6 Knee Arthroscopy: General Setup, Portal Options, and How to Manage a Complete Arthroscopic Investigation

Nicolas Pujol and Philippe Beaufils

6.1 Introduction

The cornerstone of arthroscopy performed for diagnosis or treatment is good visualization and palpation of the intra-articular structures to establish an accurate diagnosis, devise the treatment strategy, and work on the target site without damaging the surrounding tissues. Arthroscopists should be conversant not only with the standard portals but also with specific portals that are optimal for a given disorder or surgical technique. Three universal requirements must be met:

- Stringent adherence to surgical principles
- Use of equipment specifically designed for arthroscopic surgery
- Accessibility of the findings to other physicians via a standardized examination whose results are recorded in detail in a standardized report that includes a video recording or photographs (paper or digital)

6.2 Material

In addition to the video system, knee arthroscopy requires the equipment described below.

N. Pujol, MD (✉) • P. Beaufils, MD
Department of Orthopaedic Surgery,
Centre Hospitalier de Versailles,
Versailles-Saint Quentin University,
177, rue de Versailles, Le Chesnay 78157, France
e-mail: npujol@ch-versailles.fr

6.2.1 The Arthroscope

In most cases, a 25–30° wide-angle arthroscope measuring 4.5 mm in diameter is used. A 70° arthroscope is sometimes useful in some indications (to explore the posterior compartments or the anterior portion of the lateral meniscus).

6.2.2 The Standard Instrumentation

6.2.2.1 Mechanical Instruments

Mechanical instruments should be both powerful and precise.

There is no need to have a very large number of instruments. The basic set (Fig. 6.1) is composed of a probe, which is used routinely; a powerful grasping forceps, preferably with serrated jaws; straight and angled 3.5-mm scissors; 3.5-mm and 5-mm punch forceps; and a 90° basket forceps.

6.2.2.2 Motorized Instruments

At the knee, motorized instruments (shavers) are commonly used for specific procedures (e.g., synovectomy or cruciate ligament repair). For meniscectomy, motorized instruments can be helpful in order to remove all foreign bodies at the end of the procedure and to clean the meniscal rim.

6.2.2.3 Bipolar Electrocoagulation and Radiofrequency

This instrument ensures safe electrocoagulation in a saline environment. It has some indications

P. Randelli et al. (eds.), *Arthroscopy: Basic to Advanced*, DOI 10.1007/978-3-662-49376-2_6

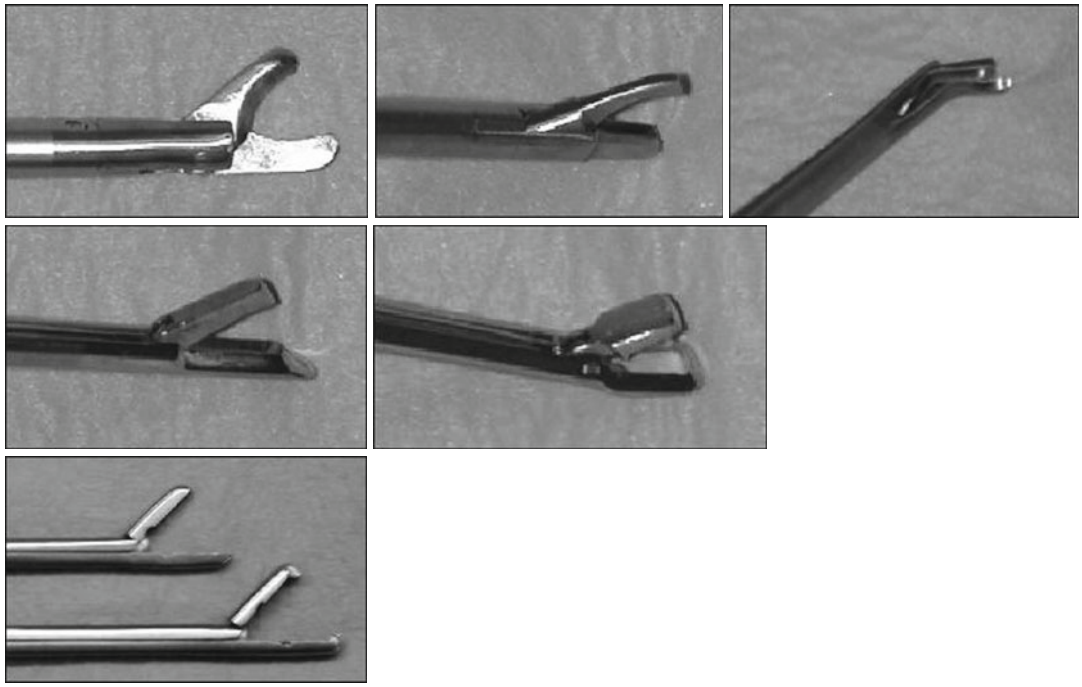

Fig. 6.1 The basic set of instruments comprises a probe, scissors, punch forceps, and grasping forceps

