Surgical Management of the Stiff Knee

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Introduction

Stiffness of the knee or, more precisely, limited range of motion of the knee is an ill-defined term. The reason is that it is both a functional description and clinical sign that can evolve over time. Absolute numbers therefore have a limited value. Stiffness of the knee can be defined by certain variables:

- Evolution over time
- Tolerance (there is a difference between a total knee arthroplasty and ligament surgery)
- Etiology (ACL surgery, intra-articular fractures, etc.)

The precise range of motion must be clearly recorded in the patient's clinical notes with the same care, for example, that is taken to document the body temperature and arterial blood pressure during the pre- and postoperative period. These values should be transferred to the physiotherapist once the patient leaves the hospital. During surgery it is important to document the range of motion prior to the anesthetic induction and also at the end of the surgical procedure.

The clinical history should be analyzed carefully, in particular the circumstances of the initial accident, the previous surgical interventions, and the different rehabilitation programs undertaken. The range of motion must be documented during each of these steps, in order to make it possible to document the evolution of the stiffness. Some threshold values are known: 90° of flexion is required for stair-climbing, and 120° is needed to comfortably perform the activities of daily living. Three measurements can quantify the range of knee motion: the first is the hyperextension, the second is the extension deficit, and the third is the maximal flexion. For example, a range of motion documented as 5/0/120 represents 5° of hyperextension, 0° of extension deficit, and 120° of flexion. The clinical examination should always be comparative; therefore the values for the contralateral knee have to be documented as well. A clinical examination in the prone position is important in order (Fig. 36.1) to evaluate an extension deficit (cyclops of the ACL). Normal function of the medial and lateral gutters and the supra-patellar pouch are necessary to have a normal range of motion, in particular for flexion. Stiffness of the knee can be classified using different criteria.

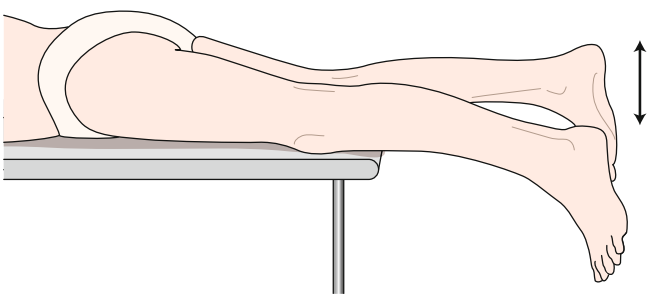

Fig. 36.1 Clinical examination in the prone position to evaluate an extension deficit

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Etiological Classification

- Reflex sympathetic dystrophy (complex regional pain syndrome): usually conservative therapy is initiated.
- Posttraumatic (femoral fracture, patella fracture, tibial plateau fracture, grade III sprain of the medial collateral ligament, ACL rupture with cyclops lesion).

Albert Trillat illustrated that adhesions between the medial collateral ligament and the medial femoral condyle could limit the motion of the medial capsular structures (Fig. 36.2a, b). These adhesions cause a functional shortening of the medial collateral ligament; the center of the rotation moves from the medial condyle to a point close to the tibiofemoral joint line. These adhesions limit flexion to approximately 60°.

- Postoperative (ACL reconstruction, total knee arthroplasty, synovectomy)
- Postinfectious (septic arthritis of the knee)
- Certain muscular diseases

