), and patients with endoprosthesis were assessed in terms of dislocation and infection.

Statistical analysis

Data obtained in the study were analyzed statistically using SPSS v.22 software, and at a confidence interval of 95%. Qualitative data were presented as frequency distribution and quantitative data, as mean, minimum and maximum values. Inter-observer and intra-observer reliability were assessed using the interclass coefficient. Demographic values and complications of the type of PFF were evaluated with the Kruskal Wallis and Chi-square tests. The follow up and complication data of patients with ITFF and FNF were evaluated with Mann Whitney U-test and Chi-square test. The complications of the three groups were compared using the Chi-square test. Kruskal Wallis test was applied in the evaluation of the Harris Hip Score according to additional surgical procedures. Correlations between mortality status and risk factors were assessed with frequency distribution and the Spearman correlation test.

Results

The mean follow-up time was 23.2 (8.4) months (range, 12-36 months). The patients included 235 females and 136 males (F/M=2/1) with a mean age of 78.5 (12.16) years; 330 (86.5%) patients were aged >65 years and 50 (13.5%) were aged <65 years. The demographic data of the patients are presented in Table 1.

In 15 (5%) patients, the hip fracture was bilateral. The fractures were classified as 225 (60%) ITFF, 120 (32%) FNF, and 26 (7%) SFF. Intra-articular and extra-articular fractures were found in 250 (67.5%) and 120 (32.5%) patients, respectively. Complications related and not related to surgery were seen in 35 (9.2%) and 25 (7%) patients, respectively. Twenty-six (6.2%) patients with a major surgical complication required additional surgery. The mortality rates were 4.6% within 1 month, 8.6% within 3 months and 26% in the first year postoperatively (Table 1).

Table 1: Demographic data of the patients

	n=380	%, mean
Age	78.5 (12.1)	
<65	50	13.5
>65	330	86.5
Gender		
Female	235	63
Male	136	36
Follow-up (month)	12-36	23.2 (8.4)
Bilateral	15	5
Charlson comorbity index	0-9	5.6 (1.6)
Subtype		
Intertrochanteric fracture	225	60.6
Femur neck fracture	120	32.3
Subtrochanteric fracture	26	7
Surgical complication	35	9.2
Major surgical complication	26	6.2
Minor surgical complication	9	3
Infection	9	1.5
Non-surgical complication	25	6
Reoperation	26	6.2
<3 months	14	3.2
>3 months	12	3
Mortality	123	33
<1 month	17	4.6
<3 months	32	8.6
<12 months	97	26

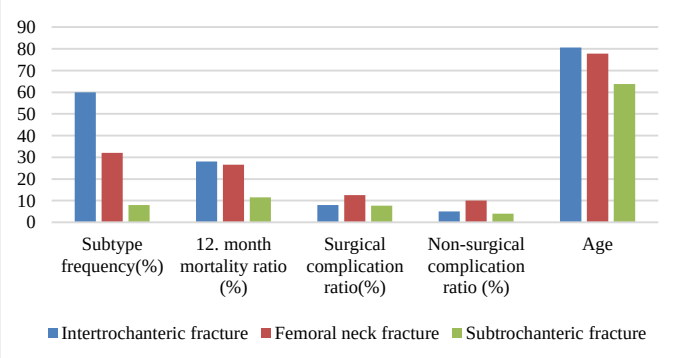
The fractures were compared according to types as intertrochanteric, femoral neck and subtrochanteric. A significant difference was observed in age and Charlson index scores of the patients (P<0.001, P<0.001). Fracture types were similar in terms of mortality in 1, 3, and 12 months (P=0.51, P=0.641, P=0.2). The mortality rate of patients with STF at 12 months (11%) was insignificantly lower than that of patients with FNF (27%) and ITFF (28%) (P=0.2).

The fracture types were similar with respect to major and minor surgical complications, non-surgical complications, and mortality rates (Table 2 and Figure 1). Non-surgical complications included pulmonary embolism (2%), cerebrovascular event (1.8%), myocardial infarct (1%), and kidney failure (2%). ITFF implant failure was seen in 3%, and dislocation in FNF was observed in 2.5%. Infection was seen in 9 (2.5%) patients, 3 ITFF, 6 FNF (P=0.04).