at the knee (lateral retinacular release, coagulation if excessive bleeding despite the use of a tourniquet, cartilage debridement with dedicated wands, synovectomy especially in the posterior compartments). For example, this is not recommended for standard ACL reconstructions in order to preserve the maximum vascularity of the remnants in the intercondylar notch.

6.2.3 Irrigation Cannulas

Irrigation can be obtained by gravity only! A pressure pump that maintains a constant pressure within the knee is useful for sophisticated procedures such as ligament repair and synovectomy. For easy partial meniscectomies, it is not always necessary.

6.3 Anesthesia and Positioning

6.3.1 Anesthesia

General anesthesia and spinal anesthesia are the main techniques for a knee arthroscopy. These two techniques are equivalent for ultrashort outpatient procedures, such as simple arthroscopies [6]. Sometimes, a local anesthesia can be used, with injection at the entry sites of lidocaine 2 % containing 1 % adrenaline (20 ml) [22] and pressure irrigation of the joint with a solution containing 200 mg/L of bupivacaine. At the end of the procedure, a single intra-articular injection of lidocaine hydrochloride can be useful, without any toxic effects on chondrocytes [19].

6.3.2 Positioning

We agree with Jackson [9] that the patient can be positioned supine on an ordinary table with no leg holder. The operator sits on the side of the knee to be treated. One advantage of this position is that it allows full mobility of the hip and knee. The other widely used position involves placing a leg holder at the proximal thigh [24]. The end of the table is folded down and the operator stands along the axis of the lower limb. This position opens up the medial compartment.

6.4 Technique

6.4.1 General Principles

Knee arthroscopy is guided by the following main principles:

- The probe should always be used, and, therefore, an instrument portal is always needed. The probe serves to displace, pull, palpate, or measure the intra-articular structures.
- The principle of triangulation is used to hold the arthroscope and instruments. A larger distance between the two portals makes triangulation easier to achieve. Insertion of a needle whose position is visualized using the arthroscope is often useful to determine the optimal site for the instrument portal.
- If needed, the positions of the arthroscope and instruments should be switched and additional portals used.
- All the main structures should be assessed during a standard arthroscopy, and their aspect should appear in the report of the surgical procedure, even normal.

6.4.2 Anterior Portals (Fig. 6.2)

6.4.2.1 Anterolateral Portal

This is the standard viewing portal. Proper positioning of the portal is crucial to enable high-quality exploration of the joint. The incision is adjacent to the lateral edge of the patellar tendon, 2 mm proximal to the lateral meniscus. The incision site is identified by placing the tip of the thumb in the depression located just above Gerdy's tubercle and creating the incision immediately above the nail.

Arthroscopic examination is performed in a systematic sequence (Fig. 6.3), as detailed below.

The suprapatellar recess and the femoropatellar compartment are examined successively by slowly withdrawing the arthroscope from the extended knee. Rotating the arthroscope provides a very good view of all the structures including the suprapatellar recess with its synovial lining, the suprapatellar or medial plica, the cartilage covering the patella and trochlea, and the proximal portions of the medial and lateral gutters.

The medial compartment is then examined by placing the arthroscope parallel to the joint space then flexing the knee to 30° while applying valgus stress. By rotating the arthroscope, the

