



CYSTIC LESIONS OF THE KNEE. PICTORIAL REVIEW

Lesiones quísticas de la rodilla. Revisión imaginológica

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Key words (MeSH)

Knee
Cysts
Magnetic resonance
imaging

Palabras clave (DeCS)

Rodilla
Quistes
Imagen por resonancia
magnética

Summary

This article presents a review of imaging findings of cystic lesions of the knee, with the purpose of differentiating them from each other and from other diseases. This will be illustrated with MRI cases performed at Pablo Tobón Uribe Hospital of Medellín. Clinical, epidemiological, etiological and especially imaging features of cystic lesions in the knee are described.

Resumen

Este artículo presenta una revisión de las lesiones quísticas de la rodilla, con el fin de diferenciarlas entre sí y de otras patologías, utilizando casos encontrados en estudios de resonancia magnética (RM) del Hospital Pablo Tobón Uribe de Medellín. Se describen las características clínicas, epidemiológicas, etiológicas y, especialmente, imaginológicas de las lesiones quísticas de la rodilla.

Introduction

The cystic lesions of the knee are frequently found in magnetic resonance studies (MR). Many of these lesions are benign and can be managed conservatively, however, they must be identified correctly given that inflammatory and tumor pathologies may also be presented as cystic lesions. In these cases, management is different (1).

Frequently, cystic lesions of the knee are described as asymptomatic. However, they might be manifested with pain, functional limitation, mechanical dysfunction or even palpable masses (2). Knowledge of anatomy is essential for an adequate diagnosis (3-5).

Imaging studies enable the diagnosis of cystic lesions of the knee. The ultrasound is used in case of palpable masses, in addition, it helps differentiate between cystic lesion and solid lesion. It is inexpensive and generally speaking, it is an available resource (6-8). Computerized tomography (CT) is limited in the evaluation of cystic lesions. Magnetic resonance (MR) is more functional (1). MR is the study of choice, in many cases these lesions are found incidentally (9,10). In MR, cystic lesions are observed with low signal images in respect to the muscle in sequences with T1 information and with high-signal images with

T2 information. If they are present with liquid rich in proteins or blood, they are heterogeneous. A contrast medium is recommended if the lesion is complex and presents a thickened wall, nodes, or septa in its interior, given that inflammatory or tumor processes must be ruled out (1).

For practical effects, cystic lesions of the knee are classified in this article according to their anatomical location. Lesions which simulate cysts are described, as illustrated in table 1 (11,12).

Materials and methods

Patients with a diagnosis of cystic lesions in and around the knee were selected. These patients underwent an MR study with a 1.5 Tesla Siemens Avanto resonator, in the Pablo Tobón Uribe Hospital of Medellín. In cases where there is suspicion of meniscus lesion, axial volumetrics were performed. In vellosynovial synovitis, trauma, hemarthrosis and postsurgical cases, GRE sequences were added with axial T2 information. The MR protocol for the study of the knee is summarized in table 2.

An imaging revision and a discussion of literature were performed based on said cases.

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Table 1. Cystic lesions of the knee

<p>Popliteal cysts</p> <ul style="list-style-type: none"> - Independent - Baker cyst <p>Synovial cysts</p> <ul style="list-style-type: none"> - Anterior synovial cyst - Vellosynovial synovitis - Synovitis through mycobacterium <p>Bursas</p> <ul style="list-style-type: none"> - Supra-patellar bursitis - Pre-patellar bursitis - Infra-patellar superficial bursitis - Infra-patellar, profound bursitis - Anserine bursitis - Bursitis of the collateral medial ligament - Bursitis of the collateral medial ligament – semi-membranous - Iliotibial bursitis - Bursitis of the collateral lateral ligament – femoral biceps - Bursa of the gastrocnemius - Post-traumatic bursitis <p>Meniscal cysts</p> <ul style="list-style-type: none"> - Anterior horn of the lateral meniscus - Posterior horn of the medial meniscus - Posterior horn and body of the medial meniscus - Anterior horn of the medial meniscus 	<p>Ligament cysts</p> <ul style="list-style-type: none"> - Cyst of the anterior crossed ligament (ACL) - Mucinoid disease of the crossed ligaments <p>Ganglion</p> <ul style="list-style-type: none"> - Intra-articular - Extra-articular - Periosteal - Intra-osseous <p>Other cysts</p> <ul style="list-style-type: none"> - Cysts of the proximal tibio-peroneal syndesmosis - Insertional cysts - Sub-chondral cysts / geode <p>Lesions which simulate cysts</p> <ul style="list-style-type: none"> - Osteomyelitis - Abscess - Arborescent lipoma - Synovial chondromatosis/osteochondromatosis - Hematoma - Lipohemarthrosis - Telangiectatic osteosarcoma - Myxoid liposarcoma
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Table 2. Protocol for magnetic resonance of the knee

Sequences	FOV (mm)	Width of the cut (mm)	TE (msec)	TR (msec)
Axial DP FS	160	2,5	35	3650
Coronal T2 FS	150	3	45	3200
Sagittal DP with and without FS	150	3	25	2990
Sagittal T2G	160	3	82	5400
Coronal T1	140	3,5	11	558
Gradient echo T2 axial	150	2,5	20	783
Volumetric T2 axial TRUFI	150	0,6	4,67	10,38

Note: FOV: Field of view TE: Time echo, TR: Time of repetition DP: Density of protons, FS: Fat saturation (this sequence is performed with a TR similar to T2 and an intermediate TE between T2 and DP).

Review

Popliteal cysts

These cysts have been described by several authors. However, in 1877, Baker gave his name to this condition (13). Even though the most frequent origin of the popliteal cyst is the communication between the joint and the gastrocnemius-semi membranous space, some appear independently (14).

Independent popliteal cysts are considered synovial cysts and are classified as primary and secondary. Primary cysts are most common in children, are not communicated with the joint space and are also not communicated to other pathologies of the knee (figure 1). Secondary

cysts communicate with the joint and are associated with intra-articular pathologies, such as meniscal tears. In up to 82% of cases, lesions of the anterior crossed ligament (ACL) followed, as well as degenerative changes in the cartilage and other pathologies such as septic arthritis, vellosynovial synovitis, and connective tissue diseases (14).

Secondary cysts are most frequent in adult men, with a prevalence of 19% (15). They are clinically manifested with pain, edema, or sensation of mass, even though the symptoms could be more related to associated pathologies. During examination, most cysts are found in the posterior-medial side of the knee, and with less frequency in the posterolateral side (16). The management of asymptomatic patients consists of the

observation or minimally invasive therapies with injection of steroids or sclerosant substances. In symptomatic patients, surgical resection is the management of choice with high degrees of relapse if the base pathology is not treated (16).

