Current Research in MRI

Original Article

Evaluation of the Presence of Additional Knee Pathology on Magnetic Resonance Imaging in Patients with Chondromalacia Patella

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Cite this article as: Kaya Ö, Dilek O, Özgül Özesen D, Bıçakçı YK. Evaluation of the presence of additional knee pathology on magnetic resonance imaging in patients with chondromalacia patella. *Current Research in MRI*, 2024;3(1):1-4.

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Received: December 26, 2023 **Revision Requested:** January 30, 2024 **Last Revision Received:** January 30, 2024 **Accepted:** February 7, 2024
Publication Date: March 22, 2024

DOI:10.5152/CurrResMRI.2024.23087

Abstract

Objective: Chondromalacia patella (CP) describes the softening of the patellar cartilage, and magnetic resonance imaging (MRI) is more useful in diagnosis than other imaging methods. The aim of study is to determine the frequency of other knee MRI findings and their relationship with chondromalacia stages in patients evaluated for reasons other than trauma and found to have patellar chondromalacia.
Methods: This retrospective study included patients who underwent knee MRI examination in the radiology departments of Cukurova University Faculty of Medicine and Health Sciences University Adana Faculty of Medicine for reasons other than trauma between January 2016 and January 2022. Magnetic resonance imaging was used to evaluate the presence and stage of CP, and the outerbridge system was used for staging. As additional findings, the presence of osteoarthritis, cruciate ligament, meniscus, collateral ligament, and patellar tendon pathologies were evaluated.
Results: A total of 278 patients, 168 women and 110 men, with an average age of 59.4 ± 9.8 years, were included in our study. Forty-six patients had stage 1, 64 had stage 2, 66 had stage 3, and 102 had stage 4 CP. A statistically significant correlation was found between increasing chondromalacia stage and the presence and stage of osteoarthritis ($P < .001$), the incidence of anterior cruciate ligament pathology ($P < .001$), the incidence of tears of the medial meniscus (anterior horn $P < .002$, posterior horn $P < .039$), and advanced age ($P < .001$).
Conclusion: It has been determined that there is a relationship between the stage of CP and some additional knee pathologies and advanced age.
Keywords: Chondromalacia patella, knee MRI, additional findings

INTRODUCTION

Chondromalacia patella (CP) is defined as the softening and degeneration of the hyalinized cartilage that forms the patellofemoral joint surface, which is the joint where the patellar bone meets the trochlear groove of the femur.[1] Chondromalacia patella presents with chronic anterior knee pain, which is one of the common complaints of admission to the hospital. It is one of the most common causes.[2] Although cartilage degeneration begins at an early age with cellular aging, it is known that some factors accelerate and facilitate the development of chondromalacia. Structural abnormalities in the patellofemoral and tibiofemoral joints may accelerate chondromalacia by increasing the load on the patellar cartilage. Other factors that facilitate the development of CP are trauma and inadequate vascular nutrition in the subchondral bone tissue.[3,4]

Although patellar cartilage evaluation is not fully possible with conventional radiography, it can be used to evaluate patellofemoral joint distance, joint osteoarthritis (OA) findings, and the presence of effusion. In lateral radiographs, changes in the subchondral bone can be noted.[5-8] It is known that plica and focal cartilage defects can be demonstrated with computed tomography arthrography, but its low sensitivity in showing early cartilage defects and the presence of ionizing radiation make magnetic resonance imaging (MRI) the preferred imaging modality for the diagnosis of CP.[9-11] The fact that it reveals the other soft tissue components of the knee joint, which is a complex structure along with the patellar cartilage, and their positional relationships with the joint in a multiplanar manner with high resolution has made MRI the most important examination in patients presenting with knee pain.[12,13] In recent years, fat-suppressed proton density/T2 sequence has come to the fore for the diagnosis of CP and has taken its place in routine knee MRI protocols.[13]

Chondromalacia patella is graded with a classification defined for arthroscopy by Outerbridge and then adapted radiologically via fat-suppressed proton density MR sequences.[11] In this classification, stage 0 is normal cartilage, stage 1 is focal hyperintensity in cartilage with normal contour, stage 2 is a focal defect affecting 50% or less of the cartilage thickness, stage 3 is chondromalacia affecting more than 50% of the cartilage thickness but not accompanied by bone marrow edema, stage 4 refers to a full-thickness cartilage defect that begins with edema in the subchondral bone and includes progressive bone changes.[14]

It is common to detect more than one pathology together in knee MRI examinations, and it is mentioned in the literature that other pathologies such as meniscopathy, ligament pathologies, and patellar tendinitis may accompany CP.[15] However, there is limited information about whether there is a relationship between the incidence of other knee pathologies and the stages of CP, and which knee pathologies and CP may frequently coexist. In this study, we investigated the existence and frequency of these associations.

