Degenerative Meniscal Tears: Meniscal Cysts

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Philippe Beaufils and Nicola Pujol

Contents

Abstract

There is not just one but many different types of meniscal tears. Two completely different conditions have to be considered: traumatic lesions and degenerative meniscal lesions. Degenerative meniscal lesions correspond to an aging process and the main question is the relationship between degenerative meniscal lesions and osteoarthritis (OA). Is degenerative meniscal lesions always the early stage of OA or are they true primary DML without OA? The answer is unclear. Practically speaking, when an orthopaedic surgeon is faced with a degenerative meniscal lesion that is assumed to be responsible for the patient's symptoms, one fundamental requirement is to search early signs of macroscopic OA.

The most important guideline in the decision-making process is the principle of meniscal sparing. If there is no OA, leaving the meniscus alone should be the first choice (many DML's are asymptomatic in the general population). If symptoms remain with time, meniscectomy, as partial as possible, could be considered. In the specific group of young athletes presenting a degenerative meniscal lesion (overuse syndrome), meniscus repair must always be considered.

In the case of advanced OA, meniscectomy or arthroscopic debridement may not benefit the patient, and initial treatment should be conservative treatment.

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There is not just one but many different types of meniscal tears and consequently not just one, but several potential treatment methods, adapted to the type of lesion and its clinical context. This has led to the concept of meniscal preservation or meniscal sparing, which is based on three pillars: meniscectomy as partial as possible, thanks to arthroscopy, meniscal repair, and benign neglect. In clinical practice, one can be faced with two distinct situations, a traumatic meniscal lesion in a stable or unstable knee or a degenerative meniscal lesion (DML), which is or not associated with macroscopic arthritic changes.

For each of these situations, a specific treatment algorithm is required.

In the degenerate group, leaving the meniscus tear alone should probably be the first choice; meniscectomy could be considered in case of functional treatment failure. Indications for meniscus repair are very selective and non-frequent.

Definition

The definition of a degenerative meniscal lesion (DML) is the conjunction of two criteria:

- Occurrence in the absence of an injury or as a result of decompensation after minor trauma.
- Macroscopic and microscopic alterations which correspond to myxoid degeneration. The meniscal tissue appears yellow. Microscopically, there is an acellular eosinophilic hyaline degeneration, a myxoid degeneration. Myxoid degeneration can be found within the meniscal substance but can also affect the perimeniscal zone which can lead to the formation of perimeniscal cysts (Ferrer-Rocca and Vilalta 1978; Boyer et al. 2010).

Classification

Arthroscopic classification was first proposed in 1983 by Dorfmann and Boyer (Dorfmann et al. 1987; Boyer et al. 2010) (Fig. 1, Table 1).

The classification of Crues et al. (1987) serves as a reference standard for MRI:

- Grade 1 is a high-intensity intrameniscal signal which is round and occupies a variable volume of the meniscus.

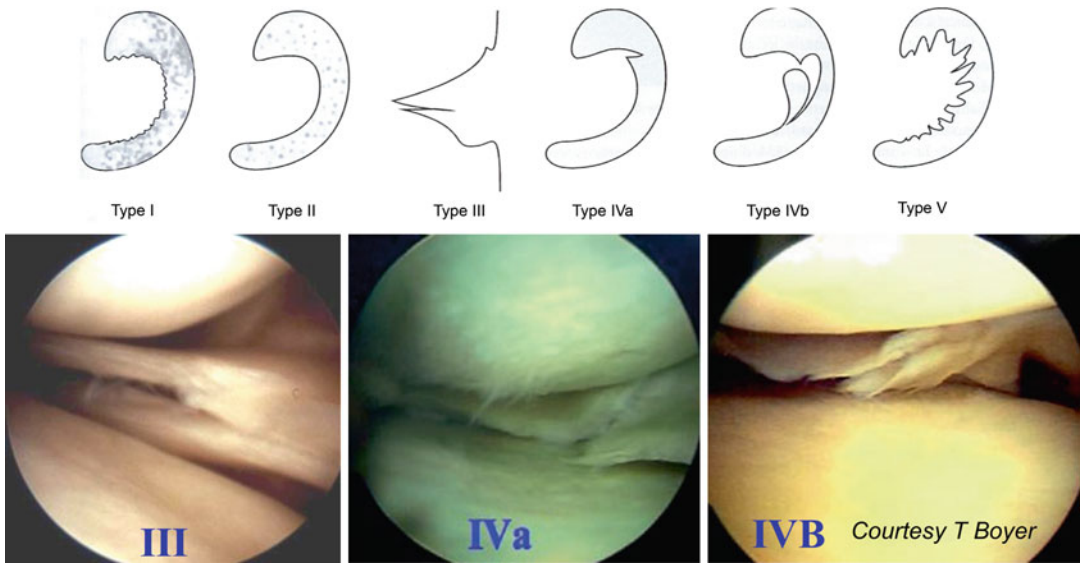

Fig. 1 Arthroscopic classification of degenerative meniscal lesions according to Dorfmann and Boyer (Dorfmann et al. 1987)

– Grade 2 is a high-intensity intrameniscal signal which is linear. It does not involve the surface (Fig. 2a).
– Grade 3 is high-intensity signal extending to the surface of the meniscus. It indicates a true meniscal tear (Fig. 2b).

