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The Relationship Between Knee Osteoarthritis and Osteoporosis

Diz Osteoartriti ile Osteoporoz Arasındaki İlişki

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Abstract

Objective: The aim of this study was to investigate the association between knee osteoarthritis (OA) and bone mineral density (BMD) in the femur and lumbar vertebrae.

Materials and Methods: A total of 74 female patients (mean age 61.9 ±9.1 years, mean body mass index 27.09±4.24) diagnosed with knee OA were included in this study. To assess knee OA, bilateral weight-bearing antero-posterior knee radiographs were taken and graded from 0 to 4 according to Kellgren–Lawrence criteria. The BMD of the subjects was measured using dual-energy X-ray absorptiometry (DEXA). BMD measurements of those with OA were compared with those without OA.

Results: While there was no correlation between BMD and the grade of knee OA, a significant negative correlation was found between age and femur BMD. Body mass index was positively correlated with OA and negatively correlated with OP.

Conclusion: Further investigations are needed to demonstrate the association between knee OA and BMD.

Key Words: Bone mineral density, Knee osteoarthritis, Osteoarthritis, Osteoporosis

Özet

Amaç: Bu çalışmanın amacı diz osteoatririti ile osteoporoz arasındaki birlikteliği araştırmaktır.

Gereç ve Yöntem: Çalışmaya diz osteoartriti olan 74 kadın hasta dahil edilmiştir (ortalama yaş: 61.9 ±9.1, ortalama vücut kitle indeksi 27.09±4.24). Diz osteoartritini değerlendirmek için yük verilmiş pozisyonda çekilen diz ön arka grafileri Kellgren-Lawrance kriterlerine göre derecelendirildi. Kemik mineral yoğunluğu (BMD) femur ve lomber omurgadan Dual energy X ray absorbsiyometri yöntemiyle ölçüldü. Radyolojik olarak diz osteoartriti olan ve olmayan hastaların kemik mineral yoğunlukları karşılaştırıldı.

Bulgular: BMD ile diz osteoartriti arasında korelasyon tespit edilemezken, yaş ve femur BMD değerleri arasında anlamlı negatif korelasyon mevcuttu. Vücut kitle indeksi ile diz osteoartriti arasında pozitif korelasyon, BMD ile negatif korelasyon mevcuttu.

Sonuç: Çalışma sonunda; daha önce yapılan çalışmalardan farklı olarak diz osteoartriti ile osteoporoz arasında anlamlı bir korelasyon tespit edilememiştir.

Anahtar Kelimeler: Diz osteoartriti, Kemik mineral dansitometrisi, Osteoporoz, Osteoartrit

Introduction

Although osteoporosis (OP) and osteoarthritis (OA) are very frequently seen in the elderly population, it is commonly believed that they rarely coexist. This reverse association was first suggested nearly 30 years ago by Foss and Byers, who found that the bone mineral density (BMD) of patients undergoing hip surgery due to OA were above the 90th percentile. In general, osteoarthrosis is associated with above-average bone density, and hip OP and osteoarthrosis do not normally occur together. It is possible, in light of existing ideas, to explore relationships between bone density and osteoarthrosis and suggest that the degree of physical activity at different times during an individual's life has an important function in the etiology of both osteoarthrosis and OP [1]. After this finding, many studies have been conducted investigating the relationship between osteoarthritis and bone density [2-11]. Steward et al. stated that the patients with OP have reduced bone density, whereas patients with OA have similar or increased bone density compared to controls. They concluded that increased bone turnover is restricted to the OA group. Also, Newitt et al. concluded that elderly Caucasian women with moderate to severe radiographic hip OA have higher BMD in the hip, spine, and appendicular skeleton than women without hip OA. Their findings are consistent with a role for elevated BMD in the pathogenesis of hip OA.

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These studies generally agree that the BMD of patients with OA is higher than that of those without OA.

The aim of this study was to investigate the association between knee OA and the BMD of the femur and lumbar vertebrae in patients diagnosed with OA.

Materials and Methods

A total of 74 female patients, diagnosed with knee OA according to American Collage of Rheumatology (ACR) criteria, were included in this study. To assess knee OA, bilateral weight-bearing antero-posterior knee radiographs were taken and graded from 0 to 4 according to Kellgren-Lawrence criteria as follows [12]:

Grade 0: Normal,
Grade 1: Possible osteophytes,
Grade 2: Definite osteophytes and possible narrowing of joint space,
Grade 3: Multiple moderate osteophytes and definite narrowing of joint space,
Grade 4: Large osteophytes, marked by joint space narrowing and/or bony sclerosis.

To assess osteoporosis, the BMDs of the subjects were measured by dual-energy X-ray absorptiometry (DEXA-NORLAND-1998, USA) on the same day. BMD measurements were obtained for the femoral neck and lumbar vertebrae (L2-L4). Patients with grade-0 and grade-1 radiographs were considered to not have OA and were compared with the grade-2, grade-3, and grade-4 patient groups. Correlation analysis was also performed.

Patient age, body mass index, age of menopause, number of children, education and exercise level were recorded. OA and its relationship with OP were evaluated. Patients with a personal history or clinical and radiological doubt of secondary OA or OP were excluded.

Statistical analysis of the data was performed using Spearman's correlation test and linear regression analysis.

Results

The mean age of the patients was 61.9±9.1 years, and their mean body mass index was 27.09±4.24. Patient OA scores, according to Kellgren-Lawrence classification criteria, lumbar vertebrae L2 and L4 and femoral neck BMD values are presented in Table 1. There was no statistically significant correlation between BMD and knee OA grade ($p \geq 0.05$). A statistically significant negative correlation was found between age and femur BMD ($p \leq 0.05$). While body mass index was positively correlated with OA, it was negatively correlated with OP ($p \leq 0.05$). OA and OP were not found to be correlated with patient education, exercise level, age of menopause or number of children.

