CHAPTER

47

Knee: Diagnostic Arthroscopy

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Regardless of the planned arthroscopic procedure, the surgeon should perform at least a quick diagnostic arthroscopy. The importance of a systematic approach cannot be overemphasized. In this chapter we describe the major areas of the knee that every arthroscopic examination should include (Table 47–1). The exact sequence is not critical, but performing the examination methodically helps to avoid missed pathology.

Scope Insertion

There are several techniques available for scope insertion. If a separate inflow cannula is used, it is inserted through either a superomedial or a superolateral portal. A small skin incision is made in the direction of Langer's line, and a blunt trocar within its cannula is inserted through the skin and joint capsule and into the suprapatellar pouch by aiming deep to the patella (posteriorly) and toward its superior tip. The posterior path allows for clearance of the patella. Access to the suprapatellar pouch can be confirmed with a side-to-side sweeping motion of the blunt trocar. In general, use of a sharp trocar to enter the knee joint should be avoided to decrease the risk of iatrogenic cartilage injury.

The anterolateral portal is typically established next. However, if the surgeon does not wish to use a separate inflow cannula, the anterolateral portal is established first as the viewing portal, with the inflow attached to the same cannula. The decision whether to use a separate irrigation inflow portal is based on the surgeon's preference. Use of the arthroscopic cannula for inflow eliminates the need for an extra incision and the associated morbidity. Previous concerns about decreased joint distention because of lower volumes through a smaller sheath have been reduced with the availability of high-flow cannulas and optional inflow pumps.

When making the skin incision for the anterolateral portal, a number 11 blade is used, aimed toward the femoral notch. Care is taken to point the blade superiorly and vertically to minimize the risk of cutting the anterior horn of the lateral meniscus. Alternatively, if the anatomic landmarks can be accurately palpated and the surgeon is confident that the incision is above the meniscus, a horizontal incision can be used. Here, the blade is oriented away from the patellar tendon to avoid injury to the fibers. This leaves a more cosmetic scar, but the incision can be difficult to extend if access is limited.

In either case, the blade should be inserted deep enough to penetrate the joint capsule, but not to the point of damaging the femoral condyles. Next, the arthroscopic sheath with a blunt trocar is introduced with a twisting motion toward the intercondylar notch with the knee flexed approximately 60 to 90 degrees. The tip of the trocar is then retracted slightly, and the knee is fully extended slowly to allow the trocar to be passed into the suprapatellar pouch.

If excessive resistance is met, the maneuver should be stopped and the site reassessed. The surgeon should ensure that the trocar is not caught in the intercondylar notch, that the portal is within the patellar tendon, and that the incision is long enough to prevent the scope from binding on the skin or capsule. If the tip of the trocar is caught on the ligamentum mucosum, which comes from the roof of the intercondylar notch to the fat pad, the patella will rotate as the trocar is advanced against resistance. In this case, the trocar should be withdrawn slightly and passed more laterally into the suprapatellar pouch.

Once in the suprapatellar pouch, the trocar is removed and the arthroscope is inserted through the sheath. If the manufacturer's name or logo is facing superiorly toward the head, the scope is oriented correctly so that "up is up." The arthroscopic camera lens generally views an area directed either 30 or 70 degrees away from the side of the light cord attachment (or straight ahead

Table 47–1
Arthroscopic Regions of the Knee

Suprapatellar pouch
Patellofemoral compartment
Lateral gutter
Medial gutter
Medial compartment
Intercondylar notch
Lateral compartment

with the 0-degree scope). In most cases, the 30-degree lens is used. Once the arthroscope is in the suprapatellar pouch, the patella can be used as a visual reference to check the camera orientation.

Suprapatellar Pouch

The suprapatellar pouch is easily visualized and is the starting point for most arthroscopic knee examinations. With the pouch distended and the knee extended, the surgeon should systematically examine the pouch from medial to lateral and superior to inferior to characterize the synovium and look for the presence of adhesions, plicae, or loose bodies. The character of the synovial villi, their vascularity, and the presence of inflammation or crystalline deposits should be noted.[55] Normally, the synovium is a light or pale red in color. When the knee is inflamed from a mechanically impinging meniscal tear or advanced arthrosis, the synovium can be thickened and extremely vascular (Fig. 47–1). Alternatively, the synovium itself can be primarily involved in the disease process, such as rheumatoid arthritis, pigmented villonodular synovitis, and ochronosis.[1,39] If an arthroscopic synovectomy is planned, it may be necessary to use three to five portals to access all knee compartments for a complete synovectomy, including posteromedial and posterolateral portals.[17,55]

Plicae are normal remnants of synovial partitions that remain from embryologic development and are classified according to their anatomic relationship to the patella (Table 47–2). They vary in size, thickness, and clinical significance.[43] Very few plicae are pathologic or contribute to a patient's symptoms.

When present, the suprapatellar plica divides the suprapatellar pouch into two partial or complete compartments. An incidental finding of a centrally placed hole or opening within the suprapatellar plica, called the *porta*, has been described (Fig. 47–2*A*).[45,46] The significance of the suprapatellar plica lies in the potential for

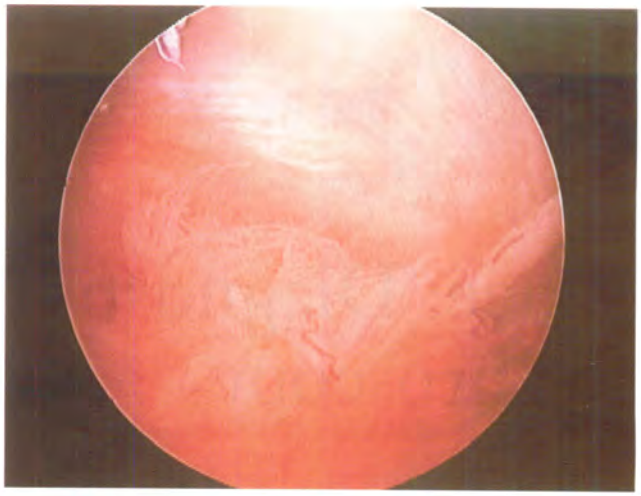
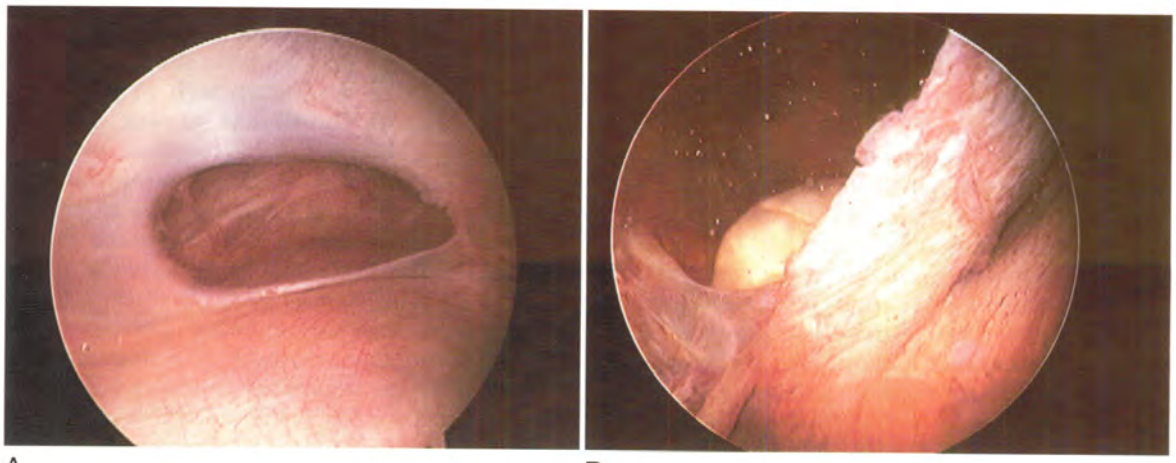


Figure 47–1 Inflamed, thickened synovium with increased vascularity from chronic inflammation.

Table 47–2
Incidence of Synovial Plicae of the Knee

Plica	Incidence (%)
Infrapatellar (ligamentum mucosum)	67
Suprapatellar	55
Medial	25
Lateral	<1



A B

Figure 47–2 *A*, Porta of the suprapatellar plica. *B*, Loose body hidden behind the porta.

loose bodies to lodge behind the septation, hidden from view (Fig. 47–2*B*).

Patellofemoral Compartment

By withdrawing the scope inferiorly with the lens rotated upward, the undersurface of the patella can be seen. The full width and length of the patella should be examined. Rotating the lens inferiorly allows inspection of the trochlear groove where the patella articulates. Document any changes in the patellar and trochlear articular surfaces.