Baker cysts are lesions of the posteromedial side of the popliteal fossa, which extend through the profound fascia between the semi-membranous muscle and the middle head of the medial gastrocnemius muscle (17) and presents intra-articular communication (figure 2). An incidence of up to 38% is presented (18), and they are generally smaller than 2 cm (19). In 60% of cases, they are associated with lesions of the posterior horn of the medial meniscus (2). Other related pathologies are lesions of the lateral meniscus or bilateral meniscus lesions, rupture of LCA, lesion of the joint cartilage, infections and rheumatoid arthritis (RA) (2). Most are asymptomatic. When they are very large or when they break, they may cause symptoms and even complications due to the compromise of neighboring structures (20). Adjacent compression of the nerves, artery and popliteal vein may lead to symptoms of entrapment, ischemia or profound venous thrombosis. Clinically speaking, Baker cysts can be touched tense in the extension, followed by a softening with the flexion of the knee, which is a sign known as Foucher (16). Differential diagnoses for the Baker cyst are profound venous thrombosis, arterial aneurysms, hematomas, tumors, and varicose veins (20). The diagnostic methods of choice are ultrasound and MR. In the ultrasound, an anechoic lesion is observed with posterior acoustic reinforcement in the popliteal fossa, well defined, with thin walls and in the shape of a “vignette” in the transversal cuts. In MRI, they are observed as low-signal lesions in respect to the muscle in the sequences with T1 information and high-signal with T2 information.

Management is the same as the one referred in the cases of other popliteal cysts (16).

Synovial cysts-synovitis

These are defined as collections of juxta-articular liquid which are covered by a membrane of synovial cells. They may extend to the anterior, medial, or lateral planes of the knee and they may or may not communicate directly with the joint (2).

Anterior synovial cyst: It is present in patients of any age. It is associated with trauma, AR, osteoarthritis, gout and systemic erythematous lupus. Clinically, they present pain and edema (2). Management if conservative (1) (figure 3).

Villosonodular synovitis: Proliferative disorder of the synovial membrane, with formation of villousities and nodules. It is present in young adults between the ages of 30-50, without showing a preference for either sex. It affects any joint, with prevalence in the knee up to 80% of cases (21). Symptoms are non-specific, such as pain, edema, palpable mass, rigidity, reduction in the movement arcs and instability (22). There is a diffuse shape, and a localized or nodular shape. The definitive diagnosis is histological and it is characterized by deposits of intra-cellular hemosiderin which produce low signal in images with T2 information (21, 23) (figure 4). The definitive management is surgical resection with a good prognosis for nodular shapes. The diffuse shapes have a high rate of recurrence (24).

Synovitis through mycobacteria: They correspond to one third of osteoarthritis through tuberculosis (TBC) (25) and are developed due to hematogenous dissemination. They are most frequent in children, given that their hip is the most compromised joint (55%). However,

prevalence in adults, especially in the knee, is at least 59% of cases (25). When performing the physical examination, there is painful rigidity in the knee and atrophy of the quadriceps. In the MR, “rice body” images have been described in 50% of synovitis through TBC, which have low or intermediate signal in the muscle, in the sequences of T1 and T2 information (figure 5). These bodies also appear in AR. For this reason, culture and biopsy are necessary for a definitive diagnosis (26). Soft-tissue septa may be formed in synovitis through TBC, which are manifested as lineal structures which extend from the joint and are re-enhanced with the contrast medium, generating an appearance of a “trolley car pathway” (27). Treatment consists of anti-consumptive therapy and orthopedic and/or surgical management with synovectomy or arthrodesis.

Bursas

They are named depending on their anatomical location (pre-rotulian, superficial infra-rotulian, and profound, anserine, iliotibial, of the middle collateral ligament (MCL) and lateral collateral ligament (LCL), and bursa of the semi membranous-tibial ligament). They are synovial structures which reduce friction between the tendons, the ligaments and the bone. There is a thickening and accumulation of liquid (2, 28), in inflammatory processes due to trauma, arthropathies, and hemorrhage. The management of acute bursitis consists of rest, local cold and use of non-steroid anti-inflammatory medications (NSAIs). During chronic stages, an infiltration with local anesthetics and steroids is performed. Inhalation and antibiotic therapy occurs in cases of infectious bursitis (2).

Bursitis of the medial collateral ligament: This bursa is a compartment which is elongated vertically, located between the superficial and profound layers of LCM. It swells more frequently in professional cyclists and horseback riders (11, 28). Its compromise is related to osteoarthritis, gout, AR, or meniscal lesions (figure 6). Pain is the most important symptom, and it may be clinically mistaken with tear of the lateral meniscus, or of the LCM (29, 30).

Bursa of the gastrocnemius: Collection of liquid close to the insertion of the lateral head of the gastrocnemius muscle which communicates with the joint in the retrocondylar recess. For this reason, it is described as a retrocondylar bursa or as a synovial cyst of the gastrocnemius (figure 7). The differential diagnosis are the ganglions which are present more in men than in women. Classically speaking, they are adjacent to the tendinous sheath, to the cartilage, to the meniscus or to the muscle. The differentiation between a synovial cyst which is not communicated to the joint, and a ganglion is only determined by the doctor (31).

Post-traumatic bursitis: Pre-patellar bursa is located anterior to the patella, in the profound part of the soft tissues. Frequently, its inflammation is related to over-use and it is popularly known as “housemaid’s knee”. It may be the result of a direct trauma in the toggle joint or of repetitive lesions, it causes pain, edema, and palpable mass (28).

Superficial infra-patellar bursitis extends at the pre-rotular level and in the tibial tubercle. It is known as “cleric’s knee” and it is caused by the flexion of the knee in a repetitive manner, and due to jumping (28). Its alteration is not frequent. It is regularly secondary to trauma, in which rupture may occur. There is pain in the tibial tubercle (figure 8).

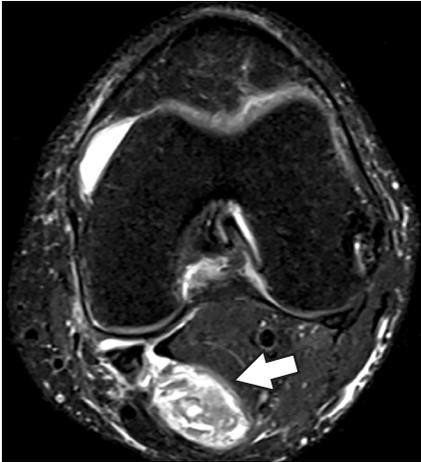


Figure 1. Popliteal cyst, DP FS axial image (white arrow) shows high-signal lesion, lobulated, with multiple detritus which protrudes towards the posterior region of the knee, without intra-articular communication.