MATERIAL AND METHODS

The study is retrospective, and ethics committee approval was received from the Clinical Research Ethics Committee of Cukurova University Faculty of Medicine (number: 129, date: January 6). Since only MR images of the patients were used retrospectively in the study, informed consent was not obtained. Between January 2016 and January 2022, patients referred to the departments of radiology for knee MRI were screened. Patients with the presence of CP on fat-suppressed proton density axial MRI sequences were included in the study. Patients admitted due to trauma were excluded from the study. The cases included in the study were grouped into 4 stages according to the CP Outerbridge staging system (Figure 1). Additional pathologies, such as the presence and stage of OA, the presence of partial or full-thickness tear in the cruciate ligaments, the presence of degeneration or tear in the meniscus, the presence and stage of injury in the collateral ligaments, and the presence of patellar tendinitis, were recorded in the knee MRI examinations of 278 patients with CP.

The images included in the study were obtained on GE 3.0 Tesla SIGNA ARCHITECT and 1.5 Tesla OPTIMA MR (General Electric Healthcare, Milwaukee, Wisconsin, USA) devices and 3.0 and 1.5 Tesla INGENIA MR (PHILIPS, Eindhoven, Netherlands) devices. The non-contrast knee MRI protocol consisted of axial fat-suppressed proton density, sagittal, and coronal fat-suppressed T2 and sagittal T1-weighted sequences.

Statistical Analysis

Chi-square or Fisher''s exact test was performed for categorical variables. Kolmogorov–Smirnov test was applied to determine whether the numerical values were normally distributed. Kruskal–Wallis *H* test was applied to compare numerical values between groups. $P < .05$ was considered statistically significant.

RESULTS

A total of 278 patients, 168 women and 110 men, with an average age of 59.4 ± 9.8 years, were included in our study. Forty-six of the patients had stage 1, 64 had stage 2, 66 had stage 3, and 102 had stage 4 patellar chondromalacia.

No significant statistical difference was detected in the frequency and distribution of chondromalacia stages between the right and left knees ($P > .05$).

MAIN POINTS

- Chondromalacia patella is a common cause of anterior knee pain.
- It may be associated with other knee pathologies.
- MRI is very successful in evaluation and it is useful to detect its association with other pathologies in order to ensure the rehabilitation of the patient.

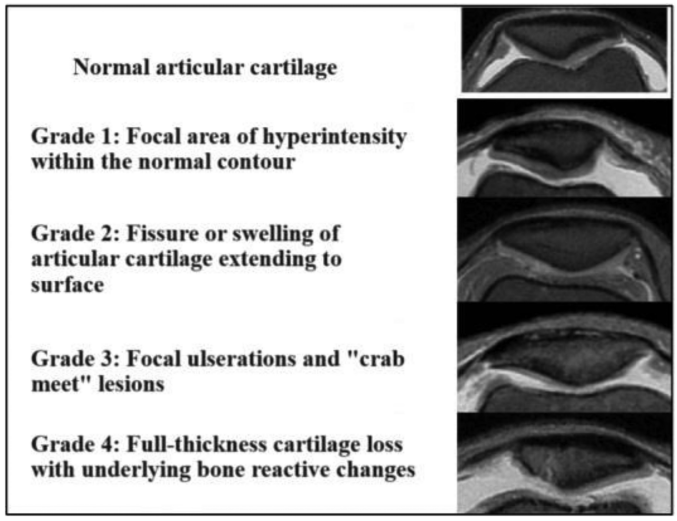

Figure 1. Outerbridge staging system on magnetic resonance images.

As the chondromalacia stage increases, the OA stage also progresses, and a linear and statistically significant relationship was detected between them ($P < .05$).

A statistically significant relationship was found between the stage of chondromalacia and the rate of anterior cruciate ligament (ACL) involvement. This statistically significant difference arises from the difference between the rates of normal ACL presence in stage 1-2 chondromalacia cases and stage 4 chondromalacia cases (45% and 17%, respectively) and the difference between the rates of full-thickness tear in stage 1 chondromalacia cases and stage 3 chondromalacia cases (4% and 22%, respectively).

No statistically significant relationship was found between chondromalacia stage and posterior cruciate ligament (PCL) pathology ($P > .05$).

A significant relationship was detected between medial meniscus (MM) anterior horn pathology and chondromalacia stage, and the presence of MM anterior horn pathology in stage 2 chondromalacia patients was found to be significantly lower than in other stages.

When looking at the relationship between MM posterior horn pathology and chondromalacia stage, there is a significant difference between the rates of patients with tears in stage 4 and 1 chondromalacia cases ($P < .05$). As the chondromalacia stage progressed, an increase in the rate of tears in the MM posterior horn was detected.

No statistically significant relationship was found between the presence of lateral meniscus (LM) pathologies, collateral ligament (lateral collateral ligament and medial collateral ligament) pathologies, and patellar tendinitis and the stage of chondromalacia ($P > .05$).

All findings are shown in Table 1.

