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Associations among chondromalacia patella and meniscopathy in youthful, active individuals with chronic anterior knee pain

Mehmet Akcicek[1], Bunyamin Ari[2]

[1]Malatya Turgut Ozal University, Faculty of Medicine, Department of Radiology, Malatya, Turkey
[2]Malatya Turgut Ozal University, Faculty of Medicine, Department of Orthopedics and Traumatology, Malatya, Turkey

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Abstract

Chronic forms of anterior knee issues are an increasingly more common condition from the clinical standpoint, mostly within active individuals. Incidence and risk factors have not been clearly defined of yet, though, patellar chondromalacia is one of the most likely causes. In our study, we aimed to investigate the possible relationship between patellar chondromalacia and meniscopathy in young and active patients without tibiofemoral joint arthrosis and patellar instability. Patients between the ages of 18-39, complaining of anterior knee discomfort and who had undertaken MRI between April 1 and May 31, 2021 at Malatya Training Research Hospital, Radiology Department were screened. Conditions such as significant patellar tilt/shift/translation, alta/baja and trochlear dysplasia were studied and measurements taken according to the methods specified in the literature. In this respect, patients outside of normal limits, those with osteochondoral lesions in the tibiofemoral joint or patients admitted after acute trauma were disqualified from the study. 337 receipients of MRIs of the knee, with chondromalacia and/or meniscopathy were reviewed. The average or mean age of the group was calculated as 28.66 ± 6.40, with 52.2% (n=176) between the ages of 18-29, and 61.1% (n=206) were women. Chondromalacia was present in 40.7% (n=137), lateral meniscal degeneration in 58.5% (n=197), medial meniscus degeneration in 82.8% (n=279), a lateral meniscus tear in 4.2% (n=14), a medial meniscal tear in 12.5% (n=42). In this study, no difference was found in terms of the coexistence and/or frequency of medial or lateral meniscopathy and patellar chondromalacia.

Keywords: Anterior knee pain, chondromalacia patella, meniscus, MRI

Introduction

Chronic Anterior knee Pain (CAP) is a frequently observed clinical condition, in mostly active individuals. Though, the incidence and risk factors have not been clearly defined [1,2], CAP is multifactorial in young and active patients and can therefore be divided into several subgroups [3,4].

Various anatomical structures like fat pads, synovium, retinaculum, plica, joint capsules, patellar tendons and femoral condyle might be present in the origin of CAP [5-8]. Some studies report that patellofemoral diseases play a role in anterior knee pain, with a higher occurrence of 20-40% of the adolescent population and athletes [9].

Patellar osteoarthritis and chondromalacia are usually the first diseases to be considered in young, active individuals experiencing CAP [10]. Structural anomalies of the patellofemoral and tibiofemoral joints, trauma and vascular insufficiency of the subchondral bone can be counted among factors promoting the development of chondromalacia. These structural anomalies cause an overloading on the patellar cartilage leading to cartilage defects [7,11].

Published literature discusses many knee pathologies associated with patellar chondromalacia (PCM) [7,12,13]. However, there is an insificient number of studies showing the connection between meniscal pathologies and PCM. In this research, the aim was to show the co-occurrence of PCM and meniscopathy and their relationship, if any, in young and active individuals with CAP.

***Corresponding Author:** Mehmet Akcicek, Malatya Turgut Ozal University, Faculty of Medicine, Department of Radiology, Malatya, Turkey
E-mail: mmakcicek@gmail.com

Materials and Methods

Permission number 2021/59 was obtained from Malatya Turgut Ozal University Clinical Research Ethics Committee for the study. Patients aged between 18-39 years who applied to Malatya Training and Research Hospital between April 1 and May 31, 2021, and had received and MRI of the knee for CAP were retrospectively scanned. The examination of patients was performed at the 1.5 tesla MRI unit (SIEMENS Magnetom Amira, Germany) using routine knee imaging protocols. A slice thickness of 4 mm, sagittal, axial and coronal impressions were obtained in all shots. The MRI sequences obtained included sagittal T1-weighted and proton density scans, and coronal and axial proton density images. Images were analyzed on the PACS system at workstations in the radiology department. Images of patients did not admit after acute trauma, without morphological abnormalities such as patellar tilt/shift/translation, alta/baja, trochlear dysplasia, without tibiofemoral joint arthrosis, and without artifactual images were included in the study.

