ORIGINAL PAPER

Is There a Role for Ordering a DEXA (Dual Energy X-Ray Absorptiometry) Scan for Patients with Symptomatic Advanced Knee Osteoarthritis?

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ABSTRACT

Background: Osteoarthritis of the knee (OA) and osteoporosis are two conditions that have a significant impact on society, have a great impact on quality of life, and can lead to functional impairment. However, the relationship between knee OA and osteoporosis is unclear. **Objective:** The aim of this study was to examine if there is a link between symptomatic advanced knee osteoarthritis and low bone mineral density. **Methods:** A total of 430 patients with symptomatic and advanced radiographic knee OA served as participants in this study. Plain radiographs were used to screen participants for osteoarthritis, and a Dual Energy X-ray Absorptiometry (DEXA) scan was used to determine each participant's bone mineral density (BMD). **Results:** The lumbar spine, whole femur, and femoral neck BMD levels were statistically higher in the early OA (Kelldren-Lawrence (KL) I and II) group compared with the advanced (III and IV) OA group. Higher BMD at the whole femur and femoral neck but not at the lumbar spine was observed when comparing patients with grades I, II, and III with patients with grade IV after adjustment for body mass index. **Conclusion:** The findings of this study indicate that the degree of knee OA is correlated with a decline in BMD. These findings lend credence to the theory that the two conditions may be linked to one another. Our study concluded that patients with advanced knee osteoarthritis are at risk of developing osteoporosis. As a result, orthopedic doctors are required to screen for osteoporosis in patients with advanced knee osteoarthritis to both prevent and treat osteoporosis at an earlier stage.

Keywords: knee osteoarthritis, osteoporosis, bone mineral density (BMD).

1. BACKGROUND

Both osteoarthritis and osteoporosis are age-related musculoskeletal conditions that frequently occur together and are linked with significant morbidity and mortality. The prevalence of these illnesses is expected to rise along with the increasing age of the population.

Articular cartilage loss is most commonly caused by osteoarthritis, a degenerative joint condition that is both chronic and progressive (1). Joint pain and dysfunction, to varying degrees, are the results for those who are affected by this condition. OA is the most common primary musculoskeletal disorder that causes functional limitations and has a negative effect on the quality of life (2). This has a significant impact on societies around the world.

Osteoporosis is a systemic skeletal illness characterized by a significant decrease in bone mineral density (BMD) as a consequence of abnormal bone mineralization, which in turn causes micro-architectural loss of the bone and raises the probability of fractures (3). It is possible for both OA and OP, which are distinct conditions but share some risk factors, to exist at the same time in the same person.

Studies suggest there is inadequate evidence to support a link between osteoarthritis and osteoporosis; however, the exact pathophysiology between both conditions remains unclear. Several studies (4, 5) have found that people with osteoarthritis are less likely to suffer from osteoporosis. Osteoarthritis has been linked to a lower risk of developing osteoporosis in a number

of studies (6). According to the findings of other studies, osteoarthritis is linked to decreased bone strength as well as increased bone fragility, and those who have OA have a higher risk of bone fractures (7-9).

The correlation between radiographic knee osteoarthritis and bone mineral density (BMD) has only been studied in a handful of studies (10-13). Additionally, only a few studies have looked at the links between osteoporosis and advanced radiographic knee osteoarthritis (14).

2. OBJECTIVE

This study aims to examine if there is a link between symptomatic advanced knee osteoarthritis and low bone mineral density. The understanding obtained from the clarification of this link will aid in the explanation of the relationship that exists between them, which will in turn support clinical practice.

3. MATERIAL AND METHODS

This study investigates the relationship between osteoporosis (BMD) and symptomatic advanced radiographic knee osteoarthritis in adults and the role of ordering a DEXA scan for these individuals. Both of these objectives will be accomplished through the use of a sample size of four hundred and thirty adults.

The patients who participated in this study were all seen in the orthopedic outpatient clinic at our institution for their OA symptoms. Over the course of the study, 430 patients participated. Both the advanced OA group (Kelldren-Lawrence (KL) grades III and IV) and the control group (KL grades I and II) each consisted of 215 patients. Participants were not allowed to participate in this study if they had a previous history of inflammatory disorders, knee deformities, ligament injuries, endocrine diseases, metabolic bone diseases, were younger than 50 or older than 75, or had traumatic arthritis. All of the patients who took part in this study had a body mass index (BMI) that ranged from 18.5 to 30 kg/m2.

