CHAPTER 49

Meniscus: Diagnosis and Decision Making

MARC R. SAFRAN AND GABRIEL SOTO

Our understanding of the meniscus and its function has grown from thinking that it is an embryologic or useless remnant of leg muscle to knowing that it is an important structure critical to the function and health of the knee.[4] Injury to the meniscus commonly occurs as a result of athletic activities and activities of daily living. Injury to the meniscus may occur in isolation or in combination with other knee injuries, particularly ligament injuries. Arthroscopic meniscal surgery is one of the most commonly performed surgeries in the United States.

Anatomy and Biomechanics

The meniscus is a semicircular fibrocartilaginous structure with bony attachments at its anterior and posterior aspects to the tibial plateau (Fig. 49–1). The medial meniscus is C-shaped. In addition to its bony attachments, the medial meniscus has a capsular attachment, known as the coronary ligament. A thickening of the capsular attachment at its midportion from the tibia to the femur is known as the deep medial collateral ligament. The lateral meniscus is more semicircular and covers a larger portion of the tibial plateau compared with its medial counterpart. The meniscus is thick at its periphery and thin centrally. Discoid variants of the lateral meniscus occur in up to 5% of cases and cover much of the lateral tibial plateau (Fig. 49–2).[38] The popliteal tendon runs posterolateral to the posterior insertion of the lateral meniscus, in an area called the popliteal hiatus. In addition to its bony attachments, the lateral meniscus is attached to the capsule except at the area of the popliteal hiatus.[34] Its capsular attachments are less well developed compared with the medial side, allowing for more motion of the meniscus with knee flexion-extension (Fig. 49–3).[37]

The menisci are composed of coarse collagen bundles that run mainly circumferentially, with binding fibers that run radially (Fig. 49–4).[3] This allows the meniscus to disperse compressive loads (hoop stresses). Sixty percent to 70% of the meniscus is composed of collagen, primarily type I collagen. At birth, the entire meniscus is vascular; however, by 10 years of age, only the peripheral 10% to 25% of the lateral meniscus and 10% to 30% of the medial meniscus has a blood supply, which is how it remains through adulthood (Fig. 49–5).[19] The blood supply comes from the geniculates through a perimeniscal capillary plexus.[1] Owing to its lack of capsular attachment, the lateral meniscus at the popliteal hiatus is relatively avascular. Nutrition of the inner 66% of the meniscus is through diffusion or mechanical pumping; the outer meniscus receives nutrition through its blood supply.[23] Neural elements are present in the outer portion of the meniscus, at the capsular junction and the insertional horns.

The menisci are important in many aspects of knee function, including load sharing, shock absorption, reduction of joint contact stresses, increase in joint congruity and contact area, articular cartilage nutrition, passive or secondary stabilization, limitation of extreme flexion and extension, and possibly proprioception.[2,13,18,23,28,33]

Historical Aspects

The meniscus was once thought to be a functionless remnant of intra-articular knee muscle and was routinely removed. Although Fairbank[12] published a paper in 1948 suggesting that the meniscus was important based on postmeniscectomy radiographs, it was not until the mid-1970s that retention of the meniscus began to be discussed. The annual incidence of meniscal tears is 60 to 70 per 100,000 general population.[14,26] Meniscal tears are more common in males (2.5 to 4:1), with a peak incidence between 21 and 30 years of age in males and 11

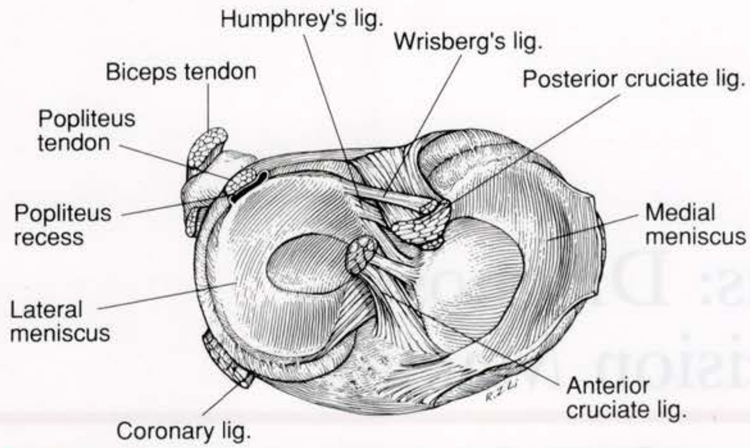

Figure 49–1 **View of the tibial plateau from above. Note the degree of coverage of the medial and lateral tibial plateau due to the different shapes of the medial and lateral menisci.** (From Tria AJ Jr, Klein KS: An Illustrated Guide to the Knee. New York, Churchill Livingstone, 1992.)

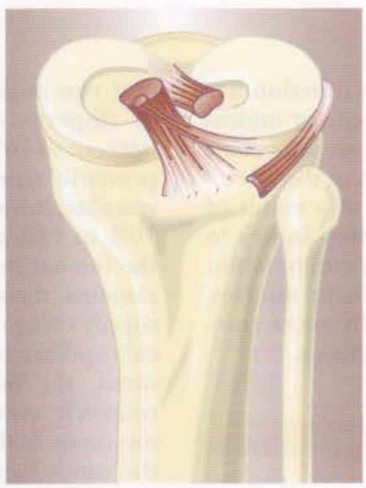

Figure 49–2 **Schematic representation of discoid lateral meniscus, covering most of the lateral tibial plateau.** (From Fu F, Harner C: Knee Surgery. Philadelphia, Lippincott, Williams & Wilkins, 1994.)

