Arthroscopic Knee Examination

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Arthroscopic knee examination seems to be a primary technique in knee arthroscopy. In fact, completing a full-scale examination of the knee joint is challenging. The main purpose of this section is to describe how, technically, a standard knee examination can be completed without omissions in examination space and some special injuries. The intra-articular space of the knee joint includes the suprapatellar pouch, the lateral gutter, the medial gutter, the patellofemoral joint, the anterior compartment, the femoral notch, the medial, lateral, posteromedial, and posterolateral compartments. From the aspect of completing the examination, there is no need to follow a certain sequence of procedures, if each space can be reached, and every part of the intraarticular structure can be checked.

The Diagnostic Value of Arthroscopic Knee Examination

At present, knee imaging examination technology has been quite mature. The diagnosis of knee injury mainly depends on medical history, physical examination, and imaging examination. In overall, knee examination operation for the diagnosis of disease is of little significance. However, despite this, there are still some diseases that rely on arthroscopic knee examination for accurate diagnosis. The overall indication of arthroscopic knee exploration is those who cannot be clearly diagnosed through medical history, physical examination, and auxiliary imaging examinations (Table 1.1).

The first specific indication of arthroscopic knee examination is a suspected meniscus tear at the conjunction with the capsule. Some special types of meniscus injury, such as injury at the junction of the meniscus and the capsule, nondisplaced root tear of the posterior horn of the meniscus, and some kinds of radius tear, are relatively difficult to detect through MRI examination and rely on arthroscopic examination as the final diagnose method. [1].

The second specific indication of arthroscopic knee examination is unexplained knee hematoma without cause of trauma. The etiologies mainly

Table 1.1 The indication of arthroscopic knee examination

1. Insidious meniscus injury
(a) Meniscus injury at its junction with the capsule
(b) Root tear
(c) Oblique vertical tear
(d) Radius tear
2. Unexplained knee hematoma
3. Insidious gout
4. Supplement diagnosis for cartilage lesion
5. Cartilage detection to define the suitability of osteotomy

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involve intra-articular hemangioma and hemorrhagic synovitis. [2].

The third specific indication of arthroscopic knee examination refers to insidious gout. Arthroscopy is the only way to diagnose insidious gout when the patient has gout-related signs and symptoms, but the result of serum uric acid test is within the normal range. Uric acid crystallization can be found on the synovium, and other types of uric acid deposition can even be found on other structures.

MRI examination is sensitive and reliable for the diagnosis of cartilage lesions, and arthroscopic examination is only used as a supplementary measure.

Another indication of arthroscopic examination is to detect the cartilage status to define the suitability of knee alignment correction operation. Compared with MRI examination, arthroscopic examination is the most accurate and can avoid unnecessary osteotomy.

Procedures of Arthroscopic Knee Examination

There is no standard procedure for knee arthroscopic examination. The following is my personal recommendation of the order of examination, in which the convergence of the checked part is often along the swing movement of the scope. In addition, the examination of the knee joint and the basic joint debridement are combined. There is no pure observation without any operation (Table 1.2).

Patient Position

The patient is placed in supine position. A tourniquet is placed at the proximal thigh. The knee is flexed at 90 degrees, and a supporting post is placed at the lateral side of the thigh in the position corresponding to the tourniquet. The knee is extended. Another supporting post is placed just at the proximal side of the joint line.

Portal Establishment

The knee is flexed at 90 degrees. The soft area among the patella tendon, the lateral femoral, and

Table 1.2 Step-by-step procedure of arthroscopic knee examination

Position of the knee	Manipulation	Special targets
90° flexion	Creating high anteromedial and high anterolateral portals	
Full extension	Checking the suprapatellar pouch	Closed suprapatellar plica
	Checking the lateral gutter	Bone fragment attached to the lateral femoral condyle
	Checking the popliteal hiatus	Free body, ramp tear connected to the popliteal hiatus
	Checking the patellofemoral joint from the lateral side	The position of the patella related to the femoral trochlea
	Removing the infrapatellar fat pad	
	Checking the medial synovial plica, removing it when indicated	The type of the medial synovial plica
	Checking the medial gutter	Free body
30° flexion	Checking and removing the infrapatellar plica	
	Checking the patellofemoral joint from the distal side	Lateral deviation of the patella; cartilage degeneration
30°–90° flexion	Checking the anterior compartment	The transverse knee ligament, the anterior meniscofemoral ligament, the tertial tibial eminence, and the insertion of the anterior cruciate ligament
	Checking the femoral intercondylar notch	Femoral notch stenosis and impingement to the ACL

Table 1.2 (continued)

