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Research article

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Does a relationship between type of hip fracture and osteoarthritis exist?

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Ethics Committee Approval
This study was approved by the Ethics Committee of Hatay Mustafa Kemal University (Decision no/date: 10/ May 12, 2022).
All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

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No conflict of interest was declared by the authors.

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Abstract

Background/Aim: Many factors have been associated with the etiology of falls and hip fractures in the elderly. However, only a few studies have examined the relationship between osteoarthritis and hip fractures, which are common in this age group. The aim of this study was to determine the relationship between the knee and hip osteoarthritis (OA) and the type of hip fracture.

Methods: Patients who underwent surgery in the Orthopedics and Traumatology Department between January 2017 and December 2021 were eligible to participate in this retrospective cohort study. Patients who were 60 years and older with a hip fracture and adequate medical records and radiographs of bilateral hip and knee joints met the inclusion criteria. Data concerning patient co-morbidities, type of hip fracture, whether they had OA in their hip and knee joints, and the severity of their OA were assessed. The severity of the osteoarthritis presence was categorized with using the Kellgren–Lawrence (KL) classification. To categorize the patients, three groups were identified: (1) femoral neck, (2) trochanteric, and (3) subtrochanteric fracture groups. The presence and severity status of OA in the hip and knee joints and co-morbidity data were compared between the groups.

Results: Three-hundred forty-one patients with a M/F ratio of 148/193 are included in this study. Femoral neck fractures occurred in 142 (41.6%), trochanteric fractures in 147 (43.1%), and subtrochanteric fractures in 52 (15.2%) patients. The mean age of the cohort was 76.72 (10.165); The mean age of the patients in the trochanteric group was higher than in the subtrochanteric group (P = 0.001). No effect of any existing co-morbidities on fracture type was observed. The overall prevalence of OA in the cohort that was observed in the hip joint was 34.3% with 33.7% in males and 35.3% in females. These rates were 66.6%, 53.4%, and 76.7% in the knee joint, respectively. No difference could be observed between hip OA presence and any type of hip fracture group (P = 0.833 for right hip, P = 0.865 for left hip). Similar rates of moderate and severe hip OA were found in the femoral neck and trochanteric fracture groups. However, the frequency of moderate hip OA was lower and the frequency of severe hip OA was higher in subtrochanteric fracture group compared to other groups (P = 0.164 for right hip, P = 0.241 for left hip. Knee OA was observed to be more common in the trochanteric fracture group (P = 0.003 for the right knee, P = 0.002 for left knee) and also, the rate of severe OA was higher in the trochanteric fracture group compared to other groups (P = 0.013 for right knee, P = 0.006 for the left knee).

Conclusion: In contrast to OA presence in the hip, knee OA presence and severity can be significant risk factors for occurrence of trochanteric type fractures in the elderly.

Keywords: Hip fractures, Osteoarthritis, Hip, Osteoarthritis, Knee

Introduction

Although osteoporosis and falling are thought to be the two main risk factors for hip fractures, other factors have been recognized as contributing to fractures, including physical characteristics of the patient, bone morphology, the fall that results in the fracture, joint diseases that can affect gait and balance, neurological diseases, muscle weakness, proprioception disorders, chronic diseases, drugs, and visual issues and etc. [1-7]. It has also been reported that the nature and severity of the fall event have no impact on the type of fracture [1, 2]. A significant health issue that restricts daily living activities for elderly people is osteoarthritis (OA), particularly in the hips and knees [8, 9]. Some researchers have previously assessed the relationship between any fracture caused by an OA-related fall event. In a cohort of 258,696 patients, Jacob and Kostev [10] reported a 1.4-fold increased risk of fracture in patients with OA. While several studies demonstrating how hip and knee OA affect the etiology of falls are available [11, 12], relatively few reports demonstrating how fracture, its morphology, or fracture type are affected have been published. While the presence of OA was confirmed radiographically, in some of these cases, analyses between OA and hip fracture geometry were made in others by assuming the presence of OA based on pain or symptoms as assessed using questionnaires [13–15]. These analyses have frequently questioned whether OA contributes to the type of fracture that occurs and whether it leads to hip fractures. However, these outcomes are inconsistent with each other. The relationship between the type of fracture and the presence of OA in knee joints is also unclear [3, 16–19].

The primary objective of this study was to investigate the impact of hip and knee joint OA on various hip fracture types. Additionally, assessing whether a relationship between chronic diseases and the type of fracture exists was also intended.