Conditions that may lead to patellofemoral instability and patellar morphological abnormalities were examined by an experienced radiologist using methods specified in the literature. Patellar tilt was gauged by calculating the angle of the line connecting the highest points of the femoral condyles and the strip connecting the two ends of the patella (Figure 1a). Lateral tilt was considered as ≥ +5°, and medial as ≤ –5 [14].

Figure 1a. Patellar tilt assessment

Patellar shift was determined by calculating the distance from the patella center and the perpendicular line passing through the center of the femoral trochlear surface (Figure 1b). Distances between 5-10 mm were categorized as displacement, while shifts of 10 mm and more were specified as subluxation. Dislocation was defined as complete absence of contact with the articular surface [14].

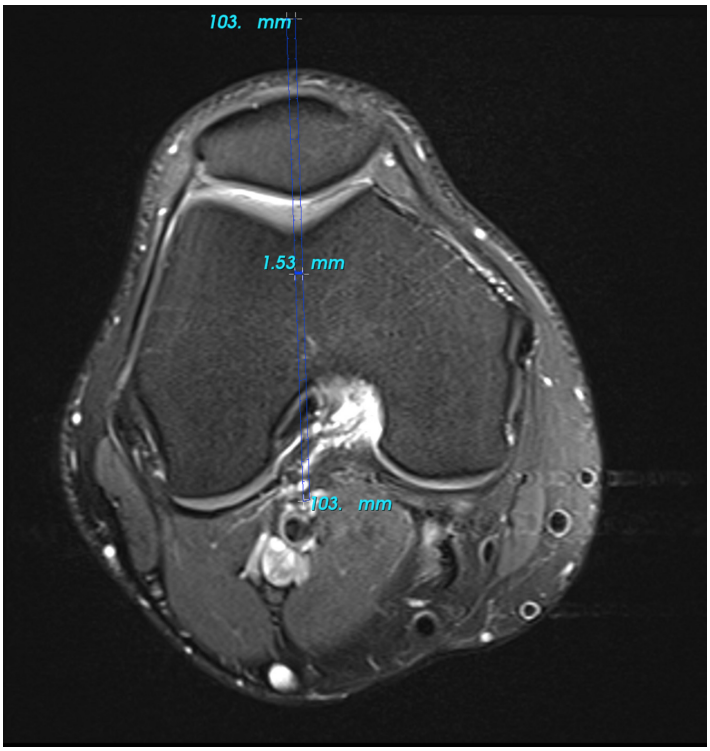

Figure 1b. Patellar shift measurement

Tibial tubercle-trochlear groove (TT-TG) distances were measured on axial MRI images using the method described in the literature by Schoettle et al., and patellar translation was evaluated [15] (Figure 2). Lenghts of 15 mm and below were considered to be normal, 20 mm and above as translation.

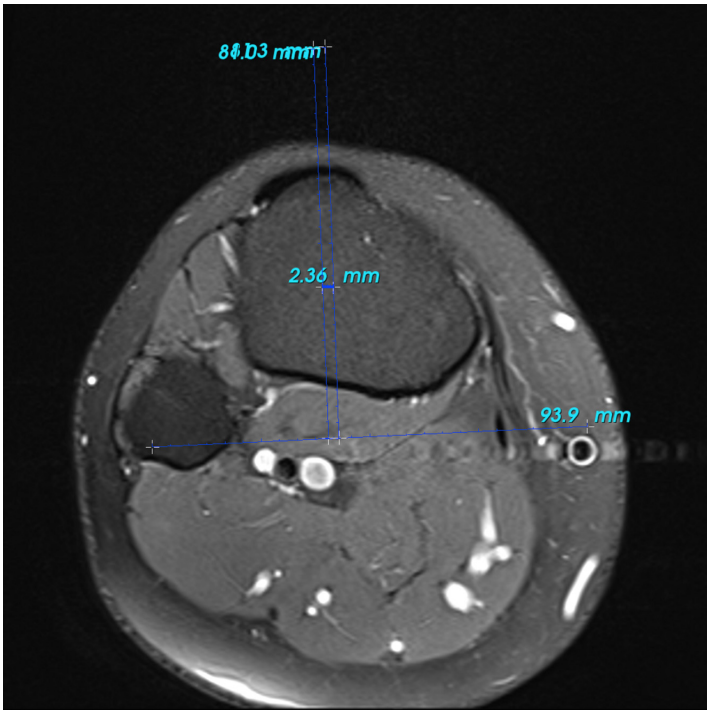

Figure 2. TT-TG measurement for patellar translation evaluation

For trochlear depth, the total distance from the base of the trochlea and a tangent line connecting the furthest anterior points of the medial and lateral facets was measured (Figure 3). Under 3 mm was considered as trochlear dysplasia [16].