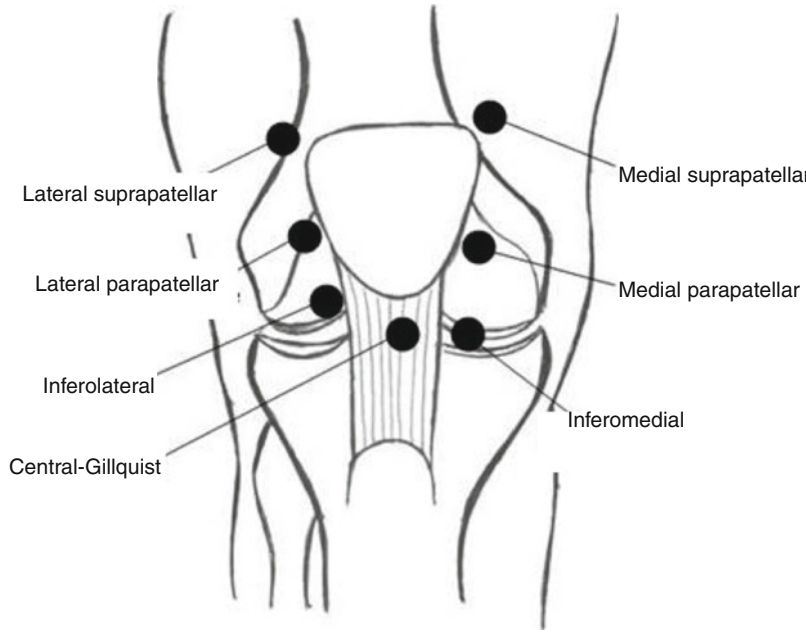

Fig. 6.2 Anterior portals

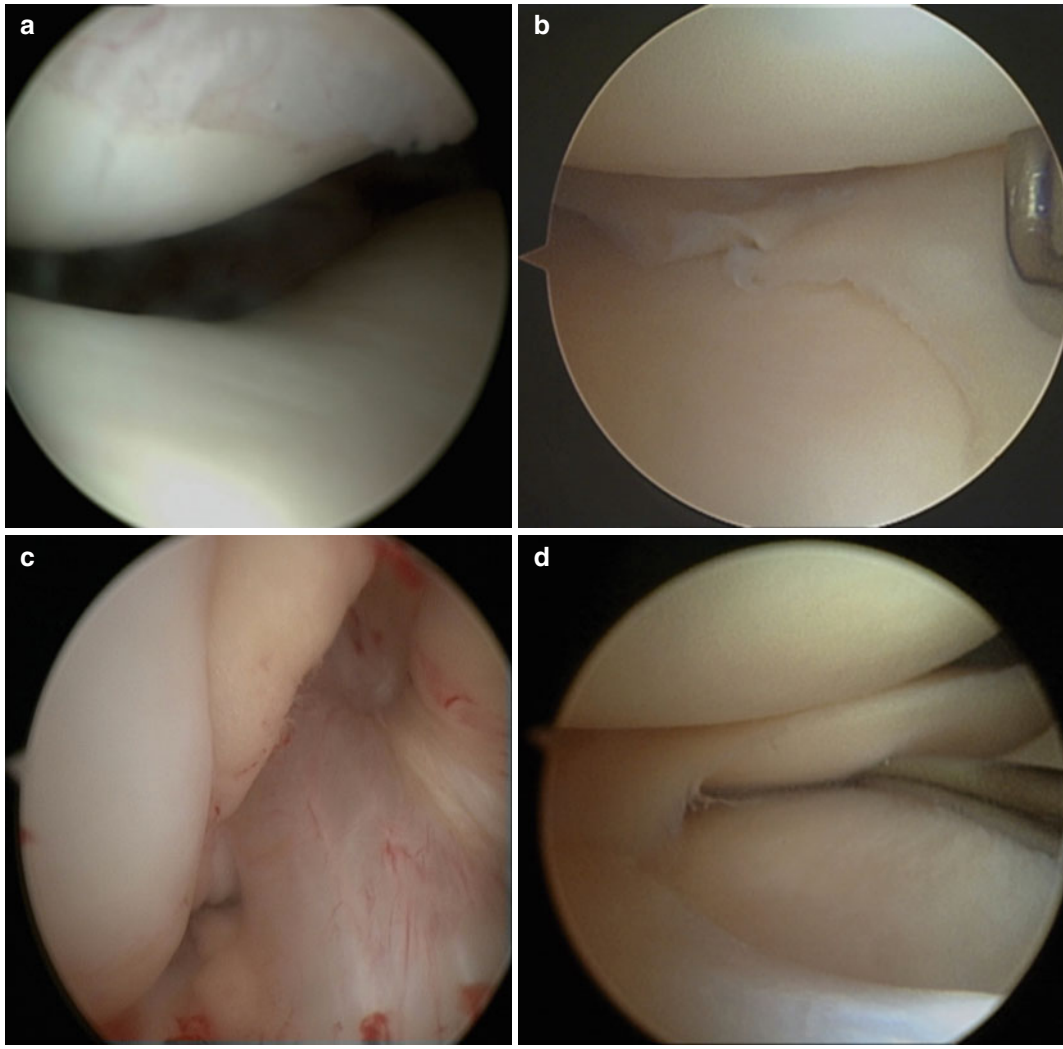

Fig. 6.3 Anterolateral viewing portal (*right knee*). (**a**) Femoropatellar compartment, (**b**) medial femorotibial compartment, and (**c**) intercondylar notch. The posterior crucial ligament is not visible. (**d**) Lateral compartment