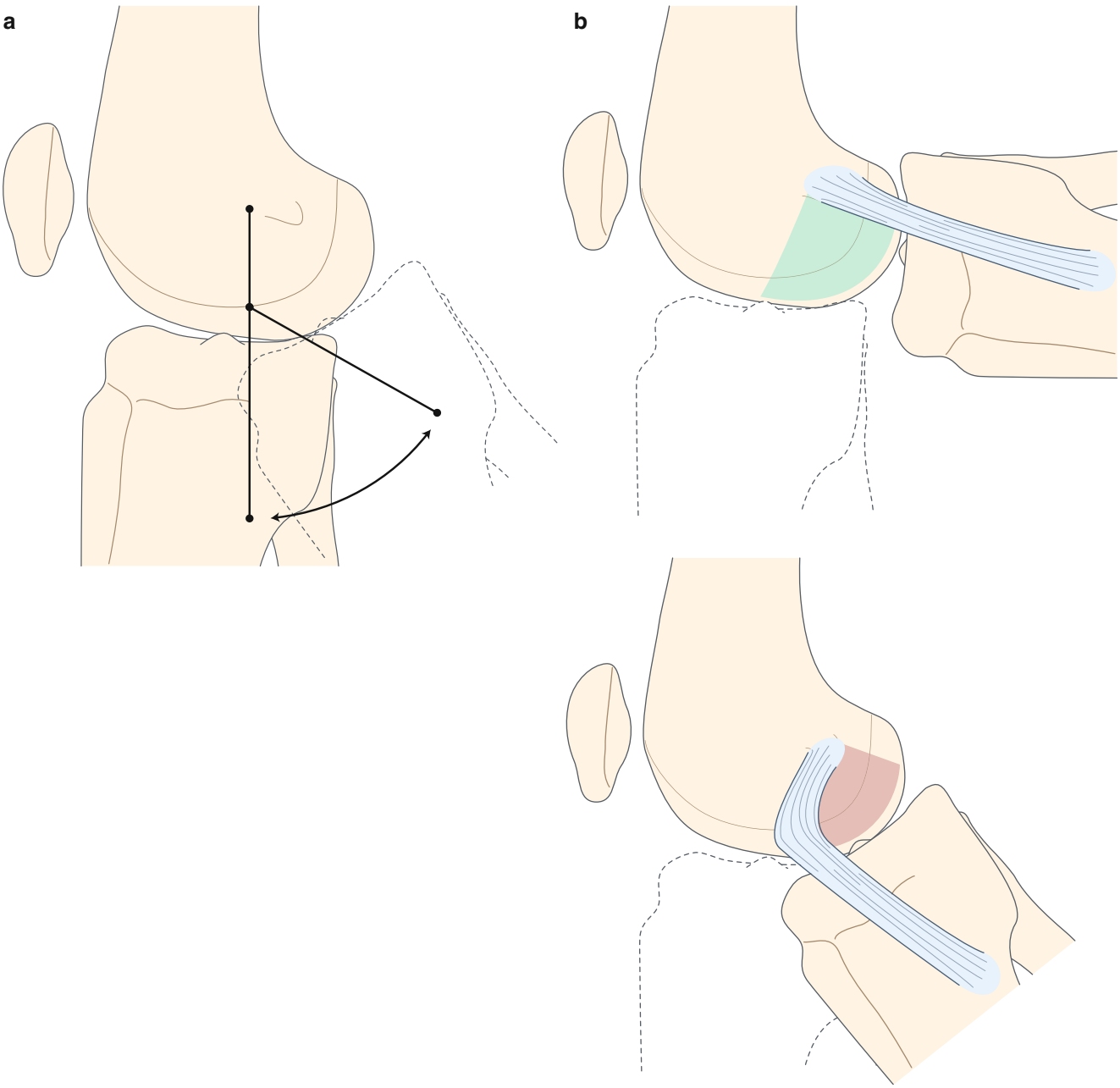

Fig. 36.2 (**a**, **b**) Albert Trillat's drawing: stiffness and MCL lesion. Adhesions limit flexion to approximately 60°

Stiffness According to the Type of Limitation (Excluding the Specific Considerations for Knee Arthroplasty)

Flexion Limitation

In the case of limitation of flexion, it is necessary to release the adhesions in the supra-patellar pouch and the condylar gutters. Sometimes retraction of the quadriceps and extensor mechanism necessitates an additional release according to Judet.

Limitation of Extension (Fixed Flexion Deformity)

A fixed flexion deformity (FFD) results in a reduction of the contact area of the cartilage, which can lead to pain and arthritis. It is very important to address a fixed flexion deformity in the hip or the contralateral knee since these can result in fixed flexion deformity of the index knee. Because of the limited extension, it is important to think about an obstacle situated in front of the intercondylar notch (e.g., a free body or a dislocated bucket handle tear of the meniscus).

Other reasons could be a recent rupture of the ACL (mop tear) or a cyclops syndrome secondary to an ACL reconstruction. Finally, a reconstructed ACL can also cause a fixed flexion deformity: most frequently secondary to malpositioning of the femoral or tibial tunnels. Capsular or ligamentous scarring is a less frequent cause but can sometimes necessitate a posterior capsulotomy or even resection of the reconstructed anterior cruciate ligament to overcome the deformity.

