Meniscal Tears of the Knee

Diagnosis and Individualized Treatment

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IN BRIEF: Meniscal tears are very common sports injuries. Typical symptoms include pain, catching, and buckling. Signs on physical exam include joint-line tenderness, effusion, and, possibly, a click when the knee is taken through full range of motion. MRI is often needed to confirm tears and differentiate pain from that caused by other injuries such as articular cartilage damage. Treatment comprises physical therapy and rest, partial meniscectomy, or, in special instances, surgical repair. Therapeutic goals, which are often achieved, are to restore a high level of pain-free function and to prevent premature joint degeneration.

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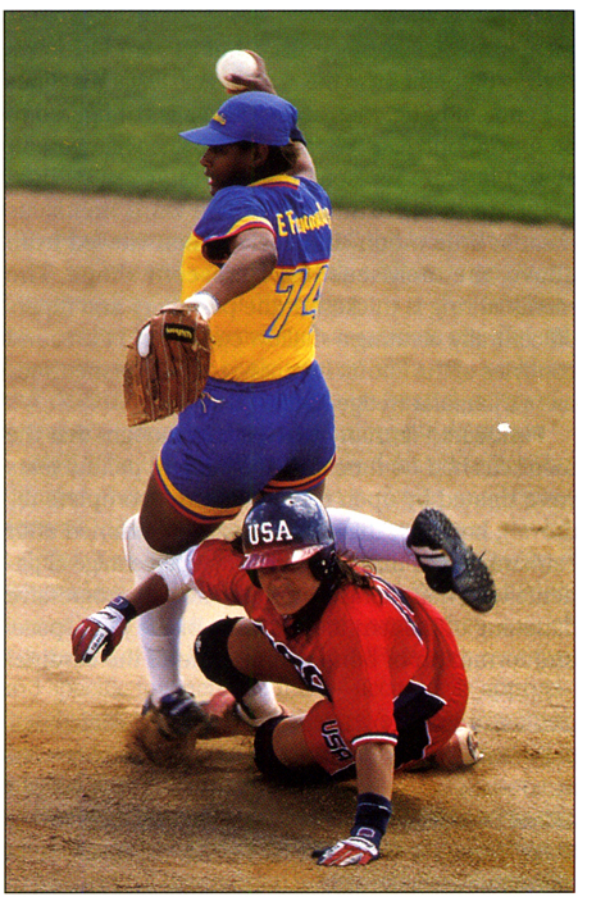

Knee meniscal tears are among the most common injuries seen in sports medicine. Twisting motions with the knee flexed, which are common in sports, place high stresses on the menisci. Many times the injury occurs when the athlete attempts a pivot; contact with another player typically does not occur, nor does lunging or landing awkwardly. A single "wrong step" is sufficient.

Meniscal tears among active patients are clinically significant on two counts. First, they cause pain, mechanical symptoms such as catching or locking, and effusion. Even if athletes can continue to play, they are rarely at top form with a tear. Second, healthy menisci are needed to prevent damage and degeneration of the joint. Thus, even if the patients are able to ignore symptoms, they should be dissuaded from doing so, especially if the tear is repairable.

Meniscus Anatomy and Function

Gross anatomy. The shape of the meniscus (figure 1) and its microanatomy are tailored to absorbing shock, distributing load, and stabilizing the joint.[1] The

