

Assessment of cystic lesions around the knee with MRI and their relationship with osteoarthritis

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Abstract

Aim: The large number and different varieties of cysts and cyst-like lesions around the knee joints are commonly encountered on the magnetic resonance scanning. We aimed to evaluate type, frequency, and size of cystic lesions observed around the knee joints and to find out its relationship with osteoarthritis.

Material and Methods: 620 knee joints belonging to 545 patients were enrolled in the study. We retrospectively examined magnetic resonance images of the knee joints which were divided into three groups as non-degenerative, mild degenerative, and severe degenerative. The cysts have been classified according to count, type and size and their relationship with knee osteoarthritis was assessed.

Results: Out of 620 knees, 248 knees (40%) had no degenerative arthritis, 178 knees (28.7 %) had mild, and 194 knees had severe (31.3 %) degenerative arthritis. Cystic lesions were identified in 411 knees (66.3%). One cyst in 261 knees, two cysts in 102 knees, three cysts in 40 knees, and four cysts in 8 knees were encountered. Increased number and average diameter of the cysts showed statistically significant relation with the degree of osteoarthritis ($p < 0.001$ and $p = 0.04$, respectively). Moreover, some types of cysts such as synovial cysts, intraarticular ganglion cysts, and intraosseous cysts were significantly increased with osteoarthritis ($p < 0.001$).

Conclusion: There was significant increase in frequency, number, and average size of knee joint cysts in patients with degenerative arthritis findings. In addition, almost all cyst types except intrameniscal and parameniscal cysts, were found more frequently in the knees with degenerative arthritis.

Keywords: Osteoarthritis; Magnetic Resonance Imaging; Bursitis; Cyst; Geode.

INTRODUCTION

Osteoarthritis is a multifactorial disease that develops due to metabolic, environmental, genetic and many other common causes, which has become widespread in recent years with prolonged human life, excessive nutritional habit, obesity and many different etiological factors (1). It is a chronic disease that occurs in synovial joints for a variety of reasons which causes cartilage damage in joints, development of osteophytes, and sclerosis in bone beneath cartilage. It has a progressive character. The most common complaints of the patients with osteoarthritis are joint pain, limitation of movement and function loss. Knee is the most commonly involved joint, and knee osteoarthritis is more common in elderly individuals (2-4).

Cysts and cyst-like lesions are commonly encountered in

the magnetic resonance (MR) images of the knee joint. In this study, it was aimed to evaluate the type, frequency and size of cysts observed in and around the knee joint in patients with and without osteoarthritis findings, and to investigate the relationship between these cysts and severity of osteoarthritis.

MATERIAL and METHODS

Study design

The study was carried out with retrospectively design, and MR images of knees between July 2015 and February 2016 were evaluated. Local ethics committee approval was obtained. Post-traumatic knees, cases with rheumatologic disease, cases with MR imaging artefacts which affect cystic-solid discrimination, and cases younger than 18 years old were excluded. A total of 620 knee belonging to

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545 cases who underwent MR imaging included in study.

Imaging protocol is summarized in Table 1. Images were obtained with 1.5 T MR imaging (General Electric Optima 450 W 1.5 T, GE Medical Healthcare, USA). A 16-channel phased array knee coil was used.

Table 1. The knee MR image acquisition parameters applied in the study

Sequences	T1 weighted	Proton density
Plane	Sagittal	Axial, sagittal and coronal
Fat suppressing	-	+
Time to repeat (ms)	458	2500
Time to echo (ms)	15.4	46
Flip angle (°)	160	160
Slice thickness (mm)	4	4
Gap (mm)	1.3	1.3
FOV (cm x cm)	18x15.3	18x15.3
Matrix	320x192	320x160
NEX	2	2

Data collection

The knees included in the study were divided into three groups as advanced degenerative, mildly degenerative and non-degenerative according to the degree of osteoarthritis. Knees with normal or suspected narrowing of the joint space without osteophytes were collected in a non-degenerative group. The mild degenerative group included the knees with small or medium sized osteophytes, mild to moderate cartilage loss, subchondral bone sclerosis. Large osteophytes, significant bone sclerosis, full-thickness cartilage loss, and severely narrowed joint space are included in the advanced degenerative group. The evaluation of images was performed by consensus of two radiologists who had 4-year and 10-year experience in MR imaging.

