CHAPTER

46

Knee: Patient Positioning, Portal Placement, and Normal Arthroscopic Anatomy

BERNARD C. ONG, FRANCIS H. SHEN, VOLKER MUSAHL, FREDDIE FU, AND DAVID R. DIDUCH

General Principles

As arthroscopic equipment, techniques, and surgical skills have improved, the role of arthroscopy in diagnosing and managing various knee pathologies has expanded. It is not the goal of this chapter, nor is it feasible, to describe all the arthroscopic equipment and techniques available. It is more important to understand the general principles and for each surgeon to develop a systematic approach to knee arthroscopy that works for him or her. By evaluating the knee joint in a consistent, reproducible fashion, the surgeon reduces the risk of missing lesions and decreases operative time by minimizing the number of "second passes" necessary. This decreases tourniquet time, operative time, patient morbidity, and complications.

Identification

Before the patient is anesthetized and brought to the surgical suite, it is important that the patient's identity be verified and that the correct operative site be identified by both the patient and the operating surgeon. The American Academy of Orthopaedic Surgeons currently recommends that the patient identify the surgical site and that the operating surgeon sign his or her name or initials on the actual operative site with indelible ink.[1] If the patient is marking the surgical site, use of a checkmark (√) is recommended, because an X may be misconstrued as indicating the incorrect site. This practice decreases the possibility of performing surgery at the wrong site.

Anesthesia

Depending on the procedure, knee arthroscopy can be performed under local, regional, or general anesthesia.[20,30] The choice of anesthetic is affected by the patient's general medical condition, the procedure, and the preference of the patient, surgeon, and anesthesiologist.

Local Anesthesia

The use of local anesthesia with or without intravenous sedation for knee arthroscopy has gained popularity. The decision to use local anesthetic must take into account the procedure performed and the estimated length of time required. Procedures that can be performed in less than 20 minutes and do not require significant joint exposure are best suited for local anesthesia with intravenous sedation.[30] This may include procedures such as diagnostic arthroscopy, removal of loose bodies, and partial meniscectomies. Longer procedures that require significant joint exposure or bone work are not good candidates for local anesthesia.[26] An arthroscopic fluid pump can minimize bleeding because a tourniquet is often poorly tolerated.

At 15 to 30 minutes before the procedure, the planned portal sites are infiltrated with 3 to 5 mL of 1% lidocaine (Xylocaine) as a small skin wheal and infiltrated down to the joint capsule. The knee joint itself is infiltrated with 30 mL of a 1:1 mixture of Xylocaine and bupivacaine to provide both immediate and longer-term analgesia.[5,30] Additional anesthetic can be delivered as needed intraoperatively, staying below the maximum

medially. However, a leg holder may be difficult to use, particularly in heavy patients with short thighs. Use of the leg holder is facilitated by positioning the foot of the table with 90 degrees of flexion. The patient must be adequately distal on the operating table to ensure that the knee is beyond the break of the table (Fig. 46–2).

The nonoperative leg should be well padded to prevent potential pressure problems, and consideration can be given to wrapping the nonoperative side to limit venous stasis. The operative extremity is then prepared and draped in the standard surgical fashion with any of the commercially available drapes.

Arthroscopic Equipment

For a surgeon just beginning to learn arthroscopic techniques, the equipment can be confusing. Few of the arthroscopic instruments are the same as those used in open procedures. Although instrumentation has evolved to make complex arthroscopic procedures easier, good fundamental arthroscopic techniques must still be applied. Knowledge of the capabilities and limitations of the arthroscopic equipment is vital to the efficiency, success, and safety of the procedure being performed.

The arthroscopes are named based on the angle between the direction of the viewing lens and the long axis of the arthroscope. The viewing lens of the 0-degree arthroscope is straight ahead, whereas the 70-degree arthroscope "looks off" at 70 degrees from the direction that the arthroscope is pointing.