Plain radiography is still the gold standard for determining the presence and severity of osteoarthritis in the knee. Using the same device, qualified radiologic technicians took weight-bearing AP radiographs of both knees for all participants. The Kellgren–Lawrence (KL) scale classified radiographic knee osteoarthritis as I, II, III, or IV.

The KL classification is a well-known grading system that is based on radiographs of the AP knee. According to the KL categorization system, there is a correlation between the increased grade of knee OA and the increasing severity of OA, with Grade IV representing the most severe form of OA (15). (Figure 1).

The bone mineral densities (BMDs) of the subjects were examined using dual-energy X-ray absorptiometry on the same day in order to determine the presence of osteoporosis. In both groups, measurements for bone mineral density (BMD) were taken for the whole femur, the femoral neck, and the lumbar vertebrae (L1–L4). The T-score was used to categorize the patients into several groups. (Fig_2)

Statistical analysis

Data were analyzed using IBM SPSS Statistical software application (version 28). For the basic demographic features, descriptive statistics were used. Mean T scores were calculated and compared using ANOVA tests and T tests. Data were presented as mean (SD) and percentages.

4. RESULTS

Variable	Study participant (n = 430)
Male	36 (8.4%)
Female	394 (91.6%)
Mean Age	64.6 ±8.03
Early Osteoarthritis	215 (50%)
Late Osteoarthritis	215 (50%)
Osteoporosis	91 (21.2%)
Osteopenia	233 (54.2%)

Table 1. Demographic Data. Data are presented as Mean (SD) / Number (Percentage)

	Early osteoarthritis	Advanced osteoarthritis	P value
Lumber	-1.202 (1.25) -1.3 (-5.4 - +2.4)	-1.489(1.21) -1.5(-5.5 -+2.3	0.016
Femur neck	-0.88 (1.02) -1 (-3.4 - +1.6)	-1.178 (0.96) -1.2 (-3.8 - +1.9)	0.002
Total femur	-0.853 (1.09) -0.9 (-3.7 - +1.9)	-1.245 (1.09) -1.4 (-4.3 - +2.3)	< 0.0001

Table 2. T-score in different regions between Early and Advanced osteoarthritis groups.Data are presented as Mean (SD) / Median (Max-Min)

	Grade				
	1	2	3	4	P value
No. of Patients	118	97	44	171	
Lumber	-1.011(1.28) -1.1 (-4 -+2.3)	-1.44 (1.19) 1.6 (-5.4 - +2.5)	-1.58 (1.3) -1.5 (-5.5 - +1.2)	-1.47 (1.19) -1.5 (-3.9 - +2.3)	0.006
Femur neck	-0.658(1.09) -0.8 (-3 -+1.9)	-1.092(1.05) -1.1 (-3.7 -+1)	-0.973 (1.11) -1.1 (-2.8 - +2.3)	-1.315 (1.01) -1.4 (4.3 - +1.8)	<0.0001
Total femur	-0.613 (1.04) -0.8 (-3.2 - +1.6)	-1.206(0.89) -1.2 (-3.4 -+1)	-1.068 (0.95) -1.1 (-2.6 - +1.9)	-1.206 (0.96) -1.3 (3.8 - +1.4)	<0.0001

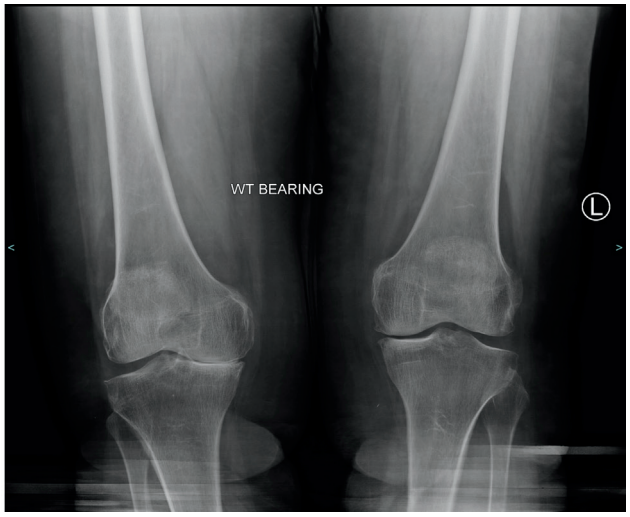
Table 3. The T-scores in different regions in accordance with the grades. Data are presented as Mean (SD) / Median (Max-Min)