Pathogenesis

It can be assumed that the aging process of the affected meniscal tissue and its deterioration has advanced to a certain degree. This idea was first introduced by Smillie (Smillie 1978) and Noble (Noble and Erat 1980). Noble, in an analysis of 115 cadaveric or post amputation knee specimens (more than half of which were obtained from subjects aged 65 years or older), documented a lesion of the medial meniscus in 38 %. Their conclusions were subsequently confirmed by arthroscopic and MRI evidence.

Table 1 Classification of degenerative meniscal lesion (Boyer et al. 2010)

Type I: alteration of the meniscus without interruption of its continuity: It is flat and yellow, and its inner edge is frayed
Type II: presence of calcium deposits (meniscocalcinosis)
Type III: horizontal cleavage
Type IV: radial tear (IVa) or a flap (IVb)
Type V: complex lesion

The prevalence of intrameniscal high signal intensity on MRI of asymptomatic subject is high and much more frequent than traumatic lesions. Moreover it increases with age. It is estimated to occur in 5 % of subjects under the age of 30 years, rising progressively to 13–15 % between 30 and 45 years, 25–63 % of subjects above 50 years, and 65 % of subjects above 65 years (Englund et al. 2008; Boyer et al. 2010). Englund et al. (2008) (Fig. 3) observed that MRI meniscus hypersignal intensities were more frequent in the male population than in the female population. Most of these degenerative meniscal tears are actually not causing any symptoms, and they are an incidental finding on MRI.

The relationship between degenerative meniscal lesion and osteoarthritis of the knee is uncertain. Currently, the question whether DML always leads to the development of osteoarthritis or whether the concept of a "primary" lesion is correct remains unanswered.

What is known?

What is the effect of knee OA on the meniscus? It is known that meniscal tears and loss of meniscal function are a strong risk factor for the development of OA (Englund et al. 2009). Englund demonstrated a three times higher risk of OA, in case of minor meniscal lesion, and even

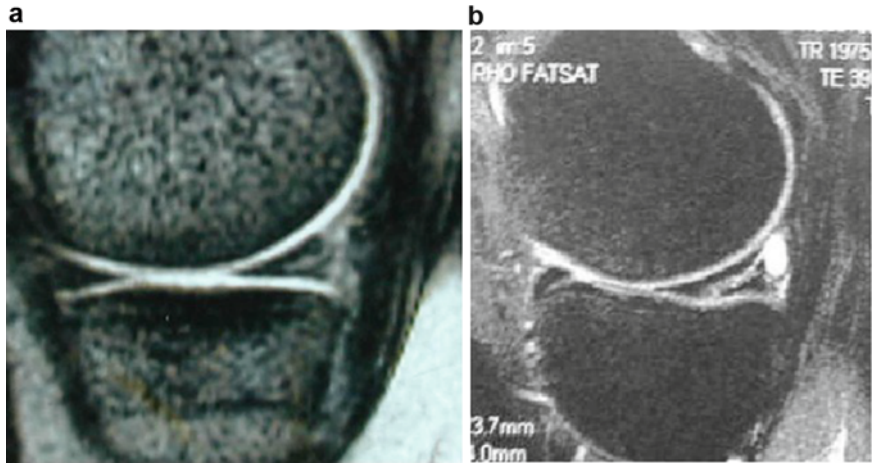

Fig. 2 (**a**) Grade 2 intrameniscal hypersignal. (**b**) Grade 3 hypersignal of the posterior horn (medial meniscus) associated with a parameniscal cyst

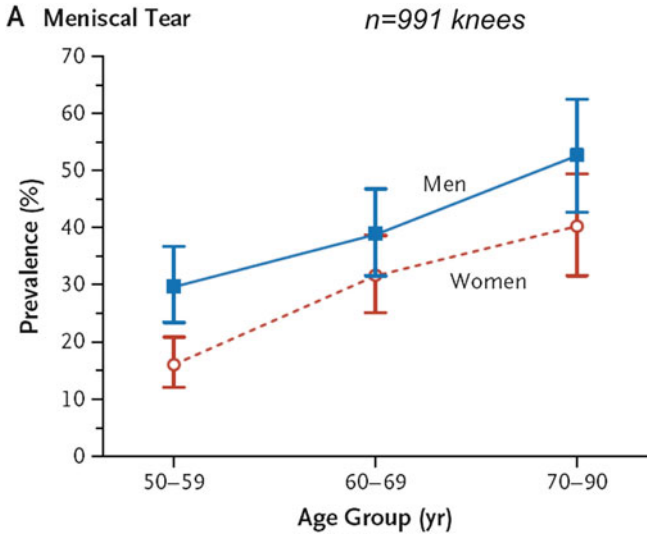

Fig. 3 Prevalence of meniscal lesions according to age and gender (Englund et al. 2008)

seven times, in case of major meniscal tears at 30 months of follow-up compared with normal knees. But it is also known that having the OA puts at increased risk of developing degenerative meniscal tears and meniscal lesions and extrusions. In other words, it is a complex relationship.