The most commonly used arthroscope is the 30-degree lens; however, for tight angles, such as when viewing structures in the posteromedial or posterolateral compartments, the 70-degree lens is often helpful.[12,18,27] The 0-degree arthroscope may be helpful when working straight ahead in the intercondylar notch from one of the more anterior portals.[18,27]

Of all the arthroscopic equipment, perhaps the most commonly used and most important diagnostic tool is the arthroscopic probe. When used properly, it is an extension of the surgeon's finger and is essential for the complete evaluation of intra-articular structures.

In general, when working in the medial compartment (in contrast to the lateral compartment), up-going arthroscopic instruments may be easier to use. Because the medial tibial plateau is concave, up-going instruments may conform better to the contours and make certain arthroscopic procedures easier. In contrast, the lateral plateau is convex, and straight instruments are often more effective. Various left- and right-angled instruments are also available to gain access to hard-to-reach areas.

When managing chondral and meniscal lesions, it is important to think "mechanically" rather than "cosmetically." Unstable lesions should be removed or repaired, as appropriate, to minimize mechanical joint wear. Once a stable lesion has been created, contouring should be performed; however, excessive attempts at making chondral or meniscal lesions look perfect increase the likelihood of doing more damage to previously healthy tissue.

When trimming meniscal tears, arthroscopic "biters" and "ducklings" are designed to take wider bites than arthroscopic "punches" do. They are typically used first because they are quicker and cause less trauma to the cartilage. Because the punch is narrower, it leaves a cleaner edge, minimizes debris, and is easier to see around when used in the knee; it is therefore used to trim the corners of flaps or the ends of a bucket handle tear. The suction shaver is generally used to contour the meniscal rim or debride chondral lesions.

Figure 46–2 When using a thigh holder, have the patient sufficiently distal on the table to allow for adequate intraoperative knee flexion.

Relevant Anatomy

The patella articulates with the anterior aspect of the femur predominantly in the trochlear groove. However, in full extension, the patella is in minimal contact with the articular surface of the femur, riding on the anterior femoral shaft just proximal to the lateral aspect of the trochlear groove.[19]

The articular cartilage on the posterior aspect of the patella is the thickest in the body and reflects the large forces that the patellofemoral joint must sustain.[16] On the femoral side, the V-shaped trochlear groove is about 5 to 6 mm deep and separates the medial and lateral femora. Inferiorly and posteriorly it becomes the intercondylar notch.

total dose of 300 mg (or 4.5 mg/kg) for Xylocaine[25] and 175 mg for bupivacaine.[24]

Regional Anesthesia

Regional anesthesia, such as a spinal anesthetic, can be considered in patients with significant medical issues for whom general anesthesia may be contraindicated or in those who simply wish to observe the procedure on the monitor. Most arthroscopic knee procedures can be adequately managed with regional anesthesia, if necessary.

General Anesthesia

For the majority of patients, general anesthesia is the preferred method. It allows for adequate joint exposure and complete muscle relaxation, and tourniquet pain is not an issue. Cases requiring bone work or long tourniquet times, such as cruciate ligament reconstruction, are best managed with general anesthesia.[30]

Examination under Anesthesia

Once the patient is anesthetized, an examination under anesthesia should be performed. A systematic physical examination with the patient comfortable or asleep can provide the surgeon with important additional information. The surgeon can correlate the examination with the pathology found arthroscopically, and at teaching institutions, it is the ideal opportunity to practice and improve examination skills.

Patient Positioning

After the examination under anesthesia, if a tourniquet is being used, it is applied to the proximal thigh of the operative extremity. In the absence of a tourniquet, the use of an arthroscopic fluid pump may be desirable to limit bleeding. Position the patient supine on the operating table. The use of either a leg holder or a lateral post allows the surgeon to manipulate the extremity intraoperatively.

A lateral post is advantageous because it leaves the extremity free for intraoperative examination, eliminates the need for leg support when in extension, and makes access to posterior and accessory portals easier (Fig. 46–1). However, it may require that an assistant be available to help manipulate the leg, and use of a post generally makes it more difficult to apply large varus and valgus stresses to the knee.