Mixed Limitation (Flexion and Extension)

Iatrogenic Limitation Associated with Tibial External Rotation

This type of stiffness is essentially observed after a Lemaire extra-articular anterolateral plasty fixed in external rotation, which has been described in detail by H. Jaeger.

Classification of Stiffness According to Anatomy (Fig. 36.3a, b)

Articular Stiffness

Capsular or intracapsular.

Intracapsular stiffness can be addressed by arthroscopy.

Extra-articular Stiffness

Requires open surgery.

In the case of limitation of flexion and extension, multiple anatomical structures are involved. The common denominator remains capsular retraction. Shortening of the posterior knee capsule secondary to a fixed flexion deformity (because of an obstacle in front of the intercondylar notch) can perpetuate the deformity. Posterior osteophyte causing a flexion deformity cannot be addressed arthroscopically.

Stiffness of the Knee According to the Degree of Limitation

A clear difference needs to be made between a fixed flexion deformity observed in the athletic population and a limitation in flexion after a total knee arthroplasty.

The following surgical options are available:

- Manipulation under anesthesia (MUA)
- Arthroscopic arthrolysis
- Open arthrolysis with an arthrotomy (anterior and posterior)
- Arthrolysis according to Judet (not in this chapter)

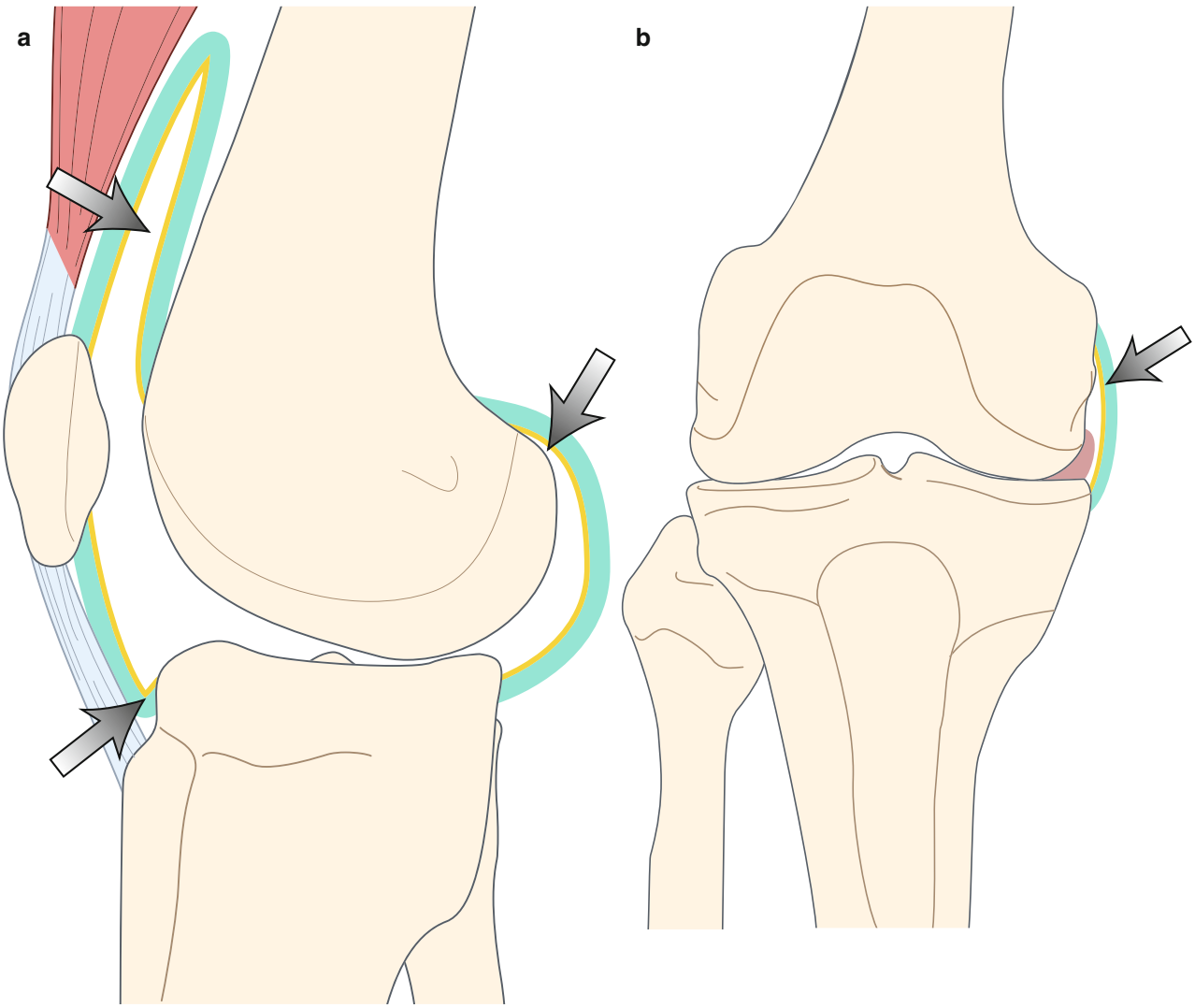

Fig. 36.3 (**a**, **b**) Intracapsular stiffness (supra-patellar pouch, condylar gutters, anterior compartment)

Manipulation Under Anesthesia

Indications and Risks

This aim of this intervention is to overcome intra-articular adhesions. Sometimes, these adhesions are present between the articular surfaces. However, one must be aware that during a forceful manipulation a fracture or damage to the articular surface of the joint can occur.

Therefore:

- Manipulation under anesthesia should be performed after healing of the skin incision.
- In the case of a non-prosthetic knee (after trauma or ligament injury), the MUA should be performed with extreme caution and should be performed at an early stage (less than 30 days from surgery).
- Arthroscopic arthrolysis is indicated and preferable within 45 days of the initial surgery that caused the stiffness. During the arthroscopy, the synovial and cartilaginous adhesions can be cut, avoiding a forceful MUA.
- In the case of a total knee prosthesis, MUA can be done up to the 90th day after surgery. Risk for injury to cartilage is limited (except in cases where the patella is not resurfaced or in case of a unicompartmental knee prosthesis).

