ORIGINAL RESEARCH

Evaluation of the relationship between Knee Osteoarthritis and Meniscus Pathologies

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Abstract

Background

Knee osteoarthritis is a common, degenerative joint disease that causes chronic pain that affects daily life. Our study aims to evaluate geriatric patients aged 65 and over with knee pain in terms of osteoarthritis with radiography and magnetic resonance imaging and to investigate its relationship with meniscal pathologies.

Methods

Radiography and magnetic resonance imaging of patients aged 65-88 years with knee pain were evaluated in terms of knee osteoarthritis and staging was performed. Meniscal pathologies were evaluated in magnetic resonance imaging, and the prevalence of different meniscal lesion types was calculated. In addition, the relationship between knee osteoarthritis and meniscal pathologies was analyzed.

Results

Radiographic evidence of knee osteoarthritis was found in 182 (84.2%) of the 216 cases in our study group. A strong correlation was found between the degrees of knee osteoarthritis on magnetic resonance imaging and radiography. At least one meniscus pathology was observed in all 182 radiography cases with knee osteoarthritis findings. At least one meniscus pathology was observed in 29 (85.3%) of those without osteoarthritis signs. It was determined that meniscus degeneration, tear, and extrusion were observed more frequently in patients with knee osteoarthritis than in patients without osteoarthritis. Meniscal extrusion and complex and horizontal-type tears were the most common lesions.

Conclusions

Osteoarthritis was found to be common in geriatric patients with knee pain. A correlation was found between radiography and magnetic resonance imaging regarding knee osteoarthritis. It was observed that meniscal pathologies were detected more frequently in patients with knee osteoarthritis.

Keywords: Knee osteoarthritis, radiography, magnetic resonance imaging, meniscus injuries

Introduction

Knee osteoarthritis (OA), one of the most common degenerative musculoskeletal diseases, has many known risk factors such as old age, female gender, malalignment, obesity, genetic factors, and trauma[1,2]. Since OA seriously affects individuals and society, it is very important to investigate the disease mechanism and risk factors[3]. Many risk factors associated with the pathogenesis of OA have been described[4]. The meniscus is an important anatomical formation in the fibrocartilage structure, which has important functions such as shock absorption, load bearing, and joint stability in the knee joint[5]. The inability of the meniscus to distribute the load during load-bearing causes damage to the joint cartilage and thus accelerates the development of osteoarthritis. An increase in body mass index and degenerative changes, meniscal degeneration, tears, and extrusions accelerate cartilage destruction. Therefore, knowing the meniscus pathologies is important in terms of evaluating the progression of OA and the degenerative changes that may accompany it[6]. Knee Magnetic Resonance Imaging (MRI) has shown that meniscus damage may occur in individuals without radiographic (RG) signs of OA[7,8]. Studies have shown that meniscal pathologies and cartilage defects detected by MRI correlate with joint distance evaluated as RG. Hall et al. reported that meniscal pathologies are associated with changes in cartilage volume and joint space[9]. Studies investigating the prevalence of meniscus injury in the geriatric population aged 65 and over are rare[10]. In the geriatric population, OA is frequently evaluated with RG. Today, frequently performed MRIs are useful in the diagnosis of OA. Additionally, other soft tissue pathologies that may cause OA can be evaluated with MRI. This study aimed to investigate the effect of OA on meniscus pathologies by evaluating OA with RG and MRI in the geriatric patient group.

Methods

Study population

A single-center, retrospective, cross-sectional study. Ethics committee approval was obtained from our institution before starting the study (19.04.2023-decision no:2023-04/16). The participants were provided with written and verbal information, and all provided their consent. This study was conducted by the Declaration of Helsinki. Our study examined clinical records and radiological images of 256 patients over 65 years of age who applied to the hospital

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with any knee pain complaint and had knee MRIs. Knee MRIs taken between January 1, 2021, and April 1, 2023, were evaluated retrospectively. Trauma patients, oncology patients, patients with metallic prostheses, and patients with poor image quality were not included in the study. As a result, knee MRI of 216 patients aged 65-88 years constituted the study group.