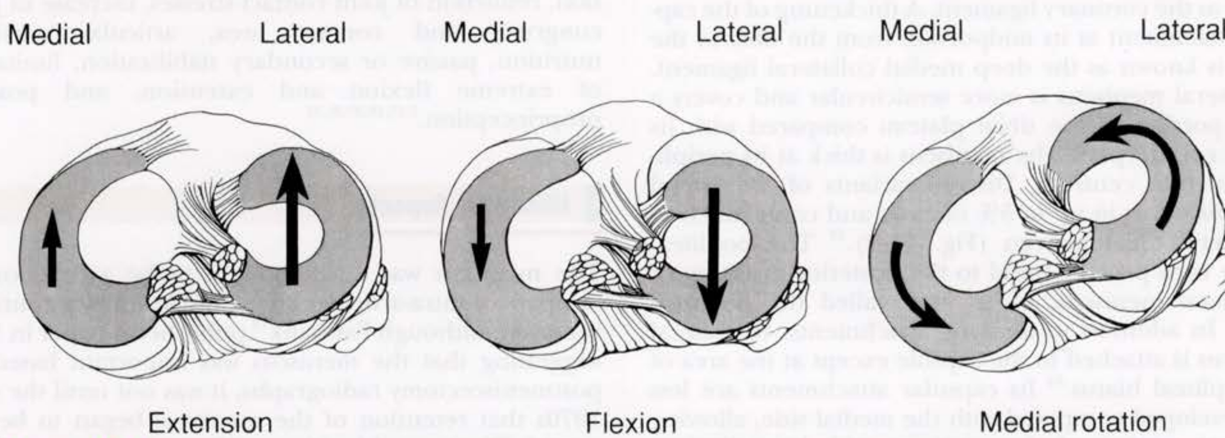

Figure 49–3 **Kinematics of the different menisci with knee flexion, extension, and rotation. Note that even though the lateral meniscus and lateral tibial plateau have a smaller anteroposterior width, the lateral meniscus moves more than the medial meniscus through each range of motion.** (From Tria AJ Jr, Klein KS: An Illustrated Guide to the Knee. New York, Churchill Livingstone, 1992.)

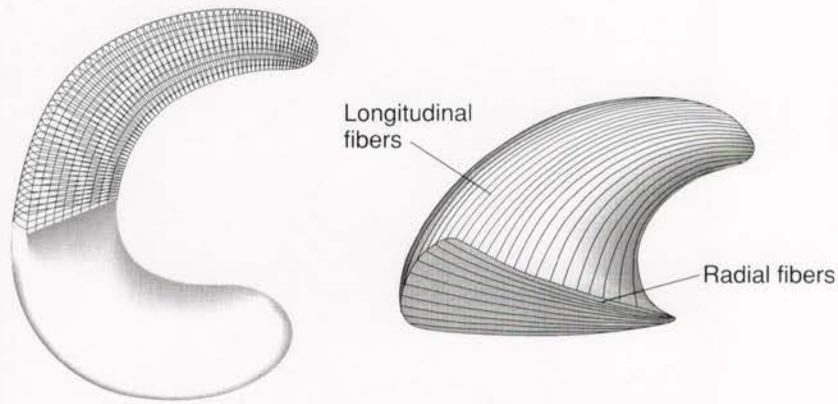

Figure 49–4 **Drawing of the meniscus showing most of the collagen fibers aligned longitudinally, with some fibers radially oriented to hold the longitudinal fibers together. These longitudinally oriented fibers allow for dissipation of compressive forces via hoop stresses.** (From Tria AJ Jr, Klein KS: An Illustrated Guide to the Knee. New York, Churchill Livingstone, 1992.)

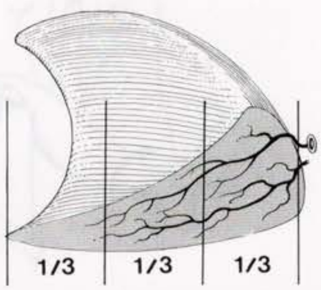

Figure 49–5 **Blood supply within the meniscus.** (From Tria AJ Jr, Klein KS: An Illustrated Guide to the Knee. New York, Churchill Livingstone, 1992.)

and 20 years in females.[27] Degenerative meniscal tears commonly occur after the third decade in men.

Mechanism of Injury

In older patients, tears may occur with activities of daily living, including squatting and deep knee flexion. Younger patients usually sustain a twisting, cutting, or hyperflexion injury, or they suffer a meniscal injury in conjunction with an anterior cruciate ligament (ACL) tear or tibial plateau fracture.

Clinical Evaluation

The diagnosis of meniscal tear can be made from a careful history, physical examination, and appropriate diagnostic tests.

History

The onset of symptoms and mechanism of injury are often clues to the diagnosis. With an injury mechanism as described earlier, there may be an acute onset of pain and swelling. Complaints of locking or catching may be present, but these may be due to other pathology. Loss of motion with mechanical block to extension may be due to a displaced bucket handle tear. Degenerative tears tend to occur in patients older than 40 years, frequently with an atraumatic, chronic history of mild joint swelling, joint line pain, and mechanical symptoms.