Table 2: Differences in proximal femoral fracture subtype

	Intertrochanteric fracture	Femur Neck Fracture	Subtrochanteric Fracture	*P*-value
Hips	225 (%60)	120 (%32)	26 (%7)	371
Age	80.6 (9.8)	70.8 (11.6)	73.8 (20.1)	<0.001*
<65	19 (%38)	19 (%38)	12 (%24)	<0.001*
>65	205 (%64)	101 (%31)	14 (%4,3)	
Gender				
Female	141 (%62)	79 (%65,8)	15 (%57.7)	0.632
Male	84 (%37)	41 (%34.2)	11 (%42.3)	
Charlson comorbidity score	4,9 (1.7)	4,7 (1.7)	2.9 (2.4)	<0.001*
Postoperative Intensive Care Unit	150 (%66)	70 (%58)	12 (%46)	0.163
Postoperative hospitalization day	2.7	4.1	2.7	<0.001*
Surgical Complication	18	15	2 (%7.7)	0.392
Major Surgical Complication	13 (%6.5)	11 (%9)	2 (%7.7)	0.410
Infection	3 (%1)	6 (%5)		0.04*
Dislocation		3 (%2.5)		-
Implant failure	8 (%3)			-
Refracture		1(%1)		0.350
Nonunion	2 (%1)		2 (%7.7)	0.108
Minor surgical complication	5	4		0.542
Non-surgical complication	12 (%5)	12 (%10)	1 (%4)	0.167
Pulmonary embolism	4	4	1	0.576
Myocardial infarct	2	1		0.891
Cerebrovascular disease	4	3		0.684
Acute renal failure	3	4	1	0.328
Mortality	9.5 (7)	7,5 (4.9)	8.6 (5.7)	0.498
<1 month	11 (%4.9)	6 (%5)		0.510
<3 month	21 (%9.3)	10 (8.3)	1 (%3.8)	0.641
<12 month.	63 (%28)	32 (%26,7)	3 (%11.5)	0.2

Figure 1: Demographics and follow-up data of the patients



The vast majority (93%) of the fractures comprised ITFF and FNF, so these two groups were compared. They were similar in terms of age, gender, or comorbidity rates (P=0.09, P=0.482, P=0.07), however, significantly differed with respect to postoperative length of stay in hospital and infection rates (P=0.03, P=0.04). No differences were detected in surgical (major and minor) and non-surgical complication rates (P=0.234, P=0.782, P=0.09), or in 1, 3, and 12-month mortality rates (P=0.943, P=0.939, P=0.946) (Table 3).

The mean follow-up period was 23.2 (8.4) months, and 123 patients did not survive. When the surviving and non-surviving patients were compared, age, Charlson morbidity score, postoperative stay in ICU > 2 days and non-surgical

complications were significantly higher in the non-surviving group (P<0.001, P<0.001, P=0.03, P=0.005 respectively). Mortality was not correlated with gender, postoperative requirement for ICU, or surgical complications (P=0.163, P=0.34, P=0.91 respectively) (Table 4).

Table 3: Comparison between Intertrochanteric and femoral neck femoral fracture

	Intertrochanteric Fracture	Femoral Neck Fracture	*P*-value
Hips	225 (%60)	120 (%32)	
Age	80,6 (9.8)	77,8 (11.6)	0.09
<65	19 (%9)	19 (%15)	0.08
>65	205 (%91)	101 (%85)	
Gender			
Female	141 (%62)	79 (%65,8)	0.482
Male	84 (%37)	41 (%34.2)	
Charlson comorbidity score	4,9 (1.7)	4,7 !1.7)	0.07
Postoperative Intensive Care Unit	150 (%66)	70(%58)	0.763
Postoperative hospitalization duration (day)	2.7	4,1	0.03*
Surgical Complication	18 (%8)	15 (%12.5)	0.234
Major Surgical Complication	11(%5.5)	10 (%9)	0.284
Infection	3 (%1)	6 (%5)	0.04*
Dislocation		3 (%2.5)	-
Implant failure	8		-
Refracture		1	0,550
Nonunion	2		0.955
Minor surgical complication	5	4	0.782
Non-surgical complication	12 (5)	12 (%10)	0.090
Pulmonary embolism	4	4	0.273
Myocardial infarct	2	1	0.831
Cerebrovascular disease	4	3	0.384
Acute renal failure	3	4	0.122
Mortality	9.5 (7)	7,5 (4.9)	0,246
<1 month	11 (%4.9)	6 (%5)	0.943
<3 month	21 (%9.3)	10 (8.3)	0.939
<12 month	63 (%28)	32 (%26,7)	0.946

Table 4: Comparison between mortal and alive groups

	Alive group (n=248)	Mortal group (n=123)	*P*-value
Age	75.7 (13.3)	86 (6.7)	<0.001*
Gender (F/M)	151/97	84/39	0.163
Charlson comorbidity score	4.1 (1.7)	5.6 (1.1)	<0.001*
Postoperative Intensive Care Unit	132	100	0.340
Intensive Care Unit >2 day	20	40	0.03*
Non- Surgical complication	11	16	0.005*
Surgical complication	23	11	0.910

Discussion

High mortality rates are seen in hip fractures in the first year (20%-40%). In a study that examined American and European data, it was reported that in a 10-year follow-up period, although mortality rates fell after the first year, they were noticeably higher than those of the normal population [13]. The foremost risk factors are age, comorbidity, and the preoperative independence score, while modifiable risk factors include high BMI, cigarette smoking, living in an old people's home, and late surgery (>2 days) [14-16]. In the demographic differences in PFF cases, STF is seen at a younger age and the frequency of ITFF increases with advancing age [11,12]. In a study by Kannus et al. [11] that examined the epidemiological feature of hip fractures, ITFF was seen at an older age and entailed greater hospital costs. The hypothesis of the current study was that ITFF would be seen at an older age and would have a higher mortality rate.

