Meniscal Injuries of the Knee

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Overview

Meniscal tears remain a daily challenge in orthopedics as they are frequent injuries, and the incorrect treatment can lead to deleterious consequences for the knee joint. The tear can be either traumatic or degenerative. The former is frequent in the young active population and can occur in the context of ligamentous lesions. Degenerative lesions are detected more in older patients without a history of trauma and frequently in the context of cartilage degeneration. In the case of a complete traumatic injury and symptomatic patient, the surgical solution is recommended. In the case of degenerative lesions, a conservative treatment should always be tried before considering a surgical approach. Conservative treatment is based on muscular strengthening, weight loss, anti-inflammatory drugs, and eventual intra-articular infiltrations. If 6 months of conservative treatment is not effective in resolving the symptoms, the surgical option can be considered. When the surgical approach is chosen, the goal is always to preserve as much meniscal tissue as possible. It means the less tissue extirpation as possible and carrying out meniscal repair when it is indicated. Meniscal repair is indicated when the lesion is acute (within the first 4 months of the lesion), the meniscal tissue is not degenerated, and the lesion is in a vascularized portion of the meniscus.

51.1 Definition

Traumatic or degenerative lesions of the meniscus can be isolated or associated with other traumatic or degenerative lesions (e.g., traumatic lesions of the anterior cruciate ligament, degenerative lesions of the articular cartilage).

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51.2 Epidemiology

Meniscal ruptures are a very frequent injury in the young population. It affects 9 in 10,000 men and has a peak incidence between 31 and 40 years old. In women, the rate is 4.2 in 10,000, and there is peak incidence between 11 and 20 years old. Meniscal ruptures are most frequently found in the medial meniscus (74%) and on the dominant side (52%).

Degenerative lesions are even more frequent even though it is not possible to calculate an exact incidence since only a small percentage of them produce symptoms.

51.3 Pathogenesis

The menisci are important knee structures that are fundamental to increasing knee articular congruence due to the geometry of the femoral condyle and tibial plateau. Their role is to transform axial load into circumferential tension or hoop-stress to preserve articular cartilage viability and function. Both menisci move from the anterior area of the tibial plateau to the posterior area with knee flexion. However, they both move in different ways due to their distinct morphologies, insertion sites, and stability. The lateral meniscus transfers around 70% on the weight placed on the lateral compartment, while the medial meniscus transfers only around 50% of the weight. These weight transmissions can be as high as 85–90% in flexion. These basic biomechanical concepts may explain both the pathogenesis of a meniscal lesion and the consequence of meniscal extirpation.

Younger patients suffering a meniscal tear usually have a history of a weight-bearing, twisting, or hyperflexion injury. With these movements, shear forces are rapidly discharged on the meniscus, causing a lesion of the meniscus body or a detachment of its roots. The femur suffers rapid and exaggerated displacement over the tibia if a ligament lesion occurs, thereby increasing the possibility of a traumatic meniscal lesion.

The pathogenesis of the degenerative meniscal lesion is multifactorial and not yet fully understood. A genetic predisposition to collagen softening may play a role. Moreover, the pathogenesis is most often correlated with joint overload. It may be because of overweight, joint deformity, chronic ligament lesions, or a sport or work overload. Considering the biomechanical properties of the menisci, it is easy to understand how degenerative changes of the meniscus cause a decrease in cartilage protection by the menisci themselves. For this reason, a degenerative meniscal lesion is almost always associated with a certain degree of degeneration of the entire joint.

51.4 Classification

51.4.1 Etiological Classification of Meniscal Ruptures

Meniscal ruptures can be classified according to their etiology as either degenerative or traumatic.

Traumatic injuries can be associated with ligament and osteochondral injuries. Some 50% of these kinds of injuries take place while practicing sports like football or ski. They are mostly found in the least mobile meniscal areas. The posterior horn of the medial meniscus is a common site of injury. The rupture usually occurs in a healthy meniscus, meaning the tissue quality is neither pathologic nor degenerated.