What is the relationship between symptoms and MRI abnormalities? Meniscal damage often seems to not be directly causing symptoms, while other features, as a consequence of loss of meniscal function, may do so (Englund et al. 2007).

The questions are:

Is there any continuum between degenerative meniscal lesion and OA? In other words is DML always an early stage of OA?

Are there some "primary" DML without any cartilaginous damage?

These questions have of course major consequences in terms of treatment strategy.

In favor of a strong relationship between DML and osteoarthritis, the prevalence of MRI meniscal abnormalities increases with age, and meniscal tears are systematically associated with osteoarthritic knees (Bhattacharyya et al. 2003; Englund et al. 2007, 2009; Pujol and Boisrenoult 2010a; Zanetti et al. 2003).

In favor of a "primary" lesion, DML are more frequent in men than women (2–1) (Englund et al. 2008), which is exactly the opposite of osteoarthritis. DML may develop earlier, even in young athletes without any chondral degenerative process. Biedert et al. (Biedert 2000; Pujol et al. 2013) recognized a specific group of symptomatic horizontal meniscal cleavage (grade 2 or 3 with or without extra meniscal cyst) which appears in young athletes and can be considered as an overuse syndrome (Fig. 4).

Diagnosis

The key point for a clinician treating a patient presenting with knee pain is therefore to know whether the patient suffers from a DML in a joint with macroscopically intact chondral surfaces or from early-stage osteoarthritis with a coexistent DML.

Surgeons have to ask two questions:

- Is the meniscal lesion responsible for symptoms? It is the concept of painful unstable meniscal lesion.
- Are there signs of osteoarthritis?

In the first case, meniscectomy would be assumed to be a "curative" procedure, while in the second one, it would be purely palliative (the so-called arthroscopic debridement). Because in

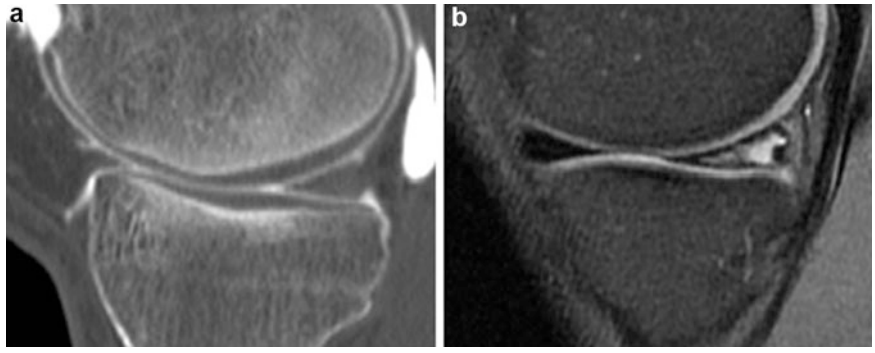

Fig. 4 Seventeen-year-old tennis man with medial complaint. (**a**) Normal arthroCT scan, (**b**) MRI showing a huge intrameniscal hypersignal of the posterior horn

everyday practice, it is impossible to obtain direct information on the microscopic structure of cartilage, its condition is assessed by means of standard radiography and MRI.

The "Painful Unstable Meniscal Tear"

It is well known that meniscal tear itself doesn't cause pain. Pain is due to inflammatory response in the periphery of the meniscus. On the other hand, pain can be due to other causes (i.e., anterior knee pain), and the association of two frequent conditions (knee pain and meniscal hypersignal on MRI) doesn't mean there is a relationship between these two conditions. There is a great difficulty for the clinician: It's quite common to have the patient sent to a MRI scan and they get the report back with the diagnosis of a meniscal tear. Just because the patient has knee pain and a meniscal tear, it's quite easy to draw the conclusion that this tear must be operated upon.

The diagnosis "Painful unstable meniscal lesion" can be established if some of the following criteria are present:

- Sudden onset without significant trauma; for example, during or after sports activities or heavy daily activities (such as squatting, gardening)
- Tenderness on the posterior aspect of the medial or lateral joint line during flexion and corresponding to the spontaneous pain

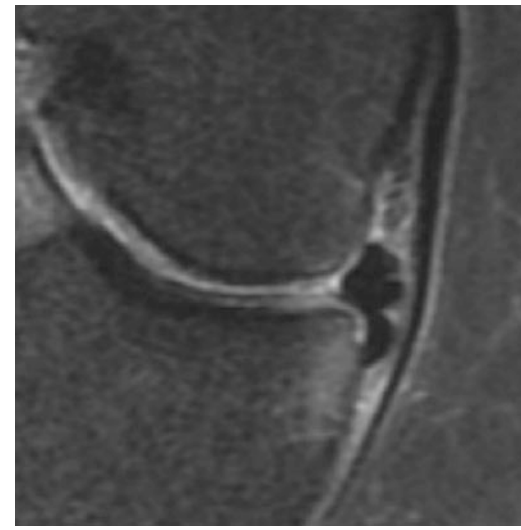

Fig. 5 Displaced flap in the tibial gutter responsible for pain and clicking knee. Note the tibial subchondral bone edema due to the impingement. Typical pattern of "painful unstable meniscus" indicating a meniscectomy