Physical Examination

Inspection should be performed to assess for effusion (present in 51% to 74% of cases; positive predictive value, 50%), quadriceps muscle atrophy, and any joint line swelling that may occur with a meniscal cyst. Range of motion must be assessed to determine whether there is a mechanical block to extension. A complete ligamentous examination and patellofemoral evaluation are important to rule out concomitant pathology or other sources of knee pain. Numerous tests have been described to evaluate the meniscus for tears, including joint line tenderness (sensitivity, 61% to 86%; specificity, 29%)[41]; pain on forced flexion (sensitivity, 50%; specificity, 68%); McMurray test (sensitivity, 16% to 59%; specificity, 93 to 98%; positive predictive value, 83%), which is enhanced when seen with loss of extension (sensitivity, 85%; specificity, 95%); Apley grind test; and others (Fig. 49–6).[7,11,20]

It has been shown that no single predictive test can make the diagnosis of meniscal tear. It has also been shown that concurrent ACL injury negatively impacts the accuracy of physical findings for meniscal pathology.[32] Most investigators have found that a composite of physical examination findings is more accurate at predicting meniscal pathology than any single test is.[35,36]

Imaging

Although plain radiographs do not show meniscal tears, they are important in any knee evaluation to assess for bony pathology and to look for joint space narrowing. A radiographic series consists of a flexion weight-bearing posteroanterior (Rosenberg) view (which is most sensitive for evaluating joint space narrowing, as this occurs in 30 to 45 degrees of flexion), a true lateral view, and a tangential patellofemoral radiograph.[30] Fairbank's changes—flattening of the medial femoral condyle, joint space narrowing, and osteophyte formation—are

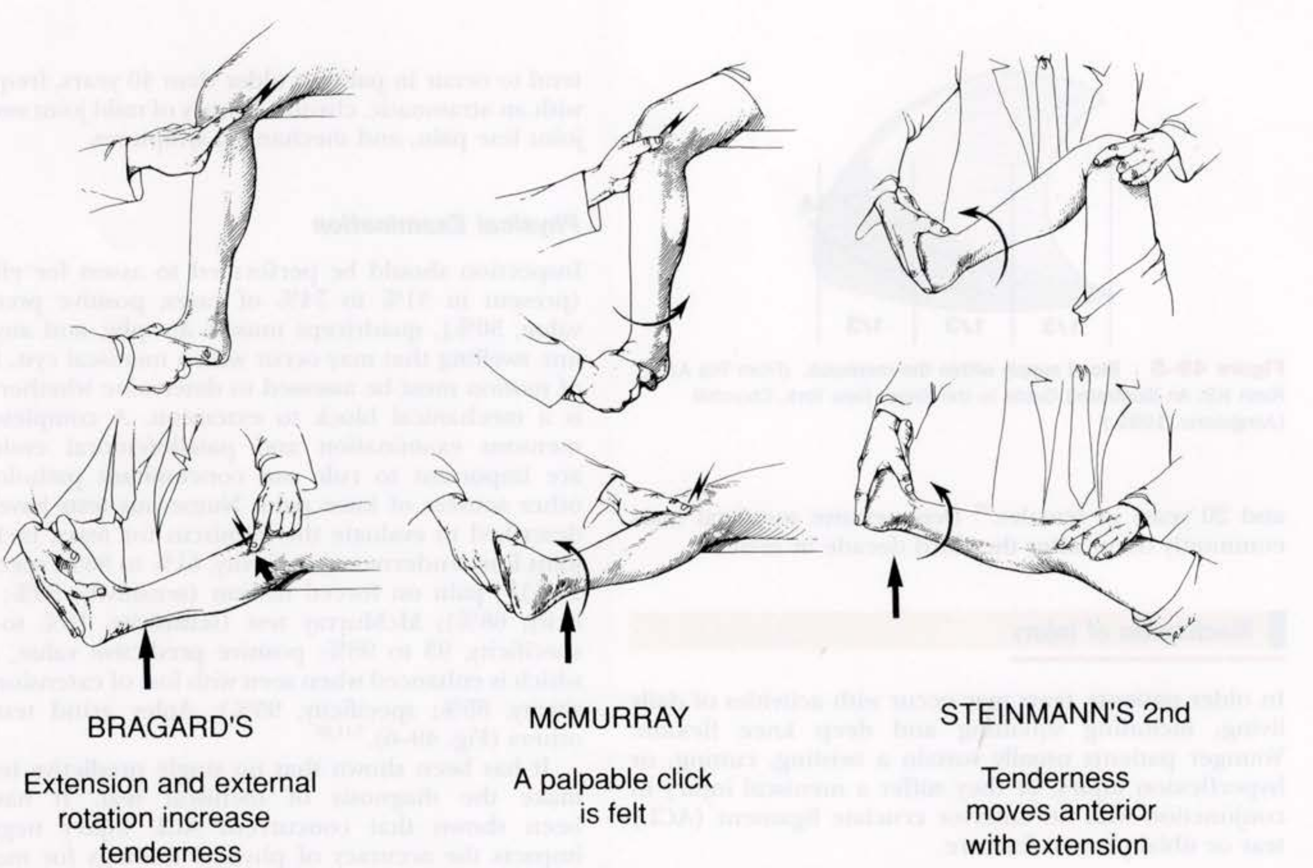

Figure 49–6 **Various physical examination tests to evaluate the meniscus.** (From Tria AJ Jr, Klein KS: An Illustrated Guide to the Knee. New York, Churchill Livingstone, 1992.)