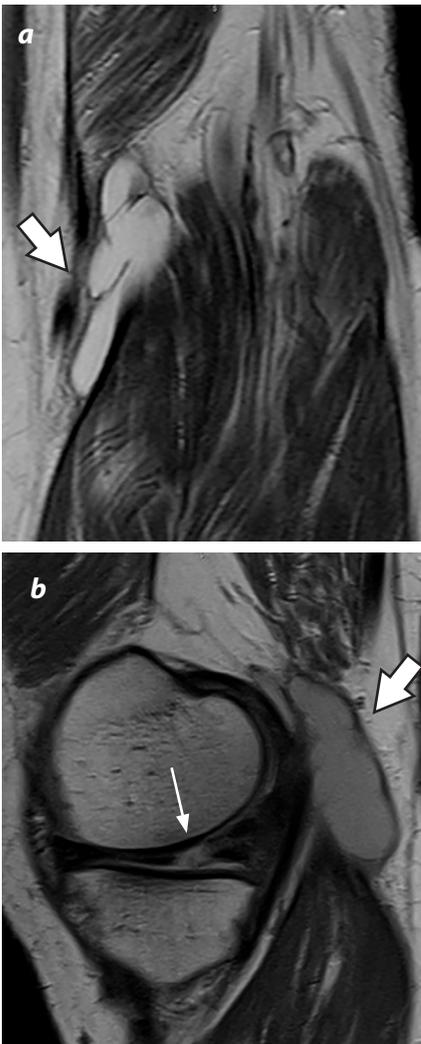


Figure 2 (a, b). Baker Cyst. Coronal sequences with T2 information (a) and sagittal with T1 information (b) show a lobulated lesion with homogenous liquid and smooth synovia (thick arrows), which presents intra-articular communication and meniscal lesion (thin white arrow). In this case, the planes of the sequences with T1 and T2 information were inverted due to a suspicion of fracture.

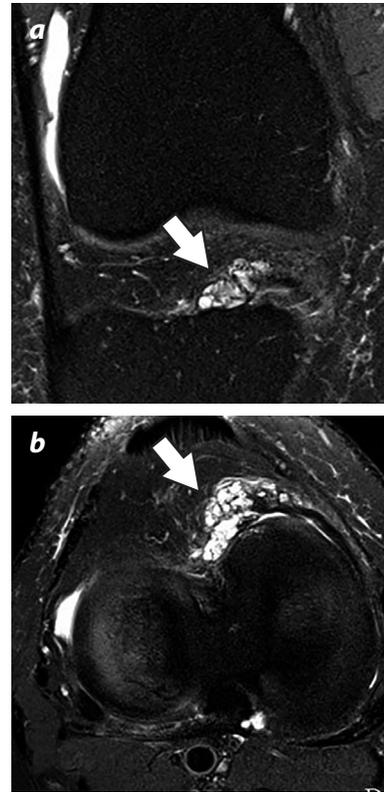


Figure 3. Anterior synovial cyst. Coronal sequences with T2 FS information (a) and axial DP FS information (b) with high-signal lesions, lobulated, subjacent to the intermeniscal transverse ligament without compromise of the medial meniscus, which protrude towards the Hoffa's fat (white arrows).

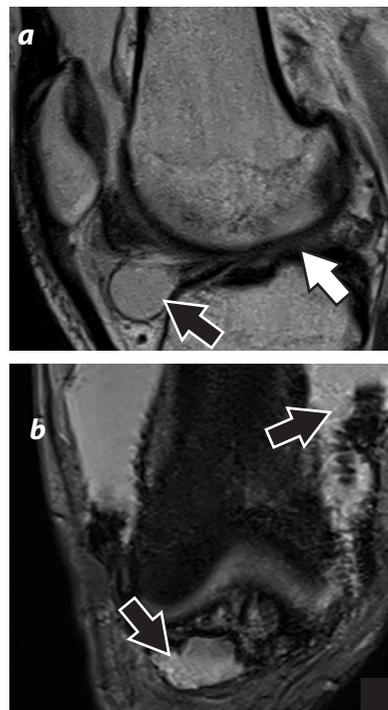


Figure 4. Vellosynovial synovitis. Sagittal sequence with T2 information (a) demonstrates joint leakage with high protein content (white arrow), and elongation of the capsule in an anterior and central direction, ruling out the possibility of parameniscal cysts (black arrow). In the coronal GRE with T2 information (b), there is low signal and a thickening of the wall of the supra-rotulian bursa and in the elongated anterior capsule (black arrows).

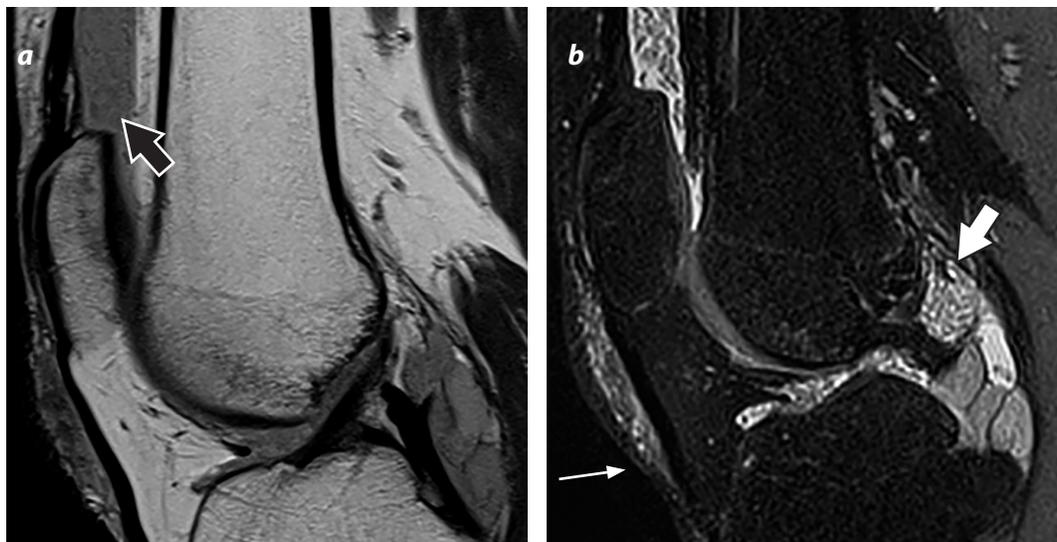


Figure 5. Synovitis due to mycobacterium (mycobacteria). Sagittal DP (a) and DP FS (b) in which joint spillage is observed (black arrow), as well as anterior collection to the rotulian tendon (thin white arrow), with multiple small low-signal images in the shape of "bodies of rice", associated with a high intra-articular protein content, adjacent to the posterior cross ligament (thick white arrow). The described findings were confirmed by a study of joint liquid and synovial biopsy.