following structures can be visualized in succession: distal part of the medial gutter, anterior and medial portions of the medial meniscus, and posterior portion of the medial meniscus. The posterior horn is rarely visible entirely along both aspects, and palpation using the probe is therefore crucial to detect lesions. Then, the medial femorotibial cartilage is inspected and palpated using the probe. If the medial compartment is tight, needle pie crusting of the deep fibers of the medial collateral ligament opens up the medial compartment by 2–3 mm without creating any damage [2, 7]. The additional space thus created allows the operator to work under satisfactory conditions without damaging the cartilage (Fig. 6.4).

The intercondylar region is examined with the knee flexed at 90°. The anterior cruciate ligament is usually clearly visible. The posterior cruciate ligament is concealed by a fat pad that covers its femoral insertion site. A large inferior plica may conceal the cruciate ligaments.

The lateral compartment is examined with the knee in 90° of flexion in Cabot's position and the foot on the table, which opens up the lateral compartment. The following structures are examined

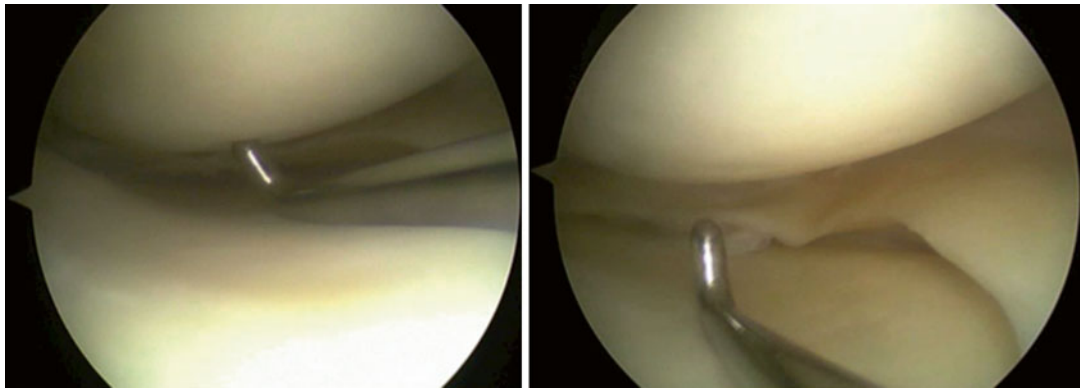

Fig. 6.4 Pie crusting of the deep fibers of the medial collateral ligament under the meniscus to open medial joint space in tight knees

successively: anterior, middle, and posterior portions of the lateral meniscus, lateral femorotibial cartilage, and popliteal tendon (Fig. 6.5) in its supra- and inframeniscal portions and in the distal part of the lateral gutter.

Although the posterior compartments are often accessible via the anterior approach, they are not examined routinely. The posterior compartments should be examined when the clinical or imaging study findings suggest a posterior abnormality or when a therapeutic intervention on posterior structures is needed.

The posteromedial compartment is very often accessible via the anterolateral approach by placing the tip of the arthroscope between the axial aspect of the medial condyle and the cruciate ligaments and then gradually advancing the arthroscope posteriorly, inferiorly, and medially in contact with the posterior meniscal horn with the knee flexed at 90°. The compartment can be examined by rotating the arthroscope, but can be broadened by substituting a 70° arthroscope for the 30° arthroscope (Fig. 6.6). Advantages of this method include the ability to visualize the posteromedial capsule and to provide visual guidance when performing a needle trial to determine the best position for a posteromedial portal. In most of the cases, the inspection of the posteromedial ramp with a 30° arthroscope is sufficient to diagnose the presence of a meniscocapsular lesion. An additional percutaneous needle palpation of the meniscocapsular junction through a posteromedial portal may be helpful to rule out so-called hidden lesions [23]. If in doubt, a 70° arthroscope or a direct visualization of this area through a posteromedial approach may be required. Internal rotation of the tibia and careful extension and flexion movements are helpful to assess this specific region and the behavior of the capsule [15].