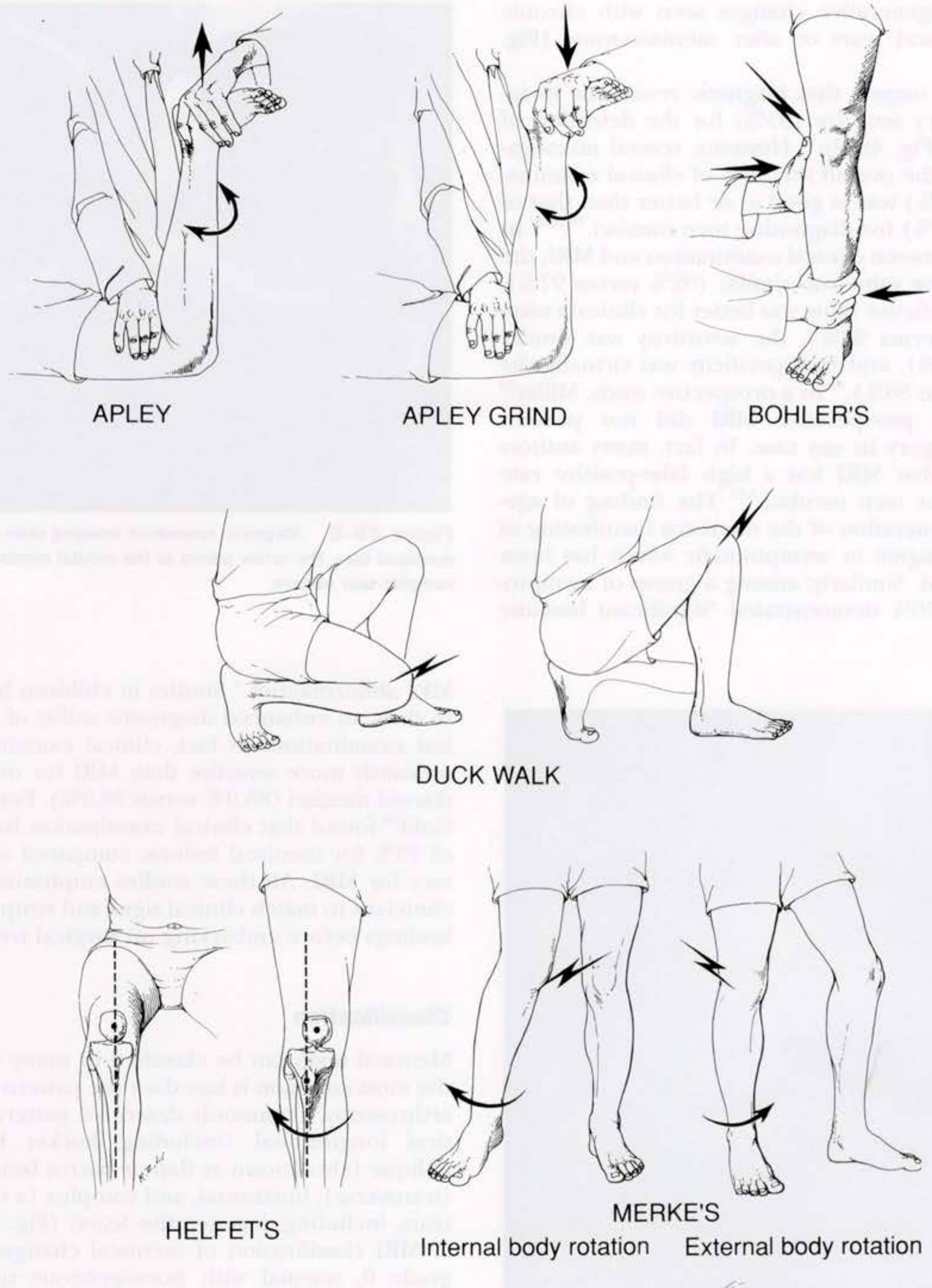

Figure 49-6, cont'd

indicative of degenerative changes seen with chronic untreated meniscal tears or after meniscectomy (Fig. 49–7).

Many studies suggest that magnetic resonance imaging (MRI) is very sensitive (95%) for the detection of meniscal tears (Fig. 49–8).[24] However, several investigators found that the overall accuracy of clinical examination (81% to 95%) was as good as or better than that of MRI (74% to 96%) for diagnosing torn menisci.[16,22,29] In a comparison between clinical examination and MRI, the positive predictive value was similar (92% versus 97%), the negative predictive value was better for clinical examination (99% versus 92%), the sensitivity was similar (97% versus 98%), and the specificity was virtually the same (87% versus 86%).[24] In a prospective study, Miller[22] concluded that preoperative MRI did not prevent unnecessary surgery in any case. In fact, many authors have reported that MRI has a high false-positive rate (5% to 36%) for torn menisci.[5,17] The finding of age-dependent degeneration of the meniscus manifesting as increased MRI signal in asymptomatic adults has been well documented. Similarly, among a group of asymptomatic athletes, 50% demonstrated "significant baseline MRI abnormalities." Studies in children have also failed to show an enhanced diagnostic utility of MRI over clinical examination. In fact, clinical examination was significantly more sensitive than MRI for detecting lateral discoid menisci (88.9% versus 38.9%). Further, Rose and Gold[29] found that clinical examination had an accuracy of 79% for meniscal lesions, compared with 72% accuracy for MRI. All these studies emphasize the need for clinicians to match clinical signs and symptoms with MRI findings before embarking on surgical treatment.