On the contrary, degenerative injuries are usually found in degenerative knees with some degree of cartilage damage. In those cases, patients do not remember a clear trauma incident.

51.4.2 Meniscal Rupture Classification According to the Irrigation (Fig. 51.1)

Meniscal ruptures can also be classified according to the area in which they occur. Given that not all the areas in the meniscus receive the same blood supply, this is an important classification because it can determine the healing potential of

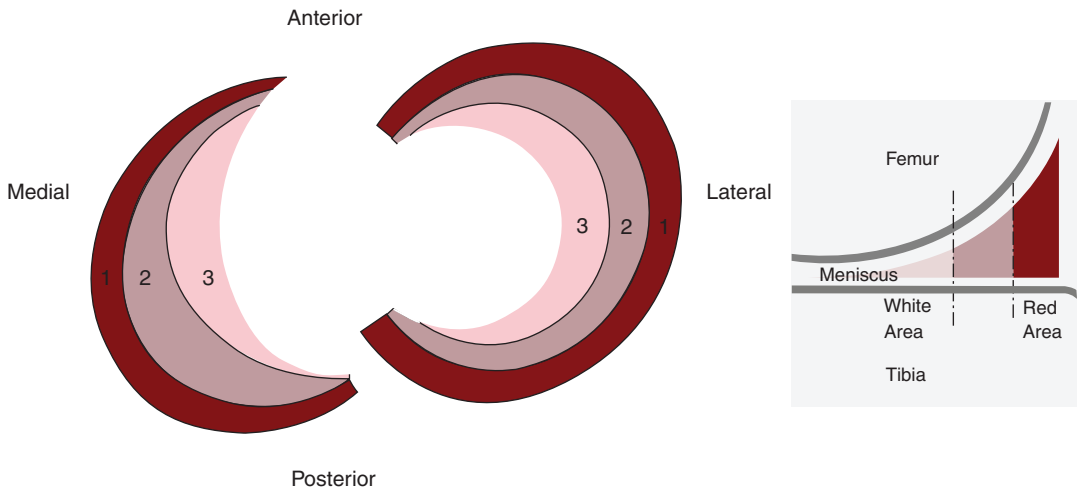

Fig. 51.1 Scheme of classification of meniscal lesions according to vascularization. Zone 1 (red), zone 2 (white-red), and zone 3 (white)

the rupture. Well-irrigated areas will heal better than those that are poorly irrigated. Therefore, three areas can be found in the meniscus:

1. The white area is the more central part of the meniscus, which is avascular. Therefore, white-on-white meniscal repair is not recommended because of the scarce potential for healing. For white-white lesions, meniscectomy is the treatment suggested.
2. The red-white area refers to the zone between the red and the white area. It has partial irrigation and thus a higher healing potential. Repairs in this area are least likely to lead to healing than in the red-to-red repair, but the repair is still recommended if the tissue quality is good.
3. The red area of the meniscus is the most peripheral and closest to the joint capsule. Therefore, it is the one that receives a better blood supply. Therefore, red-on-red repairs have the highest healing potential and the lowest risk of failure. As such, it is mandatory to try a meniscal repair on those lesions.

51.4.3 Morphological Classification of Meniscal Ruptures (Fig. 51.2)

Lastly, meniscal injuries can be classified according to rupture geometry. They can be oblique ruptures (or parrot beak), horizontal ruptures (or cleavage), vertical ruptures (longitudinal or radial), and complex ruptures (a combination of two or three of the other types, mostly found in degenerative joints). In lengthy vertical longitudinal ruptures, the central fragment can separate from the lateral one resulting in a so-called bucket handle tear. This mobile fragment can go in and out of place and cause knee locking. The mobile fragment is frequently found in the trochlear notch. Vertical radial ruptures result in a significant disruption of meniscus biomechanics and force transmission because they interrupt the circumferential meniscal fibers.