Alternatively, the use of a proximal leg holder allows the patient's foot to be placed on the surgeon's iliac crest, eliminating the need for an assistant to hold the leg in most cases. It also gives the surgeon the ability to generate greater varus and valgus stresses across the knee, which can be beneficial for visualization of and access to the joint in tight knees, especially postero-

A B

Figure 46–1 *A* and *B*, Using the lateral post during knee arthroscopy leaves the extremity free for intraoperative examination and eliminates the need for leg support when in extension.

A distinct indentation at the midportion of the lateral femoral condyle marks the lateral groove, or sulcus terminalis, which demarcates where the patellofemoral articulation ends and the tibiofemoral articulation begins. This groove can usually be seen on the lateral radiograph and should not be mistaken for an osteochondral defect. Similarly, a smaller medial groove on the medial femoral condyle delineates the most anterior extent of the medial femoral articular surface that contacts the tibia. This medial groove is well forward of the lateral femoral condyle and may be mistaken for a pathologic process caused by a hypertrophic medial plica. It is actually the area where the anterior horn of the medial meniscus abuts the femur when the knee is fully extended.

On the tibial side, the medial tibial plateau is longer in the sagittal plan than is the lateral plateau. Both the medial and lateral plateaus are concave in the coronal plane; in the sagittal plane, however, the lateral plateau is convex, producing a saddle-shaped articulation. Therefore, the articular surfaces of the knee are not congruent. On the medial side, the femur meets the tibia like a wheel on a flat surface; on the lateral side, it is like a wheel on a dome and would produce extremely high stresses if not for the meniscus. By improving joint congruence and increasing contact area, the menisci participate in load sharing.[7,10,14]

The medial meniscus is somewhat more C-shaped than the circular, O-shaped lateral meniscus (Fig. 46–3). The medial meniscus, constituting more than half of the contact surface of the medial plateau, is less mobile than the lateral meniscus, which covers approximately three fourths of the contact surface. Both have firm anterior and posterior attachments to help distribute the protective tensile hoop stresses within the body of the meniscus.[6,14,28] Up to 80% of the total load on an intact joint passes through the menisci,[9,10] and removal of even a portion of the meniscus results in a decreased ability to transmit load across the joint.[2-4]

The anterior and posterior cruciate ligaments cross each other within the notch of the femur and provide anterior and posterior stability. The anterior cruciate ligament, originating from the inner wall of the lateral femoral condyle, has a broad insertion into a nonarticular portion of the tibia between the tibial spines.[8] The posterior cruciate ligament originates from the medial wall of the intercondylar notch and descends posterolaterally, inserting into a groove on the posterior aspect of the tibia 1 to 1.5 cm below the joint line.[22]

Arthroscopy Portals

One of the keys to successful knee arthroscopy is precise placement of the portals of entry. Poorly placed portals translate into poorly positioned arthroscopes and instruments. This can complicate the procedure and lead to articular injury, missed pathology, and instrument damage. Careful palpation of the knee to identify bony and soft tissue landmarks after draping, but before joint distention, can help identify the appropriate entry portals. Surgeons who are new to arthroscopy may benefit from drawing the joint lines, soft tissue, and bony landmarks with a skin marker before making an incision.[31] Flexion and extension of the knee can aid in palpation of the landmarks.