Position of the knee	Manipulation	Special targets
30° flexion to full extension	Medial opening maneuver by an assistant Possible release of the medial collateral ligament Checking the medial compartment	Injury of the anterior horn, the body, and the posterior horn of the medial meniscus, and cartilage status
30° flexion	Enlarge the passage formed by the medial femoral condyle, the PCL, and the medial tibial eminence	
	Checking the posterior horn of the medial meniscus	Root tear of the medial meniscus
	Entering the posteromedial compartment	
90° flexion	Checking the posteromedial compartment	Root tear and ramp lesion of the medial meniscus and free bodies
Figure of 4	Placing the arthroscope in through the anteromedial portal	
	Checking the lateral compartment	Integrity of the lateral meniscus
	Checking the posterolateral compartment	Free bodies

tibial condyles are palpated. At the top edge of the soft area, close to the lateral edge of the patella tendon, the high anterolateral portal is established. The anteromedial portal is created at a position close to the medial edge of the patella tendon, at a level parallel to the high anterolateral portal.

The Suprapatellar Pouch

At full knee extension, the arthroscope is placed into the suprapatellar pouch. The suprapatellar plica is examined [3]. (Fig. 1.1) In case of closed suprapatellar plica or plica with a small hole, the plica is opened to explore the proximal side of it [4]. The suprapatellar pouch is checked for free bodies and synovium disorders such as inflammation, hypertrophy, or fibrosis. In case of knee arthrofibrosis, reduction of the suprapatellar pouch can be revealed.

The Lateral Gutter

With lateral swing and retrieving movement, the scope is placed to the lateral gutter of the knee. Lateral synovial plica usually exists but is seldom symptomatic (Fig. 1.2).

In patients with patella dislocation, bone fragment may be detected adhering to the lateral side of the lateral femoral condyle. At the bottom of the lateral gutter, the popliteal tendon hiatus can be detected (Fig. 1.3). Peripheral meniscus tear manifesting as hiatus extension and free body in the hiatus are detected.

The Patellofemoral Joint Viewed from the Lateral Side

The arthroscope is lifted from the bottom of the lateral gutter to the anterolateral edge of the lateral femoral condyle. The patellofemoral joint is checked from the lateral side (Fig. 1.4). The patella height related to the femoral trochlea, osteophyte at the proximal femoral trochlea, and the proximal patella should be checked. In case of large infrapatellar fat pad, the shaver is placed in through the anteromedial portal to partially remove it till the patellofemoral joint is clear.

The Medial Synovial Plica and the Medial Gutter

The arthroscope is placed into the patellofemoral joint. The medial synovial plica is checked. (Fig. 1.5) In case of type II or type III medial synovial plica, it is removed.

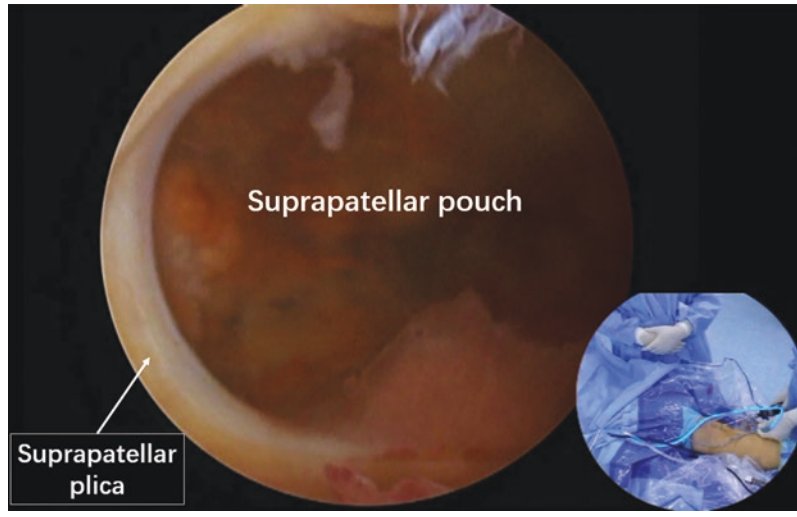

Fig. 1.1 Examination of the suprapatellar pouch (arthroscopic view of the left knee through the anterolateral portal.)