At this point, the patellar and femoral relationship is assessed (Fig. 47–3*A*). In full extension, normally no more than 20% of the patellar surface overhangs the lateral edge of the femur.[15,20,21] Visualizing the patellofemoral articulation from below as the knee is taken through a limited range of motion demonstrates contact and wear patterns or malalignment and maltracking between the patella and femur.

Normally, the lateral facet aligns at 20 degrees of flexion and the medial facet contacts the trochlear notch at about 50 degrees of flexion.[20,21] Arthroscopic evidence of malalignment is suggested if the patella is not centrally located in the trochlear notch during the first 40 to 50 degrees of flexion (Fig. 47–3*B*).[5,35]

Classification of Chondral and Osteochondral Lesions

If chondral lesions are seen in the patellofemoral joint, or anywhere in the knee, they should be documented carefully both with arthroscopic pictures and in the operative notes. Accurate diagnosis involves visualization as well as palpation with the probe for firmness and surface disruption.[50]

Several classification systems exist to describe chondral injuries. The original Outerbridge[41] classification described both the quality and the size of the chondral damage. Insall et al.[22] subsequently modified this classification system to reflect primarily the depth of cartilage loss (Table 47–3). Because no single classification system is all-inclusive, it is more important for the surgeon to be descriptive and to routinely use one system to document the findings, including the percentage of the surface area involved in each compartment.

Lateral Gutter

The lateral gutter is examined next. If this portion of the arthroscopic examination is not performed early, it is often skipped. This is unfortunate, because the latter gutter is often the site where loose bodies and resected pieces of menisci collect (Fig. 47–4). The lateral gutter is entered with the knee in full extension to relax the soft tissues on the lateral aspect of the knee. When entering from the patellofemoral joint, it is important to lift up on the cannula or retract the arthroscope slightly to

Table 47–3
Classification of Articular Injury

Grade	Description
Outerbridge System	
I	Softening and swelling of cartilage
II	Fragmentation and fissuring, <0.5 inch in diameter
III	Fragmentation and fissuring, >0.5 inch in diameter
IV	Erosion of cartilage down to exposed subchondral bone
Insall Modification	
I	Softening and swelling of cartilage
II	Fissuring to subchondral bone
III	Fibrillation of articular surface
IV	Erosion of cartilage down to exposed subchondral bone

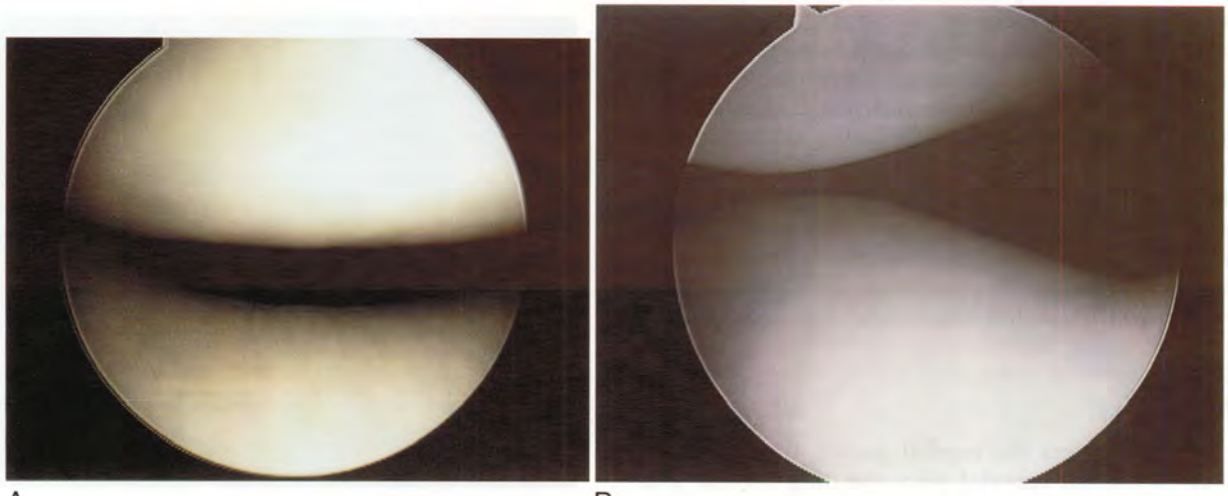


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Figure 47–3 *A*, Normal patellofemoral relationship. *B*, Maltracking of the patellofemoral joint.

Figure 47–4 Loose body in the lateral gutter.

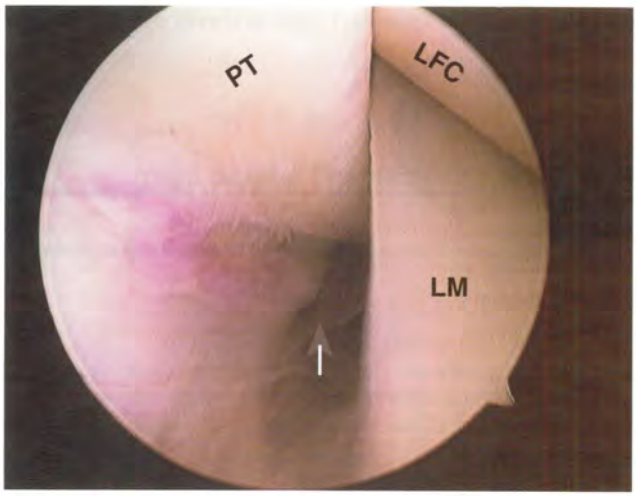


Figure 47–5 Lateral gutter *(arrow)* at the junction of the popliteal tendon (PT), posterior horn of the lateral meniscus (LM), and posterior articular surface of the lateral femoral condyle (LFC).

prevent scuffing the superolateral edge of the lateral femoral condyle. The structures visualized in this position are the posterior horn of the lateral meniscus, the meniscosynovial capsular reflection, the popliteal tendon, the posterior limits of the popliteal hiatus, and the posterior articular surface of the lateral femoral condyle (Fig. 47–5). With the arthroscopic cannula positioned at the hiatus, apply suction through the cannula to help dislodge and remove loose bodies that may have migrated into the popliteal recess. Compressing the back of the knee can also help flush out loose bodies from the inferior portion of the recess. Again being careful not to scuff the superolateral edge of the lateral femoral condyle, return up into the patellofemoral compartment and proceed to the medial side.

Medial Gutter

As the surgeon enters the medial gutter, about 40% of knees have a medial synovial plica running medial and distal to the patella, originating from the medial wall of the suprapatellar pouch and inserting into the fat pad distally (Fig. 47–6).[9] Although this is almost always an incidental finding and asymptomatic, it can occasionally be the cause of anteromedial knee pain and popping, especially with repetitive activities such as cycling.[43] If thickened from trauma or chronic inflammation, it can cause chondromalacial changes due to abrasion on the corner of the medial femoral condyle. By flexing the knee slightly, the area of contact between the plica and the medial femoral condyle can be inspected for damage that suggests the plica as a source of symptoms.[13,53] Occasionally, the arthroscope may need to be partially withdrawn to disengage from a large plica so that the medial compartment can be entered.

Next, advance the arthroscope and look inferiorly over the edge of the medial femoral condyle into the medial gutter. If the scope is entering from the anterolateral portal, as is customary, it will not be possible to "drive" the scope deep into the medial gutter, as was done on the lateral side. Look for loose bodies, synovitis, or traumatic disruptions of the capsule (Fig. 47–7). Palpation of the posteromedial knee joint may help express any hidden loose bodies.

If a leg holder is being used, flex the knee approximately 30 degrees with valgus stress and move the arthroscope into the medial compartment. If a lateral post is being used, 90 degrees of knee flexion over the side of the operating table accomplishes the same result.

Medial Compartment

As the surgeon enters the medial compartment, the medial meniscus helps orient the viewer. Valgus stress with external rotation of the tibia can help open up the medial compartment for the arthroscope. Allow the arthroscope to slip between the medial femoral condyle and the tibial plateau into the space created by the valgus stress on the knee. Forcing the arthroscope can result in gouging and scuffing of the articular surfaces that will never heal, so this should be meticulously avoided. Likewise, withdrawing the arthroscope before releasing the stress on the knee prevents the arthroscope from being

Figure 47–6 Medial synovial plica *(arrowheads)* draped over a corner of the medial femoral condyle.