We describe here the most commonly used standard and accessory portals. Although additional entry sites have been described, they are rarely necessary. Most

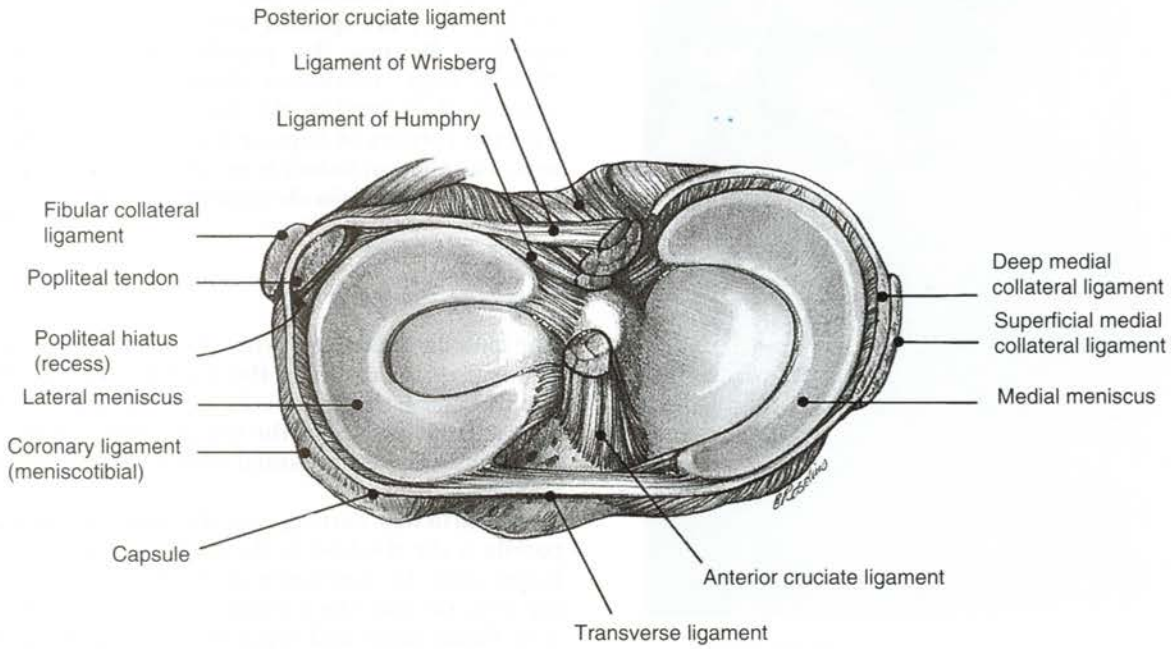

Figure 46–3 **Schematic of tibial plateau and associated structures.** (From Scott WN [ed]: The Knee. St Louis, Mosby, 1994, p 20.)

arthroscopic knee procedures can be performed through two or three standard portals, although surgeons should be prepared to use additional portals as necessary, depending on the pathology found intraoperatively.

Standard Portals

Anterolateral Portal

The anterolateral portal is the standard viewing portal where the arthroscope is first inserted. It is the most versatile portal and is located in the palpable lateral "soft spot" approximately 1 cm above the lateral joint line and adjacent to the lateral margin of the patellar tendon (Fig. 46–4).[23] The anterolateral site allows visual access to almost all the structures within the knee joint, with the possible exception of the tibial insertion of the posterior cruciate ligament and the undersurface of the anterior horn of the lateral meniscus.

When creating this portal, care should be taken not to make the incision too superiorly or inferiorly. Superior placement restricts access into the patellofemoral joint and suprapatellar pouch. In addition, visualization of the posteromedial structures is difficult owing to the arthroscope's entering at too steep an angle that is not parallel to the joint space. Inferior placement puts the anterior horn of the meniscus at risk for iatrogenic laceration. The medial tibial spine may block the path of instruments as they are passed across the notch into the lateral compartment. Further, at this level, the arthroscope enters the thickest portion of the infrapatellar fat pad. Excessively medial placement may also result in penetration of the edge of the patellar tendon, restricting maneuverability within the joint.