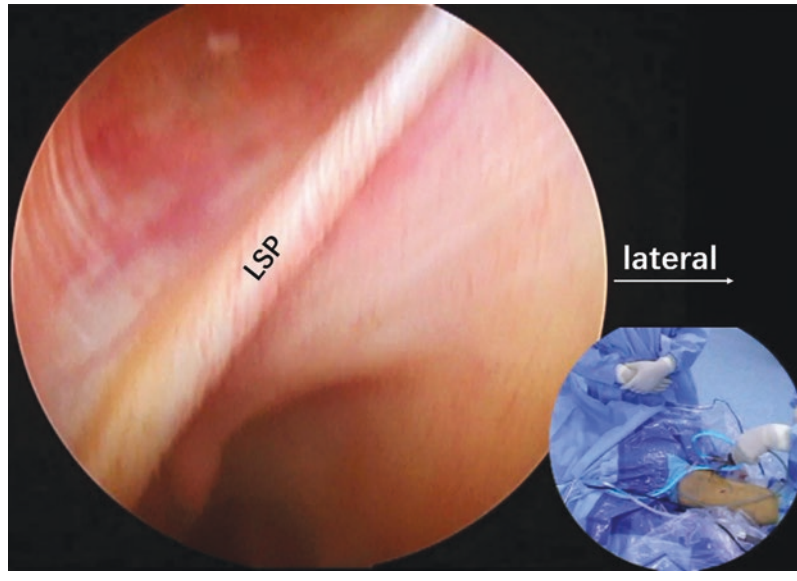

Fig. 1.2 Examination of the lateral gutter (arthroscopic view of the left knee through the anterolateral portal. *LSP*, lateral synovial plica)

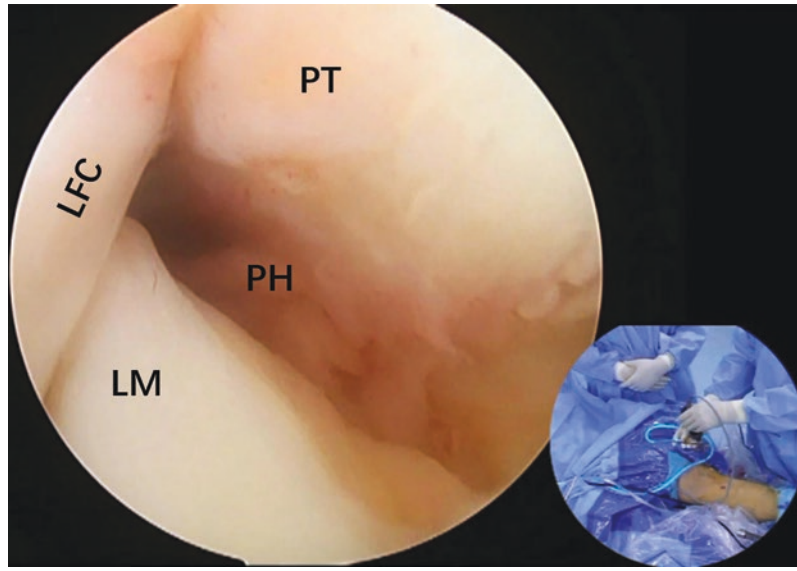

Fig. 1.3 Examination of the popliteal hiatus (arthroscopic view of the left knee through the anterolateral portal). *PH* popliteal hiatus, *PT* popliteal tendon, *LFC* lateral femoral condyle, *LM* lateral meniscus

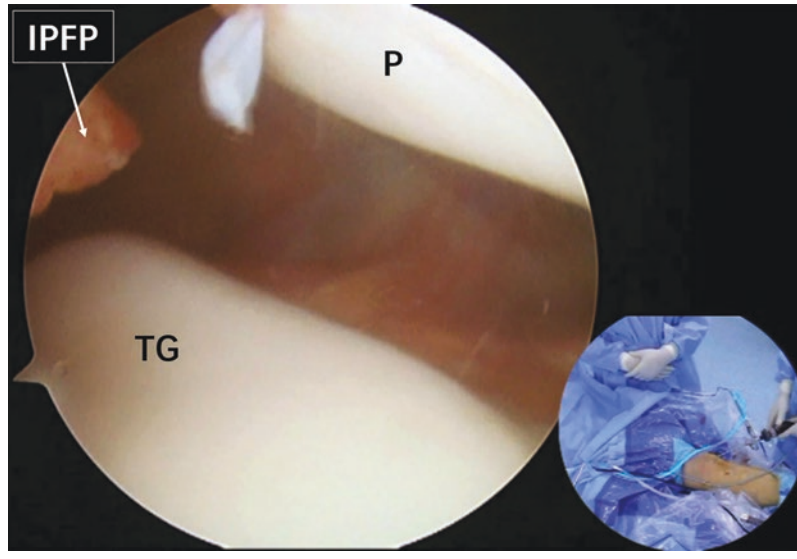

Fig. 1.4 Arthroscopic lateral view of the patellofemoral joint through the anterolateral portal. *P* patella. *TG* trochlea groove. *IPFP* infrapatellar fat pad