- Spontaneous clicking knee or during meniscal maneuvers
- MRI demonstrating not only a meniscal hyper signal but signs of a flap (Fig. 5)

Sign of Osteoarthritis

Clinically speaking, OA can be suspected if there is progressive onset, absence of clicking knee, pain in both knees, or pain at the anterior aspect

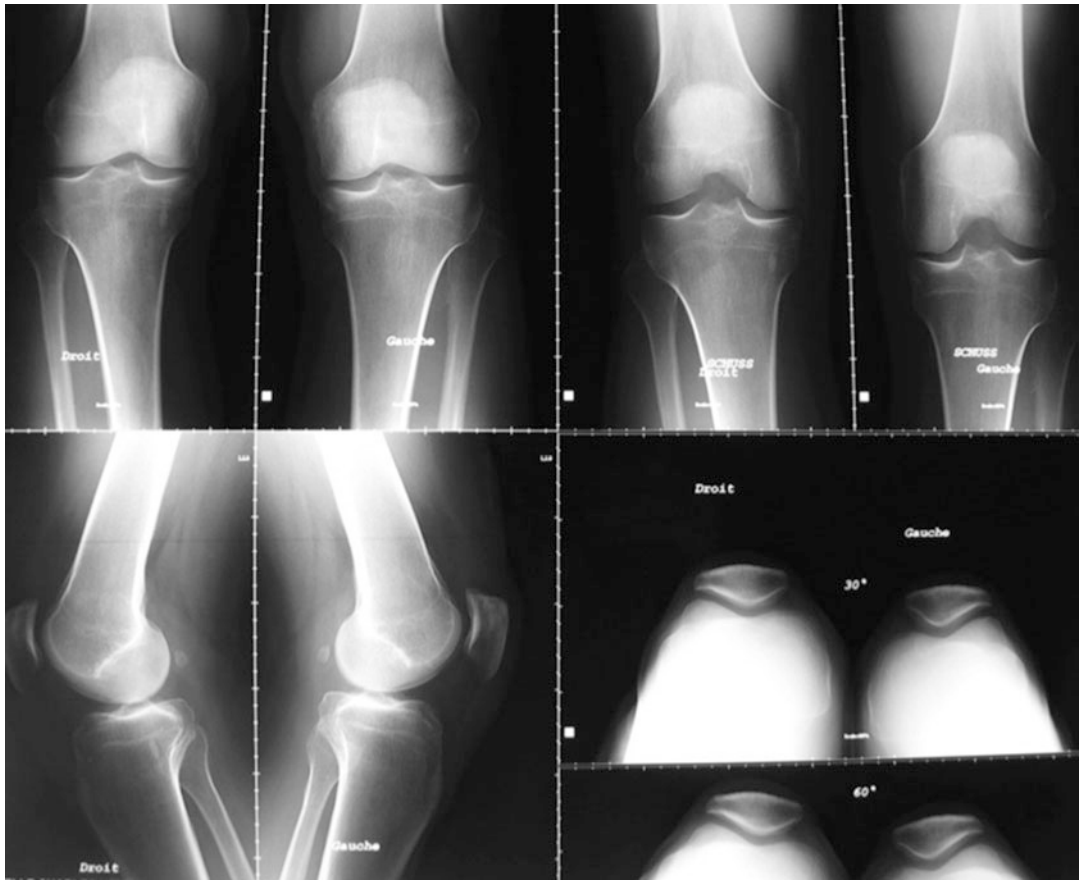

Fig. 6 Standard X-ray protocol: both knees. AP full weight bearing view in extension, schuss view, lateral view, Merchant view

Table 2 Pre- and immediately post meniscectomy joint space measurements according to Prové et al. (2004) coefficient "R" for each appaired serial of measures between both examiners

		Meniscectomized knee	Contralateral knee
Extension	Pre-op	5.8 (±1)	5.8 (±1)
	Post-op	5.6 (±1)	5.8 (±1)
Schuss	Pre-op	5.2 (±1)	5.1 (±1)
	Post-op	5.2 (±1)	5.2 (±1)

of the joint line. But the diagnosis is often provided by imaging techniques.

Radiographs are systematically carried out according to a standardized protocol: comparative X-rays (both knees) including full weight bearing AP view in extension, the so-called schuss view (standing flexed AP view), lateral view, and Merchant view (Fig. 6). The schuss view is very important: it has a good reproducibility. Narrowing of the cartilage space of 2 mm or more is strongly correlated with grade 3 or 4 cartilage degeneration. Meniscectomy itself doesn't modify the joint line width, meaning that joint narrowing is not due to the meniscus itself but is always related to OA (Prove et al. 2004) (Table 2).