Manipulation Under Anesthesia Technique

Prior to the manipulation, the full clinical history of the patient and the most recent radiographs should be available. The status of the skin and in particular the skin incision should be examined to avoid complications (Fig. 36.4a, b). Once the patient is under anesthesia, the initial range of motion is documented. The mobilization starts gently by progressively exerting manual pressure with both hands on the tibial tubercle. The hip should be flexed. Commonly, the adhesions are easily overcome. Sometimes, small cracks can be heard.

If the abovementioned details are respected, everything should go according to plan. At the end of the procedure, the range of motion is documented. Spontaneous flexion should also be documented. Spontaneous flexion is defined as the maximal flexion obtained by gravity with the hip in flexion. This spontaneous flexion is most commonly the flexion obtained at the end of the rehabilitation period. In the case of a limitation in flexion, the patient is positioned with a specially designed flexion cushion in the postanesthesia care unit (Fig. 36.5). If a "delayed" MUA is performed, the surgeon has to be aware of the risks (diaphyseal fractures, rupture of the extensor mechanism). Most importantly, the manipulation has to be done progressively without excessive force. In case of an MUA on a non-prosthetic knee, the more important, but frequently unrecognized, complication is damage to the articular cartilage.

Fig. 36.4 (**a**, **b**) Case of serious complication after MUA: patellar tendon avulsion associated with wound dehiscence

Fig. 36.5 Flexion cushion

Arthroscopic Arthrolysis

Indications

This type of surgery is indicated in cases of stiffness secondary to an intracapsular cause, most commonly following ligamentous surgery.

Several surgical procedures can be done:

- Section of the synovial adhesions
- Removal of intra-articular loose bodies
- Meniscectomy for a dislocated bucked handle tear
- Treatment of ligamentous lesions (cyclops, mop tear)
- Treatment of the stiffness after prosthetic knee surgery

Surgical Technique

The classic portals are used: anterolateral and anteromedial but also superomedial and superolateral. Different surgical procedures are available depending on the cause of the stiffness:

- Release of the adhesions in the supra-patellar pouch and condylar gutters

A specifically designed knife blade is used for this procedure (Figs. 36.6, 36.7, and 36.8).