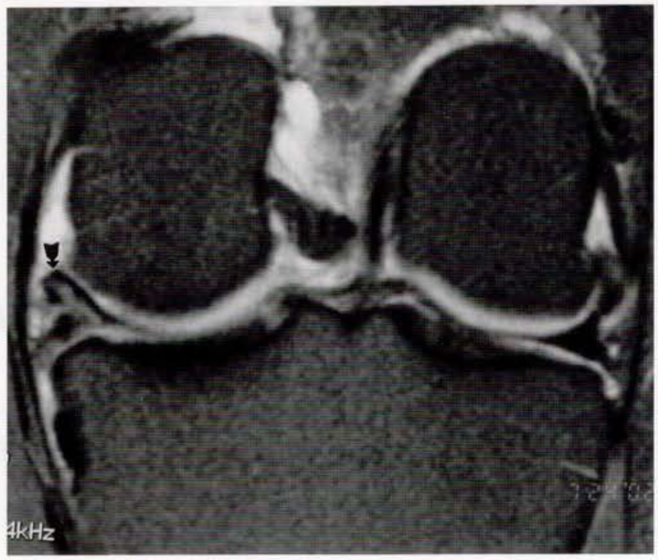

Figure 49–8 Magnetic resonance imaging scan of a typical meniscal tear. The arrow points to the medial meniscus with a complex tear pattern.

Figure 49–7 Radiographs of a 40-year-old woman seen 28 years after an anterior cruciate ligament–medial meniscus injury that was treated nonoperatively. Note the narrowing of the medial compartment joint space, sclerosis, flattening of the medial femoral condyle, and marginal osteophytes.

Classification

Meniscal tears can be classified in many ways, although the most common is based on the pattern of tear seen at arthroscopy. Commonly described patterns include vertical longitudinal (including bucket handle tears), oblique (also known as flap or parrot beak tears), radial (transverse), horizontal, and complex (a combination of tears, including degenerative tears) (Fig. 49–9).

MRI classification of meniscal changes is as follows: grade 0, normal with homogeneous signal intensity; grades I and II, high signal intensity within the meniscus that does not go to the surface; and grade III, high signal intensity that goes to the surface of the meniscus and is indicative of a tear (Fig. 49–10). The repairability of menisci cannot be inferred from MRI findings.

Associated Injuries

Meniscal tears may occur in isolation, although approximately one third of them are associated with ACL tears—lateral meniscal tears with acute ACL injuries, and medial meniscal tears with chronic ACL deficiency.[10,27] Meniscal tears also frequently occur with tibial plateau fractures.[39]