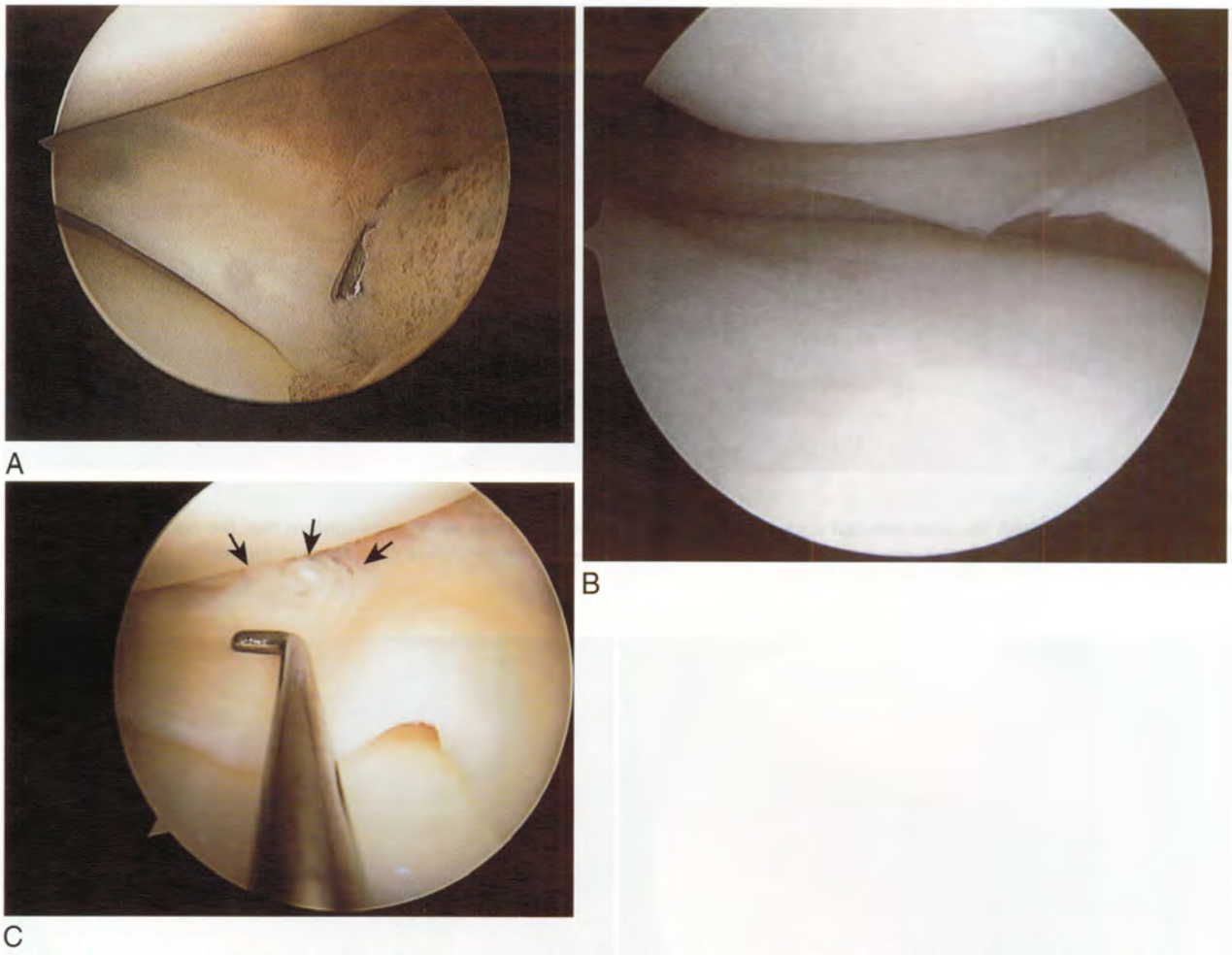


Figure 47–7 *A*, Anterior horn of the medial meniscus with a normal meniscosynovial junction. *B*, Normal posterior horn of the medial meniscus. *C*, Tear *(arrows)* in the posterior horn of the medial meniscus.

caught between the articular surfaces and gouging the cartilage as it is removed.

Creation of the Anteromedial Portal

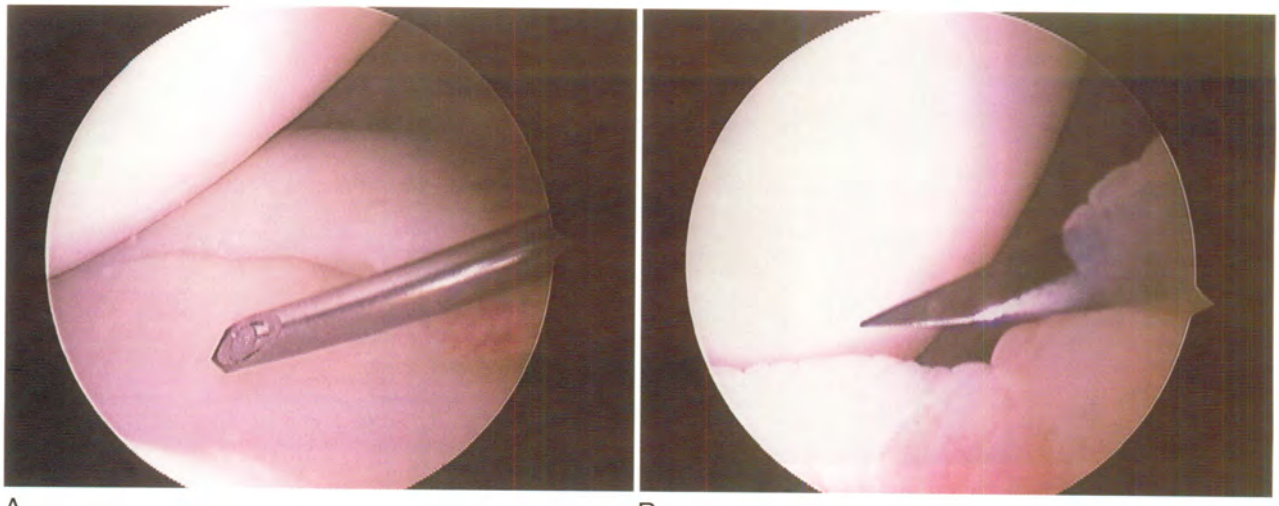
At this point, if the anteromedial portal has not been created, it can be established under direct vision. With the lens directed medially and anteriorly, an 18-gauge spinal needle is inserted through the planned portal, free of the fat pad and superior to the medial meniscus. The anteromedial portal is adjacent to the patellar tendon, 1 cm above the joint line and in the medial "soft spot" that mirrors the anterolateral portal location.[42] Under direct vision, observe the path of the needle to ensure placement in the appropriate location (Fig. 47–8*A*). A downward and medially directed path improves visualization and allows eventual instrument access to the posterior aspect of the medial compartment.

Remove the needle and make a skin and capsular incision with a number 11 blade directed toward the intercondylar notch (Fig. 47–8*B*). This can be performed under direct vision to prevent damage to the articular cartilage and anterior horn of the medial meniscus. A straight hemostat can be used to help stretch the capsular opening and improve access for instruments. A probe is then inserted through this portal.

Examination of the Medial Meniscus

For a systematic approach, the meniscus is divided into anterior, middle (or body), and posterior regions. With the lens still directed anteromedially, examine the anterior horn of the meniscus, manipulating the fat pad with a probe or resecting a portion of the fat pad if necessary to obtain a better view. In addition to a visual inspection, a complete meniscal examination should include direct palpation of the upper and undersurfaces of the meniscus with a probe (Fig. 47–9). Simple tears that are not noted on visual inspection can often be demonstrated with probing. Use the probe to lift, depress, and retract the meniscus to help palpate for clefts. This must be done gently, however, because vigorous probing can tear the meniscus, especially if the tip is used.

Follow the meniscus posteriorly to the body of the medial meniscus. Evaluate the meniscosynovial reflection and synovial covering. Probe both the superior and inferior surfaces for stability. Elevate the midportion of the medial meniscus to visualize the deep medial collateral ligament (Fig. 47–10), where the attachment runs



A B

Figure 47–8 Establish the anteromedial portal under direct vision. *A*, Insert the needle and confirm that the pathology can be reached from this position. *B*, Remove the needle and direct the number 11 blade toward the intercondylar notch.