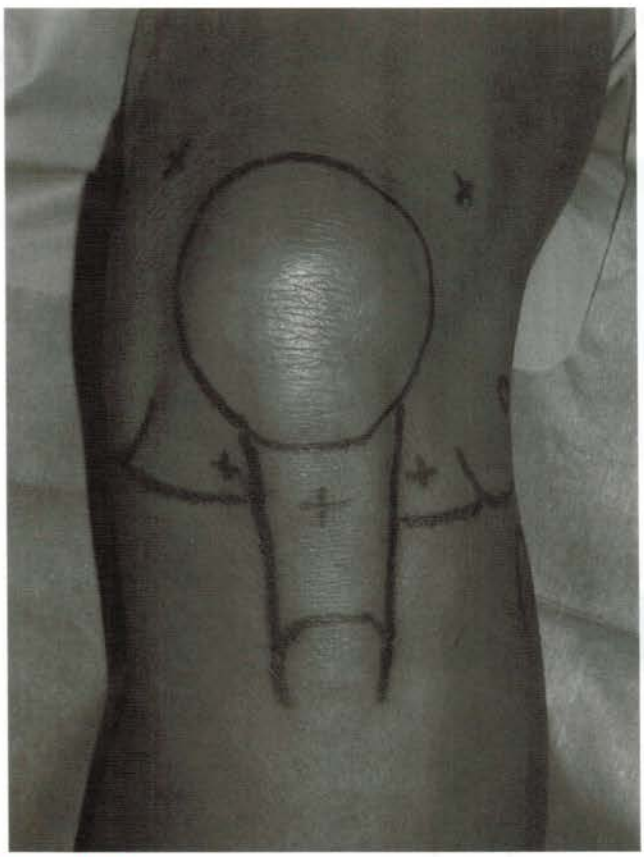

Figure 46–4 Surgeons new to arthroscopy may benefit from drawing the joint line and bony anatomy. This figure demonstrates the anteromedial, anterolateral, superomedial, superolateral, and transpatellar portals (see text).

Anteromedial Portal

The anteromedial portal is the primary working portal. It may be used to introduce arthroscopic instrumentation or as an alternative viewing portal. It is located 1 cm above the medial joint line, 1 cm inferior to the tip of the patella, and adjacent to the medial edge of the patellar tendon in the medial soft spot (see Fig. 46–4).[23] This portal can be made at the same time as the anterolateral portal, or it can be established under arthroscopic visualization after localization with a spinal needle (see Chapter 47).

Superomedial and Superolateral Portals

Either of these portals can be useful for the evaluation of dynamic tracking of the patellofemoral articulation and, if necessary, as a separate portal for an inflow cannula if the scope sheath is not used for irrigation fluid. They are located approximately 2.5 cm superior to the superomedial or superolateral corner of the patella, respectively (see Fig. 46–4).[23] One must make sure that the portal is adjacent to but not through the quadriceps tendon. The superolateral entry site is typically less traumatic to the muscle and therefore less painful for the patient postoperatively. The interval between the vastus lateralis and iliotibial band can be readily defined with manual translation of the patella laterally. Lateral subluxation of the patella tenses the lateral edge of the vastus lateralis and accentuates the interval between the vastus lateralis and the iliotibial band. The cannula is aimed toward the suprapatellar pouch during insertion to avoid inadvertent chondral injury to the patella or femoral trochlea. This portal is useful as an inflow-outflow portal or for assessment of patellofemoral tracking, visualization of the superior chondral surface of the patella and trochlea, and retrieval of loose bodies in the suprapatellar pouch.

Accessory Portals

Posterolateral Portal

This portal is rarely used in routine arthroscopy. It is located behind the lateral collateral ligament anterior to both the biceps tendon and the common peroneal nerve (Fig. 46–5). This portal can be palpated when the joint is fully distended with the knee in a figure-of-four position. It is used primarily for assisting in posterior horn repairs of the lateral meniscus,[21] total synovectomies,[15,29] and occasionally removal of loose bodies.[9,17,30]