624 cysts detected in 620 knee MRI examinations of 545 cases were classified into 6 types and 19 subtypes (Table 2).

Table 2. Relationship between cyst type and osteoarthritis*

	Osteoarthritis grade			Total
	Absent	Mild	Advanced	
Bursitis	65(42.8%)	65(34.4%)	75(26.5%)	205(32.9%)
Prepatellar bursitis	3(2%)	2(1.1%)	0(0%)	5(0.8%)
Superficial infrapatellar bursitis	1(0.7%)	1(0.5%)	0(0%)	2(0.3%)
Deep infrapatellar bursitis	12(7.9%)	12(6.3%)	16(5.7%)	40(6.4%)
Iliotibial bursitis	10(6.6%)	8(4.2%)	1(0.4)	19(%3)
Pes anserinus bursitis	7(4.6%)	1(0.5%)	6(2.1%)	14(2.2%)
Medial collateral ligament bursitis	1(0.7%)	2(1.1%)	3(1.1%)	6(1%)
Medial gastrocnemius bursitis	18(11.8%)	28(14.8%)	35(12.4%)	81(13%)
Lateral gastrocnemius bursitis	7(4.6%)	8(4.6%)	9(3.2%)	24(3.8%)
Fibulopopliteal bursitis	0(0%)	0(0%)	1(0.4%)	1(0.2%)
Popliteal bursitis	6(3.9%)	3(1.6%)	4(1.4%)	13(2.1%)
Synovial cysts	26(17.1%)	51(27%)	78(27.6%)	155(24.8%)
Popliteal cyst (Baker's)	22(14.5%)	41(21.7%)	61(21.6%)	124(19.9%)
Proximal tibiofibular cyst	4(2.6%)	10(5.3%)	17(6%)	31(5%)
Parameniscal/intrameniscal cysts	11(7.2%)	14(7.4%)	8(2.8%)	33(5.3%)
Parameniscal cysts	10(6.6%)	11(5.8%)	8(2.8%)	29(4.6%)
Intrameniscal cysts	1(0.7%)	3(1.6%)	0(0%)	4(0.6%)
Intraarticular ganglion cysts	26(17.1%)	27(14.3%)	38(13.4%)	91(14.6%)
Cruciate ligament ganglion cyst	20(13.2%)	24(12.7%)	28(9.9%)	72(11.5%)
Hoffa's fat pad ganglion cyst	6(3.9%)	3(1.6%)	10(3.5%)	19(3%)
Extraarticular ganglion cysts	13(8.6%)	12(6.3%)	30(10.6%)	55(8.8%)
Intraosseous cysts	11(7.2%)	20(10.6%)	54(19.1%)	85(13.6%)
Subchondral cysts (Geode)	3(2%)	3(1.6%)	15(5.3%)	21(3.4%)
Insertion cyst	4(2.6%)	13(6.9%)	34(12%)	51(8.2%)
Intraosseous ganglion cyst	4(2.6%)	4(2.1%)	5(1.8%)	13(2.1%)

*For cysts types, Pearson Chi-Square test, p=0.002; for cysts subtypes, Fisher exact test, p=0.006

The age and gender of the cases were taken into consideration. The number of cysts detected, their size, and the side of knees (right / left) were also recorded.

Statistical analysis

IBM SPSS Statistics for Windows version 21.0 (IBM Corporation, Armonk, New York, USA) software was used for statistical analysis. Mean, standard deviation, minimum and maximum values are expressed in descriptive statistical data of cases. Frequency and ratio for nominal variables are calculated. Pearson Chi-square and Fisher's exact test was used to compare categorical data, and ANOVA test was used to determine the relationship between degeneration and cyst size. $p < 0.05$ was considered statistically significant.