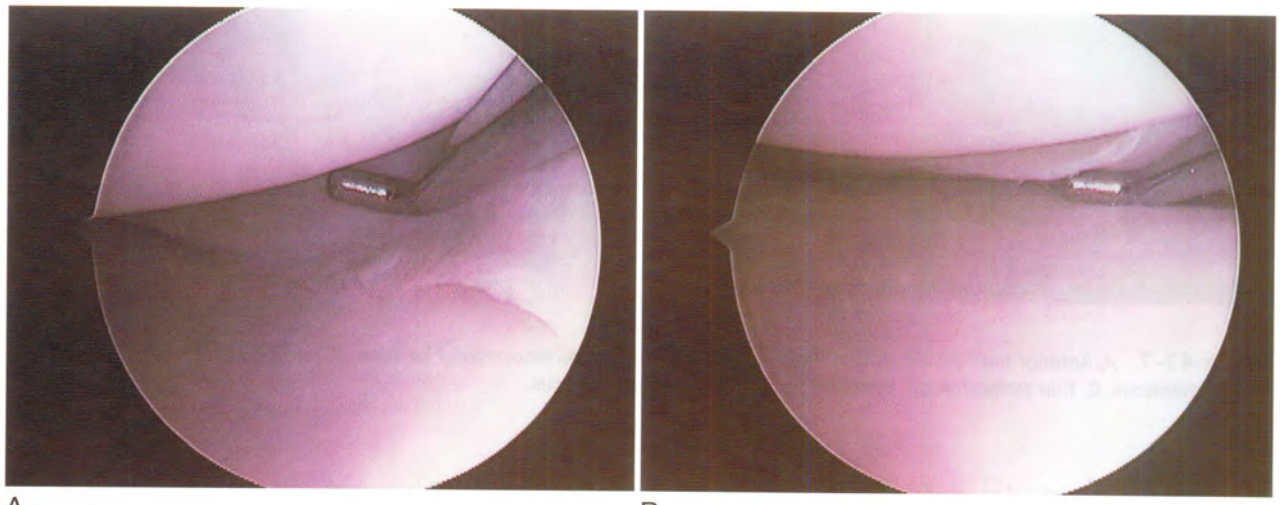


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Figure 47–9 *A* and *B*, A complete examination includes direct palpation of the upper and undersurface of the meniscus.

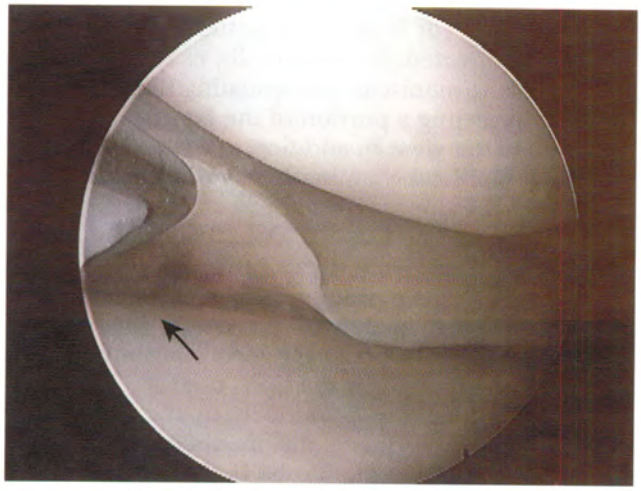


Figure 47–10 Occasionally, acute injuries to the deep medial collateral ligament *(arrow)* can be visualized arthroscopically by elevating the medial meniscus.

from the meniscal rim to the edge of the tibia. If abnormal wrinkling is seen anywhere along the length of the meniscus, a peripheral detachment should be suspected. If a small rim of the medial meniscus is seen instead of a normal-sized one, consideration should be given to either a prior partial medial meniscectomy or a displaced meniscal fragment, possibly lodged posteriorly.

In the case of a bucket handle tear, the loose fragment of the meniscus flips (displaces) into the intercondylar notch, much like the handle of a bucket flips from one side to the other (Fig. 47–11). If the displaced meniscus fills the space between the medial femoral condyle and tibial plateau anteriorly, it can block the arthroscope's access to the medial compartment unless it is manipulated back into its reduced position with a probe. If there is a radial tear associated with the bucket handle tear, the fragment is attached at only one edge and can flip behind the femoral condyle or under the intact portion of the meniscus, where it may be missed.

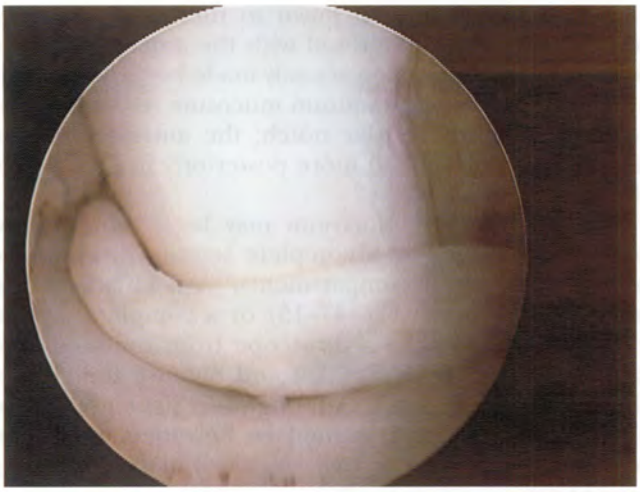


Figure 47–11 Displaced bucket handle tear into the intercondylar notch.

Table 47–4

Considerations for Meniscal Repair

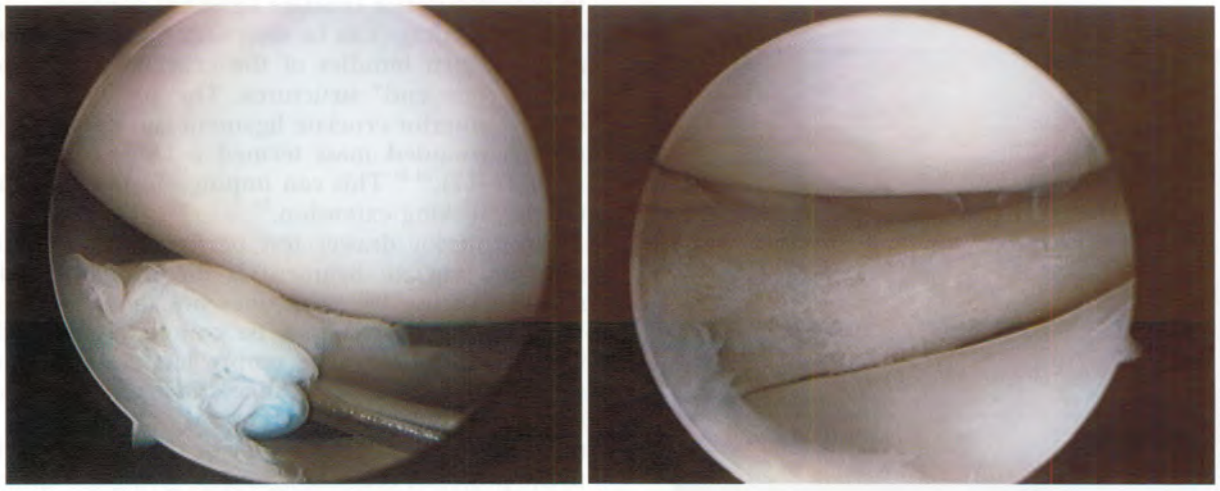
Parameter	Decreasing Likelihood of Meniscal Repair		
Acuity of tear	Acute	Subacute	Chronic
Location from periphery	Red-red (<3 mm)	Red-white (3–5 mm)	White-white (>5 mm)
Tear pattern	Vertical		Horizontal, radial, complex
Tissue quality	Good		Degenerative, macerated
Tear length	1–4 cm		>4 cm

Now direct the 30-degree arthroscope parallel to the tibia and posteriorly to aid in visualizing the posterior horn, where most medial meniscal tears occur. In tight knees, this region can be difficult to examine; extending the knee and applying a valgus force should help. The peripheral portion of the posterior horn and its attachments may also be visualized by passing the arthroscope under the posterior cruciate ligament in the intercondylar notch (modified Gillquist maneuver) into the posteromedial compartment.[14,37]

Meniscal Tears

If a meniscal tear is discovered, the decision whether to perform a partial meniscectomy versus a meniscal repair is based on several factors. It is beyond the scope of this chapter to fully describe the classification and management of all meniscal tears, but proper management requires that the acuity of the tear, degenerative changes within the tissue, tear pattern, and length and width of the tear from the periphery be considered (Table 47–4).[3,7,48] Therefore, a complete understanding of the character of the meniscal lesion is essential for proper management. Failure to accurately explore the extent of the tear may result in the needless sacrifice of healthy meniscal tissue.[36] If the location and type of tear make it amenable to repair, this is the preferred treatment.[10,18] If repair is not possible, partial meniscectomy is always preferable to total meniscectomy.[38,44] Leaving an intact, stable, peripheral rim of meniscus provides stability to the joint and protects the articular surface by sharing the load-bearing responsibilities.[3,7] Total meniscectomy decreases the load-bearing protection and reduces joint stability.[3,12,51]

During a partial meniscectomy, the torn, mobile fragment is excised, and the peripheral rim is contoured in an attempt to leave a balanced, stable rim of meniscal tissue (Fig. 47–12).[16] Sharp excision is preferable to morcellation to minimize the debris created in the joint. The blunt short trocar and cannula can be inserted through the instrument portal; the trocar is then removed to "vacuum out" the free-floating meniscal



A B

Figure 47–12 *A*, Probing of the medial meniscus demonstrates a radial tear. *B*, During a partial meniscectomy, contouring of the unstable tear results in a balanced, stable rim of meniscal tissue.

fragments. The suction shaver can complete the process and help contour the meniscal edges. If the shaver is used to remove multiple large meniscal fragments first, it frequently becomes clogged. The remaining peripheral rim must be carefully probed again to ensure that it is balanced and stable and that no additional tears are present.