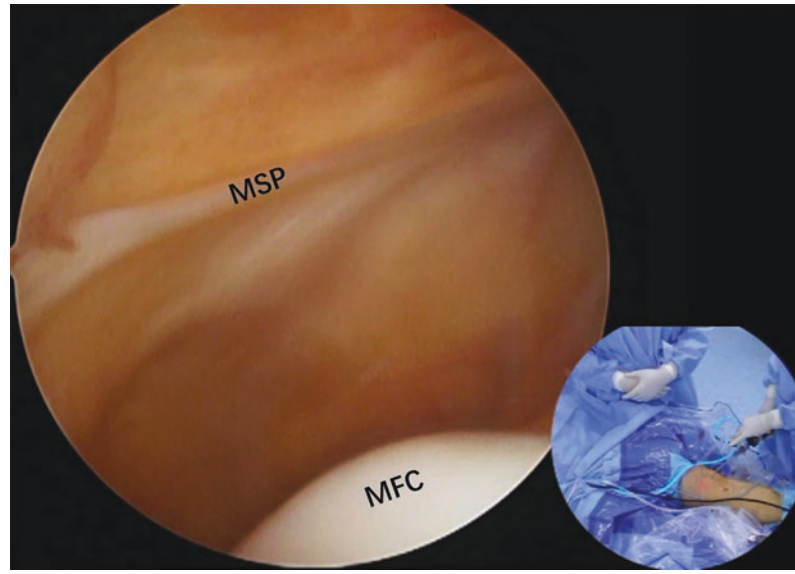

Fig. 1.5 Examination of the medial synovial plica (arthroscopic view of the anteromedial side of the left knee through the anterolateral portal). *MSP* medial synovial plica, *MFC* medial femoral condyle

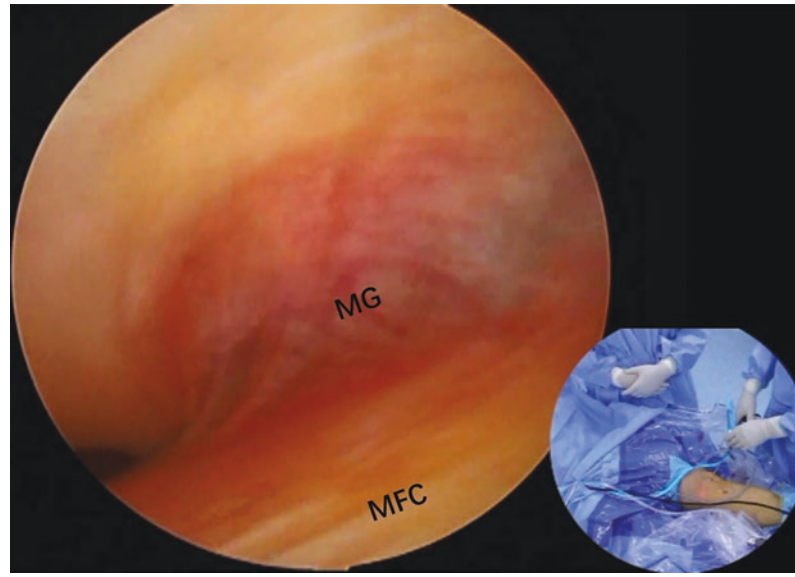

Fig. 1.6 Examination of the medial gutter (arthroscopic view of the medial gutter of the left knee through the anterolateral portal). *MG* medial gutter, *MFC* medial femoral condyle

The scope is placed through the patellofemoral joint to face the medial gutter downward. The medial gutter is checked (Fig. 1.6).

Anterior Compartment

The arthroscope is retrieved back to the anterior knee compartment. The knee is flexed at 30 degrees. The anterior compartment is checked. The infrapatellar plica is removed to expose the anterior outlet of the femoral notch (Fig. 1.7).

The transverse knee ligament is checked to detect hypertrophy. The anterior cruciate ligament insertion is checked at the inferior side of the transverse knee ligament, especially when ACL tibial avulsion fracture is to be detected. The tertial tibial eminence is detected. When there is an anterior meniscofemoral ligament, which connects the anterior horn of the medial meniscus and the lateral wall of the intercondylar notch, a fibrous structure is present at the anterior side of the anterior cruciate ligament. The anterior meniscofemoral ligament may cause

symptoms at knee extension and is recommended to be removed. [5].

The Patellofemoral Joint Viewed from the Distal Side

The patellofemoral joint is checked from the distal side. Lateral displacement of the patella and cartilage degeneration or injury of the patella and the femoral groove are checked. In case of acute patella dislocation, the medial patellofemoral ligament is checked to detect the status of injury (Fig. 1.8).