It is very easy to handle and it does not necessitate a skin incision. The procedure can be easily performed under visual control. Only those adhesions that are under tension will be cut, thus limiting blood loss.

- Removal of foreign bodies (cyclops, anterior osteophyte, osteochondral fragment).
- Meniscectomy for a displaced bucked handle tear.
- Stiffness after total knee prosthesis is detailed in another chapter.

Introduced by W. Clancy, we have also observed that scarring of the anterior inter-meniscal ligament can be a cause of an extension deficit. Due to retraction, both the medial and lateral meniscus are pulled anteriorly and can impinge with the femoral condyle. It is possible to transect this anterior inter-meniscal ligament under arthroscopy. This procedure can be useful in a chronic fixed flexion deformity (several months).

Fig. 36.6 Specifically designed knife blade

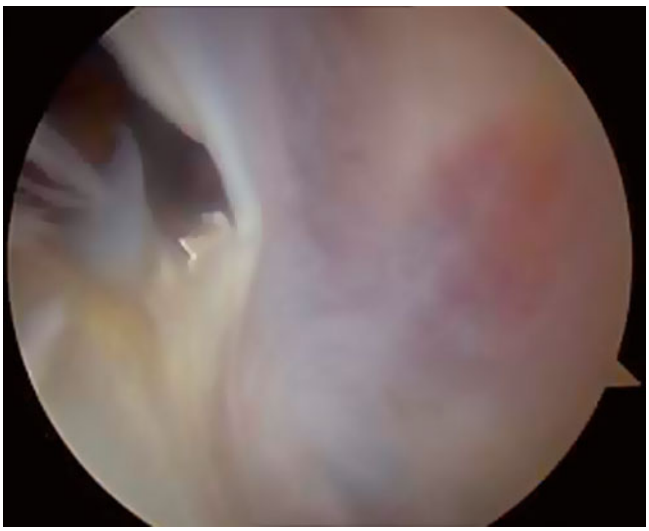

Fig. 36.7 Adhesions in the supra-patellar pouch

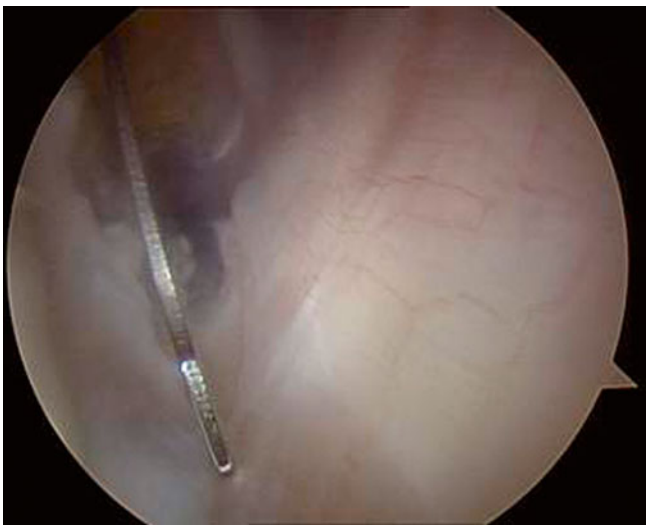

Fig. 36.8 Release of the adhesions in the medial condylar gutter

Open Arthrolysis

We will not detail the surgical approaches (cf chapter on synovectomies).

Anterior Arthrolysis

Two skin incisions can be used: anteromedial and superolateral. Both skin incisions allow an anteromedial arthrotomy and a superolateral arthrotomy.

Posterior Arthrolysis

Posteromedial and posterolateral arthrotomies are performed behind the respective collateral ligaments. In some rare cases, a posteromedial arthrolysis alone can suffice (after open medial meniscus suture or retraction of the posteromedial capsule). In all other cases, a posterior arthrolysis should be performed using both approaches. Through the posteromedial and posterolateral arthrotomies, one can easily release the posteromedial and posterolateral capsule from the posterior femoral condyles with a 15 blade knife. This release has to be a total release, meaning that "light should be observed between the incisions." Full extension is generally obtained. Sometimes full extension however is somewhat elastic in the final degrees of extension. In this situation we prefer the application of an extension brace postoperatively rather than transection of the capsule or a transection of the hamstrings. This brace should be applied for at least five nights and should be combined with a strict rehabilitation protocol.