Meniscal root ruptures are a special kind of rupture which also cause an important disruption of meniscal biomechanics due to the interruption of the circumferential meniscus fibers. They can result in complete extrusion of the

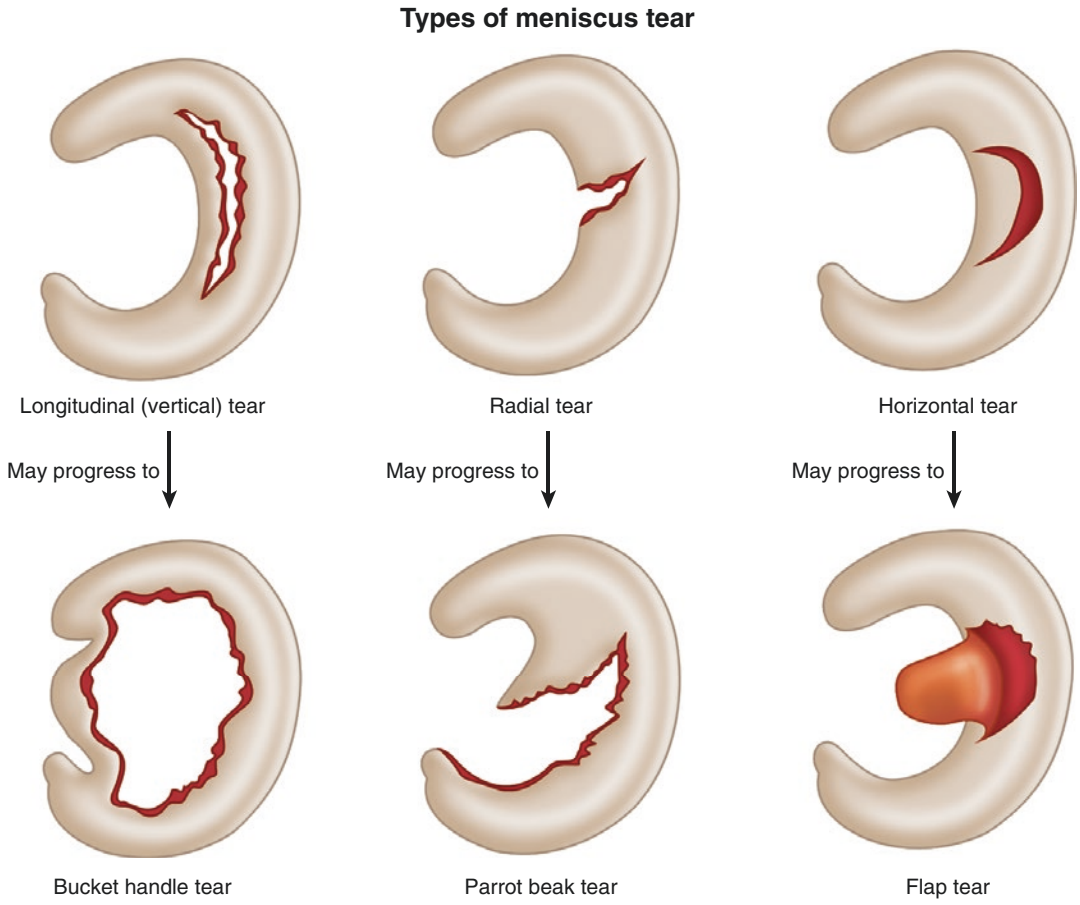

Fig. 51.2 Scheme of the classification of meniscal lesions according to morphology

menisci because of the absence of solid meniscal structure bone insertion. Meniscal extrusion is biomechanically equivalent to a complete meniscectomy and so has severe consequences on knee biomechanics. A posterolateral root lesion is usually associated with an ACL lesion with a rotatory mechanism. On the other hand, posteromedial root lesion is frequently observed in varus knee with mild degeneration in middle-age patients. The meniscal root tear is classified separately into five different types. They depend on the location and morphology of the lesion.

The most frequent location, injury mechanism, and type of patient in which each meniscal injury is found have been detailed in Table 51.1.