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Figure 1: Mary Albury-Noyes

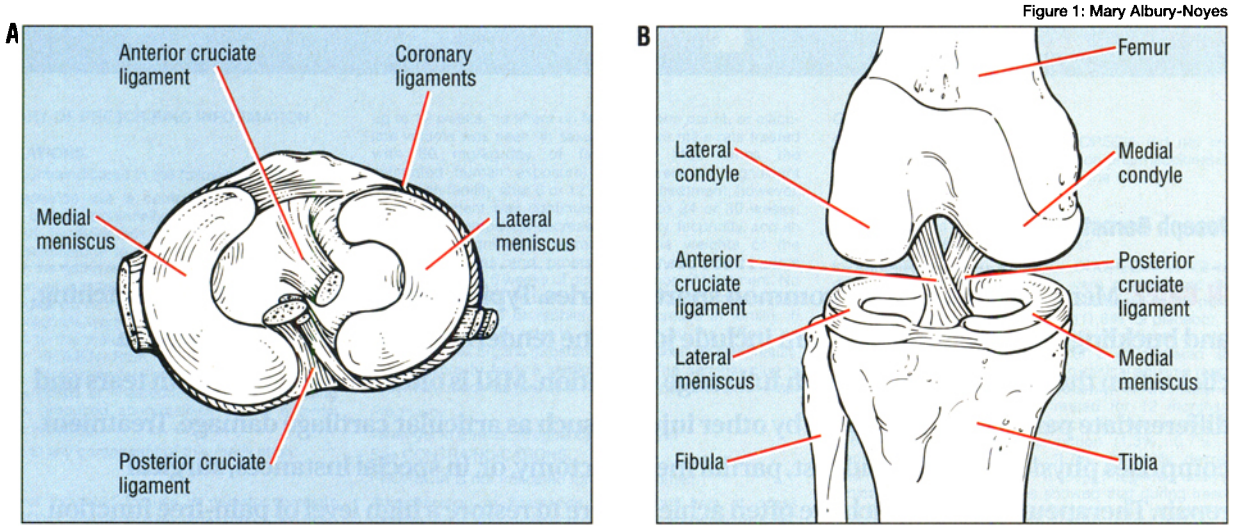

FIGURE 1. The gross anatomy of the knee menisci is shown in superior (A) and anteroposterior (B) views. The joint space shown in part B is exaggerated to illustrate ligament attachments and menisci.

meniscus consists of cartilage, but its composition is slightly different from the articular cartilage that lines the ends of bone. Meniscal cartilage is configured to be springy and resist shearing. Each knee has a medial and lateral meniscus that are attached by ligaments to the proximal tibia. The word meniscus means "little moon" in Greek—when viewed from above, the meniscus has a crescent shape. The meniscal ring is thickest at the periphery and tapers off centrally, creating a shallow cup to hold the round condyles of the femur. In cross-section, the meniscus has a triangular wedge shape.

Function. For many years, it was thought that the meniscus had no function. Accordingly, painful tears were treated by open meniscectomy (complete removal); however, this practice was abandoned after Fairbank[2] noted that x-rays in a large percentage of patients who had meniscectomies showed progressive flattening of the femur, narrowing of the joint space, and formation of bone spurs, some of the cardinal signs of osteoarthritis. These radiographic findings after meniscectomy are now known as Fairbank's changes.[2]

The menisci play important roles in the biomechanics of the knee.[3] The tapered-ring geometry of the meniscus promotes the "mating" of the rounded edge of the femur and the flat edge of the tibia. Without a meniscus, weight transmitted by the femur would concentrate on a single contact point on the tibia, under high pressure. (Pressure is defined as force divided by area; thus, a constant force on a smaller area creates higher pressure.) The meniscus allows the femur to rest effectively on nearly the entire tibial plateau, distributing the force and preventing excess stress on any single area. In addition, the meniscus functions as a shock absorber, dampening the forces that the femur may apply to the tibia under high-load activities such as jumping or running.

The meniscus also helps the anterior cruciate ligament (ACL) to stabilize the knee. Just as a block placed behind the wheel of a car prevents it from rolling, the body of the meniscus prevents the femur from gliding too far off the tibia. The posterior oblique ligament on the medial side of the knee tethers the posterior horn of the meniscus to ensure that this stabilizing wedge is kept in place. Patients who tear the posterior meniscal horn may feel instability—even if their cruciate ligament is intact—because this stabilizing effect is lost.[4]

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Bloody fluid in the knee is often associated with a significant orthopedic injury and should be referred to an orthopedic surgeon. Blood in the fluid may actually be an optimistic sign; it may indicate that the meniscus is repairable.

Differing Presentations

Tears of the menisci occur in two distinct settings. The first occurs when a healthy meniscus is traumatized and is characteristic of the young athlete. The mechanism of injury is commonly a twisting motion with the knee bent, and such tears can be found either within the body of the meniscus or at the junction of the meniscus and the inner lining of the knee, an area known as the joint capsule. When a large piece of the meniscus tears from the capsule, it can flip over within the joint creating a so-called a "bucket-handle" tear: attached at two ends, with the middle flipped upward in the center. The movable flap of meniscus can block motion and is one of the rare causes of a truly "locked" knee.