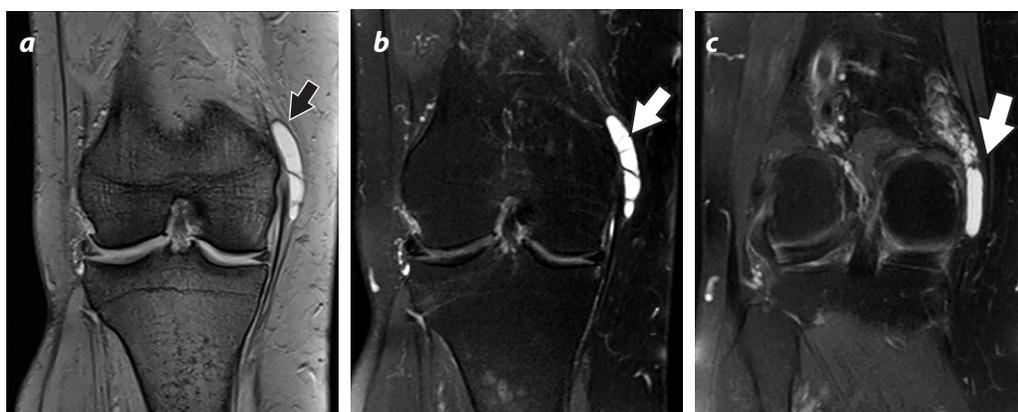


Figure 6. Bursitis of the medial collateral ligament. 66 year old woman who has suffered pain for two years. GRE coronal images with T2 information (a) show lobulated lesion with septa, located between the superficial and profound layer of the medial collateral ligament (black arrow). DP FS Coronal (b, c), shows the extension of the lesion with better definition, in a posterior direction (white arrows).

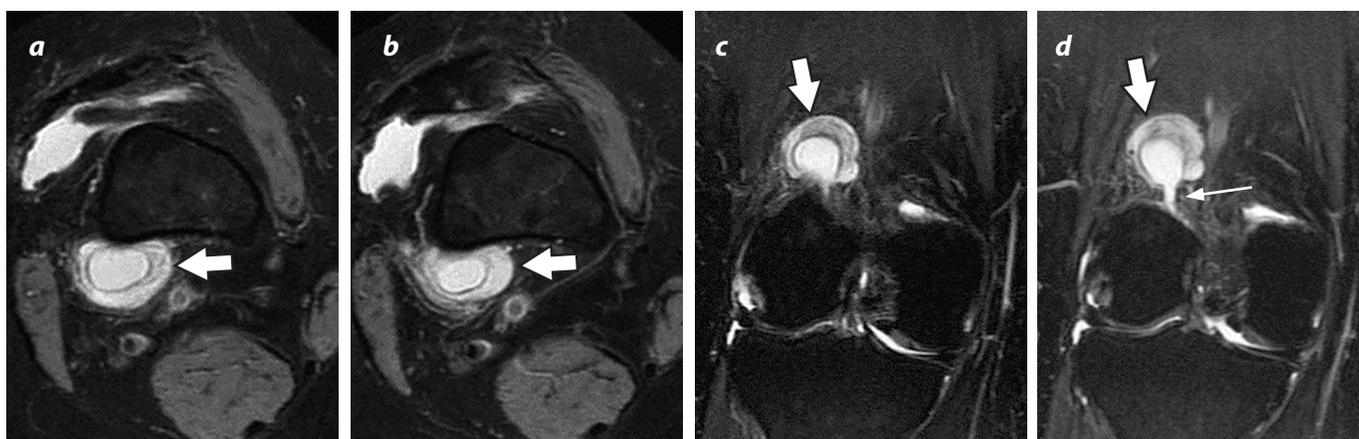


Figure 7. Bursa of the gastrocnemius muscle. Axial images (a, b), and coronal DP FS (c, d), in which an uniloculated image, with peripheral and posterior protein content (thick arrows) which communicates with the joint in the capsular recess (thin white arrow), which is a finding that is especially visible in the DP FS coronal images.