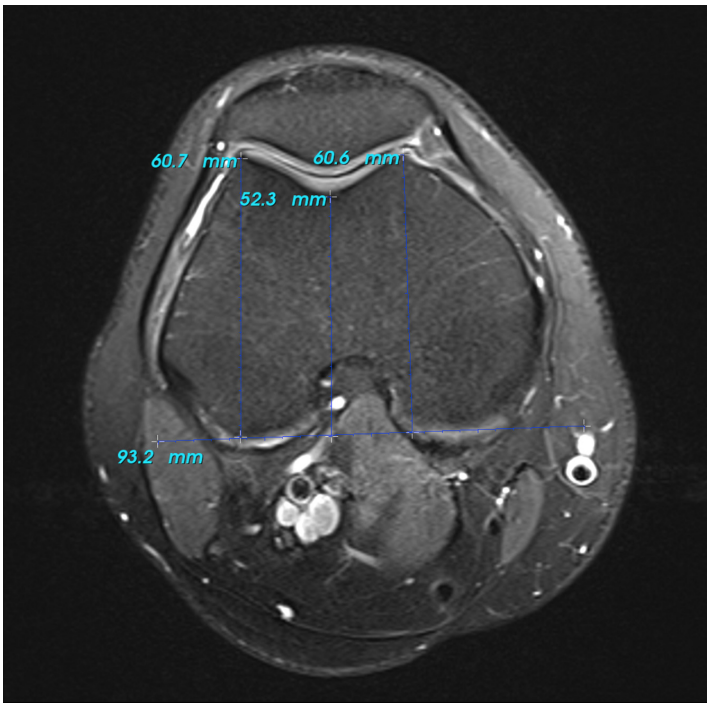

Figure 3. Measurement trochlear depth for trochlear dysplasia

Facet asymmetry was assessed by calculating the trochlear facet of the medial and lateral length ratio, with less than 40% indicating trochlear dysplasia [17] (Figure 4).

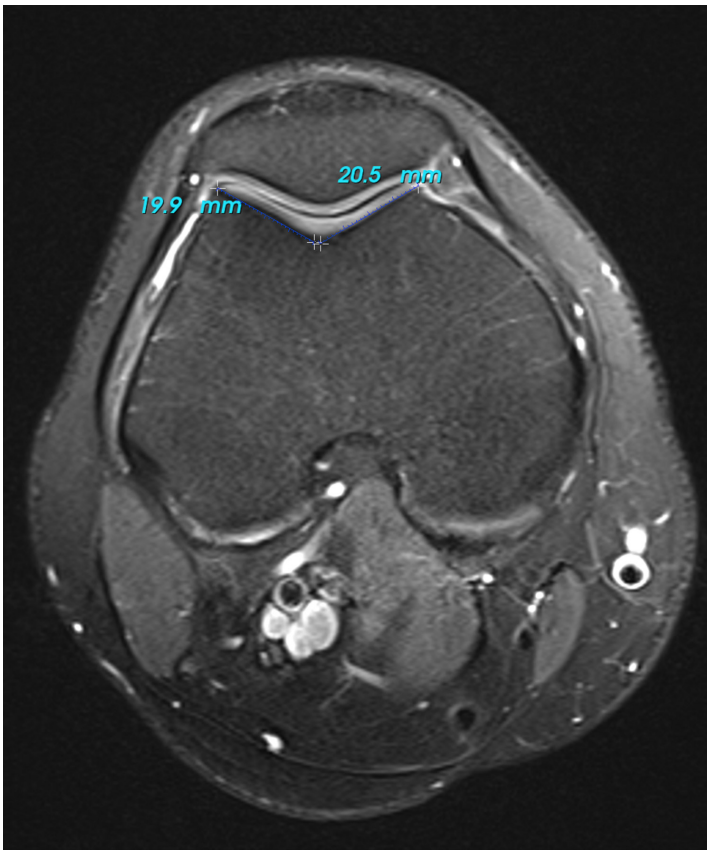

Figure 4. Facet asymmetry assessment for trochlear dysplasia

The Insall-Salvati ratio, which is the ratio of patellar tendon length to patellar length, was used to evaluate patellar height. Values between 0.8-1.2 were considered within normal limits (18) (Figure 5).