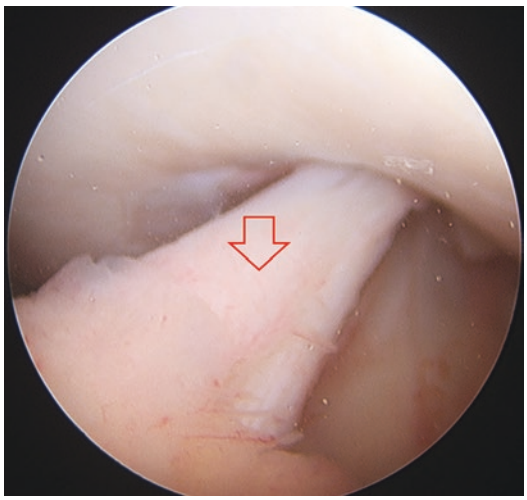

Fig. 1.7 Examination of the anterior knee compartment revealing the infrapatellar plica (arrow) (arthroscopic view of the anterior compartment through the anterolateral portal)

The Femoral Notch

The knee is flexed at 30 degrees. The femoral notch is examined to detect osteophytes and femoral notch stenosis (Fig. 1.9) and whether there is impingement to the anterior cruciate ligament. The knee is flexed at 90 degrees. The deep site of the femoral notch is examined to detect free bodies and the integrity of the cruciate ligaments.

Medial Compartment

The knee is flexed at 30 degrees. The anterior horn and the body of the medial meniscus is checked. Normally, the anterior horn of the medial meniscus is attached to the lower site of the medial tibial plateau. Cartilage status of the medial compartment is checked.

The knee is placed close to full extension. Pulling, medial opening and external rotating maneuver on the leg is performed to open the medial joint space by an assistant. The posterior horn of the medial meniscus is checked (Fig. 1.10).

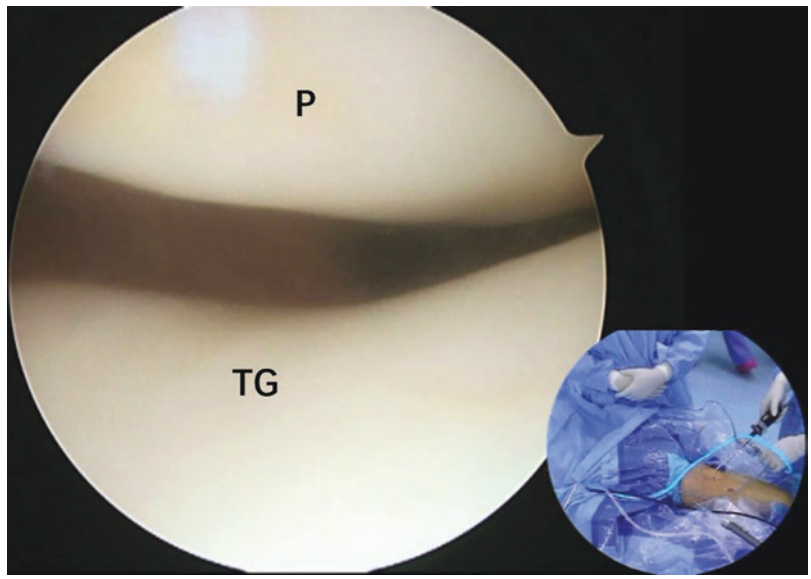

Fig. 1.8 Arthroscopic distal view of the patellofemoral joint through the anterolateral portal. *P* patella, *TG* trochlea groove

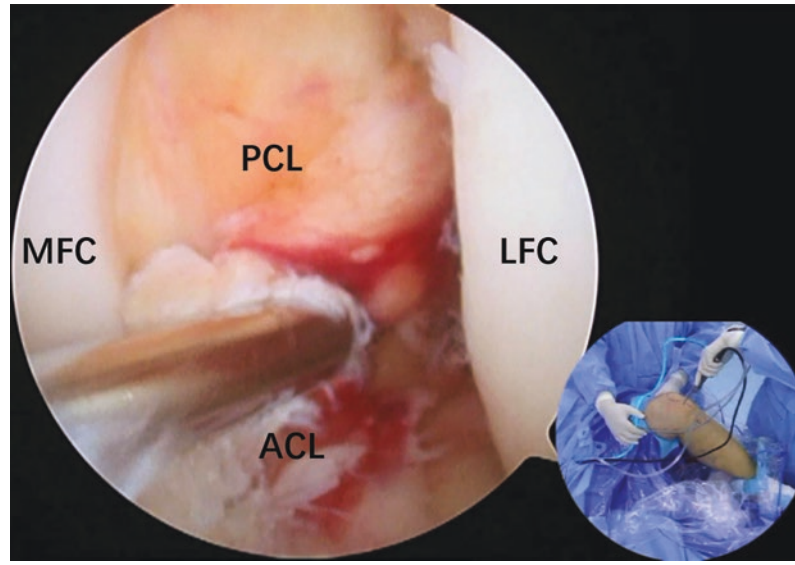

Fig. 1.9 Examination of the femoral notch (arthroscopic view of the left knee through the anterolateral portal). *ACL* anterior cruciate ligament (torn in this case). *PCL* posterior cruciate ligament. *MFC* medial femoral condyle. *LFC* Lateral femoral condyle