Materials and methods

This retrospective cohort study was approved by the Ethics Committee of Hatay Mustafa Kemal University (Decision no/date:10/ May 12, 2022) and performed in accordance with the Declaration of Helsinki. Patients who had surgery in the Orthopedics and Traumatology Department between January 2017 and December 2021 were enrolled. The inclusion criteria were: patients who were 60 years and older with diagnosis of hip fracture and who had adequate medical records and radiographs of bilateral hip and knee joints. Patients younger than 60 years old, patients with insufficient medical records, pathological hip fractures, hip fractures caused by high energy trauma, history of inflammatory arthritis, developmental and/or congenital pathologies of the lower extremity, muscular dystrophy, lower extremity trauma, and prior surgery (such as. hip/knee arthroplasty) that could cause changes in kinematics were excluded.

Three-hundred forty-one patients (193 women, 148 men) were enrolled in the study. The type of hip fracture, the presence and severity of OA in the hip and knee joints, and the patients' pre-operative co-morbid conditions were noted. The Picture Archiving and Communication System (PACS) system was used to perform radiographic evaluations and the presence of joint space narrowing, osteophyte formation, subchondral sclerosis and cysts in bilateral hip and knee joints were all noted. Data concerning the patients' co-morbidities, the type of hip fracture, whether they had OA in their hip and knee joints, and severity of their OA were assessed. The severity of the osteoarthritis presence was categorized using the Kellgren–Lawrence (KL) classification [20]. We partitioned the patients into two groups: (1) those with OA (+) and (2) those without OA (non-OA) order to assess the relationship between OA and the type of hip fracture. To avoid any confusion, KL stage 1 patients with possible osteoarthritic changes were placed in the non-OA group, while all other patients identified as KL stage 2, 3, or 4 were placed in the OA (+) group. In further analyses, patients were classified according to the severity of OA: patients diagnosed as stages 0 and 1 were classified as non-OA, (2) stage 2 as moderate, and (3) stages 3 and 4 as severe OA. The hip fracture type was determined, and patients were classified into three groups: (1) femoral neck, (2) trochanteric, or (3) subtrochanteric fracture groups. Additionally, thorough analyses were conducted by classifying the patients into intracapsular femoral fractures (ICFs) and extracapsular trochanteric fractures (ECFs) and when necessary, the subtrochanteric ones were included as were the fracture groups [21].

Statistical analysis

Statistical analyses were conducted using the Windows-based SPSS 22 program (IBM Corp. Armonk, New York, USA). To determine means, standard deviations, and ranges, a descriptive analysis was performed. To determine whether the variables adhered to the normal distribution, the Kolmogorov–Smirnov tests were used. Mean and standard deviation values were given for variables with normally distributed distributions. Counts (n) and percentages (%) were presented for the nominal variables. To investigate the relationships between hip and knee OA status, KL stages, OA severity, gender, comorbidities, and fracture types, the chi-squared and Fisher's exact tests were used. Analysis of variance (ANOVA) and post hoc test (LSD test) was used to analyze the age differences between the groups. A *P*-value of 0.05 or lower was considered statistically significant.

Results

Descriptive information and comorbidity data of the patients are given in table 1. The overall prevalence rate of OA in the hip joints in the cohort was 34.3%; 33.7% in males and 35.3% in females. These rates were 66.6%, 53.4%, and 76.7% in the knee joints, respectively The rates of OA presence in the patients in the different fracture type groups are given in table 2. When evaluated using the KL classification, no statistically significant differences in hip joint OA severity status distribution between the groups of fracture types (P = 0.132) were found (Figure 1). Similar to this result, when comparing the fracture type groups, no difference in the distribution of the knee joint. OA severity status (P = 0.065) was found (Figure 2). The comprehensive analysis revealed that the fracture type groups' gender distributions were comparable (P = 0.392). The rates for KL OA stages 0, 1, 2, 3, and 4 in the hip joint were 5.4%, 60.8%, 20.9%, 10.1%, and 2.7% in male patients, and 5.2%, 60.6%, 22.3%, 10.9%, and 1% in females (P = 0.837), respectively In

the knee, these rates were 2.7%, 43.9%, 23%, 18.9%, and 11.5% for male patients and 3.1%, 20.2%, 21.8%, 24.9%, and 30.1% for females, respectively ($P < 0.001$). The rates of OA severity status of the patients in the fracture type groups are given in table 3.