RESULTS

A total of 545 cases and 620 knees were included in the study and a total of 624 cysts were detected. The age distribution of our cases ranged from 20 to 89 with a mean age of 53.93 ± 10.54 . Of the patients, 72% (392/545) females, 28% (153/545) were males, 331 (53.4%) were in right and 289 (46.6%) were in left knee.

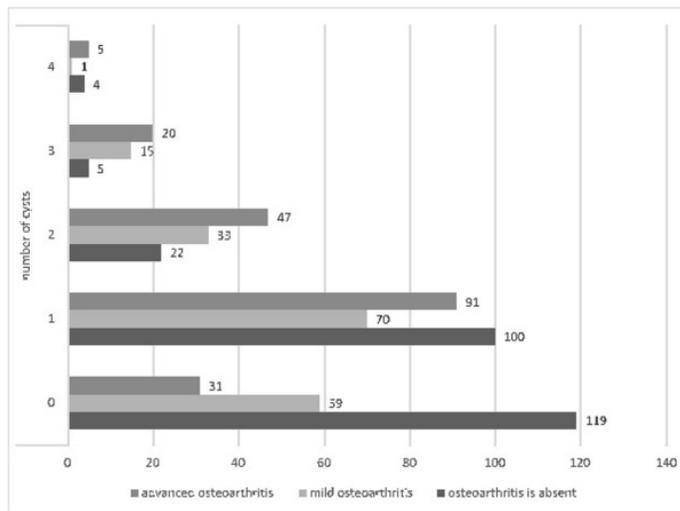
Degenerative arthritis was not present in 248 (40%) of the cases, whereas 178 (28.7%) had mild and 194 (31.3%) had advanced degenerative arthritis. The mean age was 48.59 ± 8.06 in the group without degenerative arthritis, 55.66 ± 9.81 in the group with mild degenerative findings and 58.95 ± 10.38 in the group with advanced osteoarthritis. In cases with cysts, the mean age is 55.45 ± 10.28 , while in cases who has no cyst it was 50.74 ± 9.78 .

A total of 624 cysts were found in or around the knee joint in 411 (66.3%) of 620 cases. Of these cases, one cyst was found in 261, two cysts were found in 102, three cysts were found in 40 and four cysts were found in 8 knees. As the findings of osteoarthritis increased, the number of cysts were also increased ($p < 0.001$) (Figure 1). 283 (45.4%) cysts were encountered in the knees with advanced osteoarthritis, whereas 189 (30.3%) cysts were encountered in mild osteoarthritis, and 152 (24.4%) were in cases without osteoarthritis. The incidence of cysts in the knees increased as the grade of osteoarthritis increased ($p < 0.001$) (Figure 2).

A significant correlation was also found between the mean diameter of the cysts and the degree of degeneration ($p = 0.009$). Thus, in knees without degeneration, the mean cyst diameter was $14.04 \text{ mm} \pm 9.84$, whereas the mean cyst diameter was $16.52 \text{ mm} \pm 11.86$ in the knees with mild degenerative findings, and was $17.8 \pm 13.38 \text{ mm}$ in the knees with advanced osteoarthritis.

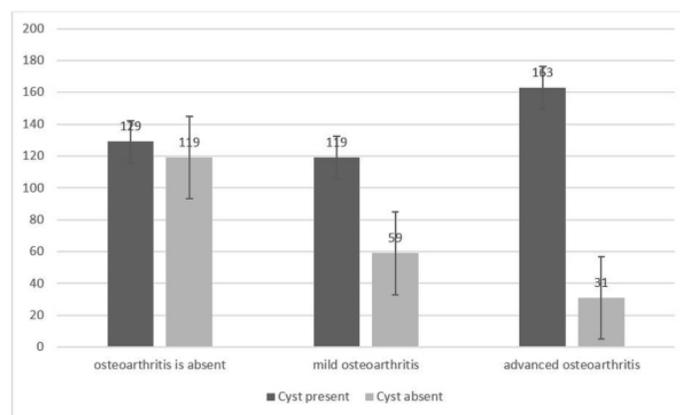
Among 624 cysts, 205 (32.9%) were bursitis, 155 (24.8%) were synovial cysts, 33 (5.3%) were parameniscal/intrameniscal cysts (Figure 3), 91 (14.6%) were intraarticular ganglion cysts (Figure 4), 55 (8.8%) were extraarticular ganglion cysts, and 86 (13.6%) were intraosseous cysts. There was a decrease with increased

degeneration in prevalence of bursitis and meniscal cysts. However, synovial cysts, ganglion cysts, and intraosseous cysts increased with joint degeneration ($p = 0.002$). Cysts subtypes also showed statistically significant difference among osteoarthritis grades ($p = 0.006$) (Table 2).