DISCUSSION

It is common for more than one support structure of the knee joint to be affected simultaneously. Accurate diagnosis and reporting of

Table 1. Statistical Relationship Between Chondromalacia and Additional Knee Magnetic Resonance Imaging Findings

	CHONDROMALACIA				
	Stage 1 n=46	**Stage 2 n=64**	**Stage 3 n=66**	**Stage 4 n=102**	***P***
Knee					
Right	19	27	38	52	.223[a]
Left	27	37	28	50	
Osteoarthritis					
Stage 1	21	28	11	14	**<.001[a]**
Stage 2	9	11	12	24	
Stage 3	10	8	17	24	
Stage 4	6	17	26	40	
ACL					
Normal	22	28	20	18	**<.001[a]**
Partial tear	22	24	31	70	
Full thickness tear	2	12	15	14	
PCL					
Normal	41	59	56	86	.678[b]
Partial tear	5	5	10	15	
Full thickness tear	-	-	-	1	
MM-A					
Normal	36	62	51	81	**.002[b]**
Degeneration	2	1	4	1	
Tear	8	1	11	20	
MM-P					
Normal	18	19	18	15	**.039**
Degeneration	7	12	8	17	
Tear	21	33	40	70	
LM-A					
Normal	52	56	56	81	.625[b]
Degeneration	1	1	1	4	
Tear	3	7	9	17	
LM-P					
Normal	42	63	61	91	.231[b]
Degeneration	2	0	0	3	
Tear	2	1	5	7	
MCL					
Normal	40	52	43	71	.071[b]
Stage 1	6	11	20	23	
Stage 2	0	1	3	7	
LCL					
Normal	45	64	66	96	.396[b]
Stage 1	1	-	-	3	
Stage 2	-	-	-	2	
Patellar Tendonitis					
Absent	41	59	59	86	.300[a]
Detected	3	5	7	16	
Age (minimum–maximum)	58.0 (39.0-76.0)	56.0 (38.0-77.0)	60.5 (40.0-82.0)	62.5 (47-79.0)	**<.001[c]**

ACL, anterior cruciate ligament, LCL, lateral collateral ligament; LM-A, lateral meniscus anterior horn; LM-P, lateral meniscus posterior horn; MCL, medial collateral ligament; MM-A, medial meniscus anterior horn, MM-P, medial meniscus posterior horn; PCL, posterior cruciate ligament.
[a]Chi-square test.
[b]Fisher's exact test.
[c]Kruskall–Wallis *H* test.

accompanying pathologies affect patient management, treatment process, and prognosis.[16]

In a study conducted by Resorlu et al[17] evaluating the relationship between OA, CP, and MM tears, a positive correlation was found between OA, MM tears, and CP. According to the results of our study, it is noteworthy that as the CP stage increases, the frequency and stage of OA increases. Likewise, an increase in the frequency of tears in the anterior and posterior horns of MM was observed with increasing CP stages. Although chondromalacia is defined as the pathology on the patellar cartilage surface, it is thought that the resulting deterioration in knee biomechanics increases the load on the menisci, especially MM, and facilitates the development of meniscopathy.[18]

No significant relationship was detected between LM pathologies and CP, which can be explained by the fact that MM pathologies are more common than LM, and MM is exposed to more load.[19-21]

The positive correlation between CP stage, which increased as the average age increased, was consistent with a similar study conducted by Ozel et al[22] It is thought that this situation may be related to cartilage degeneration that accelerates with cellular aging.

In another study investigating the co-occurrence of multiple knee joint pathologies, the positive correlation detected between CP and the presence of ACL injury and osteochondral lesion showed similar results to our study.[23]

No significant difference was found between PCL, collateral ligament pathologies, patellar tendinitis, and CP stages, and no study supporting the relationship between them and CP was found in the literature, consistent with our study.

As a conclusion, it is common for pathologies belonging to several supporting structures to be seen together in knee MRI examinations, and since their detection is important for the treatment process, the radiologist's awareness of accompanying pathologies is of critical importance in this process. According to the results of our study, the CP stage shows a positive correlation with advancing age, the presence of MM pathology, the frequency and stage of OA, and the presence of ACL pathology, and it is thought that it would be useful to evaluate the presence of these additional pathologies with MRI, especially in patients with advanced stage (stage 3 and 4) chondromalacia.

Ethics Committee Approval: Approval numbered 129, dated January 6, 2023, was received from the Ethics Committee of Çukurova University Faculty of Medicine.

Informed Consent: N/A.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – Ö.K., O.D., D.Ö.Ö.; Design – Ö.K., O.D., D.Ö.Ö.; Supervision – Ö.K., O.D., Y.K.B.; Resources – Ö.K., O.D.; Materials – Ö.K., O.D.; Data Collection and/or Processing – Ö.K., O.D.; Analysis and/or Interpretation – Ö.K.; Literature Search – Ö.K., D.Ö.Ö.; Writing Manuscript – Ö.K., D.Ö.Ö.; Critical Review – Ö.K., Y.K.B.

Declaration of Interests: The authors have no conflict of interest to declare.

Funding: The authors declared that this study has received no financial support.

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