Radiographic evaluation

Radiographic images were taken bilaterally, with the knee in full extension and anteroposterior radiographs. All RGs were interpreted separately by two expert radiologists, unaware of the patient's clinical and MRI images. Images were graded using the Kellgren Lawrence(KL) OA classification system. Grade 0, normal; grade 1, suspicious osteophyte formation; grade 2, pronounced osteophyte formation with normal joint distance; grade 3, osteophytes, joint space narrowing, and subchondral sclerosis; grade 4, reduction in joint space or ankylosis with multiple osteophytes, significant sclerosis and erosion (11). Patients with KL OA degree ≥ 2 were considered to have knee OA (Figure 1).

Figure 1: Knee osteoarthritis was observed on the knee radiograph (a) and magnetic resonance imaging (b) of a 69-year-old female patient with knee pain. Kellgren Lawrence grade 4 changes, characterized by multiple osteophytes, significant narrowing of the joint space, and subchondral sclerosis, are indicated by the arrow (a). Large osteophytes accompanied by medial meniscus extrusion, characterized by grade 4 changes in the Noyes classification system, cartilage defects, and changes in the subchondral bone, are indicated by the arrow on the proton density-weighted magnetic resonance image containing suppressed coronal fat (b).

MRI evaluation

All MR images were made with a 1.5 Tesla MRI device (Siemens Magnetom Aera, Erlangen, Germany). It was instructed to keep the knee in full extension during the examination. A protocol of 4 sequences with a slice thickness of 4 mm was used for knee imaging: coronal T1, sagittal fat-suppressed (FS) proton-weighted, coronal FS proton-weighted, and axial FS proton-weighted. All MRIs were reinterpreted prospectively by 2 expert radiologists who were unaware of the patient's clinical and RG images.

Cartilage injuries were classified according to the Noyes classification system as follows: grade 0, normal; grade 1, increased signal or swelling; grade 2, partial thinning; grade 3, fissure up to the bone level; and grade 4, subchondral bone injury (12)(Figure 1).

Meniscal evaluation

Two radiologists performed a knee MRI evaluation. Radiologists made evaluations unaware of each other and RG. When there was inconsistency in the interpretation of the images or doubtful cases, the images were re-evaluated and the final decision was taken unanimously. Medial and lateral menisci were examined. The anterior horn, body, and posterior horn of both menisci were examined. The meniscus evaluation was categorized according to normal, degeneration, and tear types. In addition, the presence of extrusion in the menisci was evaluated. This Evaluation was made according to the following criteria (Figure 2).

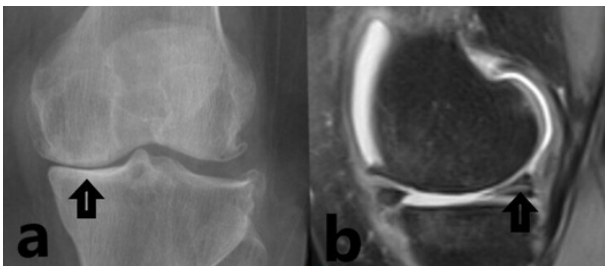

Figure 2: Knee osteoarthritis in the left knee of a 72-year-old female patient seen on radiography (a) and magnetic resonance imaging (b). On the x-ray (a) Kellgren-Lawrence grade 4 changes are indicated by the arrow. On the proton-weighted magnetic resonance image (b), a horizontal medial meniscus tear with sagittal fat suppression is indicated by the arrow.

1- Degeneration: Focal or linear hyperintense that does not extend to the articular surface

2-Tear: High signal intensity reaching the margins of the meniscus in at least two consecutive sections (13-15).

a- Basic tears: Nondisplaced longitudinally oriented tears

1-Horizontal tear: high signal intensity extending to the free edge parallel to the tibial plateau

2-Vertical tear: craniocaudal extension to the tibial plateau

3-Radial tear: perpendicular to the long axis of the meniscus

4-Root tear: located at the root of the meniscus

b- Complex tear: variable combinations of horizontal, vertical, and radial type tears

c- Displaced tear: A type of tear separated from the main junction as a result of a meniscus tear