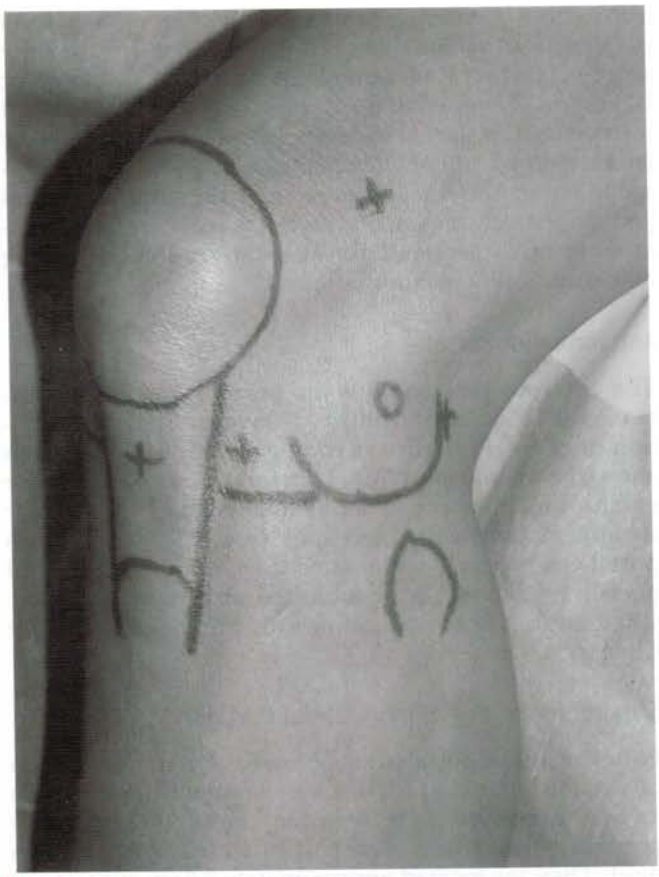

Figure 46–5 Lateral oblique view demonstrating the posterolateral portal. The femoral condyle, fibular head, and joint line have been outlined. The lateral epicondyle is marked with a circle (o).

Posteromedial Portal

Located in a small triangular soft spot formed by the posteromedial edge of the femoral condyle and tibia, this portal offers optimal viewing of and access to the posteromedial compartment structures.[12,13] The location is approximately 2 cm above the posteromedial joint line and 1 to 2 cm posterior to the palpable outline of the femoral epicondyle and the medial collateral ligament origin (Fig. 46–6). Hence, the portal is above and behind the posteromedial compartment, with instruments inserted down and anteriorly to access the joint. This small triangle is often difficult to find, but the landmarks are easier to palpate before joint distention and with the knee flexed to 90 degrees. Transilluminating the skin by passing the arthroscope under the posterior cruciate ligament into the posteromedial compartment also assists in locating this portal while decreasing the risk of saphenous nerve and vein injury by outlining their location. A spinal needle is then introduced, and the location and direction are confirmed intra-articularly under direct vision. For this portal, it is often safest to cut only the skin with the knife blade and then use a straight hemostat to spread bluntly through the soft tissues into the joint to minimize injury to the neurovascular structures.

Transpatellar Portal

First described to facilitate exposure of the intercondylar notch, this portal, as the name implies, is a vertical incision directly through the patellar tendon paralleling its fibers (see Fig. 46–4). Although this portal allows

A

B

Figure 46–6 *A*, Medial oblique view demonstrating the posteromedial portal. The femoral condyle and joint line have been outlined. The medial epicondyle is marked with a circle (o). *B*, A meniscal rasp is placed through the posteromedial portal to access the meniscosynovial junction of the medial meniscus.

excellent visualization of intercondylar notch structures, it can be difficult to manipulate the arthroscope through the patellar tendon.[11] In addition, this portal risks the complications of tendinitis and catastrophic injury to the extensor mechanism. As a result, this portal is seldom used.

Other Accessory Portals

If the surgeon has a clear understanding of the joint anatomy and the location of neurovascular structures that are potentially at risk, accessory portals can be established in almost any area of the knee. The position of these portals is dependent on the location of the pathology and the angle of access required. The same techniques used to establish other portals, such as avoidance of neurovascular structures and localization with a spinal needle under direct vision, are used for establishing these portals.

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