MRI shows the meniscus and allows one to characterize the meniscal tear, especially the presence of a flap (Fig. 5). But the cartilage,

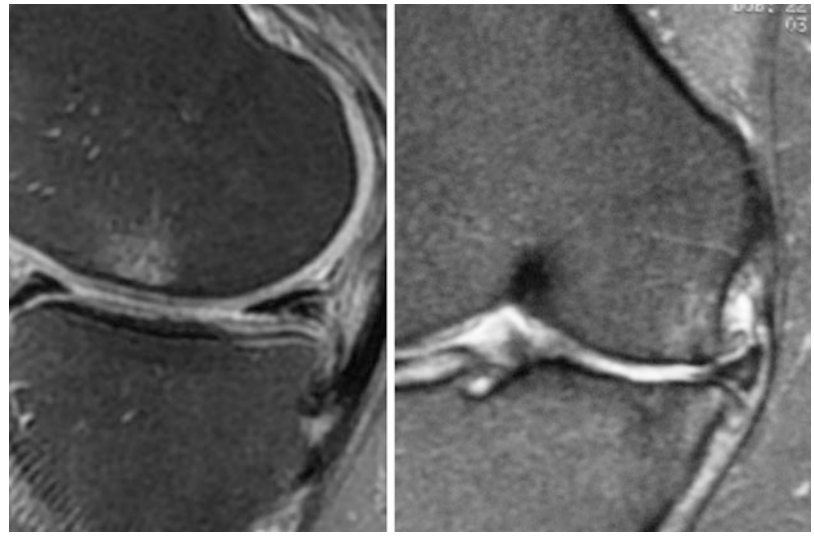

Fig. 7 MRI: early signs of macroscopic osteoarthritis. (**a**) Bone marrow edema in the weight bearing area of the medial condyle, (**b**) medial meniscus extrusion (more than 3 mm)

subchondral bone, and meniscal extrusion must be also assessed in order to detect early signs of osteoarthritis, while standard radiographs may not demonstrate any joint space narrowing.

These early signs consist of meniscal extrusion (Costa et al. 2004) and subchondral abnormalities (Fig. 7). An extrusion more than 3 mm is reported to be strongly related with osteoarthritis and should not be regarded as a meniscal lesion itself, except in particular cases such as root tears (Ahn et al. 2010). The cause of extrusion in the presence of osteoarthritis is not well known. Costa et al. (Costa et al. 2004) found a strong relationship between meniscal extrusion and radial tears, particularly those located within the posterior insertion (root tears) of the meniscus (Ahn et al. 2010).

Whatever the cause, meniscal extrusion is related to a loss of meniscal function and can be interpreted as a functional subtotal meniscectomy. Benefits of arthroscopic meniscectomy of an extruded meniscus is therefore very uncertain (Pujol and Boisrenoult 2010b).

Significance of subchondral hypersignal (bone marrow edema) is not univocal: In the weight bearing area, it could be regarded as an early sign of osteoarthritis, especially if it lies on both sides (femur and tibia: kissing sign). It also can be caused by vascular changes (early stage of osteonecrosis) or subchondral microfractures (Fig. 8), which in these circumstances may be first treated by conservative treatment. The significance of marginal bone marrow edema is more controversial: whether it is due to extrusion (early osteoarthritis) or to impingement with a meniscal displaced flap (Fig. 5).

Meniscal Cyst

Intrameniscal cysts occur in 4–6 % of knees studied with MR imaging (Helms 2002). Meniscal cysts should be considered as a degenerative process. Under pressure, the fluid in the intrameniscal cyst can be squeezed into the adjacent soft tissues, forming a parameniscal cyst. Parameniscal cysts are relatively uncommon (0.27–5 % of meniscal tears) (Hulet et al. 2010). The ratio of lateral to medial meniscal cysts has been reported to be 5–1.

Presenting complaints are usually pain and palpable cyst formation. On the lateral side, the cyst is usually large and disappears in flexion (Pisani's sign). Medial meniscal cysts are usually deeper, more posterior, and smaller, rendering the clinical diagnosis more difficult.

Radiographs are systematically carried out, especially to assess the joint line. One can sometimes find a specific sign of parameniscal cyst, as an erosion of the tibial plateau (Fig. 9a).

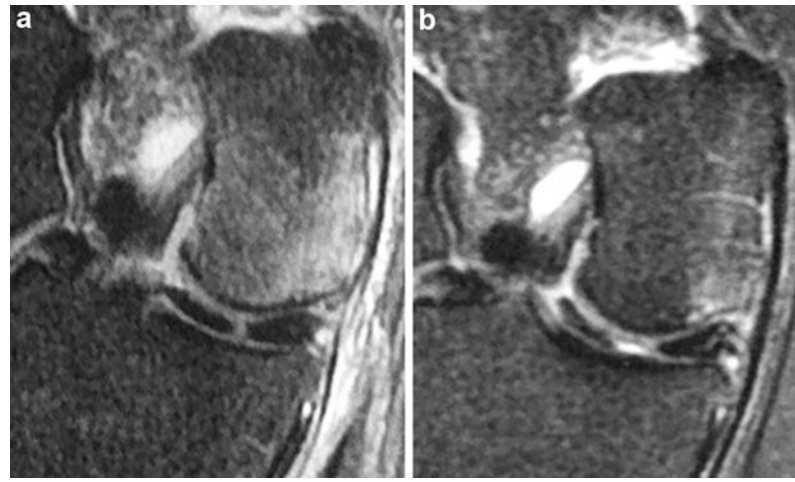

Fig. 8 Sixty-one-year-old patient with medial knee pain. (**a**) MRI shows a meniscal tear of the posterior segment associated with a femoral condylar bone marrow edema. Conservative treatment. (**b**) At 3 months, the patient is asymptomatic with a significant decrease of the condylar hypersignal. Meniscal tear is still there demonstrating that it is not responsible for pain