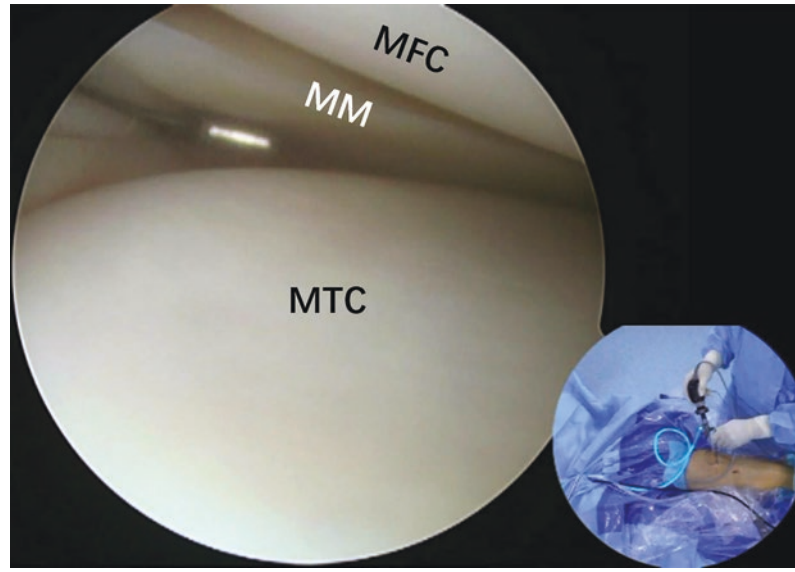

Fig. 1.10 Examination of the posterior horn of the medial meniscus (arthroscopic view of the medial compartment of the left knee through the anterolateral portal). *MM* posterior horn of the medial meniscus, *MFC* medial femoral condyle, *MTC* medial tibial condyle

If there is a high suspicion of injures of the posterior horn of the medial meniscus, and the medial joint space cannot be opened for exact evaluation. The medial collateral ligament is released first to open the medial joint space, and the posterior horn of the medial meniscus is checked [6].

Posteromedial Compartment

The knee is flexed at 30 degrees, and the arthroscope faces the intercondylar notch. Forceps are inserted through the interspace of the medial femoral condyle and posterior cruciate ligament into the posteromedial compartment. If the posteromedial compartment cannot be inserted because of the osteogenic hyperplasia on the medial wall of the intercondylar notch and the medial tibial eminence, the osteophytes on the medial wall of the intercondylar notch are removed with forceps, and the top of the medial tibial eminence is removed with a burr until the passage to the posteromedial compartment is opened. With the arthroscope placed into the femoral notch, the

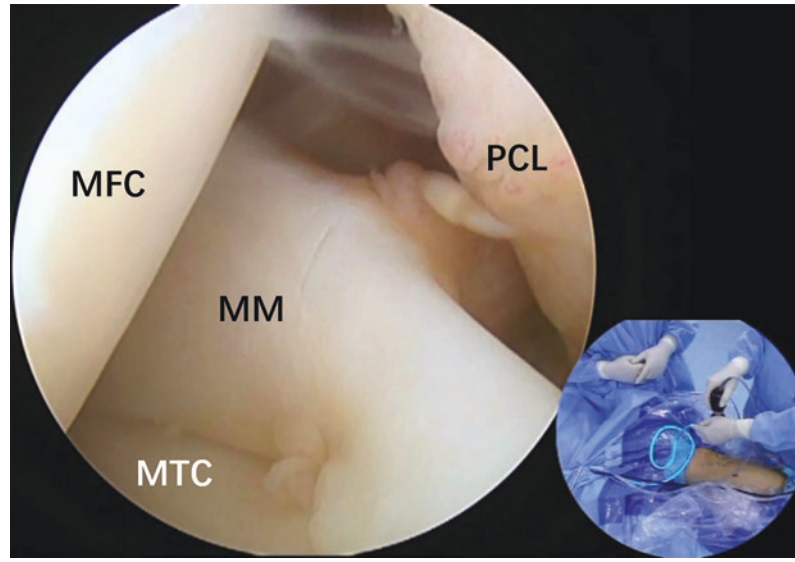

Fig. 1.11 Examination of the posterior root of the medial meniscus (arthroscopic femoral notch view of the left knee through the anterolateral portal). *MM* posterior root of the medial meniscus, *MFC* medial femoral condyle, *MTC* medial tibial condyle, *PCL* posterior cruciate ligament