While the results of this study showed no correlation between fracture types and mortality, the mortality rates of ITFF and FNF were similarly high. The factors affecting mortality were age, Charlson comorbidity score, prolonged stay in ICU, and non-surgical complications.

Majority of osteoporotic fractures are hip, vertebrae, and distal radius fractures, and those causing most concern are hip fractures [17]. PFFs constitute 22% of all the trauma surgery operations in our clinic and were observed to form a large part of trauma surgery. A substantial proportion of PFF are osteoporotic fractures caused by low-energy trauma [18]. The mean age at which PFF is seen has increased over the years with ageing populations and is over 70 years of age in all studies [19].

In the current study, the mean age of the patients was 78.5 (12.16) years and 86.5% were aged over 65 years. PFF is an injury of the elderly. While FNF and ITFF are seen at similar rates at younger ages, the frequency of ITFF increases with advancing age [19]. The prevalence of fractures in this region is attributed to the decrease in bone density in this region with ageing [20]. In the current study, ITFF and FNF were seen at the same rate in patients aged <65 years, while ITFF comprised 64% of the fractures seen in patients aged >65 years. STF constitutes the main difference for PFF.

In a study by Yoon et al, STF was found in 3%, with a rate varying between 2% and 10% in different populations, and the frequency of these fractures increased in patients aged <60 years [21]. In the current study, the mean ages of all PFF patients and STF patients were 78.5 (12.1) years and 63.83 (20.1) years, respectively. Subtrochanteric fractures were seen at a younger age and the Charlson comorbidity scores were lower in these patients.

High first-year mortality rates (17%-38%) for PFF have been reported in literature. In the current study, 1-year mortality rate was 26%, and first-month mortality rate was 4.6%. Frost et al. examined early mortality and reported in-hospital mortality rate as 5%, which was explained by congestive heart disease and liver failure in addition to age [22]. Indexes have been developed to calculate survival determined by the physiological activity level [23,24]. In the current study, early non-surgical complications of the patients were examined, and included pulmonary embolism (2%), cerebrovascular event (1.8%), myocardial infarct (81%) and kidney failure (2%), all of which had a mortal course.

The mean follow-up period of this study was approximately 2 years and the final mortality rate was 33%. Within the second year, mortality was 7%, and despite continuing, the mortal course decreased. When the variables of the survivors and non-survivors were examined, age, Charlson comorbidity score, late mobilization and non-surgical complications appeared prominent. In every study in literature, age is an unchangeable risk factor, and this is followed by comorbidities [8-10,14,15]. In some studies, the number of comorbidities has been stated, and in others the Charlson and modified Charlson comorbidity scores have been used [9,15]. The preoperative level of physical activity is a determinant of mortality [25].

Of the surgical factors that can be changed, early surgery is strongly recommended, and although there is debate about this period, it is recommended that surgery is performed together with the application of internal treatments within 48 hours [26,27]. In the current study, fracture types were an unchangeable factor which did not affect mortality. Similar mortality rates were observed for ITFF and FNF. In the surgical treatment of ITFF, there is currently support for minimally invasive fixation options for arthroplasty [28]. That there was no variation in the ITFF mortality rates could be explained by the performance of minimally invasive surgeries.

Different complications are seen according to the fracture types and surgery selected. In FNF, dislocation is more prominent, in ITFF, implant failure, and in STF, non-union. In the current study, ITFF implant failure occurred in 3% and FNF dislocation, in 2.5%. ITFF implant failure, which is a major surgical complication, has been reported at a rate of 5% in the literature [29]. Infection was more frequent in the FNF group than the other two groups. As arthroplasty is used in FNF, infection is frequent in this region and FNF has been reported to be a risk for infection [30].

No significant difference was observed between PFF types in terms of major and minor surgical complications. Although it was thought that major surgical complications could influence mortality, that was not the case. Even if surgical complications do not affect mortality, they are a factor in continuing morbidity and increasing hospital costs [12]. Non-surgical complications can be seen in all types and affected mortality.

There were some limitations to this study, primarily that it was a single-center study. Multi-center studies with more patients would be of more guidance for national data. Different surgical treatments can be used in PFF at the surgeon's discretion, therefore the differences in surgeries performed according to treatment centers could be considered a limitation. However, a strong aspect of the study was that standard treatments were used according to the fracture types, consistent with current literature. Therefore, as the treatments were standard and current, the data of the last 3 years were used.

Conclusion

ITFF is common in PFF fractures. While no relationship was found between fracture types with complication and mortality, there was a correlation between mortality and age, Charlson comorbidity score, prolonged stay in intensive care, and non-surgical complications.

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