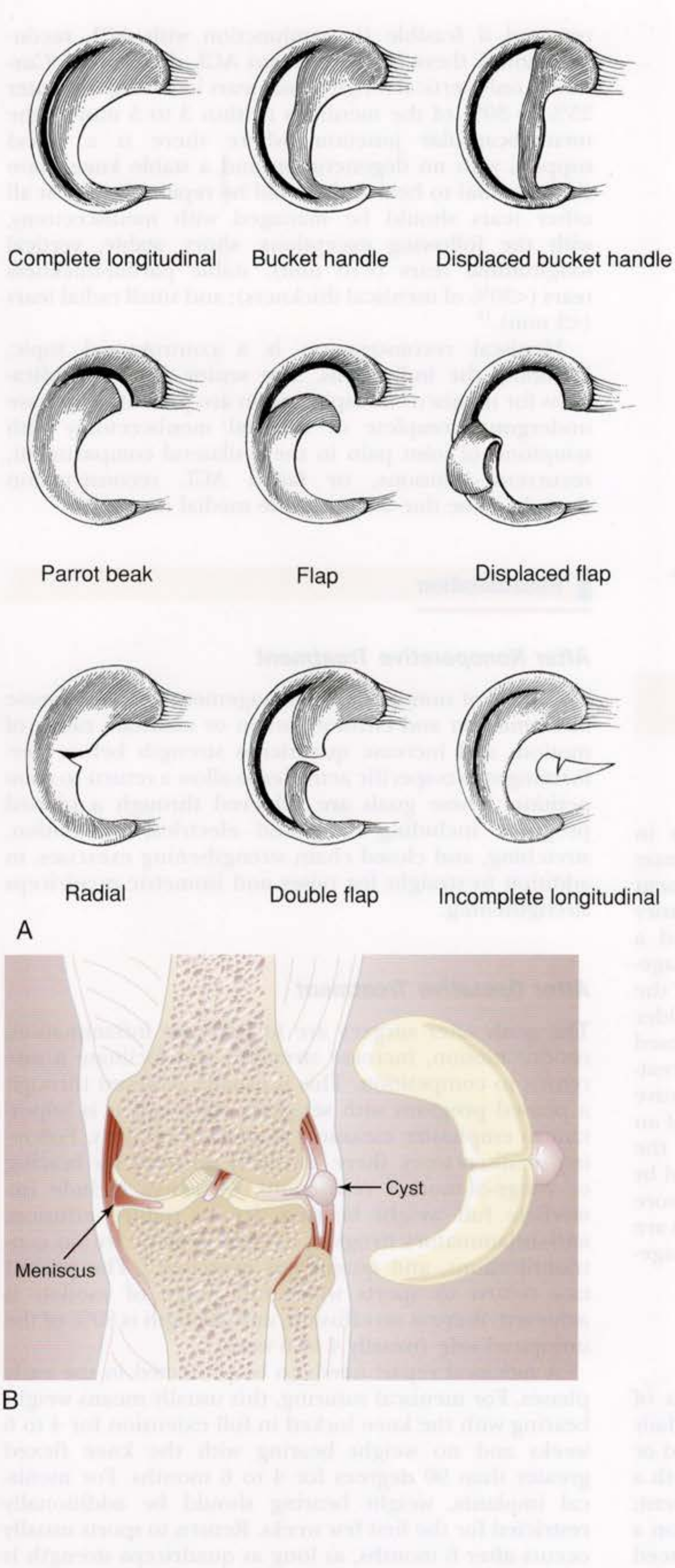

Figure 49–9 *A*, **Schematic representation of types of meniscal tears.** *B*, **Meniscal cyst.** (*A*, From Tria AJ Jr, Klein KS: An Illustrated Guide to the Knee. New York, Churchill Livingstone. 1992. *B*, From Safran M, Stone DA, Zachezewski J: Instructions to Sports Medicine Patients. Philadelphia, WB Saunders, 2002.)

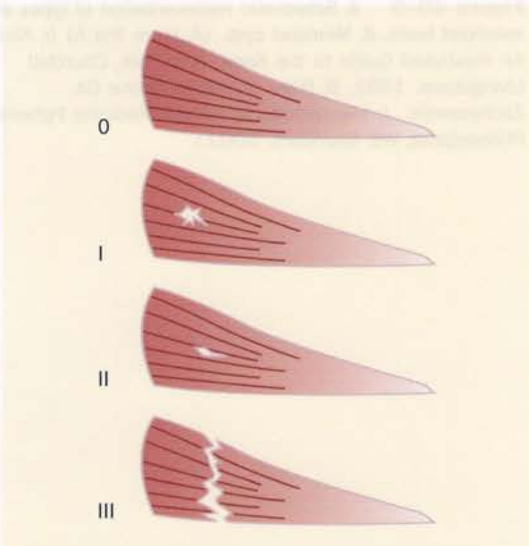

Figure 49–10 Magnetic resonance imaging classification of meniscal tears. (From Fu F, Harner C: Knee Surgery. Philadelphia, Lippincott, Williams & Wilkins, 1994.)

Treatment Options: Indications and Contraindications

Nonoperative

Many meniscal tears are asymptomatic, especially in older patients. Further, some symptomatic tears may become asymptomatic with conservative management consisting of activity modification, anti-inflammatory medications (including a cortisone injection), and a rehabilitation program. Thus, nonoperative management for 3 months should be the initial treatment if the patient has full range of motion, especially in older patients. Although chronic tears with a superimposed acute injury usually do not heal with nonsurgical treatment, they may become asymptomatic with conservative therapy alone. The chance of spontaneous healing of an acute injury is inversely proportional to the size of the tear and the amount of displacement and is impaired by concurrent ACL injury. It has been shown that more than 90% of athletes with symptomatic meniscal tears are unable to return to sports; thus, nonoperative management is usually not recommended.

Operative

Indications for surgery include (1) daily symptoms of meniscal injury that affect sports or activities of daily living or work, such as frequent locking and repeated or chronic effusions; (2) physical findings consistent with a meniscal tear; (3) failure of nonoperative management; and (4) absence of other causes of knee pain based on a complete evaluation.[21] Loss of motion due to a displaced meniscal tear should be addressed urgently with surgery. Every attempt should be made to preserve as much meniscus as possible, and the meniscus should be repaired if feasible (in conjunction with ACL reconstruction if there is concomitant ACL deficiency). Currently, only vertical longitudinal tears involving the outer 25% to 30% of the meniscus (within 3 to 5 mm of the meniscocapsular junction, where there is a blood supply), with no degeneration and a stable knee, have the potential to heal and should be repaired. Almost all other tears should be managed with meniscectomy, with the following exceptions: short, stable, vertical longitudinal tears (<10 mm); stable partial-thickness tears (<50% of meniscal thickness); and small radial tears (<3 mm).[15]

Meniscal reconstruction is a controversial topic, including the indications. The senior author's indications for meniscus transplantation are patients who have undergone complete or subtotal meniscectomy with symptoms of joint pain in the ipsilateral compartment, recurrent effusions, or failed ACL reconstruction thought to be due to loss of the medial meniscus.

Rehabilitation

After Nonoperative Treatment

The goals of nonoperative management are to decrease inflammation and effusion, attain or maintain range of motion, and increase quadriceps strength before performing sports-specific activities to allow a return to competition. These goals are achieved through a phased program, including icing and electrical stimulation, stretching, and closed chain strengthening exercises, in addition to straight leg raises and isometric quadriceps strengthening.

After Operative Treatment

The goals after surgery are to decrease inflammation, restore motion, increase strength, and facilitate a safe return to competition. This is usually achieved through a phased program with set goals, although it is important to emphasize measures to prevent reinjury. Following meniscectomy, there is usually no need for bracing or range-of-motion restrictions. Measures include immediate full weight bearing, ice to reduce effusion, anti-inflammatory drugs as needed if there are no contraindications, and quadriceps exercises.[42] The patient can return to sports when full range of motion is achieved, there is no effusion, and strength is 80% of the uninjured side (usually 4 to 6 weeks).

A meniscal repair needs to be protected in the early phases. For meniscal suturing, this usually means weight bearing with the knee locked in full extension for 4 to 6 weeks and no weight bearing with the knee flexed greater than 90 degrees for 4 to 6 months. For meniscal implants, weight bearing should be additionally restricted for the first few weeks. Return to sports usually occurs after 6 months, as long as quadriceps strength is within 80% of the contralateral extremity. The rehabilitation for meniscal reconstruction still lacks a scientific basis and is empirical at this time; however, this procedure is not performed in those expecting to return to sports.