A different injury is seen in older patients. Because the tissue is no longer as strong or resilient, less force is needed to tear the meniscus. Accordingly, the older patient may not even recall when the injury occurred. Rather, the symptoms may appear gradually. Finally, since a degenerative tear cannot be repaired in the older patient, the urgency for treatment is much lower than that required when treating a bucket-handle tear in a young person, in which the objective is to prevent damage to potentially repairable tissue.

Diagnosing Tears

History and physical. Diagnosis of meniscal tears can often be made clinically (table 1). In the young athlete, there is usually a history of twisting injury that prevented continuation of play. An older athlete may note a more gradual onset of symptoms. If no other structures were damaged, pain localizes at the joint line and worsens with hyperflexion. In the early course, patients may limp as they find full weight bearing too painful. An effusion is common but may be absent if the tear occurs as an isolated injury.

Specific tests. An aspiration may help identify the underlying cause of the effusion. Blood in the knee is an ominous sign: Since the meniscus itself is avascular, hemarthrosis should not be attributed to a meniscal tear. Rather, the physician should assume that other structures in addition to the meniscus (such as the ACL) may have been injured.[5] The lone exception to this rule is when the meniscus is torn from the capsule, a vascularized structure. Such an injury will produce blood in the joint. The presence of blood in this situation is a significant finding, but for beneficial reasons; it implies that the meniscus may be repairable. Accordingly, all patients with a bloody effusion after trauma should be referred to an orthopedic surgeon.

Special diagnostic maneuvers exist for identifying meniscal tears on physical examination, but they are not particularly sensitive. For example, the McMurray test, which attempts to detect a click as a torn meniscus is moved with knee extension, will miss at least 40% of all meniscal tears.[6,7] Thus, the best diagnostic steps are general ones: Establish a history consistent with the injury, localize the symptoms to the joint line, and exclude other injuries such as cruciate or collateral ligament tears. If the clinician suspects a meniscal tear and determines that it needs to be treated, magnetic resonance imaging (MRI) can confirm the diagnosis.

MRI. The use of MRI is a hotly debated topic. The clinician should be aware of the strengths and limitations of MRI, and use it when the technique can be helpful. The advantages of MRI are that it involves minimal risk to the patient (since no ionizing radiation is used) and that it paints a fairly accurate picture of soft tissues of the knee (figure 2). MRI is both sensitive and specific for meniscal tears—accuracy is approximately 90%.[8] Finally, MRI may reveal abnormalities that were not suspected on the clinical exam and thus may influence treatment.

One disadvantage of MRI is its high cost. In addition, patients may insist on treatment for a lesion discovered on MRI, even if the clinician is certain that such a lesion

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TABLE 1. Primary Care Diagnosis and Management of Suspected Meniscal Tears

Task	How	Why
Localize the symptoms to the joint line	• Palpate the joint line • Ask the patient to squat • Stress the collaterals	Although not a specific finding, a meniscal tear is almost always associated with joint-line signs and symptoms
Determine if there is a bloody effusion	Have the patient lie supine, compress the area above the patella with your hand closest the patient's head, and hold your other hand just below and alongside the patella. If an effusion is present, a fluid wave will move to the distal hand; aspirate this fluid with a 16-gauge needle.	Bloody effusions, in the absence of overt fracture, are associated with ACL disruption, patellar dislocation, osteochondral fracture, and red-zone meniscal tear. All need orthopedic care.
Rule out other injury (especially those associated with twisting)	• Test the ACL (Lachman test), MCL (valgus stress), and patellar stability (patellar apprehension test—if the patient remains calm as the examiner attempts to push the patella laterally, the test is negative) • Obtain x-rays	• Other injuries, with or without a meniscus tear, are possible • Do not miss a fracture
Determine if there is pre-existing arthritis	Obtain weight-bearing x-rays	If the patient has arthritis, it, rather than the meniscal tear, may be the cause of symptoms; results of arthroscopic surgery on the meniscus are much worse when arthritis is present
Assess whether the tear is repairable	• Assume that all patients younger than age 35 have potentially repairable tears • Tears associated with locking or bloody effusions may be repairable	Repairable tears should be fixed to prevent arthritis
Unless signs warrant orthopedic consultation, begin a program of physical therapy (anti-inflammatory drugs may be added)	Regimen should include range-of-motion exercises and gentle hamstring and quadriceps strengthening	Prevents atrophy while awaiting symptomatic recovery
Reassess	Unless the patient is referred to an orthopedic surgeon, reassess at least once a month to ensure that symptoms are improving and to continue to rule out other injury	Pain and swelling at the time of injury may cause guarding and thus compromise the accuracy of the physical exam

ACL= anterior cruciate ligament; MCL= medial collateral ligament

is not the source of the patient's symptoms. Although MRI is very helpful for discovering abnormalities,[9] it cannot differentiate lesions responsible for the patient's symptoms from incidental lesions. As such, MRI is not always helpful for determining a treatment plan.