*Pearson Chi-Square test, $p < 0.001$

Figure 1. Relationship between number of cyst and osteoarthritis*



*Pearson Chi-Square test, $p < 0.001$

Figure 2. Relationship between the osteoarthritis and the presence of cyst in or around knee*



Figure 3. Sagittal (a) and coronal (b) fat suppressed proton weighted MR images of a patient who has no finding of osteoarthritis. A small parameniscal cyst is observed (arrows)

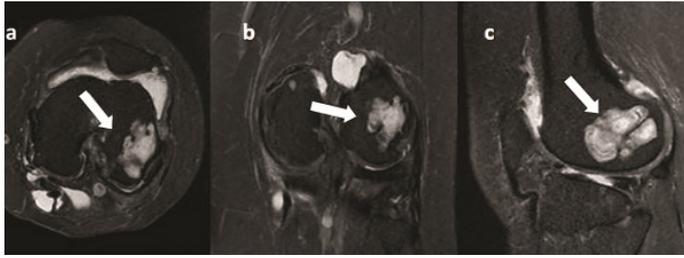


Figure 4. Axial (a), coronal (b) and sagittal (c) fat suppressed proton weighted MR images of a patient with mild osteoarthritis. An intraosseous ganglion cyst with lobulated contour and internal septa is observed in the lateral femoral condyle (arrows). A Baker cyst is also noted

DISCUSSION

MR imaging has been shown to be the most significant contributing tool in the detection of osteoarthritis and the efforts to elucidate its pathogenesis (5). During the routine knee MR examination, various cysts and cyst-like lesions are frequently encountered around knee. Although the majority of these cystic lesions are benign, they are sometimes confused by malignancy, infection, inflammation or degenerative arthritis. Knee joints and surrounding cystic lesions typically appear as fluid collections with a low signal on T1-weighted images and a high signal on T2-weighted images. MR imaging is the first choice for showing the cyst and cyst-like lesions of knee and their structure, accompanying intra-articular pathologies and anatomical relationship, as it produces high soft-tissue contrast (4).

Knee is the most common involved joint in primary osteoarthritis leading decrease of life quality due to pain (6). Although symptomatic and non-invasive treatment methods are preferred firstly, surgical treatment methods such as arthroplasty can be applied in some cases (7,8). Osteoarthritis is more frequently seen in female gender, and the clinical course is worse (9). In our study, 72% of the patients were female (392/545) and the reason for the high number of women in our study was the inclusion of cases with osteoarthritis predominantly.

There are several studies regarding the knee osteoarthritis and cystic lesions. In the study by Daichi Hayashi et al., the relationship among radiographic osteoarthritis findings, effusion and synovitis and cystic lesions of knee was evaluated and 319 knees of 163 patients with chronic knee pain was included. At the end of the study, at least one cystic lesion of any type was seen in 222 knees (70%). Most commonly, popliteal cysts (Baker's cyst) (40%, 128/319), gastrocnemius bursitis (15%, 49/319) and proximal tibiofibular joint synovial cysts (8%, 26/319) were observed. Significant increase in diameter was found only in popliteal (Baker) cysts and gastrocnemius bursitis ($p < 0.001$). There was no significant difference between the number of any of the cystic lesions in the study and radiographic osteoarthritis stage. The increased prevalence of gastrocnemius head bursitis was associated with increased effusion ($p = 0.0072$) and synovitis ($p =$

0.0033) (10). Differently, in our study, an increase in the number of cysts was detected in concordance with the osteoarthritis grade. All cyst types except for synovial and parameniscal/intrameniscal cysts had higher prevalence in knees with degenerative findings. The mean diameters of cysts were larger in patients with advanced osteoarthritis findings. The common cyst subtypes in our study were popliteal (Baker's) cysts, medial gastrocnemius bursitis, and cruciate ligament ganglion cysts, respectively.