Results

Arthroscopy has had a tremendous impact on the ability to treat meniscal injuries while reducing morbidity (Fig. 49–11). Although open total meniscectomy was once the standard of care for meniscal injuries, several long-term follow-up studies found that these patients have poor outcomes and are significantly more likely to develop arthritic changes in the operated knee.[25] Several authors compared open total meniscectomy with arthroscopic partial meniscectomy and found that leaving some of the meniscus behind led to significantly better results and reduced the rate of degenerative arthritis.[25,31]

Meniscal repair has been shown to be successful in healing the tear and retaining the meniscus. Open repair has the longest follow-up, with excellent results and retention of the healed meniscus.[9] Arthroscopic repair has comparable results in the short and medium terms.[6,8,40]

Meniscal reconstruction can be helpful in reducing symptoms associated with total meniscectomy, such as pain and effusion. However, many factors have been shown to adversely affect outcome, including extremity malalignment, irradiated grafts, lyophilized grafts, and advanced degenerative articular changes. Meniscus transplantation has not been shown to prevent arthritis or joint degeneration.

Complications

Early reports of the initial experience with arthroscopic fluid pumps found complication rates as high as 1.4%. Improved instrumentation and techniques, however, have made these complications incredibly rare. As with other surgeries, potential complications include infection, bleeding, arteriovenous fistula, and nerve injury (particularly the saphenous, as well as the peroneal and popliteal neurovasculature). Other complications of arthroscopic meniscal surgery that have been reported and should be discussed with the patient preoperatively include deep vein thrombosis and pulmonary embolism, recurrent effusions, incomplete tear removal, synovial cutaneous fistula, iatrogenic arthroscopic joint lesions, osteonecrosis (usually in the elderly), popliteal pseudoaneurysm, inability to repair the meniscus, nonhealing of meniscal repair, nonhealing of meniscal reconstruction, arthritis, complications from implants (including articular cartilage injury), and the need for further surgery.

Figure 49–11 Arthroscopic picture of a longitudinally torn meniscus.

Future Directions

The last 20 years have led to an explosion in knowledge about the meniscus and its treatment. However, there is still much to be learned about meniscal injury and healing. Further understanding of meniscal injury, such as the difference between isolated tears and traumatic tears; the ability to repair tears other than vertical longitudinal tears at the periphery; and the determination of the long-term success of meniscal repair in preventing arthritis are but a few areas to be studied. An understanding of meniscus transplantation, including the ability to properly size a meniscus preoperatively and to place it simply and reproducibly, and scientific study of the appropriate rehabilitation are critical before we can determine whether meniscal reconstruction prevents arthritis. Last, the ability to heal meniscal tears of any type or of any vascularity with gene therapy, making arthroscopy unnecessary, would be an ideal goal for the future.

References

1. Arnoczky SP, Warren RF: Microvasculature of the human meniscus. Am J Sports Med 10:90-95, 1982.
2. Baratz ME, Fu FH, Mengato R: Meniscal tears: The effect of meniscectomy and of repair on intraarticular contact areas and stress in the human knee. A preliminary report. Am J Sports Med 14:270-275, 1986.
3. Beaupre A, Choukroun R, Guidouin P, et al: Knee menisci: Correlation between microstructure and biomechanics. Clin Orthop 208:72-75, 1986.
4. Bland-Sutton J (ed): Ligaments: Their Nature and Morphology, 2nd ed. London, JK Lewis, 1897.
5. Boden SD, Davis DO, Dina TS, et al: A prospective and blinded investigation of magnetic resonance imaging of the knee: Abnormal findings in asymptomatic subjects. Clin Orthop 282:177-185, 1992.
6. Cannon WD Jr: Arthroscopic meniscal repair: Inside-out technique and results. Am J Knee Surg 9:137-143, 1996.
7. Corea JR, Mousa M, Othman A: McMurray's test tested. Knee Surg Sports Traumatol Arthrosc 2:70-72, 1994.