Figure 1: Hip osteoarthritis (OA) severity scale according to Kellegren–Lawrence (KL) classification.

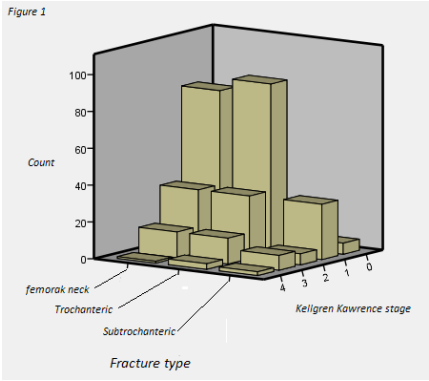
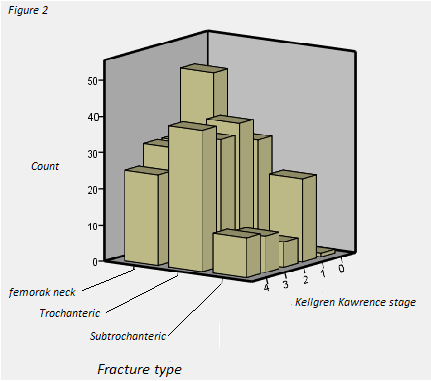


Figure 2: Knee OA severity scale according to KL classification



Discussion

Our findings show that no relationship between hip OA and any type of hip fracture could be found. However, a statistically significant relationship between the occurrence of trochanteric hip fractures and knee OA was shown.

In epidemiological studies, varying prevalence rates of hip OA of up to 45% were reported [22, 23]. However, studies that examined patients with hip fractures reported that this rate could reach 67.5% [3, 13, 14, 18]. To our knowledge, four local and no countrywide population-based studies in Turkey have been conducted that investigate the hip OA prevalence. In a comparable age group, the hip OA prevalence was reported to be 21.5% by Göker [24] and approximately 30% by Dequeker and Johnell [16] in the MEDOS study. Despite being in the range reported before, we discovered a higher prevalence of hip OA in our study (34.3%) compared to the two previous local studies. Relatively few studies in the literature concerning the relationship between OA and hip fractures or the different types of fractures are available. Conflicting evidence exists, but it has been suggested that the type of hip fracture is affected by the presence of hip OA. While some research studies suggest that hip OA is a significant factor influencing the frequency of hip fractures and the type of fracture [16, 17, 25, 26], others report that OA and the odds of hip fractures are inversely related [13, 19, 27–29]. Some researchers declared that hip OA may act as a preventative factor against intracapsular hip fractures in addition to previous studies [3, 16–18].

Table 1: Definitive information and comorbidity data of the patients

	Fracture type				
	Femoral neck n-%/Mean(SD)	Trochanteric n-% / Mean(SD)	Subtrochanteric n-% / Mean(SD)	Total n-% / Mean(SD)	*P*-value
Sex					
Female	85(44%)	77 (39.9%)	31 (16.1 %)	193(56.6%)	
Male	57(38.5%)	70 (47.3%)	21 (14.2 %)	148 (43.4%)	0.392
Age	76.17(10.942)	78.71(9.462)	72.62 (8.483)	76.72(10.165)	0.001
Fracture laterality					
Right hip	63(36.8%)	83(48.5%)	25(14.6%)	171 (50.1%)	
Left hip	79 (46.5%)	64(37.6%)	27(15.9%)	170 (49.9%)	0.115
Comorbidity					
Hypertension	49 (14.4%)	60 (17.6%)	16(4.7%)	125(36.7%)	0.341
Diabetes	35(10.3%)	34 (10.0%)	10 (2.9%)	79 (23.2%)	0.731
CHF	18 (5.3%)	13 (3.8%)	5(1.5%)	36 (10.6 %)	0.554
Demantia dis.	19 (5.6 %)	10 (2.9%)	5(1.5%)	34 (10%)	0.175
Parkinson d.	14 (4.1%)	5 (1.5%)	5(1.5%)	24 (7%)	0.073
CVD	6 (1.8%)	9 (2.6%)	3(0.9%)	18 (5.3%)	0.760
CAD	4 (1.2%)	12 (3.5%)	2(0.6%)	18 (5.3%)	0.112
COPD	4 (1.2%)	6 (1.8%)	4(1.2%)	14 (4.1%)	0.317
CKD	7 (2.1%)	6 (1.8%)	0 (0.0%)	13 (3.8%)	0.276
BA	6 (1.8%)	6 (1.8%)	0 (0.0%)	12 (3.5%)	0.326