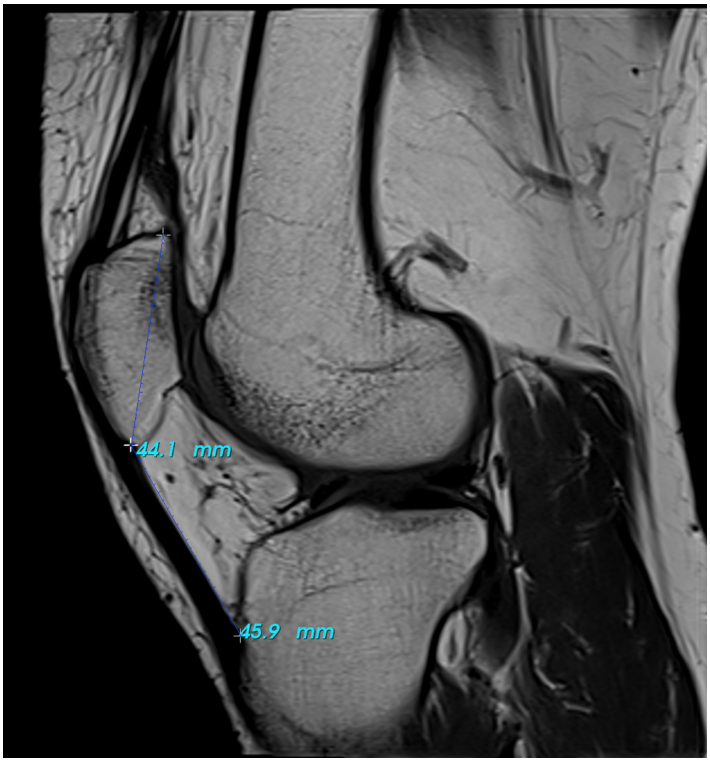

Figure 5. Measurement of Insall-Salvati ratio

As a result of these measurements, all patients with values outside of normal limits were excluded from the study. PCM was first evaluated by staging according to the Outerbridge system (grade 0-I-II-III-IV). 337 patients in total experiencing chondromalacia at the moment and/or meniscopathy, 131 males and 206 females, aged between 18-39 years, who had PCM and/or meniscopathy, were a part of the study. Since the PCM grades 2, 3 and 4 rate is low, incidents were arranged as chondromalacia "present" or "missing". Medial and lateral menisci were recorded as "degeneration" and "tear".

All statistical analysis was performed with the SPSS 25 (Statistical Package for Social Sciences) program. A statistical evaluation of the relationship between categorical variables was made using the Chi-square test. Numbers were calculated together with the percentages and the means with their standard deviations. Differences were considered significant at $P < 0.05$.

Results

The mean age of the group was determined as 28.66 ± 6.40. 52.2% (n=176) of the study group, of which 61.1% (n=206) were women, were between the ages of 18-29. While PCM was observed in 40.7% (n=137), lateral meniscal degeneration (LMD) was seen in 58.5% (n=197), and medial meniscus degeneration (MMD) occurred in 82.8% (n=279) (Table 1). While 42 patients (12.5%) had medial meniscal tears (MMT), there were 14 patients (4.2%) with lateral meniscal tears (LMT) (Figure 5 and 6). Among these, the number of patients with both MMT and LMT was 2 (0.6%).

Relative to gender, the age, side, PCM, MMD, presence of LMT and MMT groups were similar ($p>0.05$). However, LMD was found to be more prevalent in males (67.9%) than females (52.4%) ($p<0.05$) (Table 2).

Table 1. Defining characteristics of the group

		n	%
Gender	**Female**	206	61.1
	Male	131	38.9
Age Category	**18-29**	176	52.2
	30-39	161	47.8
Side	**Left**	203	60.2
	Rigt	134	39.8
PCM	**Absent**	200	59.3
	Present	137	40.7
LMD	**Absent**	140	41.5
	Present	197	58.5
MMD	**Absent**	58	17.2
	Present	279	82.8
LMT	**Absent**	323	95.8
	Present	14	4.2
MMT	**Absent**	295	87.5
	Present	42	12.5
PCM G1	**Absent**	222	65.9
	Present	115	34.1
PCM G2	**Absent**	320	95.0
	Present	17	5.0
PCM G3	**Absent**	336	99.7
	Present	1	0.3
PCM G4	**Absent**	333	98.8
	Present	4	1.2