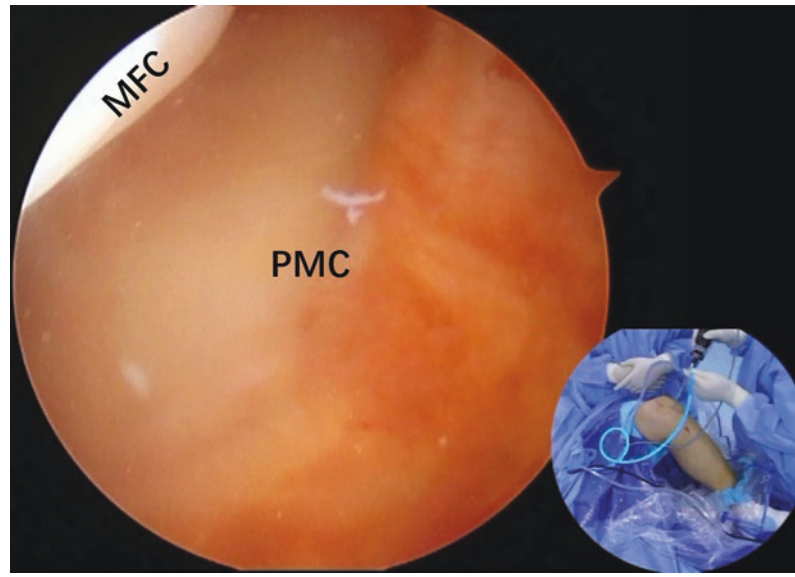

Fig. 1.12 Examination of the posteromedial compartment (arthroscopic view of the posteromedial compartment of the left knee through the anterolateral portal and the femoral notch). *MFC* medial femoral condyle, *PMC* posteromedial compartment

attachment of the posterior horn of the medial meniscus is checked to rule out the root tear of the medial meniscus (Fig. 1.11).

The arthroscope is inserted into the posteromedial compartment along the space between the medial wall of the intercondylar notch and posterior cruciate ligament. The knee is then flexed at 90° and the posteromedial compartment is examined thoroughly (Fig. 1.12). The main purpose is to detect whether there is damage at the junction of the meniscus and the joint capsule (ramp lesion), synovial lesions, and free body.

Lateral Compartment

The arthroscope is pulled out of the joint. The lower leg is placed in a figure-of-4 position. The arthroscope is placed into the joint through the anteromedial portal. A shaver is placed in to remove the synovial tissue near the anterolateral portal to expose the anterior edge of the lateral meniscus. The anterior horn of the lateral meniscus is observed (Fig. 1.13). The hook is used to check the stability of the lateral meniscus, and check whether there are free bodies at the infe-

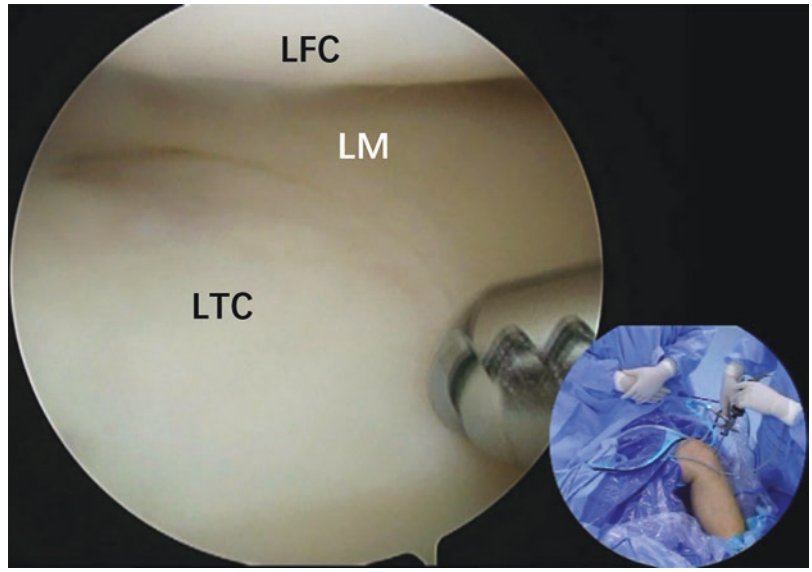

Fig. 1.13 Examination of the lateral compartment (arthroscopic view of the lateral compartment of the left knee through the anteromedial portal). *LFC* lateral femoral condyle, *LTC* lateral tibial condyle, *LM* lateral meniscus