CHF: Chronic heart failure, CVD: Cerebrovascular disease, CAD: Coronary artery disease, COPD: Chronic obstructive pulmonary disease, CKD: Chronic kidney disease, BA: Bronchial asthma

Table 2: The rates of osteoarthritis presence of the patients' in the fracture type groups

	Fracture type				
Joint	Neck n=142 (41.6%)	Trochanteric n=147(43.1%)	Subtrochanteric n=52(15.2%)	Total n:341 n (100%)	*P*-value
Left hip	49 (34.5%)	51 (34.7%)	16 (30.8%)	116 (34%)	0.865
Right hip	49 (41.9%)	52 (35.4%)	16 (30.6%)	117 (34.3%)	0.833
Left knee	87(61.3%)	112 (76.2%)	27 (51.9%)	226 (66.3%)	0.002
Right knee	87(61.3%)	112 (76.2%)	28 (53.8%)	227 (66.6%)	0.003

Table 3: The rates of osteoarthritis severity status of the fracture type groups

Joint		Fracture type				
	Grade	Neck n=142(41.6%)	Trochanteric n=147 (43.1%)	Subtrochanteric n=52(15.2%)	Total n=341 n (100%)	*P*-value
Right hip	Absent	93 (65.5 %)	95 (64.6%)	36 (69.2%)	224(65.7 %)	
	Moderate	32 (22.5 %)	34 (23.1%)	5 (9.6 %)	71 (20.8 %)	0.164
	Severe	17 (12 %)	18 (12.2 %)	11 (21.2 %)	46 (13.5 %)	
Left hip	Absent	93 (65.5%)	96 (65.3%	36 (69.2%)	225 (66 %)	
	Moderate	34 (23.9%)	34 (23.1%)	6 (11.5%)	74 (21.7 %)	0.241
	Severe	15 (10.6%)	17 (11.6%)	10 (19.2%)	42 (12.3 %)	
Right knee	Absent	55(38.7%)	35 (23.8%)	24 (46.2%)	114(33.4%)	
	Moderate	31 (21.8%)	38 (25.9%)	7 (13.5%)	76 (22.3%)	0.013
	Severe	56 (39.4%)	74 (50.3%)	21(40.4%)	151(44.3%)	
Left knee	Absent	55(38.7%)	35(23.8%)	25(48.1%)	115(33.7%)	

According to Maluta et al. [18], a diagnosis of hip OA was made in 53.01% of patients with ICFs , while the proportion was 83.12% in the group with ECFs. fractures. Contrary to those studies, Cumming and Klineberg [13] reported the risk of fracture as one-third with the presence of hip OA compared to those patients without OA. Interestingly, Dretakis et al. [17] reported that unlike other studies, no hip OA in any patient with femoral neck fractures could be found. Robstad et al. [3] declared that the presence of hip OA does not protect from hip fracture; however, hip OA incidence was more in the trochanteric fracture group compared to the femoral neck fracture group (22% to 15%). In our study, we could not demonstrate a protective or causal relationship between OA as observed in both the fractured and intact hip joints and the risk of developing any type of fracture.

The severity of OA was felt to be another factor affecting the type of hip fracture [6, 15, 18]. Maestro-Aguda et al. [15] declared that patients with severe hip OA had a higher rate of extracapsular hip fractures, and patients with moderate OA had a higher rate of ICFs. Partially in contrast, Maluta et al [18] found a 2-fold increase in the risk of ECF compared to ICF in patients with moderate OA (stage 2), and a 3-fold increased risk of ECF in patients with advanced OA (stage 3 and 4). Although Calderazzi et al. [25] reported that the fracture is not related to the severity of OA, they reported a 3-fold increase in the risk of trochanteric fractures in the presence of OA compared to femoral neck fractures, consistent with the findings of Maluta et al. [18]. In our study, the rates of moderate and severe OA in the femoral neck and trochanteric fracture groups were comparable. Remarkably, moderate hip OA was less frequent in subtrochanteric fractures than in the other two fracture groups, whereas severe OA was more frequent. We could not identify any study examining subtrochanteric fractures, except one by Franklin et al. [29]. However, due to the small number of patients with this type of fracture (about 5% of the cohort), they also examined these patients within the extracapsular fracture group. So, we could not able to compare the subtrochanteric group separately. We did not notice an inverse relationship with hip OA when we combined the subtrochanteric fractures with the trochanteric ones in the ECF group and compared them to intracapsular fractures, such as those of Franklin et al. [29].