Table 51.1 The most frequent location, injury mechanism, and type of patient in which each meniscal injury is found

Type of meniscal rupture	Most frequent location	Injury mechanism	Type of patient
Vertical longitudinal tears (incomplete or complete depending on whether they involve part or the entire thickness of the meniscus)	Posterior horn of the medial meniscus because it is less mobile	Shearing forces	Young patients (usually associated with ACL ruptures)
Vertical radial tears	Area between the posterior horn and meniscal body	Axial load and rotation	Young patients (usually associated with a traumatic event)
Horizontal or cleavage ruptures	Start at the free edge and press towards the peripheral wall of the meniscus	Shearing forces	More frequent in degenerative knees and often associated with parameniscal cyst
Complex ruptures	Complex geometry and are most frequent in the posterior horn of both the medial and lateral meniscus		More frequent in degenerative knees (most frequent in patients over 40 years old)

51.5 Diagnosis

The diagnosis should include a clinical evaluation with a thorough physical examination and diagnostic imaging.

51.5.1 Medical History

Traumatic ruptures, which occur usually in younger patients, present with swelling and acute joint-line pain. Catching, "popping," or locking may also be present, suggesting a bucket handle tear that is displaced. The patients can always remember a precise trauma and complains about mechanical symptoms like pain during hyperflexion and twisting. On the other hand, degenerative meniscal tears, occurring in patients over 40 years old, usually present a history of mild swelling and joint-line pain without any clear trauma in their anamnesis. These ruptures are often associated with some degree of chondral degeneration. In this case, the patients always complain about both mechanical and inflammatory symptoms.

51.5.2 Physical Examination

Examination of the knee should begin with inspection of the skin and surrounding tissues. The knee should be examined for evidence of effusion. Range of motion (ROM) should be assessed and compared to the opposite side to evaluate possible mechanical locking. The ligamentous structures should be tested to determine whether concomitant ligament lesions are present. There are two specific clinical tests that have been described to assess meniscal lesions. The first is the McMurray test. To perform it, the examiner holds the knee with the patient supine and palpates the joint line with one hand. The thumb is on one side and fingers on the other, while the other hand holds the sole of the foot and acts to support the limb and provide the required movement through range. From a position of maximal flexion, extend the knee with internal rotation of the tibia and a varus stress. Then, return to maximal flexion and extend the knee with external rotation of the tibia and a valgus stress. With internal rotation of the tibia followed by extension, the examiner can test the entire

posterior horn to the middle segment of the meniscus. The anterior portion of the meniscus is not easily tested because the pressure to that part of the meniscus is not as great. The second specific test is the Apley grinding test. Here, the knee is flexed to 90 degrees with the patient in the prone position. The examiner holds the thigh fixed to the examining table with the examiner's knee. First off, the examiner rotates the tibia laterally and medially in combination with distraction while noting any excessive movement, restriction, or discomfort. Then, the process is then repeated using compression instead of distraction. If rotation plus distraction is more painful or shows increased rotation relative to the normal side, the lesion is most likely ligamentous. If rotation plus compression is more painful or shows decreased rotation relative to the normal side, the lesion is most likely a meniscus injury.

51.5.3 Diagnostic Imaging

51.5.3.1 Radiography

Standard knee radiographic films should include a PA weight-bearing view at 30° of flexion (Rosenberg view), a lateral view, a merchant or skyline view, and a weight-bearing long leg X-ray. These should be used to assess the alignment of the lower limb and osteoarthritic signs. The Rosenberg view assesses the posterior femoral condyles and will detect early osteoarthritic changes or joint collapse. The detection of joint degeneration or malalignment is important to detecting degenerative meniscal lesion and to directing towards a therapeutic choice.

51.5.3.2 Magnetic Resonance Imaging

MRI is a powerful tool in the assessment of knee pathology, but it should be analyzed in the context of the patient's history and examination. Some patients may show meniscal tears on MRI scans but are asymptomatic. It has been shown that 5.6% of the patients between 18 and 39 years of age with no knee complaints and a normal examination had a meniscus rupture on the MRI. The MRI can provide us with the precise location of the meniscal lesion and show us associated lesions (i.e., cartilage, ligaments). In a few cases, the MRI can miss small or peripheric meniscal lesions.