Fig. 6.5 Popliteal fossa through anterolateral portal

The posterolateral compartment is easier to examine. With the knee in 90° of flexion in Cabot's position, the arthroscope is advanced between the axial aspect of the lateral condyle and the anterior cruciate ligament. Then, as described for the medial compartment, the following structures can be examined: posterior capsule, posterior wall of the lateral meniscus, and posterior part of the lateral condyle. The popliteal tendon is not normally visible via this approach.

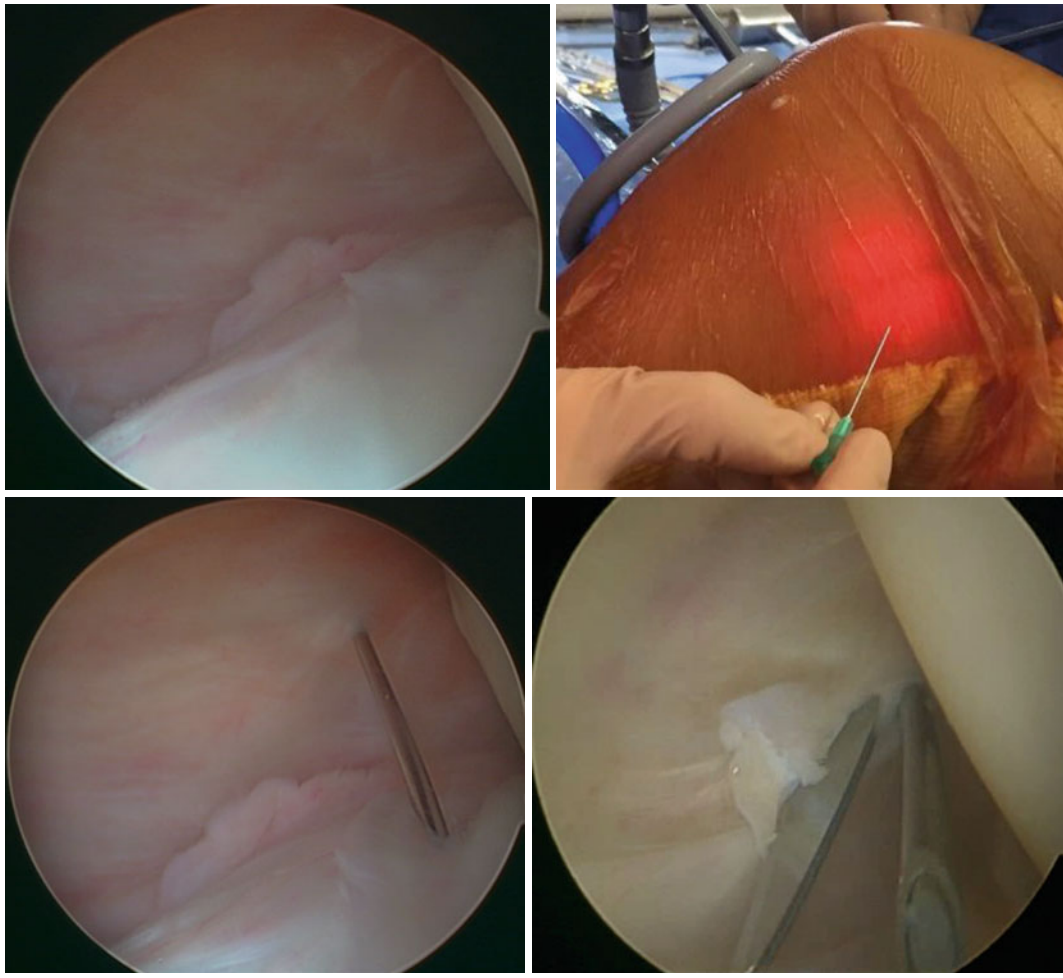

Fig. 6.6 Posteromedial portal

The anterolateral portal is the standard viewing portal and is used routinely for arthroscopy of the knee. This portal offers the largest field of view and has the smallest blind spots [11]. However, it is inadequate for visualizing the anterior third of the lateral meniscus, the medial gutter, the femoropatellar dynamics, and the posterior compartments (unless a 70° arthroscope is used).

6.4.2.2 Anteromedial Portal

The anteromedial portal is the main working or instrumentation portal. The placement of this portal is critical for effectively reaching the various intra-articular structures with the arthroscopic instruments. It is recommended to create this portal under direct vision using the arthroscope. The portal is created just above the wall of the medial meniscus taking care to avoid contact with the patellar tendon in order to ensure sufficient freedom of movement of the instruments. Transcutaneous illumination is also helpful in order to avoid vessels and skin nerves (infrapatellar branches of the saphenous nerve).