The important clinical factors to consider in management include the severity and location of symptoms, the patient's preferences, and the overall impact of the tear on the function of the patient's knee. None of these is reflected on the MRI. As such, MRI cannot replace the history and physical and does not supplant medical judgment.

Figures 2-4: Courtesy of Joseph Bernstein, MD, MS

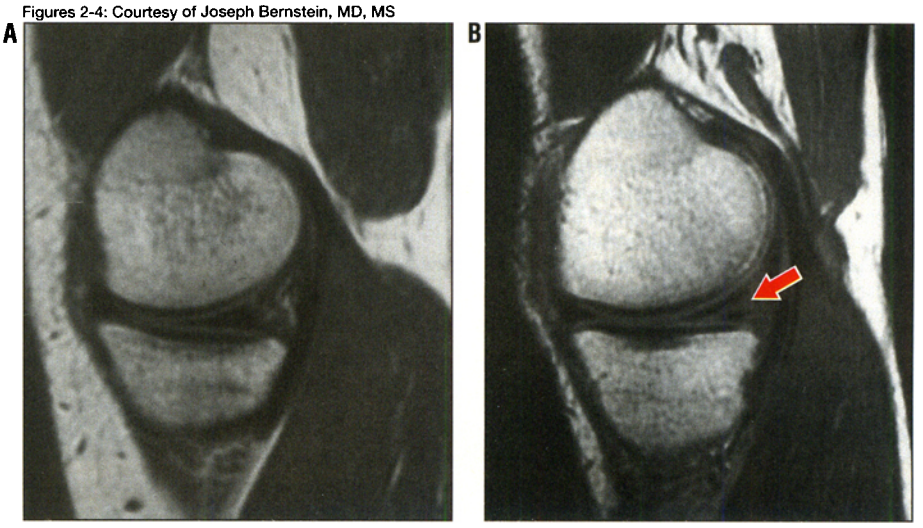

FIGURE 2. MRI of a normal (A) and torn (B) meniscus. The normal meniscus appears as a solid black wedge. The tear appears as a white line (arrow) through the body of the meniscus.

Clearly, an MRI is not necessary for all patients. Consider, for example, an athlete who has a locked knee after a twisting injury, medial joint-line tenderness, and bloody effusion. These findings strongly suggest a bucket-handle tear of the medial meniscus. This tear needs to be reduced and repaired, if possible. Urgent arthroscopy, without MRI, is warranted. On the other hand, if the patient had known osteoarthritis and was not, accordingly, a good candidate for arthroscopy, using MRI for diagnosing a tear is unnecessary because it would not influence the immediate treatment plan.

Radiographs. Omitting an MRI does not mean that all imaging studies should be skipped. Athletes who have had an injury and cannot fully bear weight or have tenderness along the tibia, femur, or patella should be sent for plain radiographs to rule out a fracture. Because x-rays show only bone, plain radiographs cannot detect a meniscal tear; however, they can often exclude other problems such as a fracture or an osteochondral defect. In addition, weight-bearing x-rays can help detect degenerative arthritis, a finding that may affect treatment.

Treatment Options

Nonoperative therapy. Current treatment for meniscal tears can be grouped into three categories (table 2): nonoperative, partial meniscectomy, and meniscal repair. Nonoperative treatment includes the use of anti-inflammatory medications as well as physical therapy to prevent quadriceps weakness, stiffness, and other consequences of disuse. Conservative treatment is appropriate even when there is a documented meniscal tear as long as the tear is not repairable and the patient is willing to wait and monitor symptom progression. In older patients, symptoms may simply abate with time. In Europe, where some national health insurance plans require a long wait for surgery, many patients cancel their operations because they have recovered sufficiently.[10,11]

Small tears are especially good candidates for nonoperative therapy.[12] If the tear is small and peripheral, it may heal without intervention.[13] The risk of neglecting a tear is that a second, perhaps trivial, injury may lengthen the original tear. This risk, however, is small. Nonoperative treatment should always include an exercise program as well as physical therapy to prevent muscle atrophy. There is no formal role for knee braces, but some patients report a subjective improvement wearing a wrap or sleeve, perhaps because of the retained body warmth or increased proprioception from skin stimulation.

