



Magnetic Resonance Imaging Findings of Suprapatellar Fat Pad Impingement Syndrome: A Retrospective Study

Suprapatellar Yağ Yastığı Sıkışma Sendromunda Manyetik Rezonans Görüntüleme Bulguları: Retrospektif Çalışma

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ABSTRACT

Objective: Peripatellar fat pads are extrasynovial intracapsular fat tissues. Suprapatellar, perifemoral, and infrapatellar (Hoffa fat pad) fat pads are included in the peripatellar fat pad. This study aimed to describe the magnetic resonance imaging (MRI) signs of suprapatellar fat pad impingement syndrome, describe their prevalence and pattern, and look into the relationship between their MRI and clinical signs.

Methods: Two radiologists retrospectively analyzed 5,700 patients' knee MRI data between December 2010 and December 2015. We documented the MRI findings that were associated with suprapatellar fat pad impingement syndrome. The correlations between age, osteoarthritis, chondromalacia, and the patellofemoral joint were evaluated using Pearson's correlations.

Results: In our study group, the prevalence of suprapatellar fat pad impingement was 5.3%. Of the patients 52% were men and 48% were women. Patients who were admitted to the clinic complained of non-specific pain in 80.3% of patients. Twenty-seven patients (8.9%) presented with isolated suprapatellar impingement syndrome; 185 (60.9%) showed an increase in intra-articular fluid; 4 (1.3%) had synovitis findings; 17 (5.6%) had medial collateral ligament tears; 107 (35.2%) had quadriceps femoris tendinitis; 8 (2.6%) had patellar tendinitis; 80 (26.3%) had a

ÖZ

Amaç: Peripatellar yağ yastıkçığı, ekstrasinovyal intrakapsular yağ dokusudur. Ekstrasinovyal intrakapsüler yağ dokuları, peripatellar yağ yastıklarındır. Suprapatellar, perifemoral ve infrapatellar (Hoffa yağ yastığı) yağ yastıkları, peripatellar yağ yastığını oluşturmaktadır. Bu çalışma, suprapatellar yağ yastığı sıkışma sendromunun manyetik rezonans görüntüleme (MRG) bulgularını tanımlamayı, bunların prevalansını ve paternini tanımlamayı ve MRG ile klinik belirtileri arasındaki ilişkiyi incelemeyi amaçlamıştır.

Yöntemler: Aralık 2010 ile Aralık 2015 arasında 5.700 hastanın diz MRG verilerini geriye dönük olarak 2 radyolog tarafından analiz edildi. Suprapatellar yağ yastığı sıkışma sendromu ile ilişkili MRG bulguları değerlendirildi. Yaş, osteoartrit, kondromalazi ve patellofemoral eklem arasındaki korelasyon Pearson korelasyonu kullanılarak değerlendirildi.

Bulgular: Çalışma grubumuzda suprapatellar yağ yastığı sıkışması prevalansı %5,3 olarak bulundu. Hastaların %52'si erkekti ve %48'i kadındı. Kliniğe başvuran hastaların %80,3'ünde non-spesifik ağrı şikayeti vardı. Yirmi yedi hastanın (%8,9) izole suprapatellar impingement sendromu vardı, 185 hastada (60,9%) eklem içi efüzyon mevcuttu, 4 hastada (%1,3) sinovitis bulguları vardı, 17 (%5,6) hastada medial kollateral bağ yaralanması vardı, 107 (%35,2) hastada kuadriceps femoris tendiniti vardı, 8

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ABSTRACT

medial meniscus tear; 23 (7.6%) had Baker's cyst; and 30 (9.9%) had soft-tissue edema. Medial meniscus degeneration was observed in 51 (16.8%) patients, Hoffa edema was observed in 31 (10.2%) patients, and anterior cruciate ligament tears in 3 (1%) patients. There were positive correlations between age and osteoarthritis ($r=0.4660$, $p<0.05$), between chondromalacia and the grade of the chondromalacia ($r=0.5198$, $p<0.05$), and between lateral subluxation and lateral tilt as opposed to the normal patellofemoral relationship ($r=0.3171$, $p<0.05$).in patients with suprapatellar fat pad impingement.