The basic demographic features are illustrated in Table 1. A total of 430 patents were included in the study, with the majority of them being females. The mean age of the population was 64.6 (SD: 8.03); 54.2% of patients had osteopenia while 21.2% had osteoporosis. In terms of K-L score, grade IV K-L score was the most prevalent (39.8%), followed by grade I (27.4%), grade II (22.6%), and grade III (10.2%).

Patients were divided into two groups: early osteoarthritis (KL grades I and II) and advanced osteoarthritis (KL grades III AND IV), and the mean T score for the two groups were compared; table 2 illustrates the T score comparison between

	Grade					
	Grades 1,2,3	Grade 4	P value	Grade 1	Grades 2,3,4	P value
Number of Patients	259	171		118	312	
Lumber	-1.27(1.27) -1.3 (-5.5- +2.5)	-1.47(1.19) -1.5 (-3.9- +2.3)	0.099	-1.011(1.281) -1.1 (-4 -+2.3)	-1.472 (1.2) -1.5 (-5.5 - +2.5)	0.001
Femur neck	-0.912(1.01) -1 (-3.4 - +1.9)	-1.206 (0.957) -1.3 (-3.8 - +1.4)	0.003	-066 (1.94) -.8 (-2.3 - +1.6)	-1.197 (1.08) -1.2 (-3.8 - +1.9)	<0.0001
Total femur	-0.874(1.1) -0.9 (-3.7 - +2.3)	-1.32(1.1) -1.4 (-4.3- +1.8)	<0.0001	-0.613(1.37) -.8 (-3 -+1.9)	-1.187 (0.934) -1.3 (-4.3 – +2.3)	<0.0001

Table 4. Comparison of T-scores in different regions between various groups of osteoarthritis. Data are presented as Mean (SD) / Median (Max-Min)



Figrue 1. Ap weight bearing knee x-ray

the two groups. T score was significantly lower in the advanced osteoarthritis group compared to the early osteoarthritis group in the three observed regions (lumber, neck of femur, total femur).

The impact of osteoarthritis grade on T score in various locations was evaluated using an ANOVA test. Patients were divided into four groups according to their grade of osteoarthritis (grades I-IV). A statistically significant difference was found between the four osteoarthritis grades regarding T scores in different locations (Table 3). A post-hoc test using the Tukey HSD test was conducted. The test indicated that the T score in the lumber region was significantly different between Grade I (-1.011, SD= 1.28) in one hand and Group III (-1.58, SD= 1.3) and Group IV (-1.47, SD= 1.19) in the other hand. The difference between the other groups was not significant.

The post-hoc test for the femur neck region showed that grade I had a statistically significant higher value than the other groups. In contrast, there was no significant difference between the three other groups. The post-hoc test for the whole femur region showed that there was a significant difference between Grade I (- 0.613, SD= 1.04) in one hand and Grade II (-1.206, SD= 0.89) and Grade IV (-1.206, SD= 0.96) in the other hand. The difference between the other groups was not significant.

In a sub analysis, we compared K-L grades I, II, and III vs. IV and grade I vs. II, III and IV in terms of T score; the results are illustrated in Table 4. The T score decreased in the higher K-L grades, and the difference between all grades was statistically significant except for the lumber score of grades I, II and III vs. IV was insignificant.