Similar to the wide range of reported rates for the prevalence of hip OA in the general population, the prevalence of knee OA was reported to reach 70.8% [22, 30]. Research conducted on patients with hip fractures reported this rate as high to be as high 30.78% [13, 14, 17, 31]. Although some evidence of knee OA-related falls and associated hip fractures has been published, the relationship between hip fracture type and knee OA is unclear. According to Arden et al. [31], patients with knee OA and knee pain present an increased risk of hip fractures. Regardless of bone mineral density and postural stability parameters, Bergink et al. [32] declared that knee OA is linked to an increased fracture incidence that could not be explained by an increase in the risk of falling. According to Cai et al. [33], patients with bilateral moderate knee OA had a lower risk of fractures and falls than those with early-stage OA unlike Dretakis et al. [17] who reported that 45% of patients with trochanteric fractures and 14% of patients with femoral neck fractures had ipsilateral knee OA. Despite the lack of a nationwide prevalence study, Kaçar et al. [34] reported this rate to be as high as 14.8% in a local study. However, our prevalence rate for knee OA (66.6%) was quite high and close to the upper bound of the range noted in the literature. This rate, which was found to be quite high, prompted us to think that knee OA may be a facilitating factor rather than a protective factor in the occurrence of hip fracture as Bergink et al. [32] stated. We hypothesized that additional evidence of the influence of knee OA on the type of hip fracture exists because of the statistically significant correlation between the trochanteric hip fracture and the presence of knee OA that we found in our analysis.

According to Pereira et al. [35], it was determined that the radiological stage and clinical variables, functional status, and quality of life parameters deteriorated and the group that showed the most significant difference was the group of patients with knee OA Stage 4, while no similar relationship was found between the functional status and radiological stage of hip OA. Considering the view that OA creates a serious increase in the risk of falling, we thought that the correlation found between the presence of fracture and the stage in patients with knee OA, but not found in hip OA patients, could be explained by this hypothesis. Although Franklin et al. [29] stated that no difference in males could be found, they stated that ECF was more common in females with KL stage ≥ 2. However, when we examined the hip joint, we could not find a difference in either sex. We also observed that no difference in the evaluation of OA severity by gender existed. In addition, when we analyzed the effect of OA severity on fracture types according to gender, we did not observe any relationship with hip OA severity. The severity of OA was found to have no effect on the type of fracture in the knee joint in males, but it was found to be significantly associated with trochanteric fractures in females with knee OA status KL stage ≥ 2. Additionally, similar to hip OA, the subtrochanteric fracture group had a lower rate of moderate OA than the other two groups. These two conditions suggest that the development of trochanteric and subtrochanteric fractures may be influenced by the presence of OA in the joint.

According to data from previous studies [10, 36–39], a number of chronic diseases, primarily causing osteoporosis and changes in bone architecture, can lead to an increase in the the risk of hip fracture. However, no information that specifically examines the impact of fracture type in addition to OA is available. In our study, no relationship between each of the co-morbidities and the fracture type was observed when examined using a detailed analysis.

Limitations

We did not examine the patients' walking ability and posture balance status. Therefore, the effects of deterioration on the existing balance and gait biomechanics on fracture formation were not evaluated. Bone mineral density and bone microarchitecture of the patients were not evaluated by any method. Therefore, the effect of the possible presence of osteoporosis was not evaluated. Although the design of our study was different since the incidence of OA and the distribution of etiological data were found to be correlated with increases in the risk of falls and hip fractures in the population were not fully known, analyses could not be performed in detail on this issue.

The frequency of co-morbidities of our patients may be similar to those in the literature, which may be because our institution is a tertiary hospital that operates on patients who have multiple co-morbidities.

Conclusion

To the best of our knowledge, our study is the first to demonstrate the effect of hip and knee OA on subtrochanteric fractures. No relationship could be found between hip OA and any type of hip fracture. However, a significant relationship between the occurrence of trochanteric fractures and knee OA was found. In patients with knee OA, but not those with hip OA, a clear relationship between the type of fracture and the severity of OA was shown. Although the results of our study on subtrochanteric fractures are remarkable, larger series of data are required for confirmation. The hip fracture type is associated with knee OA, and the multifactorial etiology of fall and hip fracture development reveals the necessity of comprehensive studies in which all possible factors are evaluated together.

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