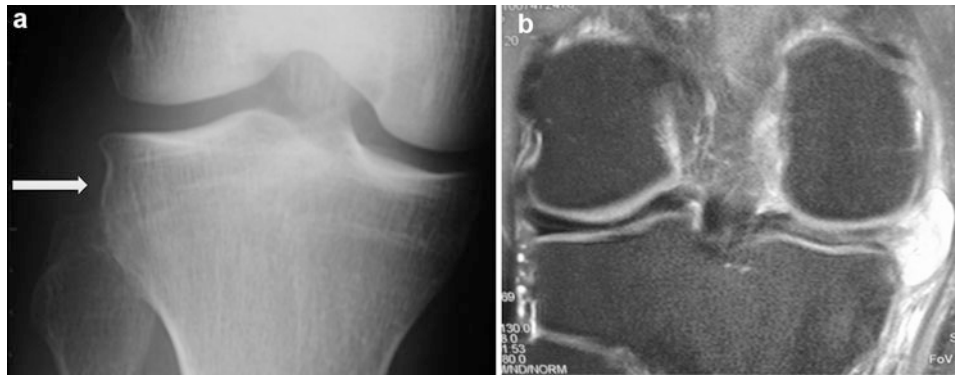

Fig. 9 Meniscal cyst. (**a**) AP standard X-ray demonstrating an erosion of the lateral tibial margin. (**b**) MRI: typical medial meniscal cyst of the mid part

MRI is critical to precisely define the cyst location, the presence of a meniscal tear, and the connection between cyst and meniscus (Fig. 9b). It is important to distinguish between a meniscal cyst associated with a grade 2 intrasubstance meniscal lesion and one with a complete grade 3 tear.

Treatment

It is possible to establish an algorithm for the management of knee pain in these cases (Beaufils et al. 2009; Beaufils 2010) (Fig. 10). Usually, the patient presents with an MRI which shows a meniscal tear. The surgeon must evaluate the patients for signs of early osteoarthritis.

Two different situations must be distinguished:

- There is no macroscopic osteoarthritis on standard radiographs and no early signs of OA on MRI.
- There is evidence of OA

No Evidence of OA

The patient has no joint line pain, the MRI shows a grade 3 meniscal lesion with or without a meniscal cyst, and the subchondral bone signal is unaltered. Treatment in these patients should consist either of benign neglect or arthroscopic meniscectomy because surgical repair is seldom indicated.