Conclusion: The most common symptom of suprapatellar impingement, that is one of the major causes of anterior knee pain, is non-specific pain. The most common additional MRI findings are increased intra-articular fluid and quadriceps femoris tendinitis.

Keywords: Suprapatellar fat pad impingement syndrome, knee MRI, knee pain, quadriceps fat pad

ÖZ

(%2,6) hastada patellar tendinit vardı, 80 (%26,3) hastada medial menisküs yırtığı vardı, 23 (%7,6) hastada Baker kisti vardı ve 30 (%9,9) hastada yumuşak doku ödemi vardı. Medial menisküs dejenerasyonu 51 (%16,8) vakada, Hoffa ödemleri 31 (%10,2) olguda ve ön çapraz bağ yırtığı 3 (%1) olguda gözlenmiştir. Suprapatellar yağ yastığı sıkışması olgularında yaş ile osteoartrit arasında ($r=0,4660$, $p<0,05$), kondromalazi ile kondromalazinin derecesi arasında ($r=0,5198$, $p<0,05$) ve normal patellofemoral ilişkinin aksine lateral sublüksasyon ile lateral tilt arasında pozitif korelasyon vardı ($r=0,3171$, $p<0,05$).

Sonuç: Ön diz ağrısının başlıca nedenlerinden biri olan suprapatellar sıkışmanın en sık görülen semptomu non-spesifik ağrıdır. En yaygın ek MRG bulguları eklem içi sıvı artışı ve kuadriseps femoris tendinitidir.

Anahtar Sözcükler: Suprapatellar yağ yastığı sıkışma sendromu, diz MRG, diz ağrısı, kuadriseps yağ yastığı

Introduction

The knee is a complex joint with movements in multiple planes and along multiple axes. Many anatomical structures cause complex motion in the knee. The peripatellar fat pads are one of the most significant soft tissues of the knee. The synovium is separated from the joint capsule by fat pads (1). Fat pads consist of deformable fat and fibrous tissues. Fat pads adapt during movement in the knee and protect the joint from stress by displacing it. It increases the synovial surface and acts as a lubricant (2,3). The suprapatellar fat pad, perifemoral fat pad, and infrapatellar (Hoffa fat pad) fat pads are all parts of the peripatellar fat pad (2). The suprapatellar fat pad is triangular in the anterior knee. It is the smallest of the fat pads on the front knee. On average, the suprapatellar fat pad is 7-8 mm thick (4). It occupies the anatomical space between the quadriceps tendon insertion and the posterior superior portion of the quadriceps tendon.

Trauma, inflammation, tumors, infection, and congenital anatomical abnormalities can cause soft tissue injuries. Impingement syndrome occurs due to 2 main reasons in lower extremity pathologies. The first are bone deformities, the second are soft tissue abnormalities, or combinations thereof. Magnetic resonance imaging (MRI) is a suitable imaging method for evaluating bone and soft tissue components in the evaluation of impingement syndrome. This study aimed to characterize the MRI findings of suprapatellar fat-pad impingement syndrome, define its prevalence and pattern, and investigate the correlation between its clinical findings and MRI findings.

Methods

Between December 2010 and December 2015, 5,700 patients' knee MRIs were reviewed retrospectively. All knee MRIs were performed with 1.5 Tesla and 3 Tesla systems (Magnetom

Symphony and Skyra; Siemens Healthineers, Germany) equipped with a knee coil with 15 channels. Supine position according to standard knee MRI protocol 10-15° flexion and 15° external rotation were also applied. The radiology information system was evaluated with PACS (Evrad Research PACS). The knee MRI protocol included PD-weighted sequences (sagittal, coronal, and axial) with fat-saturation and T1-weighted coronal and T2-weighted fat-sat sagittal sequences.