Introducing the arthroscope via the anteromedial portal adds to the information obtained via the anterolateral portal by visualizing the medial patellofemoral ramp, the posteromedial compartment, the anterior third of the lateral meniscus, and the femoral insertion of the ACL.

6.4.3 Other Anterior Portals

Each of these portals can serve for the arthroscope or the instruments. Their use is far from routine and depends on the nature of the lesions to be treated (Table 6.1).

6.4.3.1 Central Portal

The central transpatellar tendon portal was first described by Gillquist [13]. The arthroscope is inserted through the patellar tendon, 10 mm above the tibial plateau. This rarely used portal has two main indications, namely, a need for a second instrument portal when performing a difficult meniscectomy, after removal of the middle third of the patellar tendon during ACL reconstruction, and as an accessory portal to reduce anterior tibial spine fractures.

6.4.3.2 Lateral and Medial Suprapatellar Portals

These portals are located 1 cm above the border of the patella on a line prolonging the medial or lateral edge of the patella. For viewing, the superolateral portal is chiefly used to examine the patella (femoropatellar dynamics), trochlea, fat ligament, and plicae [5]. It provides a good view of the proximal part of the lateral gutter (Fig. 6.7). As instrumental portals, the lateral and medial suprapatellar sites are mainly useful for anterior recess synovectomy and for the treatment of lesions located in the anterior knee.

Table 6.1 Viewing portals depending on the lesion to treat

	Anterolateral	Anteromedial	Central	Superior	Posterior
Medial meniscectomy	+++	++	+	0	+
Lateral meniscectomy	++	++	0	0	+
Repair of the medial meniscus	+++	+++	0	0	++
Repair of the lateral meniscus	+++	+++	0	0	0
Foreign bodies	+++	++	0	+	++
Femoropatellar compartment	++	0	0	+++	0
Synovectomy	+++	+++	0	+++	+++
Anterior cruciate ligament reconstruction	+++	++	0	0	0
Posterior cruciate ligament repair	+++	+++	+	0	+++

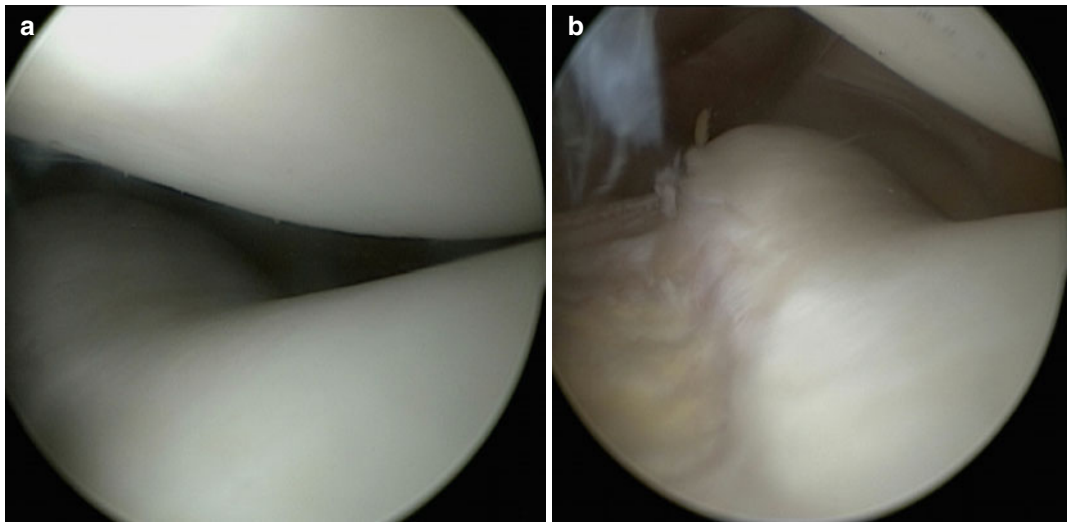

Fig. 6.7 (**a**) Femoropatellar compartment examined via the lateral suprapatellar portal. (**b**) Top of the trochlea is well visible through suprapatellar portal

6.4.3.3 Lateral Midpatellar Portal

D. Patel [18] routinely uses the lateral midpatellar portal for viewing. This portal is in a high anterolateral location. Compared to the standard anterolateral portal, it provides a better view of the anterior portions of both menisci. However, visibility of the posterior structures is decreased compared to the standard anterolateral portal.