Discussion

OA and OP are major public health problems in the elderly population due to their high prevalence, negative impact on quality of life and economic burden. While both disorders are expected to occur simultaneously, a opposite relationship between these diseases has been demonstrated in previous studies.

We could not detect any correlation between knee OA and BMD in this study. Even if the majority of previous studies suggest a negative correlation, conflicting opinions do exist [13-15]. The coexistence of OA and OP has been demonstrated in experimental animal studies [16, 17].

In various studies, spinal, femoral neck, total-body, knee, femoral shaft and calcaneus BMD values were found to be increased in patients with hip OA [2, 4, 5, 8]. Spinal, femoral neck and total-body BMD values were found to be high in patients with spinal OA [6, 10]. Hart et al. stated that small increases in BMD are present in middle-aged women with early radiological OA of the hands, knees and lumbar spine. These data support the hypothesis that the two conditions are inversely related, although the mechanisms remain unclear. Despite high BMD values in the spinal and femoral regions of patients with knee OA, knee BMD values were found to be low [3, 6-8, 11]. In general, BMD values were found to be unchanged in hand OA, and hand OA is thought to be another form of disease or a component of generalized OA [3, 6], as suggested by Sowers et al. Women with radiographically defined knee OA have a greater BMD than women without knee OA and are less likely to lose that higher level of BMD. There was less bone turnover among women with

Table 1. OA grading and mean BMD values of the patients

OA Kellgren-Lawrence score	Number of patients	L2 mean t-score	L4 mean t-score	Femur mean t-score
Grade 0	11	-0.78	-0.75	-0.66
Grade I	6	-0.84	-0.75	-0.71
Grade II	7	-0.76	-0.81	-0.67
Grade III	43	-0.77	-0.79	-0.70
Grade IV	8	-0.76	-0.97	-0.67

hand OA and/or knee OA. These findings suggest that bone-forming cells might exhibit differential responses in hand vs. knee OA, suggesting differential pathogenesis of hand versus knee OA.

Although different hypotheses have been proposed regarding the basis of the negative correlation between OA and OP, it has not been fully elucidated. Genetic factors have been implicated. In the light of the fact that peak bone mass is influenced by genetic factors by 80% in patients with OP, it would not be fully incorrect to define the relationship with OA on a genetic basis. Vitamin D receptor (VDR) gene polymorphism has been found to be increased in patients with OA; however, it was not associated with BMD and has been suggested to contribute to osteophyte formation and progression. Thus, a possible association of OA with VDR polymorphism and IGF-1 was suggested. Tamai et al. investigated the correlation between the VDR genotypes, as defined by the BsmI restriction enzyme, other related factors and BMD of the lumbar spine in 90 Japanese patients with OP to better understand the pathogenesis of OP. They found that the BMD of the lumbar spine in Japanese patients with OP is affected by body weight and might be affected partially by VDR genotype [18].

Furthermore, Jones et al. aimed to describe the relationship among spinal degenerative disease, allelic variation in the VDR gene and lifestyle factors in a population-based association study. They concluded that both genetic and lifestyle factors were associated with the presence and severity of spinal degenerative disease in their elderly sample. There were site-specific differences in associations in the spine, which may have arisen from a misclassification of disease status or may indicate possible environmental or genetic differences in the pathophysiology of spinal degenerative disease. [19-23]

While softer bone characteristics lead to OP, harder bone quality might lead to OA. High concentrations of osteocalcin, local growth factors, insulin-like growth factors (IGF-I, IGF-II) and transforming growth factor-b (TGF-b) have been found in patients with OA. These endocrine factors and mediators might increase BMD through increased bone formation and protection against bone loss [19-21].

In a study conducted in patients with hip OA [24], BMD values of those with or without OP were compared. Hip BMD values of patients with OA were found to be higher than in the OP and healthy groups. Compared to both control groups, levels of pyridinoline, a bone resorption marker, were found to be higher in these patients, and no significant differences were found in osteocalcin levels.

High BMD values in patients with OA do not produce a parallel decrease in fracture rates. Although investigators have attributed this finding in patients with OA to an increased number of falls, it is difficult to determine whether this might be entirely responsible [22].

Subchondral bone loss in patients with OA is well known [7]. It is not always possible to isolate OA-related changes, such as osteophytes, during the selection of regions of interest in densitometric analyses. BMD values might have been found to be high due to these changes in OA patients [25]. Correspondingly, femoral BMD values in women with osteophytosis have been found to be higher than in those without osteophytosis [26]. Studies evaluating the association between bone density and OA have focused on the knee, hip and lumbar regions. These three regions are the highest weight-bearing regions in the body. Factors predisposing to OA are expected to influence all three regions. Even though the region where bone density is measured might be different from the site of OA, it should be kept in mind that OA can be observed in all synovial joints and may affect several other joints, except in secondary OA. For this reason, osteophytes seem to be the main factor that increases bone density in patients with OA. Furthermore, the following facts support this hypothesis: 1. Fracture rates were decreased in studies where high BMD levels were found. 2. There is no association between hand OA and BMD. 3. High BMD has not been found in bones with less loading, such as the radius [27].

Long-term controlled studies are needed to elucidate the association between OA and OP.

Conflict of interest statement: The authors declare that they have no conflict of interest to the publication of this article.

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