51.6 Treatment

51.6.1 Conservative Treatment

The conservative management of meniscus injuries includes symptomatic treatment with cryotherapy and NSAIDs as well as physiotherapy with muscle strengthening and working on maintaining adequate range of motion. Moreover, a loss of weight is suggested in cases of overweight, and a temporary correction of the alignment (braces, insoles) is useful in patients with varus or valgus knee. That has proven to be especially useful in patients with degenerative injuries. When considering treatment for degenerative meniscal tears, surgery should only be considered if the patient presents with knee locking and pain with rotation or with hyperflexion after a minimum of 6 months of conservative treatment. We can define these three as mechanical meniscal symptoms. Conservative treatment could also be employed for isolated traumatic lesions when they are incomplete or partial ruptures (<1 cm) and even in cases of meniscal root tears with intact meniscofemoral ligaments. In these cases, conservative treatment should include avoiding sports activity and deep knee flexion and symptomatic treatment.

51.6.2 Surgical Treatment

51.6.2.1 Meniscectomy

When removal of meniscal tissue (meniscectomy) is necessary, it must be limited to removing the unstable as well as highly degenerated tissue. Nowadays, the meniscectomy is performed arthroscopically through sharp forceps of different sizes and shapes (basket clamp). The arthroscopic shaver and radiofrequency are other

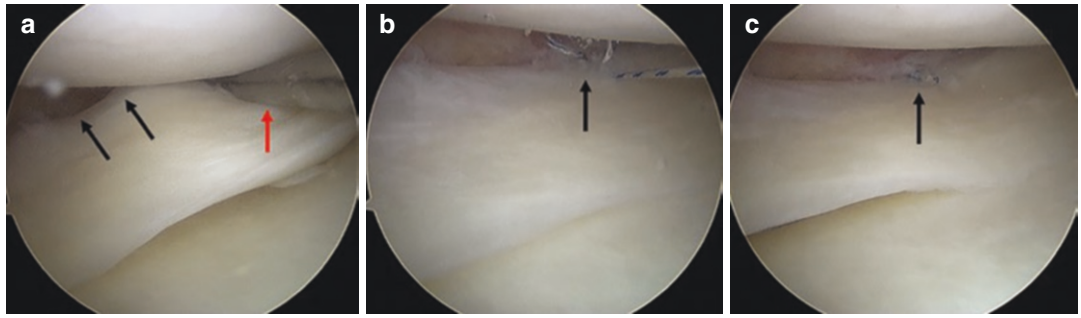

Fig. 51.3 (**a**) Longitudinal medial meniscal tear (showed by black arrows). A probe (red arrow) is evaluating the stability of the lesion and the quality of the tissue. (**b**) All-inside suture has been performed, the suture is retrieved, and the knot is pushed. (**c**) Vertical stitch completed

arthroscopic tools that can be used for a fine-tuning of the meniscal remnant once the unstable tissue is removed.

51.6.2.2 Meniscal Suture

There are different arthroscopic techniques and tools for meniscal suturing that are used, depending on the type and location of the lesion. In general, all-inside stitches are used for the posterior horn and for the posterior part of the meniscal body while the inside-out or outside-in suture is the preferred technique for the anterior part of the body and the anterior horn. The all-inside suture is so named because it allows to perform a suture without the need to pierce the patient's skin by using specific instruments and disposable implants through the arthroscopic portals. Implants penetrate the meniscus thanks to a needle and consist of a loop with a sliding knot. Through the needle, at the peripheral edge of the meniscus, we place a device made of rigid material, while the loop with its knot remains at the level of the articular surface of the meniscus. Once the suture is made, the knot can be tightened as needed and the suture cut with arthroscopic instruments. In the outside-in and inside-out techniques, needles and cannulas that allow the sutures to be passed in two different directions are used. They can be introduced, always under arthroscopic guidance, either through the skin towards the meniscus or from the meniscal surface towards the skin. In both techniques, there is a need for small cutaneous access points to retrieve and tighten the suture knots.