6.4.4 Posterior Portals

Posterior portals are difficult to create, and special care is required to avoid injuring the major blood vessels and nerves located behind the knee, not only the popliteal neurovascular bundle but also the peroneal nerve laterally and the medial saphenous nerve medially. The posteromedial portal is located at the posterior angle of the condyle, which is easily felt when the knee is flexed, 1 cm proximal to the femorotibial joint space (Fig. 6.6). There are three crucial requirements: the knee must be flexed at 90° and distended, and the portal must be created under visual guidance after introduction of the arthroscope into the relevant compartment via the anterolateral portal. The entry site is then identified by introducing a needle or no. 11 scalpel posteromedially. The arthroscope is then introduced into the portal. The posterolateral portal is located symmetrically to the posteromedial portal and is created according to the same principles.

The posterior portals can be used for the arthroscope or instruments, which can be switched from the anterior portals. They provide a better view of the posterior structures than do the anterior portals [10]. Thus, the posterior aspect of the condyles is entirely visible, as well as the posterior meniscal wall, condylar cartilage, and base of the posterior cruciate ligament.

Louisia and Beaufils described a combined posteromedial and posterolateral portal established using a back-and-forth technique [14]. This portal can be used to collapse the septum located above the posterior cruciate ligament in order to create a single posterior cavity (Fig. 6.8). It is particularly valuable for extensive posterior synovectomy but should be reserved for experienced arthroscopists [1].

6.5 Intraoperative Complications

Overall, arthroscopy is associated with some complications [3, 8, 25], around 1 % for simple arthroscopies such as meniscectomies [12].

6.5.1 Instrument Breakage

Despite improvements in instrument design, breakage continues to occur, at a rate of less than 0.1 % [20]. To ensure the early diagnosis and to avoid subsequent malpractice suits, the instruments should be examined carefully after each procedure [17].

6.5.2 Vascular Injuries

Vascular injuries are exceedingly rare (the incidence after arthroscopic meniscectomy is 0.003 %) [4]. Injury to the popliteal blood vessels can have devastating consequences.

Fig. 6.8 Back and forth posterior portal (outer appearance, arthroscopic view)

A few simple precautions help to prevent vascular injuries: instruments should be used only under visual guidance, aggressive motorized instruments should not be used in the posterior compartments, the drainage fluid should be examined at the end of the procedure to check that it is clear, and the vascular supply to the limb should be checked in the operating room after releasing the tourniquet.

6.5.3 Nerve Injuries

Nerve injuries occur in 0.4–0.6% of cases [11]. The most common form of nerve injury is neuroma of the infrapatellar branch of the medial saphenous nerve, which has been reported during medial meniscectomy or medial meniscus repair (out-in technique). Injury to the popliteal nerve or fibular nerve is exceedingly rare but devastating.

6.5.4 Other Complications

Many complications can occur after arthroscopy. Examples include ligament injury after valgus or varus stress application [16]; complete or partial section of the anterior cruciate ligament during lateral meniscectomy; damage to the cartilage while inserting the instruments or doing a meniscectomy [21], which may be extensive if the joint is tight; damage to a meniscus during portal creation; and burns during electrocoagulation.

The prevention of complications involves the use of appropriate equipment, proper portal positioning, the development of a well-defined treatment strategy, and gentleness.

6.6 Postoperative Care

The portals are closed with resorbable sutures or adhesive strips. Drainage is unnecessary after diagnostic arthroscopy or simple arthroscopic interventions (e.g., meniscectomy). Postoperative analgesia can be obtained by injecting a morphine-bupivacaine mixture into the joint or around the wounds [22].

Conclusions

Arthroscopy of the knee is one of the most common procedures that orthopedic surgeons perform. Although minimally invasive, arthroscopic knee surgery is a surgical procedure that involves pre-, intra-, and postoperative constraints. This technique is routinely used and requires specific instruments and training. Rigorous standard exploration and positioning of the portals are essential steps to start always the surgical procedure in perfect conditions.