1-Flap tear: Displaced horizontal tears

2-Bucket-handle tear: Displaced vertical tear

3-Parrot beak tear: Oblique radial tear

Statistical analysis

Statistical analysis of study data was performed using Statistical Package for Social Sciences (SPSS) version 22.0. The conformity of the quantitative data to the normal distribution was examined using the Shapiro-Wilk test. For quantitative data suitable for normal distribution, analyses were performed using a t-test or one-way analysis of variance in independent groups according to the number of groups. For quantitative data not suitable for normal distribution, analyses were performed using the Mann-Whitney U or Kruskal Wallis test according to the number of groups. Descriptive statistics of the data were given as standard deviation and median (min-max). The relationship between the data in the patient group was analyzed by Pearson Correlation for data with normal distribution, and Spearman Correlation test for data not suitable for normal distribution. In the analysis of qualitative data, the Chi-square (χ^2) test and Fisher exact χ^2 test were used. The error level was taken as 0.05.

Results

In our study, RG evidence of knee OA was found in 182 (84.2%) of the 216 cases we examined (KL grade≥2).

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Table 1. Demographic characteristics of the study population

	Patients with OA on RG and MRI(n=182)	Patients without OA on RG and MRI(n=34)	P
	Median (min-max)	Median (min-max)	
Age	69(65-88)	69(65-76)	>0.05
Gender Female Male	 121 61	 19 15	>0.05
OA: Osteoarthritis, RG: Radiographic, MRI: Magnetic Resonance Imaging			

Table 2. Distribution of meniscal pathologies according to the presence of osteoarthritis radiographically

	Patients with OA on RG and MRI(n=182)(%)	Patients without OA on RG and MRI(n=34)	P
Medial-Meniscopathy normal			
degeneration	0	5(%14.7)	
tear	54(%29.6)	28(%82.4)	<0.001*
	128(%70.4)	1(%2.9)	
Lateral-Meniscopathy normal			
degeneration	133(%73.0)	32(%94.1)	
tear	39(%21.4)	2(%5.9)	0.03*
	10(%5.6)	0	
Medial Meniscus Extrusion			
Yes	143(%78.5)	1(%2.9)	<0.001*
No	39(%21.5)	33(%97.1)	
Lateral Meniscus Extrusion			
Yes	6(%3.2)	0	0.6
No	176(%96.8)	34(%100)	
OA: Osteoarthritis, RG: Radiographic, MRI: Magnetic Resonance Imaging *p<0.05 statistically significant			

It was observed that the finding of knee OA increased with age. OA findings were observed more frequently in women than in men. The main characteristics of the study group are summarized in Table 1. In the evaluation of OA, Kellgren Lawrence OA classification was used for RG, and the Noyes classification system was used for MR. OA grades in both were evaluated with Spearman correlation analysis and a strong correlation was found ($r=0.89$, $p<0.001$).

At least one meniscal pathology was observed in all (100%) 182 cases with knee OA as RG. At least one meniscus pathology was observed in 29 (85.3%) of those without knee OA findings. In both groups, medial meniscus pathology was observed more frequently than the lateral one. Medial meniscus extrusion was detected in 143 (78.5%) of the patients with OA, and medial meniscus extrusion was found in only one (2.9%) of the patients without OA. Medial meniscus pathologies and extrusion were found to be statistically significantly more common in patients with OA than in patients without OA ($p<0.001$). The distribution of meniscal lesions according to the presence of OA is shown in Table 2.

Medial meniscus tear was observed in 128 (70.4%) of 182 cases with OA finding on RG. The medial meniscal tear was observed in only one (2.9%) of the cases without OA signs. A statistically significant difference was found between the groups ($p<0.001$). In cases with knee OA, complex-type tears were most frequently observed in the medial meniscus in 49 (27%) cases. Horizontal tears were found in 42 (23.1%) cases with the second frequency. The distribution of tear types is shown in Table 3.