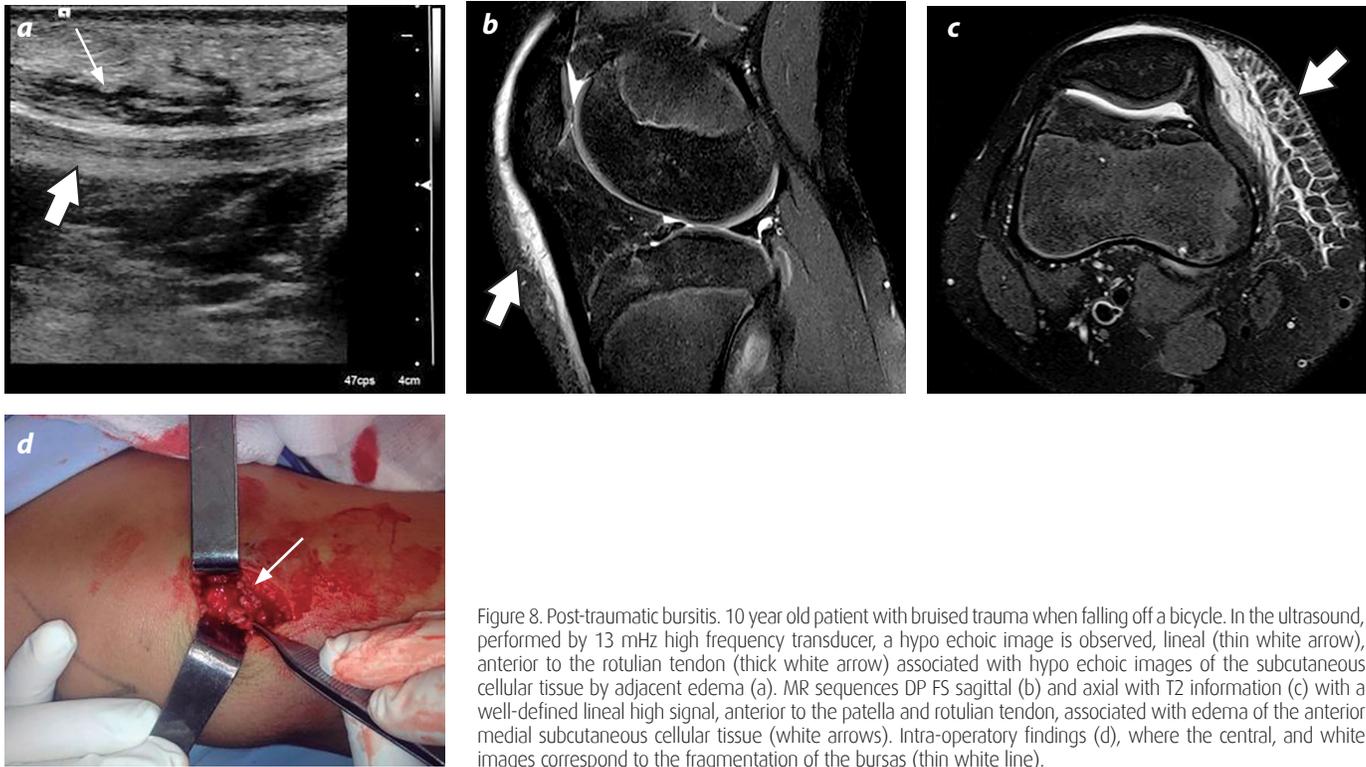


Figure 8. Post-traumatic bursitis. 10 year old patient with bruised trauma when falling off a bicycle. In the ultrasound, performed by 13 mHz high frequency transducer, a hypo echoic image is observed, lineal (thin white arrow), anterior to the rotulian tendon (thick white arrow) associated with hypo echoic images of the subcutaneous cellular tissue by adjacent edema (a). MR sequences DP FS sagittal (b) and axial with T2 information (c) with a well-defined lineal high signal, anterior to the patella and rotulian tendon, associated with edema of the anterior medial subcutaneous cellular tissue (white arrows). Intra-operative findings (d), where the central, and white images correspond to the fragmentation of the bursas (thin white line).

Meniscal cysts

Generally speaking, its prevalence is 4% (2). They may be intermeniscal and parameniscal (32). The most accepted reason for the formation of these cysts is the accumulation of joint liquid at the interior of the broken meniscus, with extravasation of the liquid towards the adjacent soft tissues. The horizontal lesions of the meniscus are present in 90% of cases. It is informed that meniscal tears have a size of 12 mm throughout the circumferential axis, they are associated with the formation of these cysts (33). Most meniscal cysts contain septa and are lobulated; they can cause pain, edema, or even palpable mass (11, 34). Treatment consists of draining the cyst and repair the tear of the meniscus (35, 36).

Parameniscal cysts of the anterior horn of the lateral meniscus: They have a prevalence of 33%. The most common location is adjacent to the anterior horn or body of the lateral meniscus (54%) (3). Their size vary from 0.1 to 8 cm (37). They are most frequent in cases of trauma and are less associated with meniscal tears. They are most frequently present in case of trauma and they are less associated with meniscal tears (38). They protrude towards Hoffa's fat (figure 9).

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Parameniscal cysts of the posterior horn of the medial meniscus: 66% of parameniscal cysts are medial (74% of the posterior horn). They may also extend to LCM and to other ligaments (figure 10) (11).

Parameniscal cysts of the posterior horn and of the body of the medial meniscus: The parameniscal cysts of the body of the medial

meniscus protrude towards the surface of the medial collateral (figures 11 and 12).

Parameniscal cysts of the anterior horn of the medial meniscus: The anterior location of the cysts of the medial meniscus is the least frequent.

Cysts of the ligaments

They are present in 1.3% of the population. Two theories have been suggested for its pathogenesis: The first one due to mucinous degeneration of the conjunctive tissue, and the second one is related to a herniation of the synovial tissue through a defect in the capsule or sheath of the ligament (39). Recurrent trauma is more frequently present in men; women are less likely to suffer from it (40, 41). Generally speaking, they are an incidental finding. Symptoms are manifested with pain in the middle articular line, mechanical blockage and inflammation. They may be present with other intra-articular pathologies such as meniscal tears and chondromalacia. Its association is informed with intra-osseous cysts in the femorotibial joint, probably due to the pressure which the cysts causes on the osseous surface. A gradual erosion of the bone is generated, until a cyst is formed. The high incidence of intra-osseous cysts in patients with mucinous degeneration suggests that these two conditions may share a similar pathogenesis (39).

Cyst of the anterior crossed ligament: In the MR, the cysts of the anterior crossed ligament are low-signal with T1 information, high signal in the sequences sensitive to liquid, may present septa and be very large or may include several small cysts (42). The size, location, complexity, and degree of the lobulation of the cyst must be taken into account (39). Generally speaking, they are located inside or around the ligament and they are not connected to the meniscus (figure 14) (40).



Figure 9. Cyst of the anterior horn of the lateral meniscus. Patient with pain who presents fluctuating and fixed mass. Background of trauma, which occurred a year ago. In the DP FS sagittal sequences (a, b), lobulated lesions with septa are observed, which protrude in an anterior manner (thick arrows), originating from the anterior horn of the lateral meniscus (thin white arrow). In the DP FS axial image (c) with lobulated image which protrudes towards Hoffa's fat (thick arrow).