Nonoperative treatment also can produce complications. The patient's function may deteriorate until the meniscus is removed. Muscles may atrophy from disuse, and the meniscal fragment can detach and block knee motion or injure the adjacent articular cartilage. Blocked motion, especially if it persists after the

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TABLE 2. Comparison of Treatment Options for Meniscal Tears

Treatment	Advantages	Disadvantages	Comments
Nonoperative	• Surgery and its risks are avoided • Small peripheral tears may heal on their own • Preferable in patients whose chief complaints are caused by arthritis, rather than a meniscal tear	• May not relieve all symptoms, especially catching and clicking • Potentially repairable tear may become irrepairable	• Does not mean no therapy • Requires an exercise program and some physical therapy to prevent quadriceps weakness
Partial meniscectomy	• Often relieves symptoms very well • Rapid return to joint function • Yields poor results if articular cartilage is already damaged	Meniscal tissue is lost, creating some risk for degeneration	Only for patients who are sufficiently bothered by their tear, and for whom meniscal repair is not possible
Meniscal repair	• Provides reliable short-term relief from pain • Helps long-term preservation of joint	• Not all tears are repairable • The risk of complications is higher than for simple meniscectomy • Longer recovery than for meniscectomy	This surgery is not as simple as a meniscectomy and should be performed by a sports medicine specialist
Open meniscectomy	None	Excessive dissection, causing a slower functional recovery	Rare now, but physicians may see patients who had this surgery years ago; arthritis likely

pain improves, indicates a need for specialist referral. Finally, a potentially repairable tear can be pulverized by the articular surfaces and become irrepairable.

Partial meniscectomy. Typically, meniscectomies are performed arthroscopically, as are most repairs (figures 3 and 4). This minimally invasive approach lessens the disruption of normal tissue and allows for rapid rehabilitation. Arthroscopy leads to less postoperative swelling, faster achievement of full flexion, quicker return to work and sports, and lower hospital costs compared with open surgery.[14,15] Meniscectomy reliably treats the acute symptoms of the tear.[16] In the absence of a second intra-articular problem, excellent results are the norm.[17-19] Still, most patients will need supervised postoperative physical therapy to regain full muscle strength.[20,21]

One disadvantage of partial meniscectomy relative to repair is that it eliminates some of the benefits provided by the cartilage in that area; eg, arthroscopic partial meniscectomy may lead to Fairbank's changes if a large fragment is removed.[22] Repairable tears should thus be fixed and not removed. Also, meniscectomy is not appropriate in all patients: If there is extensive articular damage, simply removing the meniscus will not revitalize the joint.[23-25]

Meniscal repair. Meniscal repair, on the other hand, may prevent Fairbank's changes.[26] In this surgery, the torn edges of the meniscus are sutured to preserve the form and function of the cartilage. Short-term follow-up shows that approximately 90% of sutured peripheral meniscal tears do, in fact, heal.[27,28] Better still, some evidence suggests that repaired menisci can prevent articular degeneration.[29]

In one 10-year study[30] of 50 arthroscopically repaired meniscal tears, only 8% of surgically treated knees had minimal joint changes, as compared with