Examination of the Femoral and Tibial Condyles

The articular surfaces of the femoral and tibial condyles should be systematically examined through a range of motion. It is important to note that early articular wear on the medial femoral condyle is typically located slightly posteriorly, making contact with the tibia when the knee is flexed 30 to 50 degrees (Fig. 47–13). These arthroscopic findings correlate with standing flexion (Rosenberg) radiographs.[47]

Systematic palpation with the probe is important to demonstrate softening of the cartilage (chondromalacia),[50] collapse of the underlying subchondral bone (avascular necrosis, osteonecrosis),[28] osteochondritis dissecans,[2,31,56,60] or unstable chondral flaps (Fig. 47–14).[19] The tip of the probe can be used as an "arthroscopic ruler" to measure the dimensions of the lesion. With the lens directed superolaterally, the medial femoral condyle can be followed into the intercondylar notch.

Intercondylar Notch

The structures to examine in the intercondylar notch include the infrapatellar fat pad, ligamentum mucosum, medial and lateral tibial spines, attachments of both menisci, anterior and posterior cruciate ligaments, ligaments of Humphry and Wrisberg (meniscofemoral ligaments), and intermeniscal ligament.

Ligamentum Mucosum

The ligamentum mucosum, or infrapatellar plica, is the most commonly encountered plica in the knee and rarely produces any symptoms.[43] It runs from the superior intercondylar notch down to the fat pad and, in some cases, can be confused with the anterior cruciate ligament. The distinction is easily made by visualizing the attachment of the ligamentum mucosum to the anterior roof of the intercondylar notch; the anterior cruciate ligament attaches much more posteriorly in the back of the notch.

The ligamentum mucosum may be a thin, narrow band of synovium or a complete septum dividing the medial and lateral compartments.[43] An enlarged ligamentum mucosum (Fig. 47–15) or a complete septum can make passing the arthroscope from the medial to lateral compartments difficult and obscure the view of the intercondylar notch. Although this structure has no clinical significance, it should be debrided only when necessary because it is well vascularized and bleeding may occur.

Anterior Cruciate Ligament

The ligaments within the intercondylar notch are best viewed with the knee flexed 60 to 90 degrees. Because 80% of anterior cruciate ligament tears are from its femoral attachment, it is important to visualize the origin clearly. This can be performed with the scope through the anterolateral portal by rotating the lens until the medial aspect of the lateral femoral condyle is visualized (approximately 10 o'clock on right knees and 2 o'clock on left knees). Alternatively, the knee can be placed in the figure-of-four position to tension the anterior cruciate ligament and view it from the lateral compartment by looking toward the notch. Check the integrity of the anterior cruciate ligament by probing along its length and, most importantly, its femoral origin (Fig. 47–16). Occasionally, inspection of the anterior cruciate ligament is best performed with the arthroscope through an anteromedial portal.

The appearance of the anterior cruciate ligament varies from patient to patient. Normally, a thin synovial lining covers the ligament. If significant synovitis exists and an injury is suspected, this tissue may need to be removed to adequately visualize the underlying ligament. In recent anterior cruciate ligament ruptures, considerable hemorrhage can be seen within the synovial tissues, and the torn bundles of the cruciate can be seen as white "rope end" structures. The tibial stump of the injured anterior cruciate ligament can also hypertrophy until a rounded mass termed a Cyclops lesion exists (Fig. 47–17).[34,40] This can impinge in the intercondylar notch, blocking extension.[34]

An anterior drawer test performed when the torn anterior cruciate ligament is directly viewed demonstrates that the ligament does not tense appropriately (Fig. 47–18*A*), or it may be completely avulsed from its femoral origin—the empty lateral wall sign (Fig. 47–18*B*). Often, at first glance, the ligament may appear to be intact.[6,30,33] However, careful probing of the origin reveals that the ligament is lax or that it is scarred down to the posterior cruciate ligament, giving the appearance

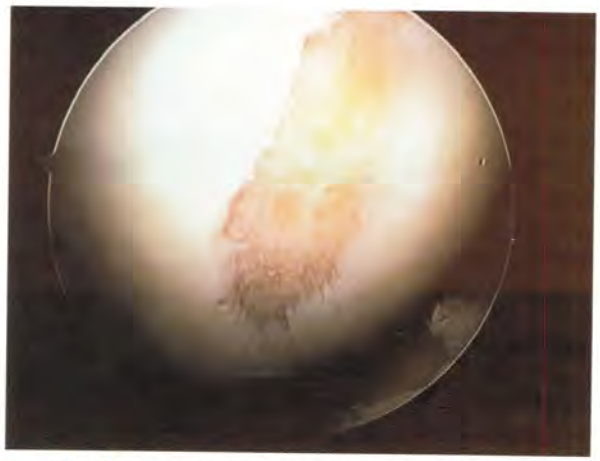


Figure 47–13 Early medial femoral condyle arthritis is typically located more posteriorly and often is not visualized until the knee is flexed 30 to 50 degrees.

Figure 47–14 Palpation of the articular surface can reveal unstable chondral flaps *(A)*, grade I softening *(B)*, grade II fissuring with some fibrillation *(C)*, more extensive grade III fibrillation *(D)*, or grade IV exposed bone *(E)*.

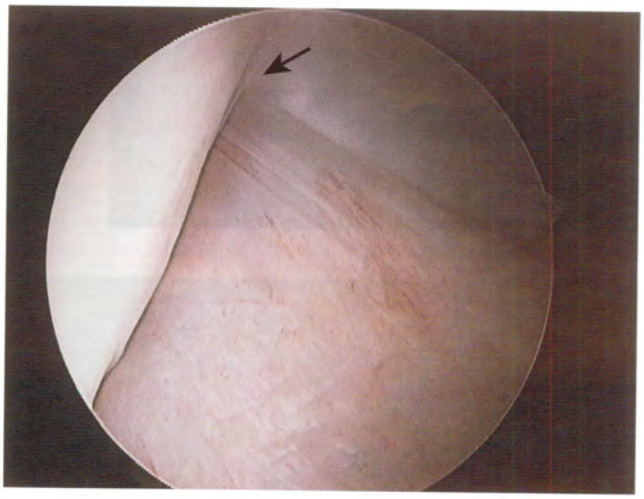


Figure 47–15 Note that the ligamentum mucosum can be differentiated from the anterior cruciate ligament (ACL) by its attachment to the anterior roof of the intercondylar notch *(arrow)*. The ACL, which in this patient is completely obscured by an enlarged ligamentum mucosum, attaches more posteriorly in the notch.

Figure 47–16 An intact anterior cruciate ligament tensions normally when the anterior drawer test is performed with the arthroscopic probe.

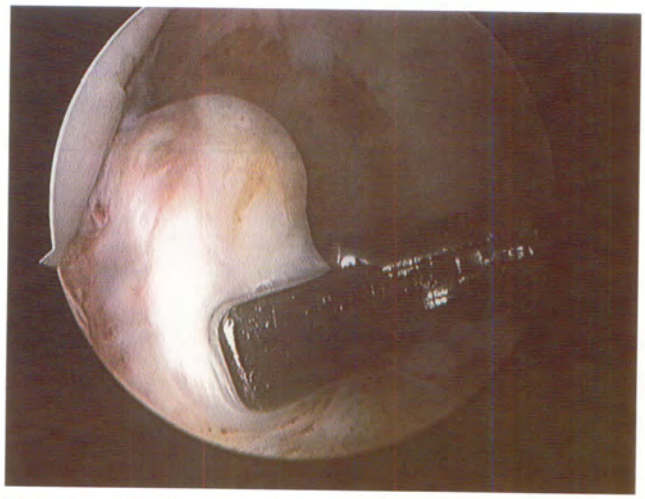


Figure 47–17 The tibial stump of an injured anterior cruciate ligament can hypertrophy and become a Cyclops lesion.