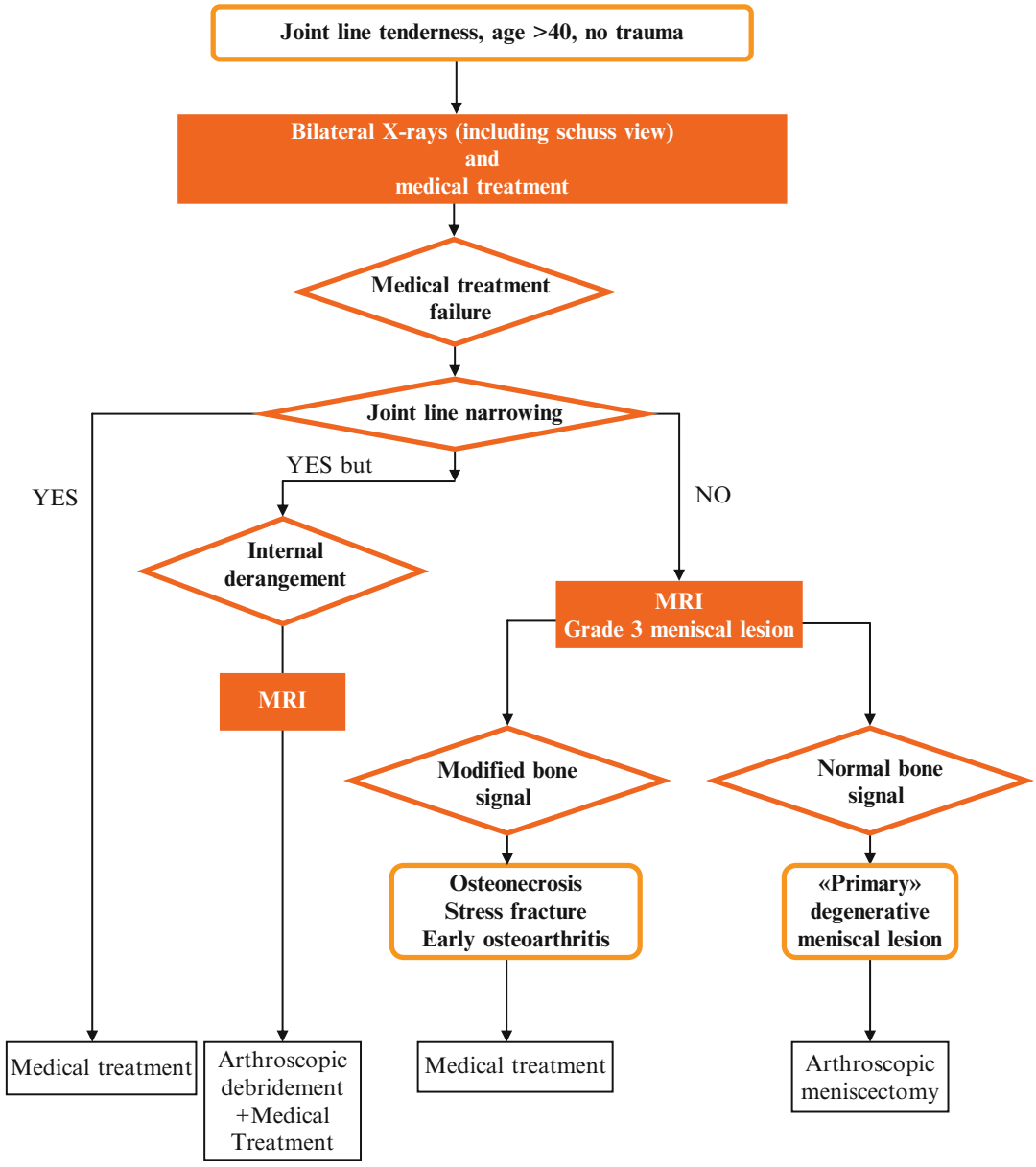

Fig. 10 Algorithm for the management of knee pain in middle-aged patients according to the Haute Autorité de Santé guidelines (Beaufils et al. 2009)

The primary choice is conservative and consists of rest, nonsteroidal anti-inflammatory drugs, and physiotherapy (Weiss et al. 1989; Hede et al. 1990; Baufils et al. 2009; Herrlin et al. 2007; Pujol and Boisrenoult 2010b). Herrlin et al. (2007) compared arthroscopic and conservative treatment in a randomized trial and found that 6 months after treatment, arthroscopic partial medial meniscectomy followed by supervised exercise did not result in less pain and higher knee function compared with supervised exercise alone. A substantial number of degenerative meniscal lesions respond well to conservative treatment, and the symptoms resolve spontaneously even if the lesions

do not heal. If improvement fails to occur within a few months (around 6 months), arthroscopic meniscectomy is suggested, especially if the symptoms are made not only of pain but also of clicking or locking suggesting an unstable meniscal tear (i.e., flap) (Figs. 1 and 5).

Which type of meniscectomy should be performed? As partial as possible, resecting the unstable part of the meniscus or more extended to resect the pathological meniscal tissue (meniscal disease)? However, there is no evidence-based answer at this time.

Whatever the type, one can expect a good result. According to Chatain et al. (2001) who reported the results of a large multicenter study conducted by the French Arthroscopy Society, poor results factors are presence of degenerative cartilage lesions (Odd Ratio 2.8), resection of the meniscal wall (Odd Ratio 2.2), and higher age >35 (Odd Ratio 5.0).

In the case of a parameniscal cyst, and when a meniscectomy is indicated, it is very important not only to treat the meniscal tear but also to evacuate the content of the cyst. It is therefore necessary to resect a sufficient amount of the meniscus until the meniscosynovial junction at least at the level of the cyst and to enlarge the opening of the cyst.

To do so, under arthroscopic control, a needle is introduced percutaneously through the cyst to locate the tract junction. Once the meniscus has been resected to the periphery (so-called saucerization), the tract can be enlarged using a forceps punch or a motorized shaver. Mucoid substance appears into the joint indicating the cyst is widely opened. It is then possible to abrade the wall of the cyst with a shaver. Open excision of the cyst, in conjunction with arthroscopic meniscectomy, is only needed in the case of a very large subcutaneous cyst.

Horizontal cleavage, especially grade 2 lesions, with or without parameniscal cyst, in young athletes is a specific group of injuries where meniscus preservation is mandatory.

Biedert (2000) was the first to propose repair in these cases. Rather than an arthroscopic repair, Pujol and Beaufils (2012) use an open technique which allows debriding the intrameniscal lesion, closing the horizontal cleavage, and putting vertical strong bioabsorbable stitches (Fig. 11).

Pujol and Beaufils (Pujol et al. 2013) reviewed 21 patients (24) after 40 months FU. IKDC score was between 87.9 (medial meniscus) and 90.7 (lateral meniscus). There were only four failures (19 %). Functional results deteriorate in patients older than 30 and in grade 3 meniscal lesions.

Root tears have been recently described (Ahn et al. 2010; Vyas and Harner 2012). Degenerate root tears specifically of the medial posterior horn must be differentiated from traumatic root tears which are rare and often associated with an ACL tear and a posterior root tear of the lateral meniscus. Degenerative meniscal root tears are often associated with a meniscal extrusion. In young patients, one should propose meniscal repair rather than meniscectomy: Transtibial root insertion allows to reconstruct the peripheral meniscal rim and insure a functional role to the meniscus (Ahn et al. 2010).