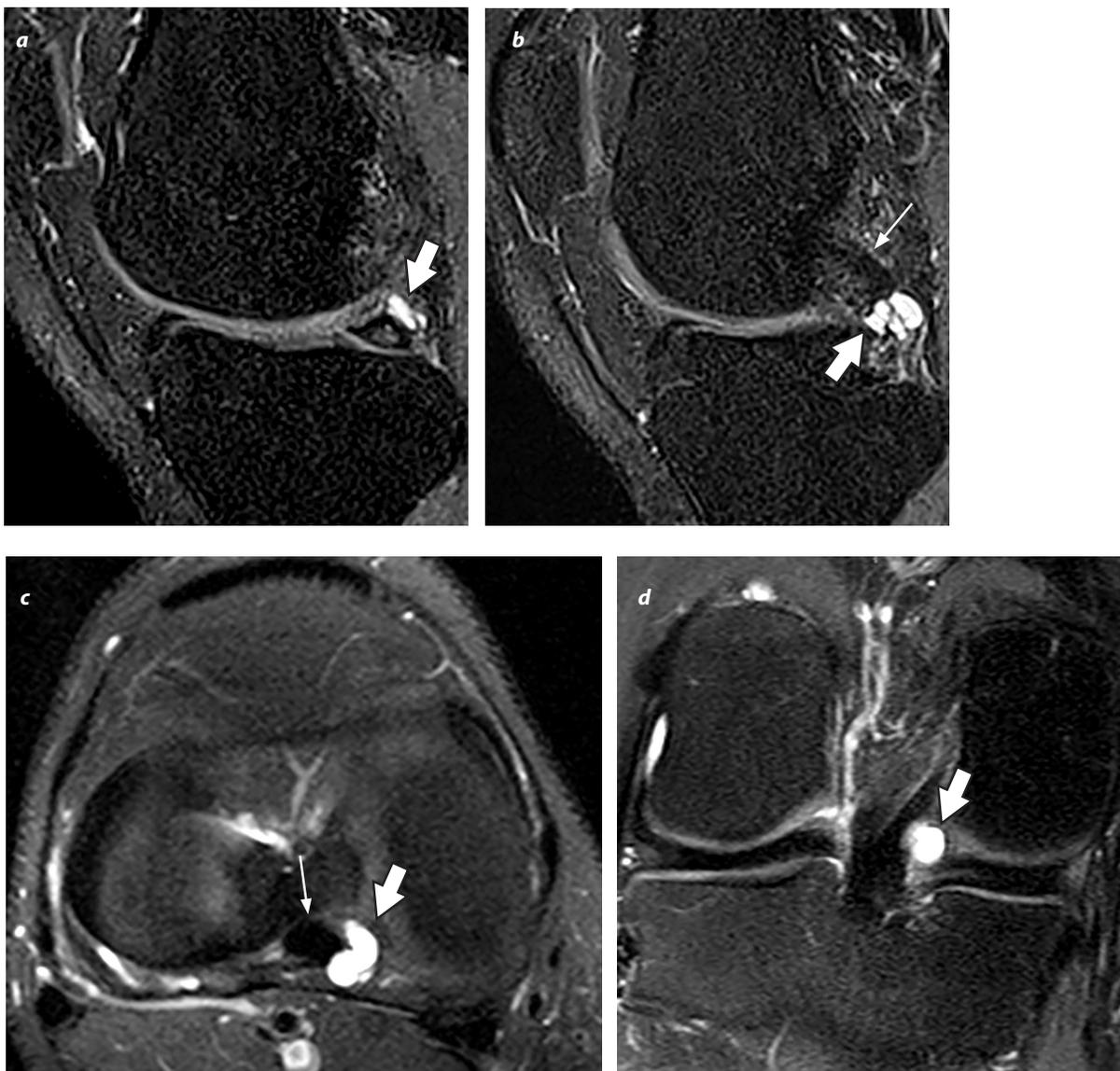


Figure 10. Cyst of the posterior body of the medial meniscus. Patient with chronic pain and background of work trauma. Sagittal sequences (a, b), axial (c) and coronal (d) DP FS, show lobulated lesion (thick arrows) which surrounds the posterior cross ligament (thin white arrow), and originates from the posterior horn of the medial meniscus.

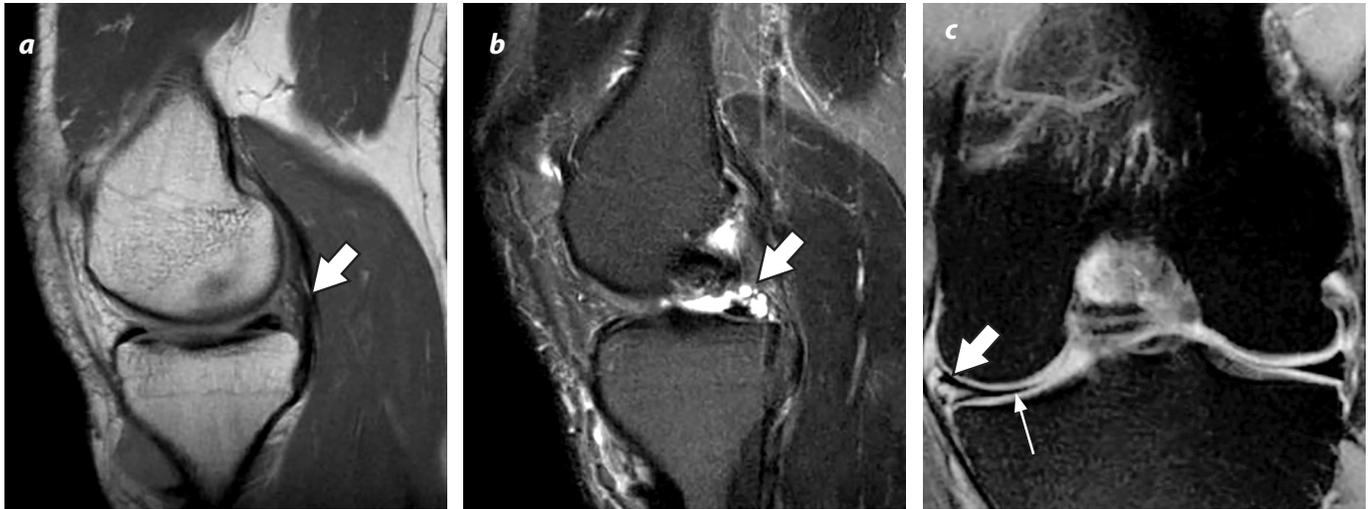


Figure 11. Cyst of the posterior horn and body of the medial meniscus. Patient with chronic pain and background of trauma in a traffic accident. Intermediate posterior lobulation is observed in the DP sagittal sequence (a), as well as a round image of a central high-signal and thin halo of low-signal in sagittal and coronal sequence DP FS (b, c), (thick arrows), originated from the posterior horn of the medial meniscus (thin white arrow).