Suprapatellar fat pad impingement was detected in 304 patients. The age, gender, physical activity history (whether they participated in sports regularly or not), trauma, tumor, and arthroscopic surgery history were all investigated. The clinical symptoms were divided into three categories: anterior knee pain, meniscus pain (pressing and sticking sensations), and non-specific pain. Chondromalacia (types, if any), patellofemoral joint relationship (normal, lateral subluxation, lateral tilt), and other associated findings [intra-articular fluid, synovitis, medial collateral ligament (MCL) tear, quadriceps femoris tendinitis, patellar tendinitis, medial or lateral meniscus tear, anterior cruciate ligament (ACL) tear, medial meniscus degeneration, Hoffa's edema, Baker's cyst, soft-tissue edema] were defined.

The patients were evaluated together by two radiologists (8 years and 20 years of musculoskeletal MRI experience). The study was approved by the Acibadem University Institutional Ethics Committee (approval number: 2022-11/38). In patients with suprapatellar impingement syndrome, Pearson's correlations were used to assess the age-osteoarthritis-chondromalacia-patellofemoral joint relationship. This study was performed in accordance with the ethical standards as laid down in the 1964 Declaration of Helsinki.

Statistical Analysis

Statistical analysis was performed using the IBM SPSS Statistics 23.0 package program (SPSS Corp; Armonk, NY, USA). The

correlation between age, osteoarthritis, chondromalacia, and the patellofemoral joint were analyzed using Pearson's correlations. $P < 0.05$ was considered statistically significant.

Results

Suprapatellar impingement was identified on MRI in 304 patients (Table 1). Two hundred ten (69%) patients were visualized in a 1.5 Tesla and 94 (31%) patients in a 3 Tesla MRI device. In patients with suprapatellar fat pad impingement, there was a positive correlation between age and the presence of osteoarthritis ($r=0.4660$, $p < 0.05$), between the presence of chondromalacia and its grade of chondromalacia ($r=0.5198$, $p < 0.05$), and between the presence of lateral subluxation and lateral tilt instead of the normal patellofemoral relationship ($r=0.3171$, $p < 0.05$). No significant difference was observed between 1.5 Tesla and 3 Tesla devices.

The prevalence of suprapatellar fat pad impingement in our study group was 5.3%. One hundred fifty-eight (52%) patients were female, and 146 (48%) patients were male (Table 1). Anterior knee pain was present in 44 (14.5%) of the patients, while pain from meniscus degeneration and ACL rupture were reported in 16 (5.2%) of the patients (difficulty pressing, stuck feeling). Two hundred forty four (80.3%) patients were admitted to the clinic with the complaint of non-specific pain (Table 2).

While 296 (97.3%) of 304 patients with suprapatellar impingement did not participate in sports regularly, 8 (2.7%) did. There were 23 (7.56%) patients with a history of trauma, 2 (0.66%) patients with a history of malignancy, and 10 (3.3%) patients with a history of arthroscopic surgery (Table 1). Osteoarthritis was observed in 65 (21.3%) patients (Table 2).

Chondromalacia patella (CP) was not found in 138 (45.4%) patients: grade 1 CP in 28 (9.2%) patients, grade 2 CP in 24 (7.9%) patients, grade 3 CP in 44 (14.5%) patients, and grade 4 CP in 70 (23%) patients. The patellofemoral joint relationship was observed as lateral subluxation in 60 (19.7%) patients, lateral tilt in 10 (3.3%) patients, and normal in 234 (77%) patients

(Table 3). A contrast-enhanced knee MRI was performed in 6 patients. In all of the patients, contrast enhancement was observed.