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Table 3. Prevalence of medial meniscal tear types according to the radiographic presence of osteoarthritis

		Patients with OA N(%)	Patients without OA N(%)	P
Medial Meniscus Tear				
	Normal	**54(%29.6)**	**33(%97)**	
	Horizontal	**42(%23.1)**	**0**	
	Vertical	**6(%3.2)**	**0**	
	Radial	**13(%7.2)**	**1(%3)**	
	Root	**6(%3.2)**	**0**	
	Complex	**49(%27.0)**	**0**	
	Flap	**9(%5.0)**	**0**	
	Bucket Handle	**2(%1.1)**	**0**	
	Parrot Beak	**1(%0.6)**	**0**	
Total		**182**	**34**	**P<0.01***

OA: Osteoarthritis

***p<0.05 Statistically Significant**

Discussion

Knee osteoarthritis is a musculoskeletal degenerative disease in which many factors are held responsible for its development. The diagnosis of OA is made with RG. OA findings can also be evaluated with MRI. Meniscus pathologies are quite common in knee MRI examinations and pose a significant risk for the development and progression of OA[20].

In this study, the evaluation of knee OA was done with RG and MRI. Knee OA was detected in 84.2% of the cases and was observed to be quite common in the geriatric population. In addition, meniscal pathologies were evaluated in the geriatric population, and meniscal pathology was found in 97% of the cases. The medial meniscal tear was detected in 59% of all cases and 70.4% of cases with knee OA. Lateral meniscus pathologies were detected less frequently than medial ones. A lateral meniscal tear was observed in only 4% of the cases.

The most common pathology detected in all cases was medial meniscus extrusion.

Osteoarthritis is detected quite frequently in the geriatric population. It is one of the most common causes of knee pain. In addition, knee pain has many causes other than OA. In a study, meniscal pathology was found in 84% of cases without OA and in 94% of cases with OA (7). Similarly, in our study, at least one meniscus pathology was found in 86% of cases without OA and in 100% of cases with OA. In the study conducted by Englund et al., meniscus pathology was found at a rate of 32% in patients aged >50 years without OA and 64% in patients with OA[10]. In this study, it is thought that meniscus pathology was detected less frequently in both groups because it was taken in the 50-65 age group and meniscus extrusions were not included in the study.

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The prevalence of meniscal tears is approximately 12-14%. Approximately 61 cases are seen in every 100,000 people[16]. While pathologies due to acute trauma affect the young population, degenerative meniscus pathologies are seen in the geriatric population[16]. In the geriatric population, meniscal pathologies are quite common as seen in our study. In patients with OA, degeneration, extrusion, or tear is often found in the meniscus. This indicates a strong relationship between OA and meniscal pathology[17]. However, there is a complex relationship between meniscal pathologies and OA. OA may lead to meniscal pathologies, and meniscal pathologies may accelerate the OA process[18]. The causes of cartilage loss in the OA process also affect the meniscus. In our study, the prevalence of meniscal pathologies and their relationship with OA were determined in the geriatric population. Types of meniscus tears have been revealed. Complex and horizontal tear types were the most common.

Meniscus extrusion is the most common meniscus pathology. In a study by Hada et al., it was emphasized that extrusion can be seen without meniscal tears in patients with OA[19]. In the study of Aylanc et al., it was shown that medial extrusion increases when the medial femoral cartilage thickness decreases, and lateral extrusion increases when the lateral femoral cartilage thickness decreases. The relationship between OA and meniscus extrusion has been demonstrated[20]. In the study of Roubille C et al., it was revealed that meniscus extrusion causes loss of joint cartilage and OA progression[21]. Similarly, in this study, extrusion was the most common meniscus pathology in patients with OA.

The biggest limitation of this study is that it is retrospective and cannot be evaluated together with physical examination findings. Therefore, there is a need for studies with more patient groups that evaluate prospective clinical findings together.

Conclusions

In our study, the relationship between OA and meniscal pathologies was revealed. Meniscal pathologies pose a risk in terms of structural disorders associated with OA, such as bone marrow edema, cartilage loss, and decreased subchondral bone density. However, many meniscal pathologies cause strain on the knee joint, leading to the progression of OA. Considering the cause-effect relationship, it is thought that both pathologies trigger each other.

Conflict of interests

The authors declare that they have no competing interests.

Authors contribution

The study was conceived by IA and SA. IA and EG coordinated the fieldwork. IA, EG, and SA did data analysis. All authors have read and approved the final version of this manuscript.

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