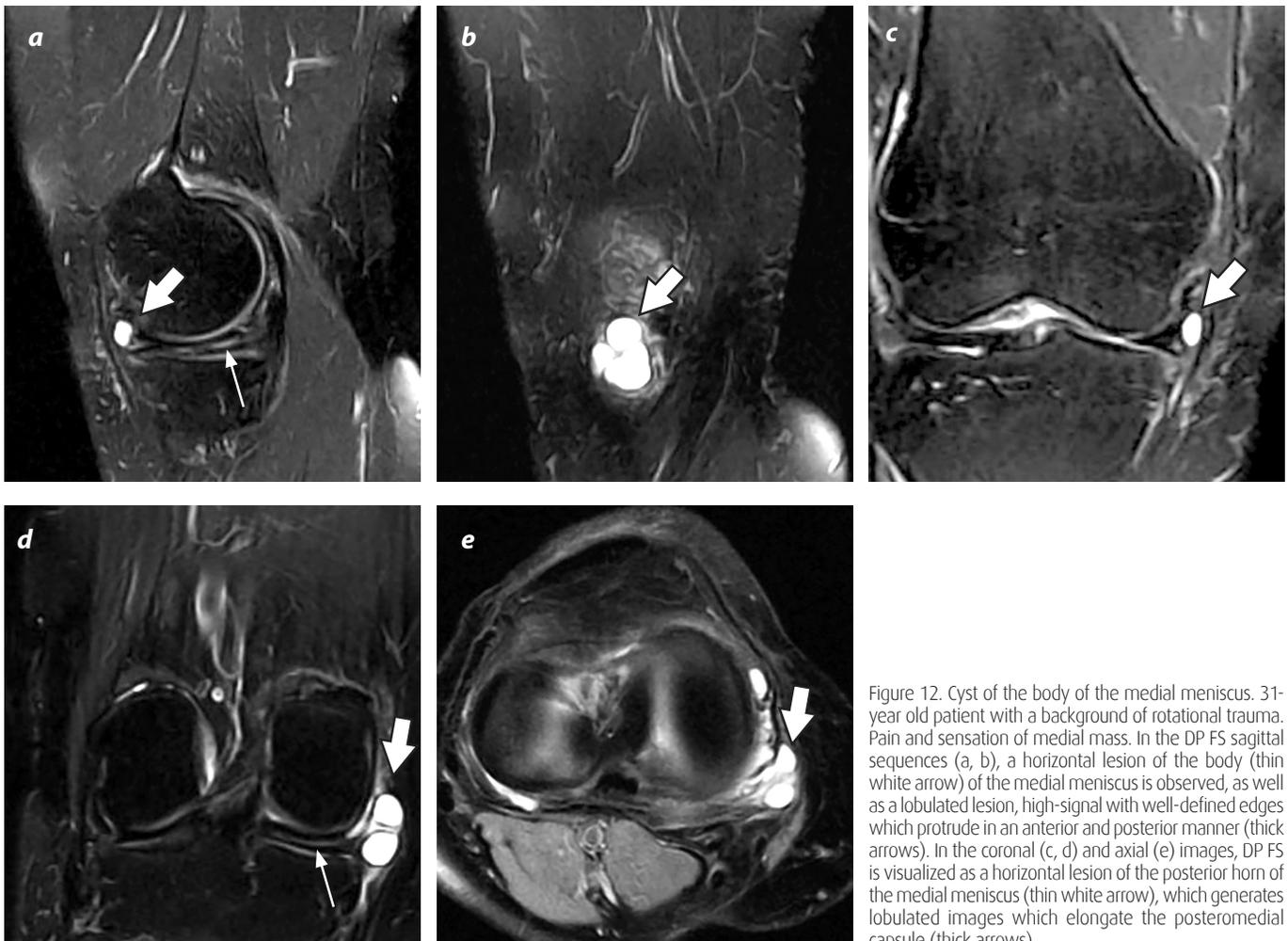


Figure 12. Cyst of the body of the medial meniscus. 31-year old patient with a background of rotational trauma. Pain and sensation of medial mass. In the DP FS sagittal sequences (a, b), a horizontal lesion of the body (thin white arrow) of the medial meniscus is observed, as well as a lobulated lesion, high-signal with well-defined edges which protrude in an anterior and posterior manner (thick arrows). In the coronal (c, d) and axial (e) images, DP FS is visualized as a horizontal lesion of the posterior horn of the medial meniscus (thin white arrow), which generates lobulated images which elongate the posteromedial capsule (thick arrows).

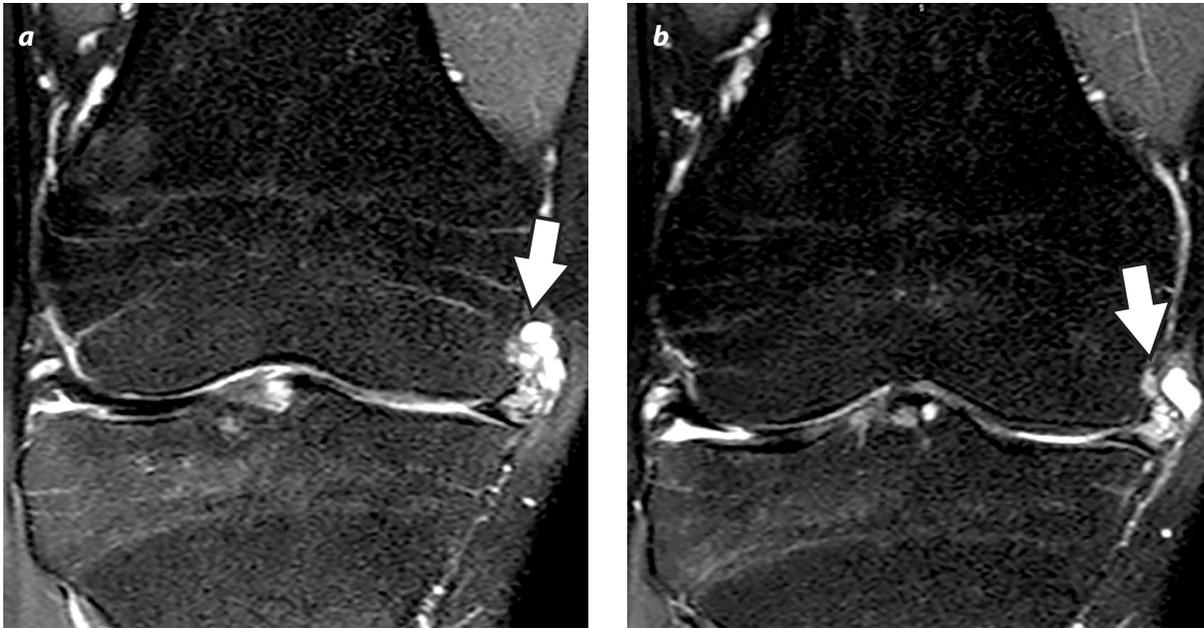


Figure 13. Cyst of the anterior horn of the medial meniscus DP FS coronal image (a, b), with lobulated lesion, high-signal, which protrudes in a medial and anterior manner (thick arrows), emerging from the medial meniscus and presenting a horizontal lesion.