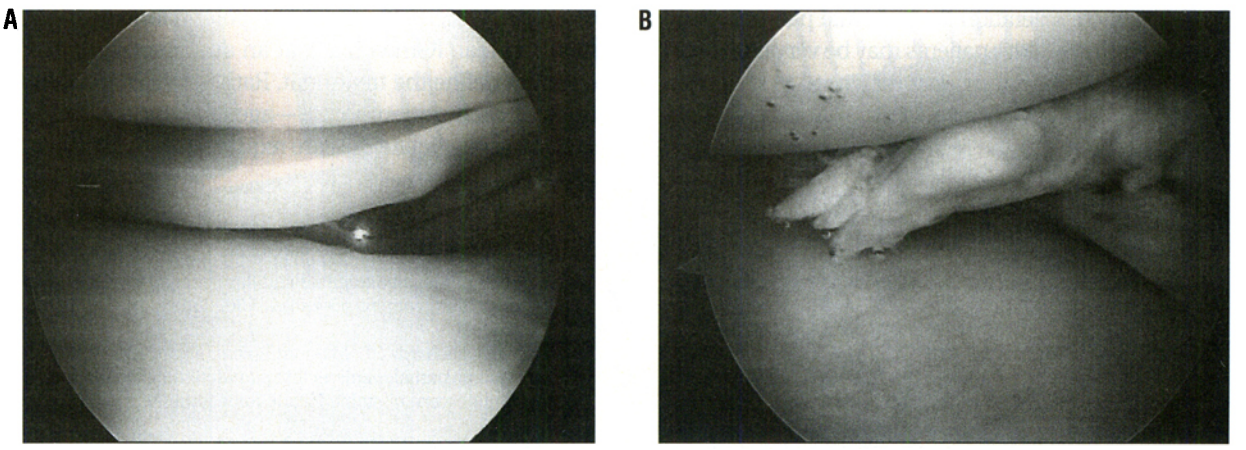

FIGURE 3. Arthroscopy reveals a normal (A) and torn meniscus (B). A probe is visible on the right in part A; it is unable to displace an intact meniscus. The jagged edge of the tear is easily seen in the knee in part B.

3% in the uninjured knee. This finding represents a dramatic improvement over that noted by Fairbank[2] and suggests that the repaired cartilage can prevent degenerative changes. This potential benefit prompts some surgeons to advocate attempted repair of even those tears that have a fairly low chance of healing.[31]

Not all patients are candidates for meniscal repair.[32] Sometimes the tissue is too damaged to save. Also, since the meniscus itself is avascular, only tears at the periphery of the meniscus, adjacent to the synovial blood supply and capsule, are likely to heal. This region near the capsule is called the "red zone" because of its proximity to the capillaries of the synovium. The more central area is called the "white zone." It may be possible to repair a tear in the white zone under special circumstances. For instance, if a repair were undertaken at the same time as a ligament reconstruction, a white-zone tear may heal.[33] It is thought that the intra-articular bleeding caused by drilling tunnels for ligament reconstruction provides the biological factors that can stimulate healing. When the tear is not quite in the red zone and no ligament surgery is done, creating vascular channels or placing a fibrin clot in the tear may increase the healing potential.[34-36]

Rehabilitation and Education

If none of the signs that warrant orthopedic consultation are present, the primary care physician should recommend a program of physical therapy

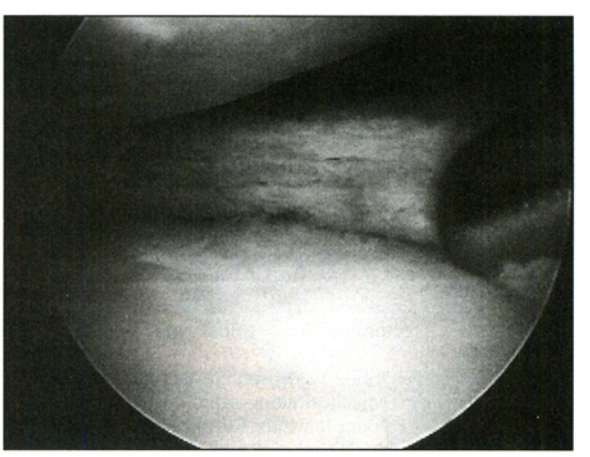

FIGURE 4. An arthroscopic view of a meniscus shown after partial meniscectomy. The suction shaver is seen on the right.

and perhaps medication for pain such as an anti-inflammatory drug or acetaminophen. Relative rest, but not complete inactivity, may also be helpful. It is also important to reassess the patient after a few days. At this point, the acute pain should have subsided, and a more accurate physical examination will be possible. Rehabilitative exercises, including stretching, flexion and extension strengthening, and stamina building can speed the patient's return to function, both as a primary treatment modality and as part of the postoperative regimen.

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The final consideration is to educate patients about their injury. Some older patients may be very hampered initially by their symptoms, but they need to know that recovery is possible without surgery. On the other hand, a young athlete may be inclined to persevere despite the injury, which may damage a potentially repairable meniscal tear. Remember that an anatomic diagnosis does not define the treatment. Rather, the unique features of each patient's case—age, activity, symptom severity, etc—dictate the care required. **PSM**

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