Regardless of the technique used, the sutures can be placed in three different ways according to the type of lesion being dealt with. They are vertical, horizontal, and crossed stitches (Fig. 51.3).

As regards the meniscal roots, special repair techniques must be used, given the anatomical peculiarity of this structure. It is necessary to place suture wires at the end of the root under repair with special arthroscopic instrumentation and then create a tunnel at the level of the anatomical insertion of the root itself. In this tunnel, the suture wires will be retrieved and passed through this tunnel in order to fix the root.

51.6.2.3 Meniscal Substitution

More recently, new treatments have been introduced to deal with postmeniscectomized painful knee. The aim is to replace the extirpated meniscal tissue in order to improve knee function and prevent progressive deterioration of the joint. The first possibility is to use meniscal implants that have been designed to replace partial meniscal defects. They serve as a scaffold for the ingrowths of new meniscal tissue, which eventually leads to a regeneration of the meniscal tissue lacking. The second possibility is to use meniscal allografts that are intended to replace a whole meniscus lost.

Take-Home Message

- Meniscal tears are frequent and can lead to biomechanical problems and consequently joint degeneration.
- Meniscal injuries can be caused by a knee trauma or developed because of joint degeneration.
- Meniscal lesion can be classified based on the pathogenesis (traumatic or degenerative), on the localization of the rupture (from red zone more vascularized to the white zone less vascularized), and on the morphology of the lesion (vertical, horizontal, oblique, root tear).
- A precise clinical evaluation and an MRI are enough for a correct diagnosis and to check the joint for associated lesions. An X-ray can be used to further investigate the joint status.
- Conservative treatment is suggested in cases of partial traumatic lesions or degenerative lesions.
- In cases of traumatic complete lesions or degenerative lesions associated with mechanical symptoms, a surgical approach is indicated.
- The surgical treatment aims to conserve as much meniscal tissue as possible. The meniscectomy should be restricted to unstable tissue. When the lesion is reparable, a meniscal suturing should be carried out.
- In case of symptomatic meniscal deficiency, meniscal substitution can be considered.

Summary

Meniscal tears can be roughly divided into traumatic and degenerative. Traumatic tears are common in young patients and are often associated with ligament injuries. The degenerative tears are found in older patients and are associated with joint degeneration. An MRI makes it possible to evaluate the location and type of lesion and evaluate any associated lesions at the same time. When joint degeneration is present, the surgical approach is not recommended. Therefore, a nonoperative approach is the best option. When faced with a traumatic tear or a degenerative tear with mechanical symptoms, the surgical approach should be considered. Unstable meniscal tissue located in a poorly vascularized area is suitable for removal. When the meniscal tear is in a well-vascularized area of the meniscus and the meniscal tissue is not degenerated, a suture is recommended. Independently of the technique of suturing chosen, the aim of a repair is to stabilize the meniscal rupture to allow for proper cicatrization.

Questions

Multiple correct answers are possible. Answers available in the book back matter.

1. Traumatic meniscal lesions are frequently associated with:
   (a) Genetic predisposition
   (b) Inflammatory diseases
   (c) Ligamentous knee lesions
   (d) Osteochondritis dissecans
2. Which is the initially recommended treatment for degenerative meniscal lesions?
   (a) Arthroscopy
   (b) Meniscectomy
   (c) Meniscal suture
   (d) Nonoperative treatment
3. Meniscal lesions may be classified by:
   (a) Morphology
   (b) The age of the patients
   (c) The shape of the meniscus
   (d) None of the above is correct
4. Which is not a meniscal suturing technique?
   (a) All-inside technique
   (b) Outside-in technique
   (c) Inside-out technique
   (d) Root repair technique
   (e) Single-stitch technique
5. Which meniscal area has the best chances of repair after a suture:
   (a) Red-white zone
   (b) Anterior meniscal root
   (c) Posterior meniscal root
   (d) Red-red zone

Further Reading

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