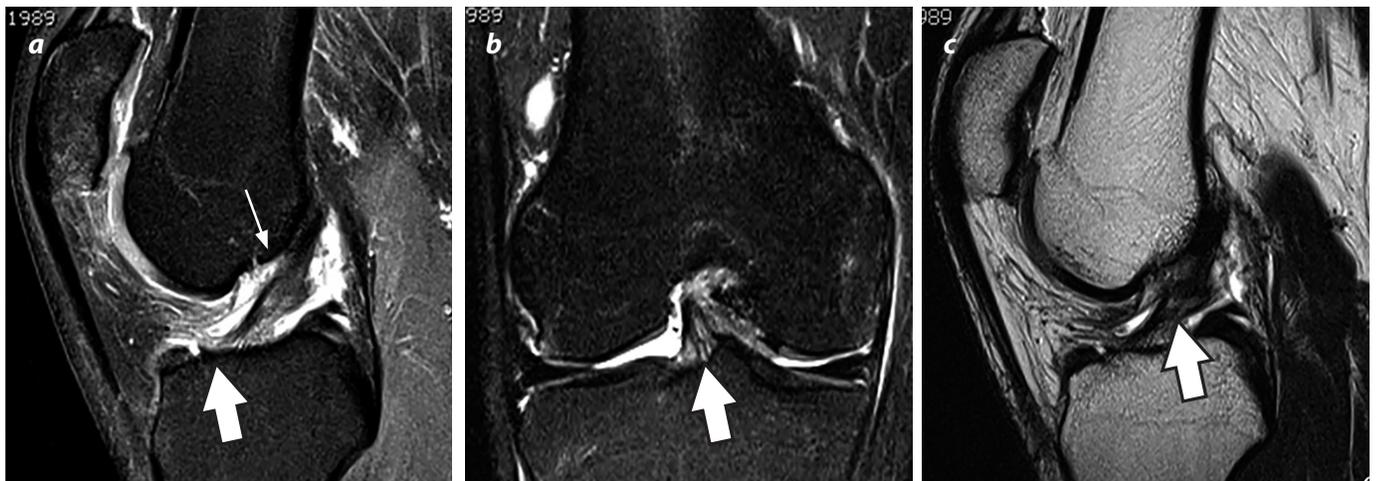


Figure 14. Cyst of the anterior cruciate ligament. Sagittal (a) and coronal (b) images DP FS, with anterior and posterior movement of the central anterior fibers of the anterior cruciate ligament (thin white arrow) and high central signal which extends towards its tibial fibers (thick arrows). In the sagittal image with T2 information (c), the signal in the interior of the crossed ligament and of the described lesion is lesser than the signal of the joint liquid, probably due to chronicity (thick arrow).

Mucinous disease of the crossed ligaments: The term mucinous disease is more appropriate than mucinous degeneration given that it is present in patients of approximately 40 years of age (43), with pain in the posterior region of the knee, limited arcs of movement and without signs of instability of the joint (44). In MR, the beams of the ligament present an intermediate signal in average sequences with T2 information. These beams, due to their signal, are not well defined in T1 or DP and are better defined in sequences with T2 information (figure 15). Joint liquid may extend between the crossed ligaments if the synovial membrane is not complete (42). When treatment with NSAIs and physical therapy fails, the indicated management is surgical management in most cases (45).

Other cysts

Cysts of the proximal tibioperoneal syndesmosis: The prevalence is 0.76% (46). They are considered secondary to a hernia of the capsule, due to an increase in intra-articular pressure (figures 16 and 17) (47). They are asymptomatic, but compression of the common peroneal nerve may occur, causing dorsal foot pain, atrophy in the muscles of the anterior compartment of the leg and drop foot (48). In these cases, management is surgical (49). When the cyst invades muscles, the bone or nerve receives the name of Ganglion migrans (50). The differential diagnoses are schwannomas, neurofibromas and juxta-articular synovial sarcoma.

They are treated conservatively. Its content is inhaled and in some cases, the use of steroids has been informed. After surgical resection, the rate of recurrence is 10% (49).



Figure 15. Mucinous disease of the crossed ligaments. GRE coronal sequences with T2 information (a), axial DP FS (b) and sagittal DP (c), in which high-signal is observed in the interior of LCA which separates the fibers in an anterior and posterior direction and medial to lateral. Sagittal DP FS sequences (d) with movement of the fibers of the anterior crossed ligament in an anterior to posterior direction with "celery stalk" image. In a different case, a volumetric reconstruction is observed (e) similar compromise in the posterior crossed ligament (arrows).

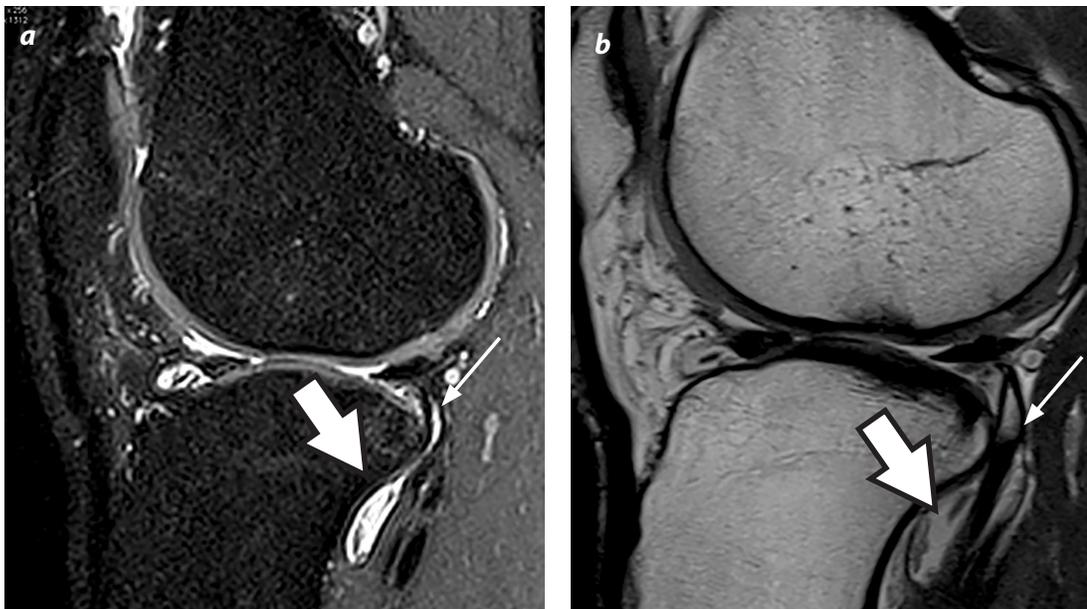


Figure 16. Cyst of the proximal tibioperoneal syndesmosis. DP FS sagittal image (a) proves a lesion which communicates with the joint (thin white arrow) and presence of detritus (thick arrow). In the DP sagittal image (b), a lesion is observed (thick arrow) which surrounds the popliteal tendon (thin white arrow).



Figure 17. Cyst of the proximal tibioperoneal syndesmosis. The sagittal (a) and DP FS coronal (b, c) images show a lesion of high intensity with detritus inside and posterior lobulation (thick arrows), originated from the syndesmosis (thin white arrows).

Conclusions

Cystic lesions of the knee are common, especially parameniscal cysts and Baker's cyst.

There are some atypical cysts which compromise the area adjacent to the gastrocnemius, tibioperoneal syndesmosis, anterior synovia and pre-patellar and superficial infra-rotulian bursas. The most frequent etiology is the proliferation of mesenchymatous cells starting from the synovial liquid, towards the interior of lesions or micro-traumas of the ligaments, meniscus, syndesmosis and bursas, among others.

The differentiation of the lesions through the symptoms, physical examination and clinical history is difficult due to the presence of common findings such as pain, edema, and mostly palpable mass.

The imaging diagnostic modality of choice for the characterization of cystic lesions of the knee is MR.

Benign lesions are seldom larger than 5 cm and are generally soft; therefore, any mass around the knee, fixated, hard, profound and with a diameter of over 5 cm, must be considered malign until proven otherwise.

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Received for evaluation: September 22, 2014
Accepted for publication: February 11, 2015