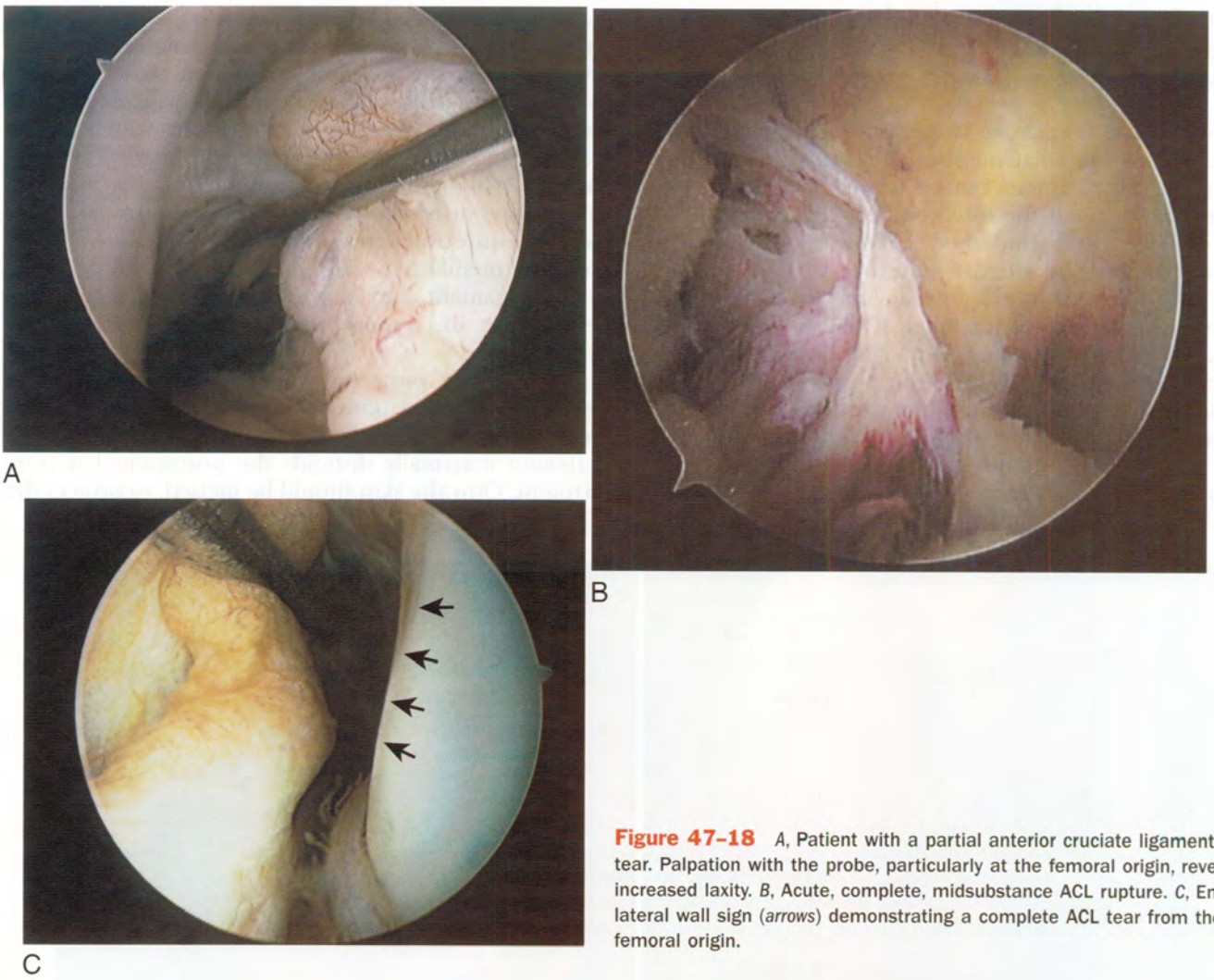


Figure 47–18 *A*, Patient with a partial anterior cruciate ligament (ACL) tear. Palpation with the probe, particularly at the femoral origin, reveals increased laxity. *B*, Acute, complete, midsubstance ACL rupture. *C*, Empty lateral wall sign (*arrows*) demonstrating a complete ACL tear from the femoral origin.

of an intact ligament but not providing any functional stability.

Posterior Cruciate Ligament

Next, the femoral insertion of the posterior cruciate ligament, which is also covered by synovial tissue, is inspected. It arises from the lateral aspect of the medial femoral condyle and runs in a more vertical direction, just over the back of the tibia to insert approximately 1 cm below the articular surface. Palpation of the posterior cruciate ligament is performed by probing the undersurface of the femoral attachments and pulling anteriorly (Fig. 47–19).[32]

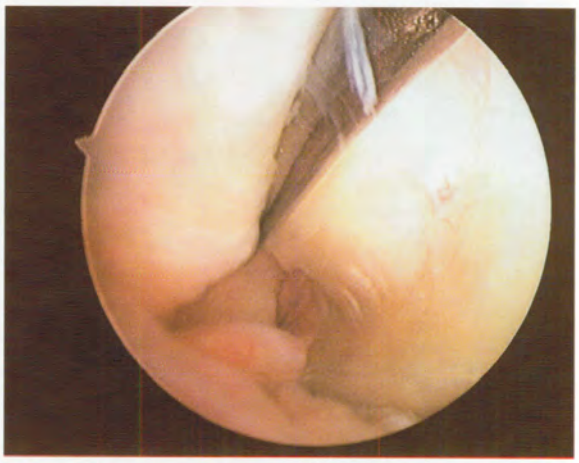


Figure 47–19 Palpate the posterior cruciate ligament by probing the undersurface of the femoral attachment and pulling anteriorly.

Meniscofemoral Ligaments

The two meniscofemoral ligaments are the ligament of Humphry and the ligament of Wrisberg. Either or both of these meniscofemoral ligaments can be seen originating adjacent to the posterior cruciate ligament and attaching to the posterior horn of the lateral meniscus in up to 83% of patients.[29,59] The ligament of Humphry runs anterior to the ligament of Wrisberg, which is easily remembered by the fact that alphabetically Humphry precedes Wrisberg. Their function is to help stabilize the posterior horn attachment of the lateral meniscus.[4,29,59]

Examination of the Posteromedial Compartment through the Intercondylar Notch—Modified Gillquist Maneuver

Whenever loose bodies are suspected, or to better visualize the posteromedial meniscal attachment, the posteromedial compartment can be viewed by passing the arthroscope through the intercondylar notch from the anterolateral portal (modified Gillquist maneuver).[37] Visualization may be aided by the use of a 70-degree scope.[14,52] Structures to examine include the peripheral attachment of the posterior horn of the medial meniscus, the distal half of the posterior cruciate ligament, the posterior femoral condyle, and the posteromedial joint capsule. Free loose bodies and meniscal fragments also gravitate to this region.

To perform the modified Gillquist maneuver, the arthroscope is passed between the posterior cruciate ligament and medial femoral condyle (Fig. 47–20).[14,52] Ninety degrees of knee flexion with valgus stress may help pass the arthroscope. To avoid damage to the joint surface or the arthroscope, "drive" the arthroscope into the notch under the origin of the posterior cruciate ligament and rest it gently against the medial femoral condyle. While holding the cannula in this position, replace the arthroscope with the blunt trocar. With gentle pressure and a twisting motion, advance the trocar along the medial femoral condyle, under the posterior cruciate ligament, and into the posteromedial compartment. Once in, remove the trocar and reinsert the arthroscope.

An accessory posteromedial instrument portal can then be established under direct vision, using a spinal needle to locate the optimal portal site. Placing the knee in flexion maximally distends the posteromedial compartment. Only the skin should be incised, to protect the