Isolated suprapatellar impingement syndrome was observed in 27 (8.9%) of the patients, intra-articular fluid increase in 185 (60.9%), synovitis findings in 4 (1.3%), MCL tears in 17 (5.6%), quadriceps femoris tendinitis in 107 (35.2%), patellar tendinitis in 8 (2.6%), medial meniscus tear in 80 (26.3%), Baker's cyst in 23 (7.6%), and soft-tissue edema in 30 (9.9%). Medial meniscus degeneration was detected in 51 (16.8%), Hoffa edema in 31 (10.2%), and ACL tear in 3 (1%) patients (Table 2).

Table 2. Distribution of knee symptoms and MRI findings with SIPS

Knee symptoms (n=304)	(n)	(%)
Anterior knee pain	44	14.5
Pain caused by intra-articular pathology	16	5.2
Non-specific pain	244	80.3
MRI findings with SPIS	(n)	(%)
Isolated SPIS	27	8.9
Osteoarthritis	65	21.3
Intra-articular effusion	185	8.9
Synovitis	4	1.3
ACL rupture	3	1
MCL rupture	17	5.6
Quadriceps femoris tendinitis	107	35.2
Patellar tendinitis	8	2.6
Medial meniscus tear	80	26.3
Medial meniscus degeneration	51	16.8
Baker cyst	23	7.6
Hoffa edema	31	10.2

n: Number of patients, %: Percentage of patient, SPIS: Suprapatellar impingement syndrome, ACL: Anterior cruciate ligament, MCL: Medial collateral ligament

Table 1. Details of the patients

MRI (n=5700)	(n)	(%)
Normal MRI	5396	94.7
Suprapatellar impingement MRI	304	5.3
Mean age		
Female	158	52
Male	146	48
Sport activity (-)	296	97.3
Sport activity (+)	8	2.7
Trauma	23	7.5
Tumor	2	0.6
Arthroscopic surgery	10	3.3

n: Number of patients, %: Percentage of patient, MRI: Magnetic resonance imaging

Table 3. Distribution of chondromalacia and patella femoral joint pathology

Chondromalacia with SPIS (n=304)	(n)	(%)
Chondromalacia grade 0	138	45.4
Chondromalacia grade 1	28	9.2
Chondromalacia grade 2	24	7.9
Chondromalacia grade 3	44	14.5
Chondromalacia grade 4	70	23
Patella femoral joint with SPIS (n=304)	(n)	(%)
Normal	234	77
Lateral subluxation	60	19.7
Lateral tilt	10	3.3

n: Number of patients, %: Percentage of patient, SPIS: Suprapatellar impingement syndrome

Discussion

In this study, we aimed to evaluate and characterize the MRI findings of suprapatellar fat pad impingement syndrome, define its prevalence and pattern, and evaluate the correlation between its clinical findings and MRI findings. Non-specific knee pain is the most prevalent clinical finding in suprapatellar fat pad impingement syndrome, but anterior knee pain is also a significant clinical finding. In addition, no significant relationship was found between suprapatellar impingement syndrome and gender, sports activities, or trauma. The most common accompanying MRI findings in this study were increased intra-articular fluid and quadriceps femoris tendinitis.

In the study of Tsavalas and Karantanas (5), no significant relationship was established between anterior knee pain and suprapatellar impingement syndrome. This finding suggests that injury to the suprapatellar fat pad after repetitive microtrauma and overuse does not exceed the threshold for pain. Edema of the suprapatellar fat pad and anterior knee pain are controversial issues. Studies show that 12-14% of patients undergoing knee MRI have suprapatellar fat pad edema (5-7). Some studies found a relationship between suprapatellar fat pad volume and knee pain (7). However, some studies did not find a relationship between suprapatellar fat pad with pain (8). Suprapatellar impingement syndrome was found in 304 (5.3 %) of 5700 knee MRIs of patients in our study. The most common clinical finding with suprapatellar impingement syndrome was non-specific knee pain in 244 patients (80.3%). The second most common symptom was anterior knee pain in 44 (14.5%) patients. Anterior knee pain was found to be similar to previous studies. The association between suprapatellar impingement syndrome and knee pain requires more research.