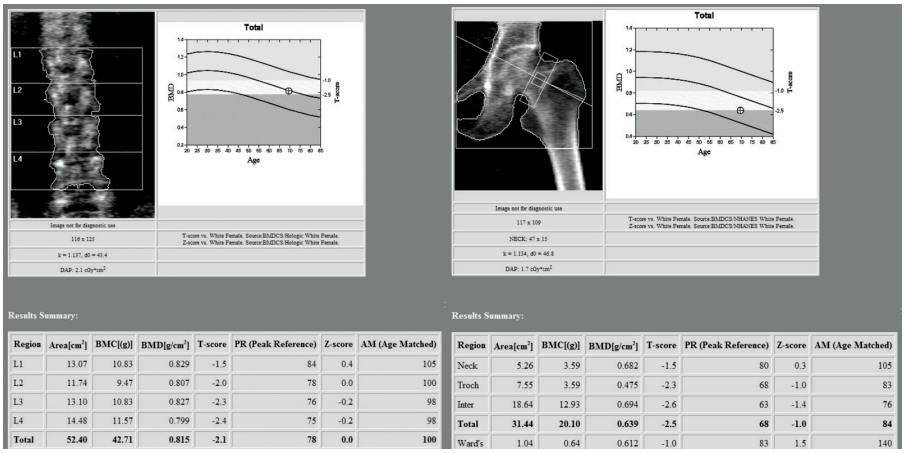
5. DISCUSSION

There are a number of relationships that appear to exist between osteoarthritis and osteoporosis; however, the nature of these linkages is not fully understood. In this particular research study, the link between the BMD and grades of knee radiological OA was the primary focus of our attention.

Several studies on OA have yielded conflicting findings. Hordon et al. (16) analyzed twenty postmenopausal women with generalized osteoarthritis as well as eighty-nine control cases and evaluated them by comparing them according to the BMDs of the hip, spine, and total body. They noticed that the osteoarthritis group had higher spine and total body BMD values. Also, Hannan et al. (17) investigated the Framingham study and found that patients who had radiographic changes associated with knee OA had higher hip BMD values.

In contrast, Linde et al. (18) published their findings on 450 patients who were scheduled to undergo knee arthroplasty procedures, and they found that the T-score was significantly lower in patients with the most severe forms of knee OA (grades III and IV), and they came to the conclusion that more advanced knee osteoarthritis was associated with lower bone mineral density. On the other hand, Reid et al. (19) observed no significant BMD change in primary generalized osteoarthritis patients compared to controls.

In our study, when we analyzed the lumbar, whole femur, and femoral neck T scores of OA patients, we found that the T-scores of OA patients were lower and decreased in accordance with the degree of OA except for grade III. When we



Figrue 2. Dexa scan results

compared these values, we discovered a statistically significant difference between the OA grades I, II, III, and IV. There was a significant difference between the lumbar and femoral neck T-scores of patients with grade I OA and those with grades III and IV OA (Table 3).

Choi et al. (20), who analyzed the correlation between radiographic knee OA and bone mineral density in 4,250 people over the age of 50, found similar outcomes. Bone mineral density was evaluated between those without OA and those with mild OA, as well as between those with mild OA and those with moderate to severe OA. They found that BMD and T-scores of the entire hip and lumbar spine were substantially lower in the moderate-to-severe radiological knee OA group and greater in the mild OA group as compared to the non-OA group. Im et al. (21) evaluated 189 female patients with knee pain and radiological knee osteoarthritis (OA) in order to investigate the correlation between the bone mineral density (BMD) of the ipsilateral proximal femur and the severity of radiological knee OA in a Korean population. These patients all had knee pain. According to what they found, having severe osteoarthritis in the knee was linked to having a decreased BMD in the proximal femur (P = 0.05).

In our study, both groups were analyzed and compared in terms of OA grades, as well as the T-score of the lumbar spine, the whole femur, and the values of the femoral neck. When patients with OA grades I and II were compared with those of patients with OA grades III and IV, the T scores were found to be lower in grades III and IV, and statistically significant differences were noted between the two groups.

Limitation of the study

There are several limitations to this study that need to be addressed. The study was limited by the relatively small number of patients. In addition, we were only able to include patients who were experiencing symptoms of knee osteoarthritis in this study; as a result, we were unable to evaluate the relationship in healthy groups.

6. CONCLUSION

Our study suggests that bone mineral density (BMD) may correlate with osteoarthritis severity. Our study's results suggest that all primary care and orthopedic doctors should be aware of the potential for the coexistence of these two illnesses. If a patient has advanced knee OA, it is important to order a DEXA scan in order to prevent osteoporosis complications.

- **Patient Consent Form:** All patients were informed that data concerning the case would be submitted for publication and agreed.
- **Author's Contribution:** M.K., J.A.: data collection, conception, study design, methodology, writing, reviewing, and editing; and final approval of the version to be published. M.A., M.A., R.A.: data collection and methodology. A.A.: analysis.
- **Conflicts of interest:** There are no conflicts of interest.
- **Financial support and sponsorship:** none.

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