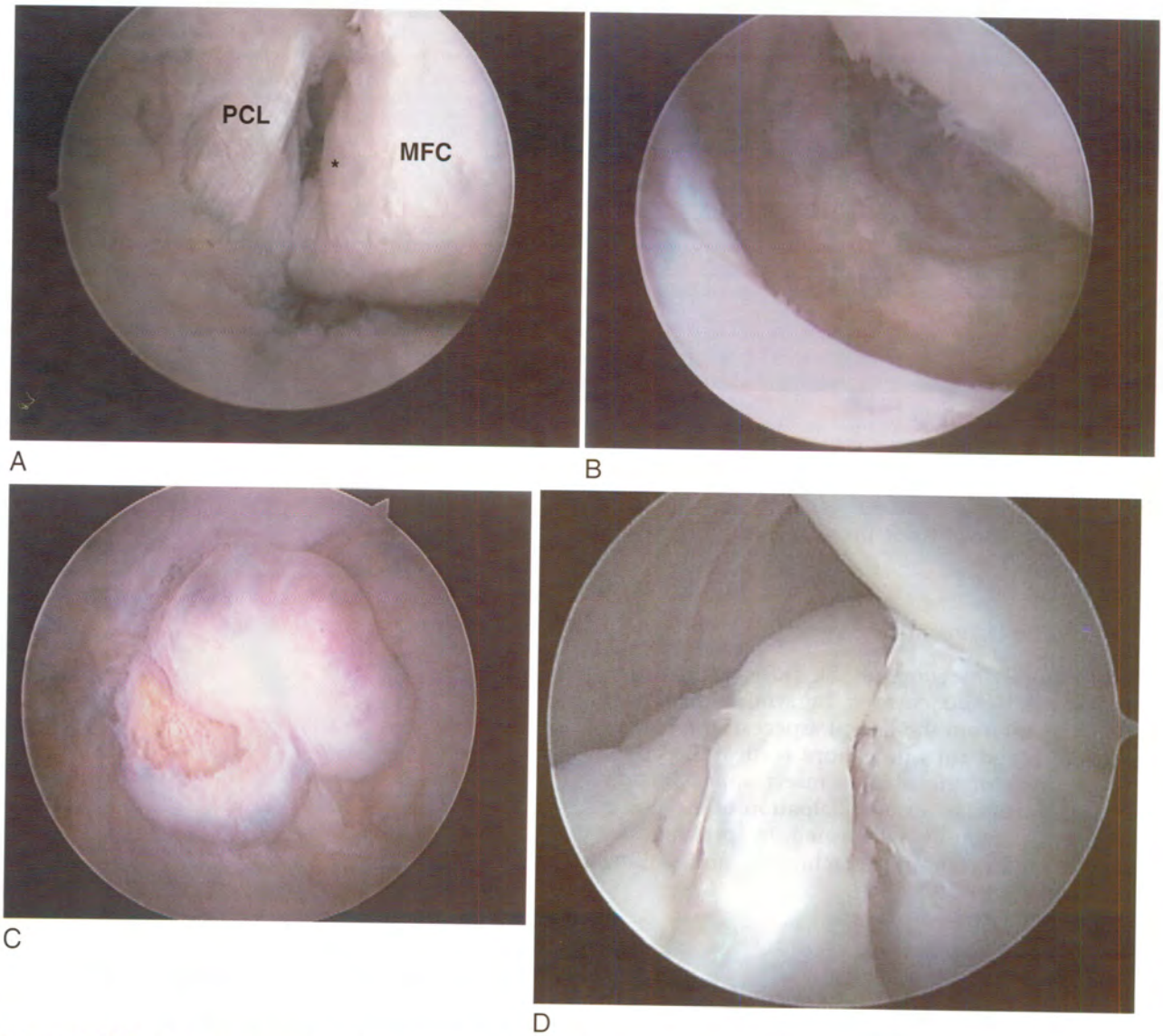


Figure 47–20 Access to the posterior compartment is possible through the modified Gillquist portal. The posteromedial compartment *(A)* can be entered by passing the arthroscope between the posterior cruciate ligament (PCL) and the medial femoral condyle (MFC). The star locates the position where the arthroscope should rest on the medial femoral condyle. Once the posterior compartment *(B)* is entered, loose bodies *(C)* or a peripheral meniscal tear *(D)* may be seen.

nearby saphenous nerve and vein. A blunt hemostat is passed through the skin and subcutaneous tissue along the posterior aspect of the medial femoral condyle. Be careful to glance off the condyle posteriorly rather than directing the instrument too deeply into the posterior soft tissues. Penetrate the capsule with the tip of the hemostat under direct vision, and then replace the hemostat with the arthroscopic cannula using the blunt trocar.

The arthroscopic camera can be inserted through the cannula directly into the posteromedial portal. The posterior aspect of the medial femoral condyle helps orient the surgeon. Turn the lens inferiorly to visualize the meniscocapsular junction of the posterior horn of the medial meniscus. Farther down, the tibial insertion of the posterior cruciate ligament can also be seen. Palpate the posterior horn of the meniscus and the posterior cruciate ligament by passing a probe from the anterolateral portal through the intercondylar notch between the posterior cruciate ligament and the medial femoral condyle into the posteromedial compartment.

By rotating the lens posteriorly, occasionally the opening of a popliteal (Baker's) cyst can be visualized as a fold of synovium. If the cyst is oriented appropriately, passage of the arthroscope into the popliteal cyst may be possible.

Examination of the Posterolateral Compartment through the Intercondylar Notch

If the specific pathology warrants, such as loose bodies, the posterolateral compartment can be accessed from either the anterolateral or the anteromedial portal using a maneuver similar to the one used to enter the posteromedial compartment.[37] Direct the arthroscope back into the notch, but this time between the anterior cruciate ligament and the lateral femoral condyle. Again, if difficulty is encountered, a cannula and blunt trocar can be used to slide along the edge of the lateral femoral condyle. Exchange the trocar for the arthroscope and rotate the lens to view the meniscus posterolaterally.

Lateral Compartment

The lateral compartment can be viewed with the arthroscope through either the anteromedial or, more commonly, the anterolateral portal. When using a lateral post, this compartment is best visualized by placing the leg in the figure-of-four position with flexion and abduction of the hip and flexion of the knee (Fig. 47–21). If additional varus stress is required, have the assistant push down on the thigh just above the knee, resulting in varus and internal rotational opening of the lateral compartment. When using a leg holder, varus stress on a slightly flexed knee with internal rotation of the tibia provides the same lateral opening.

With the arthroscope in the anterolateral portal, sweep the scope laterally from the intercondylar notch into the lateral compartment. Examine and palpate the meniscus with the probe coming from the anteromedial portal. If a hypertrophic, edematous fat pad blocks the view of the anterior horn of the lateral meniscus, partial resection of the fat pad may be necessary. Excessive shaving in this area can result in inadvertent destabilization of the rim attachment of the anterior horn of the lateral meniscus and should be minimized.

Figure 47–21 Figure-of-four position creates a varus stress, opening the lateral compartment.

Occasionally, a prominent intercondylar eminence forces the probe superiorly, making palpation of the posterior third of the lateral meniscus difficult. Also, because the lateral meniscus is more circular than the medial meniscus,[7] the anterior horn attachment is more posterior in the intercondylar notch, forcing arthroscopic instruments to come more superiorly over the anterior horn before entering the lateral compartment. In this instance, the portals for the probe and the arthroscope can be switched.

Examination of the Lateral Meniscus and Popliteal Tendon

Rotate the lens posteriorly and examine the lateral meniscus systematically from posterior to anterior. Note that the mobile lateral meniscus tends to ride up off the lateral tibial condylar surface. Probe both the inferior and superior surfaces of the meniscus to check for tears and assess the integrity of the meniscosynovial attachment. Note that the intercondylar attachment of the posterior horn of the lateral meniscus is located more anteriorly than on the medial side.

In the posterolateral corner of the lateral compartment, the obliquely coursing popliteal tendon within the popliteal hiatus can be easily seen (Fig. 47–22). Lifting up on the meniscus can enhance visualization of the tendon as it heads inferiorly toward its muscular origin on the back of the tibia. In this region, the increased mobility of the meniscus to probing is normal, and the gap in the coronary ligament attachment between the meniscal edge and capsule should not be confused with a peripheral meniscal tear.[3,27] The anterior and posterior horn should remain attached with a smooth synovial reflection, and the body of the meniscus should not translate beyond the apex of the convex lateral femoral

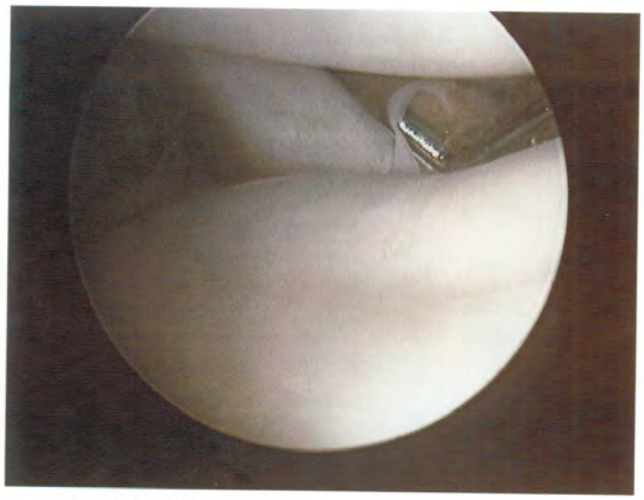


Figure 47–22 Obliquely coursing popliteal tendon within the popliteal hiatus.