References

1. Ahn JH, Ha CW. Posterior trans-septal portal for arthroscopic surgery of the knee joint. Arthroscopy. 2000;16:774–9.
2. Atoun E, Debbi R, Lubovsky O, Weiler A, Debbi E, Rath E. Arthroscopic trans-portal deep medial collateral ligament pie-crusting release. Arthrosc Tech. 2013;2:e41–3.
3. Basques BA, Gardner EC, Varthi AG, Fu MC, Bohl DD, Golinvaux NS, Grauer JN. Risk factors for short-term adverse events and readmission after arthroscopic meniscectomy: does age matter? Am J Sports Med. 2015;43:169–75.
4. Bernhoff K, Bjorck M. Iatrogenic popliteal artery injury in non arthroplasty knee surgery. Bone Joint J. 2015;97-B:192–6.
5. Brief LP, Laico JP. The superolateral approach: a better view of the medial patellar plica. Arthroscopy. 1987;3:170–2.
6. Camponovo C. Spinal 1% 2-Chloroprocaine versus general anesthesia for ultra-short outpatient procedures: a retrospective analysis. Acta Biomed. 2014;85:265–8.
7. Fakioglu O, Ozsoy MH, Ozdemir HM, Yigit H, Cavusoglu AT, Lobenhoffer P. Percutaneous medial collateral ligament release in arthroscopic medial meniscectomy in tight knees. Knee Surg Sports Traumatol Arthrosc. 2013;21:1540–5.
8. Hagino T, Ochiai S, Watanabe Y, Senga S, Wako M, Ando T, Sato E, Haro H. Complications after arthroscopic knee surgery. Arch Orthop Trauma Surg. 2014;134:1561–4.
9. Jackson RW. Arthroscopic surgery. J Bone Joint Surg Am. 1983;65:416–20.
10. Kim SJ, Song HT, Moon HK, Chun YM, Chang WH. The safe establishment of a transseptal portal in the posterior knee. Knee Surg Sports Traumatol Arthrosc. 2011;19:1320–5.
11. Kim TK, Savino RM, McFarland EG, Cosgarea AJ. Neurovascular complications of knee arthroscopy. Am J Sports Med. 2002;30:619–29.

12. Kinsella SD, Carey JL. Complications in brief: arthroscopic partial meniscectomy. Clin Orthop Relat Res. 2013;471:1427–32.
13. Lindberg U, Hamberg P, Lysholm J, Gillquist J. Arthroscopic examination of the patellofemoral joint using a central, one-portal technique. Orthop Clin N Am. 1986;17:263–8.
14. Louisia S, Charrois O, Beaufils P. Posterior "back and forth" approach in arthroscopic surgery on the posterior knee compartments. Arthroscopy. 2003;19:321–5.
15. Lubowitz JH, Rossi MJ, Baker BS, Guttmann D. Arthroscopic visualization of the posterior compartments of the knee. Arthroscopy. 2004;20:675–80.
16. Nandi S, Parker R. Deep medial collateral ligament tear during knee arthroscopy. J Knee Surg. 2012;25:79–81.
17. Oztekin HH. An unusual complication of knee arthroscopy: an extra-articular migrated asymptomatic broken probe from the knee joint. Arch Orthop Trauma Surg. 2005;125:285–7.
18. Patel D. Proximal approaches to arthroscopic surgery of the knee. Am J Sports Med. 1981;9:296–303.
19. Ravnihar K, Barlic A, Drobnic M. Effect of intra-articular local anesthesia on articular cartilage in the knee. Arthroscopy. 2014;30:607–12.
20. Reigstad O, Grimsgaard C. Complications in knee arthroscopy. Knee Surg Sports Traumatol Arthrosc. 2006;14:473–7.
21. Schmid RB, Wirz D, Gopfert B, Arnold MP, Friederich NF, Hirschmann MT. Intra-operative femoral condylar stress during arthroscopy: an in vivo biomechanical assessment. Knee Surg Sports Traumatol Arthrosc. 2011;19:747–52.
22. Shaukat Y, Malik E, El-Khateeb H, Koeweiden E. The role of local anaesthesia in knee arthroscopy. J Orthop. 2013;10:193–5.
23. Sonnery-Cottet B, Conteduca J, Thaunat M, Gunepin FX, Seil R. Hidden lesions of the posterior horn of the medial meniscus: a systematic arthroscopic exploration of the concealed portion of the knee. Am J Sports Med. 2014;42:921–6.
24. Ward BD, Lubowitz JH. Basic knee arthroscopy part 1: patient positioning. Arthrosc Tech. 2013;2:e497–9.
25. Westermann RW, Pugely AJ, Ries Z, Amendola A, Martin CT, Gao Y, Wolf BR. Causes and predictors of 30-day readmission after shoulder and knee arthroscopy: an analysis of 15,167 cases. Arthroscopy. 2015;31:1035–40. e1031.