8. DeHaven KE: Meniscus repair. Am J Sports Med 27:242-250, 1999.
9. DeHaven KE, Lohrer WA, Lovelock JE: Long-term results of open meniscal repair. Am J Sports Med 23:524-530, 1995.
10. Duncan JB, Hunter R, Purness M, Freeman J: Meniscal injuries associated with acute anterior cruciate ligament tears in alpine skiers. Am J Sports Med 23:170-172, 1995.
11. Evans PJ, Bell GD, Frank C: Prospective evaluation of the McMurray test. Am J Sports Med 21:604-608, 1993.
12. Fairbank TJ: Knee joint changes after meniscectomy. J Bone Joint Surg Br 30:664-670, 1948.
13. Fukubayashi T, Kurosawa H: The contact area and pressure distribution pattern of the knee: A study of normal and osteoarthritic knee joints. Acta Orthop Scand 51:871-879, 1980.
14. Hede A, Jensen DB, Blyme P, Sonne-Holm S: Epidemiology of meniscal lesions of the knee: 1215 open operations in Copenhagen 1982–1984. Acta Orthop Scand 61:435-437, 1990.
15. Henning CE, Clark JR, Lynch MA, et al: Arthroscopic meniscus repair with a posterior incision. Instr Course Lect 37:209-221, 1988.
16. Kocher MS, DiCanzio J, Zurakowski D, Micheli LJ: Diagnostic performance of clinical examination and selective magnetic resonance imaging in the evaluation of intraarticular knee disorders in children and adolescents. Am J Sports Med 29:292-296, 2001.
17. LaPrade RF, Burnett QM II, Veenstra MA, Hodgman CG: The prevalence of abnormal magnetic resonance findings in asymptomatic knees: With correlation of magnetic resonance imaging to arthroscopic findings in symptomatic knees. Am J Sports Med 22:739-745, 1994.
18. Levy IM, Torzilli PA, Warren RF: The effect of medial meniscectomy on anterior-posterior motion of the knee. J Bone Joint Surg Am 64:883-888, 1982.
19. McDevitt CA, Webber RJ: The ultrastructure and biochemistry of meniscal cartilage. Clin Orthop 252:8-18, 1990.
20. Medlar RC, Mandiberg JJ, Lyne ED: Meniscectomies in children: Report of long-term results (mean 8.3 years) of 26 children. Am J Sports Med 8:87-92, 1980.
21. Metcalf RW, Burks RT, Metcalf MS, McGinty JB: Arthroscopic meniscectomy. In McGinty JB, Caspari RB, Jackson RW, Poehling GC (eds): Operative Arthroscopy, 2nd ed. Philadelphia, Lippincott-Raven, 1996, pp 263-297.
22. Miller GK: A prospective study comparing the accuracy of the clinical diagnosis of meniscus tear with magnetic resonance imaging and its effect on clinical outcome. Arthroscopy 12:406-413, 1996.
23. Mow VC, Fithian DC, Kelly MA: Fundamentals of articular cartilage and meniscus biomechanics. In Ewing JW (ed): Articular Cartilage and Knee Joint Function: Basic Science and Arthroscopy. New York, Raven Press, 1990, pp 1-18.
24. Muellner T, Weinstabl R, Schabus R, et al: The diagnosis of meniscal tears in athletes: A comparison of clinical and magnetic resonance imaging investigations. Am J Sports Med 25:7-12, 1997.
25. Neyret P, Donell ST, Dejour H: Results of partial meniscectomy related to the state of the anterior cruciate ligament: Review at 20 to 35 years. J Bone Joint Surg Br 75:36-40, 1993.
26. Nielsen AB, Yde J: Epidemiology of acute knee injuries: A prospective hospital investigation. J Trauma 31:1644-1648, 1991.
27. Poehling GG, Ruch DS, Chabon SJ: The landscape of meniscal injuries. Clin Sports Med 9:539-549, 1990.
28. Radin EL, de Lamotte F, Maquet P: Role of the menisci in the distribution of stress in the knee. Clin Orthop 185:290-294, 1984.
29. Rose NE, Gold SM: A comparison of accuracy between clinical examination and magnetic resonance imaging in the diagnosis of meniscal and anterior cruciate tears. J Arthrosc Rel Surg 12:398-405, 1996.
30. Rosenberg TD, Paulos LE, Parker RD, et al: The forty-five-degree posteroanterior flexion weight-bearing radiograph of the knee. J Bone Joint Surg Am 70:1479-1483, 1988.
31. Schimmer RC, Brulhart KB, Duff C, Glinz W: Arthroscopic partial meniscectomy: A 12-year follow-up and two-step evaluation of the long-term course. Arthroscopy 14:136-142, 1998.
32. Shelbourne KD, Martini DJ, McCarroll JR, Van Meter CD: Correlation of joint line tenderness and meniscal lesions in patients with acute anterior cruciate ligament tears. Am J Sports Med 23:166-169, 1995.
33. Shoemaker SC, Markolf KL: The role of the meniscus in the anterior-posterior stability of the loaded anterior cruciate deficient knee: Effects of partial versus total excision. J Bone Joint Surg Am 68:71-79, 1986.
34. Simonian PT, Sussman PS, van Trommel M, et al: Popliteomeniscal fasciculi and lateral meniscal stability. Am J Sports Med 25:849-853, 1997.
35. Solomon DH, Simel DL, Bates DW, et al: The rational clinical examination: Does this patient have a torn meniscus or ligament of the knee? Value of the physical examination. JAMA 286:1610-1620, 2001.
36. Terry GC, Tagert BE, Young MJ: Reliability of the clinical assessment in predicting the cause of internal derangements of the knee. Arthroscopy 11:568-576, 1995.
37. Thompson WO, Thaete FL, Fu FH, Dye SF: Tibial meniscal dynamics using three-dimensional reconstruction of magnetic resonance images. Am J Sports Med 19:210-216, 1991.
38. Vandermeer RD, Cunningham FK: Arthroscopic treatment of the discoid lateral meniscus: Results of long-term follow-up. Arthroscopy 5:101-109, 1989.
39. Vangsness CT Jr, Ghaderi B, Hohl M, Moore TM: Arthroscopy of meniscal injuries with tibial plateau fractures. J Bone Joint Surg Br 76:488-490, 1994.
40. Venkatachalam S, Godsiff SP, Harding ML: Review of the clinical results of arthroscopic meniscal repair. Knee 8:129-133, 2001.
41. Weinstabl R, Muellner T, Vecsei V, et al: Economic considerations for the diagnosis and therapy of meniscal lesions: Can magnetic resonance imaging help reduce the expense? World J Surg 21:363-368, 1997.
42. Wheatley WB, Krome J, Martin DF: Rehabilitation programmes following arthroscopic meniscectomy in athletes. Sports Med 21:447-456, 1996.