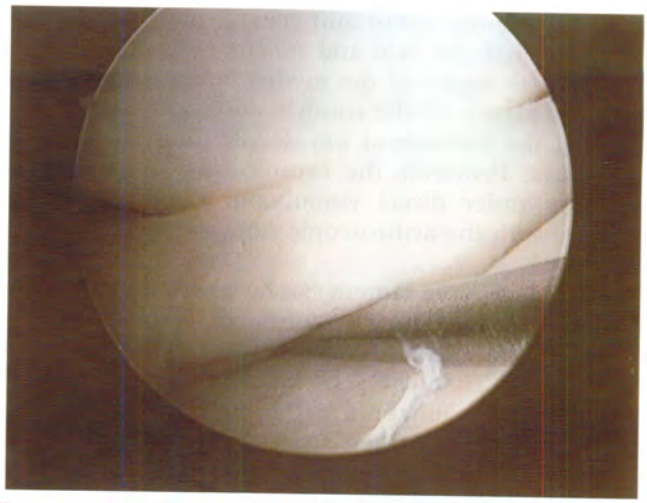
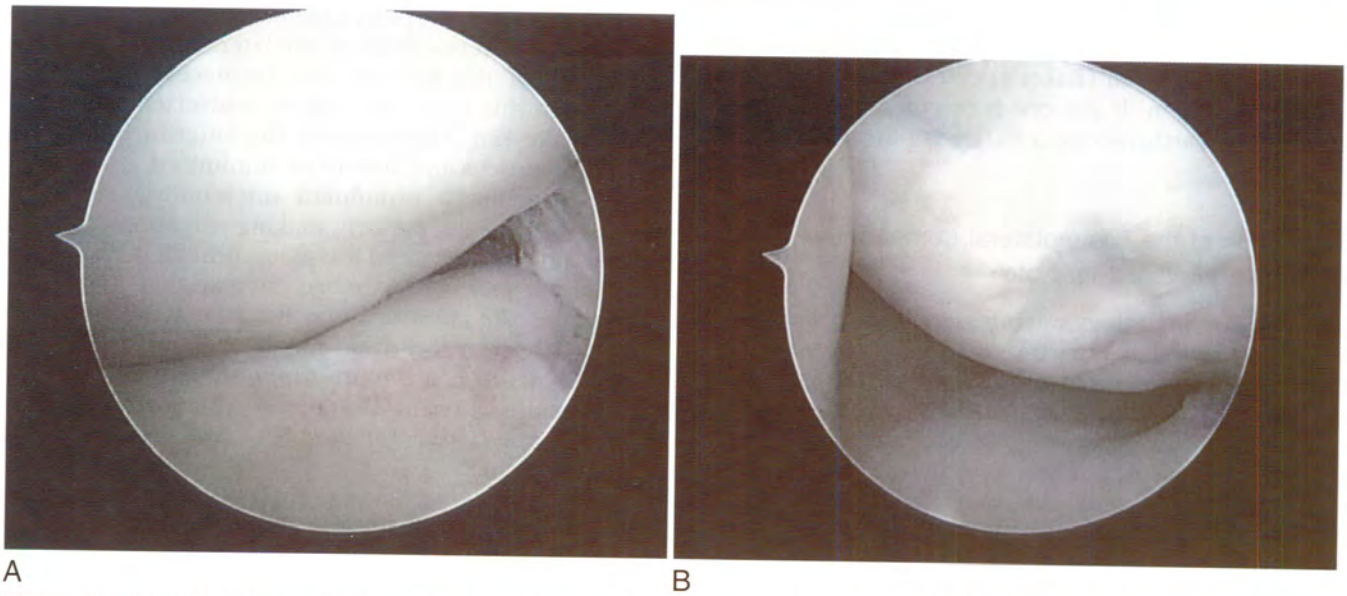


Figure 47–23 Normal translation of the lateral meniscus with palpation.



A B

Figure 47–24 The normal sulcus terminalis *(A)* indentation is not the same as the traumatic chondral injury *(B)* commonly seen in the same location and associated with anterior cruciate ligament tears.

condyle (Fig. 47–23).[7,27] After examination of the meniscus, the articular surfaces of the femoral and tibial condyles should be examined and probed with the same technique used for the medial compartment. The sulcus terminalis is a normal indentation demarcating the junction between the patellofemoral and femorotibial articulations (Fig. 47–24*A*). This should be distinguished from a traumatic chondral injury that might be seen with the bone bruises commonly associated with anterior cruciate ligament tears (Fig. 47–24*B*).

Documentation of the Arthroscopic Examination

Clear documentation of the arthroscopic findings and surgical intervention is imperative. This should include both arthroscopic images and concise operative notes. Arthroscopic pictures of all pathology should be obtained before and after the surgical intervention. In the case of a meniscal tear, for example, arthroscopic pictures should demonstrate the unstable tear before and after repair or partial meniscectomy. These images can be reviewed with the patient and family postoperatively; this often improves their understanding of the knee pathology and what was done to treat it.

Operative notes should be concise but descriptive. Preoperative and postoperative diagnoses and procedures performed should be accurately listed at the beginning of the operative dictation. A separate section listing the operative findings can also be included at the beginning of the notes before the full description of the procedure. This is often helpful for the surgeon because it allows a quick review of the pertinent findings of the arthroscopic examination without having to dissect the body of the operative notes. In this section, the locations

and types of chondral lesions can be described, based on the modified Outerbridge classification,[22,41] along with the size of the lesions in terms of the percentage of the articular surface involved. Descriptions of meniscal tears should include the percentage of stable meniscal rim remaining if a partial meniscectomy was performed.

Complications

Complications associated with knee arthroscopy are uncommon. In a series of more than 8000 arthroscopic knee procedures, the overall complication rate was 1.68% (Table 47–5).[54] Infection, loss of range of motion,[58] and iatrogenic articular cartilage injuries are the most common complications.[6,8,23,26]

Iatrogenic cartilage injuries can be minimized with proper portal placement, careful technique, and adequate visualization.[8] Careless and forceful movements and inappropriate use of arthroscopic tools should be avoided. Surgeons should pay attention to the "feel" of the arthroscope and arthroscopic tools. Remember that the arthroscope and cannula together create a long lever arm capable of generating large forces at the tip. With increased proficiency, "surgeonmalacia" and "divotoses" can be minimized.

Infection, which occurs in less than 1% of all knee arthroscopies, can be a devastating complication.[54,63] Surgeons should not be cavalier about arthroscopic knee surgery, and care should be taken to use strict sterile technique. Although the routine use of preoperative prophylactic antibiotics is not recommended by the American Academy of Orthopaedic Surgeons, it is a common practice.[60-62]

Staphylococcus epidermidis and *Staphylococcus aureus* are frequently the offending pathogens and can be difficult to diagnose in the immediate postoperative period.[25,54,55] Aspirations should be performed and the fluid sent for Gram stain, culture, sensitivity, and cell count. White blood cell count greater than 25,000/mm^3 with a polymorphonuclear predominance in the aspirate is typical. Sedimentation rates and C-reactive protein levels are usually elevated, but this is a nonspecific finding.

Treatment should include early arthroscopic debridement and lavage and intravenous antibiotics to help eradicate the infection.[24] Arthroscopic treatment of septic arthrosis offers the advantage of high-volume fluid lavage and debridement of fibrinoid material and infected debris. It may reduce morbidity and shorten hospitalization. Smith[57] studied 30 patients treated with arthroscopic debridement and lavage combined with parenteral and oral antibiotics. Twenty-eight patients had excellent results, and two had good results; no cases of osteomyelitis were reported.

Standard arthroscopy equipment, setup, and portals are used to treat infections. Do not exsanguinate the extremity. Repeat aspirates can be sent at the beginning of the case. Use a large-bore cannula or an arthroscopic pump for irrigation. Complete debridement of necrotic and infected tissue and thorough lavage with 9 L of fluid may enhance the chances of a good outcome. All compartments, including the medial and lateral gutters, should be addressed. Following the procedure, place suction drain tubes through the arthroscopic cannula, and close the incisions loosely. Debridement and lavage can be repeated, if necessary, at 24 to 72 hours. Early rehabilitation may help decrease permanent knee stiffness.

The use of a tourniquet for longer than 50 minutes has been found to increase the incidence of deep vein thrombosis.[11,47,49] Pulmonary embolism may occur in up to a quarter of these cases, especially in older patients.[26] A high index of suspicion should be maintained. Postoperative calf tightness, pain, and swelling may be the only signs. In rare cases, warfarin (Coumadin) prophylaxis may have an acceptable role in extremely high risk patients.

Table 47–5
Complications of Arthroscopic Knee Surgery

Postoperative hemarthrosis
Infection
Arthrofibrosis
Deep vein thrombosis
Anesthetic complications
Instrument failure
Complex regional pain syndrome (reflex sympathetic dystrophy)
Iatrogenic ligament injury
Iatrogenic fracture
Neurologic injury

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