In the study of Lapègue et al. (3) and Nouri et al. (9), repetitive compression, trauma, and instability of the patellofemoral joint are all known to cause inflammation and metaplasia of the fat pad. After metaplasia, fibrotic tissue is formed. This causes anterior knee pain (3,9). Publications are showing that edema-like changes in the suprapatellar fat pad seen on knee MRIs are rarely associated with anterior knee pain (10). In our study, 23 (7.56%) patients had a history of trauma, 2 (0.66%) patients had a history of tumors, and 10 (3.3%) patients had a history of arthroscopic surgery.

Suprapatellar fat pad edema is thought to result from repetitive friction against the trochlea during knee flexion (7,11). The terms suprapatellar fat pad impingement and suprapatellar fat pad edema impingement are interchangeable (12). However, there is no evidence to support it. In retrospective studies, no relationship was found between suprapatellar fat pad edema and patellar maltracking (5-7). In our study group, patella lateral subluxation was found in 60 (19.7%) patients, patella lateral tilt in 10 (3.3%) patients, and patellofemoral joint pathology in 224 (77%) patients. Suprapatellar fat pad edema and patellofemoral degeneration have been linked in recent publications (13). The relationship between suprapatellar fat pad size and osteoarthritis is unclear. Wang et al. (14) found a positive association with

femorotibial osteoarthritis in their study. Shabshin et al. (1) found no association between patellofemoral osteoarthritis and suprapatellar fat pad size. Osteoarthritis was found in 65 (21.3%) of the participants in our study.

Quadriceps tendon edema has been observed in patients with suprapatellar fat pad edema in the literature (15). In our study, isolated suprapatellar impingement syndrome was observed in 27 (8.9%) patients, an intra-articular fluid increase was observed in 185 (60.9%) patients, and synovitis findings were observed in 4 (1.3%) patients. Quadriceps femoris tendinitis was found in 35.2% of the patients, patellar tendonitis in 8 (2.6%), and soft tissue edema in 30 (9.9%). In the study of Roth et al. (7), no significant relationship was found between chondromalacia and suprapatellar fat pad. In our study, CP was found in 138 (45.4%) patients, grade 1 CP in 28 (9.2%) patients, grade 2 CP in 24 (7.9%) patients, grade 3 CP in 44 (14.5%) patients, and grade 4 CP in 70 (23%) patients.

Study Limitations

There were certain limitations to our research. To begin with, our study was a retrospective, single-center study. Multicenter prospective studies should back up our findings. Since our study included a large patient population, all patients might not be adequately and objectively screened for clinical symptom evaluation. Our paper included a heterogeneous patient group. The study's strengths included a large-scale analysis of comprehensive MRI data with a large patient cohort.

Conclusion

Non-specific pain was the most common symptom in the suprapatellar impingement, it was one of the most significant causes of anterior knee pain. No significant relationship was found between suprapatellar impingement and gender, sports, and trauma. Increased intra-articular fluid and quadriceps femoris tendinitis were the most prevalent additional MRI findings.

Ethics

Ethics Committee Approval: The study was approved by the Acıbadem University Institutional Ethics Committee (approval number: 2022-11/38).

Informed Consent: Retrospective study.

Peer-review: Externally peer-reviewed.

Authorship Contributions

Surgical and Medical Practices: B.B., A.A., H.M.Ö., Ö.B., Concept: B.B., A.A., H.M.Ö., Ö.B., Design: B.B., A.A., H.M.Ö., Ö.B., Data Collection or Processing: B.B., A.A., H.M.Ö., Ö.B., Analysis or Interpretation: B.B., A.A., O.Ö., H.M.Ö., Ö.B., Literature Search: B.B., A.A., H.M.Ö., Ö.B., Writing: B.B., A.A., H.M.Ö., Ö.B.

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