In another study conducted by Tschirch et al. the prevalence and dimensions of 102 asymptomatic cystic lesions in knees without osteoarthritis were assessed. Synovial cysts (Baker's) in the popliteal region of 26 knees and not exceeding 3 cm in maximum diameter were the most common cystic lesions in asymptomatic knees (25.5%). Meniscal cysts were also found in four knees (3.9%) (11). Similarly, in our study, Baker's cyst was the most common cystic lesion in the knees without osteoarthritis, and 10 parameniscal and one intrameniscal cysts were detected in non-degenerative knees.

In a study by Rytter and colleagues, the risk of development of cyst and cyst-like lesions in the knee and its surroundings was investigated in cases of selected occupational groups that could lead to knee degeneration. As a result of the study, there was a significant increase in the formation of cysts and cyst-like lesions in the posterior compartment of the knee compared with the control group (12).

Guermazi et al. studied the relationship among cyst-like lesions of knee, incidental knee pain, and incidental radiographic knee osteoarthritis. In the study consisting of 157 patient group and 336 control group, Baker's cysts and proximal tibiofibular joint synovial cysts were seen twice more in the patient group than the control group. As a result of this study, it was found that the cystic lesions didn't trigger the incidental knee pain and radiologic knee osteoarthritis, but on the contrary, osteoarthritis might play a role in cyst development (13). The increase in the frequency of cysts in cases of advanced degenerative arthritis in our study supports this finding. However, there is no evidence that degenerative arthritis is the triggering factor in cyst development in our study. In addition, we did not investigate pain and other clinical symptoms associated with cyst and cyst-like lesions.

Rodica Traistaru and colleagues found a close association between Baker's cyst and knee osteoarthritis (14). In other similar studies, Baker's cysts are shown as the most common cystic lesions in osteoarthritic knees in the elderly population (15,16). In our study, the most common cyst was also popliteal (Baker) synovial cyst in the patients with osteoarthritis. Baker's cyst accounted for 21.7% (41/189) in the group with mild osteoarthritis and 21.6% (61/283) in the group with advanced osteoarthritis.

In a study by Crema et al. 400 knee joints of 400 cases in the risk group for osteoarthritis between 50-79 years of age were evaluated and 4.6% had subchondral cyst. Contrast

enhancement was detected in 94.2% in subchondral cysts after intravenous contrast agent administration (17). Since we did not use intravenous contrast material in the study, we could not assess the contrast enhancement pattern of cysts. Nevertheless, the frequency of subchondral cysts was similar to our study.

There are some limitations in our study. Although the 1.5 T MR device we use is successful in showing cyst and cyst-like lesions in the knee joint, the 3 T MR device with high magnetic strength can give more information in the differential diagnosis of some cystic lesions. Hematomas, infections and synovial sarcomas, relatively rare cyst-like lesions have not been included in the study. Also, suprapatellar bursitis was not included in the study because the link between the synovial fluid of knee joint and the suprapatellar bursa may create confusion in the knees with effusion. Some cystic lesions that cannot be clearly distinguished by MRI have been included in the most probable cyst group because there is no histopathologic correlation. Because the knee X-rays of our cases were not evaluated, the Kellgren-Lawrence classification used in the knee osteoarthritis could not be used in our study.

CONCLUSION

In conclusion, cyst frequency, number and mean cyst size in knees increase with degenerative arthritis. In addition, degenerative arthritis findings of cyst types other than parameniscal and intrameniscal cysts were observed more frequently in the knees with osteoarthritis. The most common cysts in the groups with no evidence of degenerative arthritis and mild degenerative arthritis were bursitis while the most common cysts in the cases with advanced degenerative arthritis were synovial cysts.

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