Table 2. Relationship of variables to gender

		Age Category					
		18-29		**30-39**		**X^2**	**p**
	Female	104	50.5%	102	49.5%	0.643	0.423
	Male	72	55.0%	59	45.0%		
		Side					
		Left		**Right**			
	Female	127	61.7%	79	38.3%	0.442	0.506
	Male	76	58.0%	55	42.0%		
		Related Parameter					
	Gender	**Absent**		**Present**			
PCM	**Female**	119	57.8%	87	42.2%	0.548	0.459
	Male	81	61.8%	50	38.2%		
LMD	**Female**	98	47.6%	108	52.4%	7.934	0.005
	Male	42	32.1%	89	67.9%		
MMD	**Female**	35	17.0%	171	83.0%	0.018	0.893
	Male	23	17.6%	108	82.4%		
LMT	**Female**	197	95.6%	9	4.4%	0.061	0.804
	Male	126	96.2%	5	3.8%		
MMT	**Female**	182	88.3%	24	11.7%	0.321	0.571
	Male	113	86.3%	18	13.7%		

Respective to age, it was determined that the presence of PCM, MMD, LMT, and MMT was not different according to age groups (p>0.05), though LMD was found more frequently in the 30-39 age group (70.8%) than in the 18-29 age group (47.2%) (p<0.001) (Table 3).

In in terms of left or right knees, all parameters were found to be similar (p>0.05) (Table 4). At the same time, from the perspective of presence/absence of PCM, no difference was found in terms of variables (p>0.05) (Table 5).

Table 3. Relationship of variables to age group

		Related Parameter					
	Age Group	Absent		Present			
PCM	18-29	113	64.2%	63	35.8%	3.603	0.058
	30-39	87	54.0%	74	46.0%		
LMD	18-29	93	52.8%	83	47.2%	19.363	<0.001
	30-39	47	29.2%	114	70.8%		
MMD	18-29	32	18.2%	144	81.8%	0.244	0.621
	30-39	26	16.1%	135	83.9%		
LMT	18-29	170	96.6%	6	3.4%	0.514	0.473
	30-39	153	95.0%	8	5.0%		
MMT	18-29	159	90.3%	17	9.7%	2.655	0.103
	30-39	136	84.5%	25	15.5%		

Table 4. Relationship of variables to side

	Side	18-29		30-39		X^2	p
Age	Left	112	55.2%	91	44.8%	1.777	0.183
	Right	64	47.8%	70	52.2%		
		Related Parameter					
	Side	Absent		Present			
PCM	Left	119	58.6%	84	41.4%	0.112	0.738
	Right	81	60.4%	53	39.6%		
LMD	Left	87	42.9%	116	57.1%	0.363	0.547
	Right	53	39.6%	81	60.4%		
MMD	Left	32	15.8%	171	84.2%	0.750	0.386
	Right	26	19.4%	108	80.6%		
LMT	Left	195	96.1%	8	3.9%	0.058	0.809
	Right	128	95.5%	6	4.5%		
MMT	Left	178	87.7%	25	12.3%	0.010	0.920
	Right	117	87.3%	17	12.7%		

Table 5. Relationship of variables to presence/absence of PCM

		Related Parameter					
	PCM	Absent		Present			
LMD	Absent	84	42.0%	116	58.0%	0.042	0.837
	Present	56	40.9%	81	59.1%		
MMD	Absent	38	19.0%	162	81.0%	1.105	0.293
	Present	20	14.6%	117	85.4%		
LMT	Absent	194	97.0%	6	3.0%	1.646	0.199
	Present	129	94.2%	8	5.8%		
MMT	Absent	173	86.5%	27	13.5%	0.485	0.486
	Present	122	89.1%	15	10.9%		

Discussion

Many studies have concluded that patellofemoral diseases contribute to the development of CAP, with a prevalence of 20-40% in the adolescent population and athletes [9]. Patellar osteoarthritis (OA) and PCM are usually the first diseases to be considered in young and active individuals with CAP [10]. In this study, PCM was detected in 40.2% of 337 young and active patients with CAP without OA. PCM is the softening of the patellofemoral cartilage and may be a sign of degenerative joint disease in this area of the knee [19]. In addition to factors like dislocation, rheumatological diseases, fracture and insufficient vascular ability among the reasons behind PCM, variations of anatomy and pathology that disrupt the physical stress placed on the surface of joints have also been theorized [20].