Macroscopic Osteoarthritis

If joint line narrowing is present, especially on the AP 30° flexion view, the diagnosis of osteoarthritis is obvious. Several studies have reported that the outcome of arthroscopic debridement and meniscectomy is roughly similar to the effect of placebo (Moseley et al. 2002; Siparsky et al. 2007). Moseley et al. (2002) randomly assigned 180 patients (mean age 52 years) with OA of the knee to undergo arthroscopic debridement, arthroscopic lavage, or placebo surgery. Patients in the placebo group received skin incisions and underwent a simulated debridement without insertion of the arthroscope. The mean follow-up was 24 months. Subjective results including pain and walking ability were not statistically different between the groups. Siparsky et al. (2007) performed a retrospective, evidence-based review of the current literature on the arthroscopic treatment of osteoarthritis of the knee. Of the 18 relevant studies, one was level I evidence (Moseley et al. 2002), five were level II, six were level III, and six were level IV. They found limited evidence-based research to support the use of arthroscopy as a treatment method for osteoarthritis of the knee. Arthroscopic

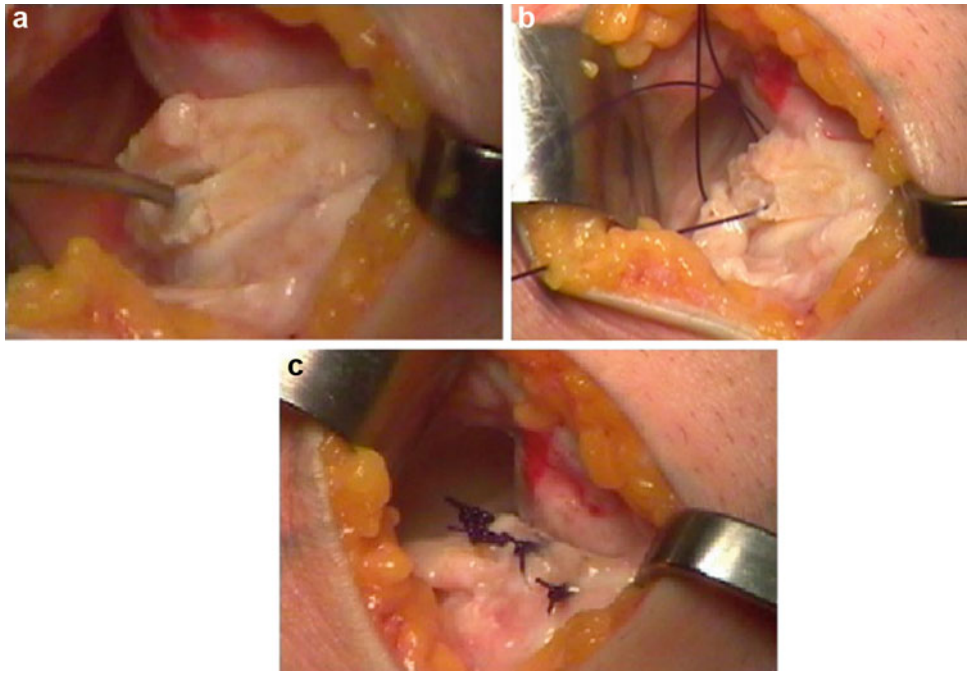

Fig. 11 Open meniscus repair of the medial meniscus (post segment) in young athletes. (**a**) After posterior arthrotomy and meniscosynovial junction release, the horizontal cleavage is clearly visible on the peripheral wall of the meniscus

debridement of meniscus tears and knees with low-grade osteoarthritis may be useful in some patients, but it should not be recommended as a routine treatment for all patients with knee osteoarthritis.

There is no need for arthroscopic debridement in these patients, with the rare exception of acute trauma to the osteoarthritic knee, which can result in an additional traumatic meniscal lesion, or symptoms of internal "derangement" (Pujol and Boisrenoult 2010).

If there is no evidence of joint line narrowing, but the MRI shows a meniscal extrusion or a subchondral bone abnormal signal, treatment should be focused on the cause of the disease, and meniscectomy is not routinely indicated. There is a high risk of postoperative problems such as rapid chondrolysis or subsequent osteonecrosis, especially if a meniscal root tear is debrided rather than repaired. Refraining from surgical treatment should always be considered in such case, except in the rare cases of "internal derangement" with evidence of unstable meniscal tears responsible for bone marrow edema (Fig. 5).

Conclusions

Meniscectomy, one of the most frequent orthopaedic procedures, may be performed too frequently. Meniscus preservation (benign neglect or repair) is probably too rare, even in the case of degenerative meniscal tears. It is not possible to exactly assess the rate of nonsurgical treatment (since many of these patients do not come to the surgeon) so that it is not possible to compare the respective parts of nonsurgical treatment, meniscectomy, or meniscus repair. But it can be assumed that the rate of partial meniscectomies should decrease and the rate of repair or conservative treatment should increase.

Based on a precise diagnosis, treatment principles become clear. And the above-mentioned algorithm can be easily utilized. In these degenerative lesions, waiting before surgical procedure is undertaken never a mistake, except in young athletic patients where early repair is probably necessary to avoid extension of the lesion and allow healing of the tear.

Cross-References

- Arthroscopic Repair of the Meniscus Tears
- Arthroscopic Treatment of Knee Osteoarthritis in Athletes
- Asymptomatic Meniscal Tears
- Meniscectomy

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