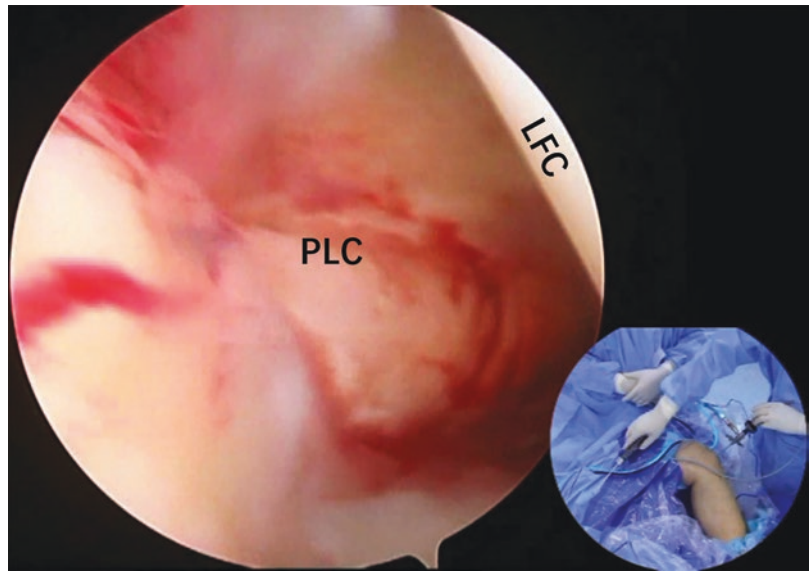

Fig. 1.14 Examination of the posterolateral compartment (Arthroscopic view of the posterolateral compartment of the left knee through the anteromedial portal). *LFC* lateral femoral condyle, *PLC* posterolateral compartment

rior site of the lateral meniscus. Then the body and the posterior horn of the lateral meniscus is checked.

The Posterolateral Compartment

The arthroscope was inserted through the space between the anterior cruciate ligament and the lateral femoral condyle into the posterolateral compartment (Fig. 1.14). Free bodies are found out. Any synovium lesions are checked.

Comments on Current Procedures

The pearls and pitfall of the current procedure are listed in Table 1.3. The most difficult part of this procedure is getting access to the posteromedial compartment in case of femoral notch stenosis.

Table 1.3 Pearls and pitfalls of arthroscopic knee examination

Pearls

1. The high anterolateral portal is slightly higher and closer to the patellar tendon than the ordinary anterolateral portal, which is conducive to the observation of the anterior compartment and the medial space of the knee, and to the insertion of the arthroscope into the posteromedial compartment. The high anteromedial portal is beneficial to the operation of the posterior horn of the medial meniscus
2. In the case of severe patella Baja, the anterior compartment of the knee is covered by the patella, and routine access to the joint through the anterolateral and medial portal is impossible. At this point, patellar tendon release (arthroscopically possible, followed by restoration of the patellar height and patellar tendon reconstruction) is required before a portal to the joint can be established
3. One premise of successful entry into the posteromedial compartment is that the passage to the posteromedial compartment is not blocked. In the case of bony hypertrophy obstructing the passage to the posteromedial compartment, the hypertrophic bone should be removed to open the passage
4. For the examination and treatment of lesions in the posterior septum, manipulation through the posteromedial and posterolateral portals are needed
5. For the free bodies in the knee joint, the most likely sites at which they are missed are the popliteal hiatus, the inferior site of the anterior horn of the lateral meniscus, and the posteromedial compartment. Therefore, it is necessary to conduct targeted exploration of relevant sites with preoperative imaging examination
6. In the case of ACL injury, sometimes even at the cross-legged figure-of-4 position, the lateral joint space cannot be opened, and it is necessary to lift the foot while cross-legged

Pitfalls

1. Under the condition that the height of the patella is normal, the high anterolateral portal should level the lower pole of the patella. However, a high anterolateral portal cannot always be established by referring to the lower patella pole, as patella Alta and Baja may occur, and a constant reference to the lower patella pole may result in too high or low a portal
2. The operation of the posterior horn of the lateral meniscus through the high anterolateral portal is sometimes inconvenient, and an additional low anterolateral portal can be added in case
3. The medial synovial plica can be classified into type I (residual), type II (non-femur contacting shelf), and type III (shelf with femur contact or impinged in the patellofemoral joint). For type II or III medial synovial plica, we routinely perform resection regardless of preoperative symptoms and signs associated with the medial synovial plica. Without resection, postoperative synovial edema and fibrosis may cause symptoms
4. Another premise of successful entry into the posteromedial compartment is that the anterolateral portal is properly set, which means the high anterolateral portal is used. Lower and lateral deviation of the anterolateral portal can cause difficulties in the entry to the posteromedial compartment
5. The tear on the inferior side and instability of the meniscus needs to be checked with a probe, and it is easy to miss related diseases through simple observation
6. The lateral deviation of patella found by arthroscopic examination does not mean that there is contracture in the lateral retinaculum of the patella, but only represents the tension imbalance of the soft tissue medial and lateral to the patella, which is not an inevitable indication of the release of the lateral retinaculum. Lateral retinaculum release requires a well-defined lateral retinaculum contracture to be performed
7. The laxity degree and injury of ACL should be explored with a probe in flexion position of the knee. Simple observation is easy to miss diagnosis, especially for the injury of the femoral attachment
8. Release of the medial collateral ligament is a routine procedure for the examination and management of the posterior horn of the medial meniscus. If the medial space of the joint is not fully opened, it is easy to miss the diagnosis of lesions, and the treatment of the posterior horn of the medial meniscus is easy to damage the articular cartilage

As for a thorough examination of the posterior septum, posteromedial and posterolateral portals should be used.

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