Diagnoses may be difficult in patients with suspected patellar OA or PCM due to a lack of specific findings upon physical examination. Retro patellar crepitus, effusion, and quadriceps atrophy greater than 2 cm may be important discoveries in the detection of PCM [21]. Since our study was retrospective and physical examination information was not included in the hospital system records, we evaluated our patients only radiologically. Radiological findings usually help the diagnosis. Tangential patella radiographs can be taken to evaluate patellofemoral articulation, including patella morphology, patella size relative to the trochlea, and angle of the sulcus [22]. As radiographs are insufficient against early cartilage changes, which in the patellar can be evaluated with higher accuracy with MRI [22]. As with the Outerbridge grading system in MRI, cartilage abnormalities can be evaluated best with a four-level grading method, corresponding to the MRI arthroscopy scale [22]. Generally, the accuracy of MRI grading in patellofemoral cartilage lesions is highly accurate for high-grade lacerations (> 50% thickness), plus it clearly demonstrates underlying bone marrow abnormalities and signals. Though, accuracy is reduced inconsistently in low-grade lesions (< 50% thickness) minus underlying bone marrow abnormalities [23]. In our study, 96% of the 137 patients with PCM detected on MRI consisted of grade 1 and 2 patients according to the Outerbridge system.

A frequently injured structure in knee joints is the meniscus. Medial meniscus sprains and tears are three times more common than lateral meniscus sprains and tears [24]. In the current study, while the medial meniscus tear ratio was also 3 times higher than the lateral, this ratio was approximately 2 times in patients with PCM. Since the medial meniscus is connected by stronger ligaments and is exposed to more load forces, the risk of injury is higher [25-27]. Some studies report that meniscus tears are significantly responsible for the development of osteo-chondral lesions [28]. Burger et al. researched the onset of OA with inadequate repair of meniscal tears in an animal experiment and found that insufficient repair led to arthritis in the medial tibiofemoral and patellofemoral joints [29]. In their study, which took OA as the reference point, Resorlu et al found a significant association with meniscal tears between both OA and PCM depending on the changes in the biomechanics and morphology of the knee [30]. Although chondromalacia is thought to be a pathology of the cartilage on the patellar surface, it is believed that meniscus pathologies may develop due to the deterioration of the biomechanics of the knee in its later stages [31]. Synovitis caused by meniscal pathology might contribute to the onset and exacerbation of cartilage loss in the patellofemoral joint [32]. However, no significant difference was found between PCM and the coexistence and/or frequency of meniscal degeneration or tears in our study. Possible reasons for this are that our study group was made up of younger and more active individuals, and that our reference point consisted of patients without patellar instability, morphological abnormality and tibiofemoral joint arthrosis.

Though pathology of the medial meniscus is more common, meniscal pathology seems to be less harmful to the patellofemoral joint. Studies show that this is due to the relationship of the lateral meniscus, as it is more mobile in rotational movements, to the lateral tibial plateau [33]. However, more research should be conducted to explore the specific compartment related biomechanical effects of the pathology of medial and lateral menisces [34]. In a study, the incidence of medial meniscal tear was found to be 25% in cases with normal patellar cartilage, 30% in mild chondromalacia, and up to 47% in severe chondromalacia. Since lateral meniscus tears were detected only in 7 patients, they were not considered statistically [35]. Hart et al., showed that pathology of the medial and lateral meniscuses was connected to an increased prevalence of cartilage damage detected by MRI within medial and lateral PF joints respectively. They even found that lateral meniscus pathologies and joint arthrosis of the lateral patellofemoral was associated more with medial meniscus tears than joint arthrosis of the medial patellofemoral [34]. In our present study, no significant difference was found in this respect either. Medial meniscopathy was found in 96.3% of the patients with PCM, and lateral meniscopathy was found in 64.9%, and no significant difference was found in this regard. The incidence of meniscal tear in PCM patients is 16.7%, and it is seen approximately 2 times more in the medial meniscus than in the lateral.

Limiting factors of this study are as follows: first, due to the nature of our study, it was not possible to determine which of the tears, PCM or meniscus, occurred first. Another is that all structural and angular differences of the tibia, femur, patella and trochlea, were not included in the study.

Conclusion

It is important to investigate the causes of CAP in active, young individuals and to make the differential diagnosis correctly, to provide the correct treatment for patients and to prevent patellofemoral articular cartilage loss. Although there was no significant relationship between PCM and meniscopathy observed in our study, more research is needed to gain an understanding of the possible development of OA, PCM or meniscopathy in the patellofemoral joint following meniscus or cartilage pathology, as well as any possible mechanisms.

Conflict of interests
The authors declare that they have no competing interests.

Financial Disclosure
All authors declare no financial support.

Ethical approval
Permission number 2021/59 was obtained from Malatya Turgut Ozal University Clinical Research Ethics Committee for the study

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