Remarks

Posterior arthrolysis is being performed less frequently.

Anterior arthrolysis is more frequently performed under arthroscopy.

Release According to Judet

This release is beyond the aim of this chapter and is detailed in another chapter. The release of the extensor apparatus according to Judet has become a very rare surgical intervention since the introduction of arthroscopy and the decrease in road traffic accidents. Nevertheless, a release of the quadriceps muscle according to Judet is indicated in very severe cases of stiffness.

The surgical procedure is composed of two essential steps:

- The first is the arthrolysis.
- The second is release of the quadriceps muscle.

This intervention is very demanding and the risk for fractures because of devascularization is real. An isolated transection of the vastus medialis has also been reported in the literature recently to address this important problem.

Stiffness and the ACL

Although the treatment is similar, one must make a distinction between two diagnostically different situations:

(a) Recent rupture of the ACL with a mop tear (positioning of the distal end of the ruptured ACL inside the intercondylar notch). Arthroscopic resection should result in full extension (Fig. 36.9). A reconstruction can be indicated during the same surgical procedure.

(b) Cyclops syndrome after reconstruction of the ACL, which is a fibrous soft tissue reaction in front of the reconstructed ACL. Arthroscopic resection usually results in full extension (Fig. 36.10). In general we combine this procedure with a notchplasty. The notchplasty can be done with curved osteotome or a burr.

If extension still cannot be obtained, a complete sectioning or removal of the ACL reconstruction should be considered. This decision is of course easier to make if the femoral and tibial tunnels are malpositioned. Not uncommonly, an osteophyte can be observed in front of the tibial tunnel. This osteophyte can be easily removed. We commonly combined this procedure with a notch plasty to create a sufficiently large clearance for the graft.

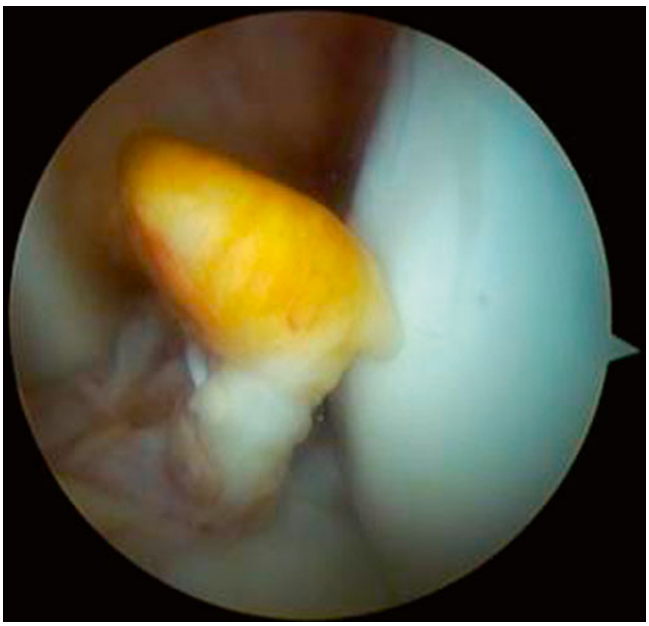

Fig. 36.9 Recent rupture of the ACL with a mop tear

Fig. 36.10 Resection of a fibrous soft tissue reaction in front of the reconstructed ACL (cyclops syndrome)

Stiffness After Total Knee Arthroplasty

General Information

Stiffness after a total knee arthroplasty is not an uncommon phenomenon (10–15 %). It is important to determine the origin of the stiffness, its extent, and its impact on function in order to institute the appropriate treatment. Stiffness after a total knee arthroplasty can be defined as a flexion less than 90° or an extension deficit greater than 10° irrespective of the type of knee prosthesis.

Four surgical procedures are available:

- Manipulation under anesthesia
- Arthroscopic arthrolysis (attention should be paid not to damage to the prosthetic surfaces)
- Open arthrolysis
- Revision of the prosthesis

Our therapeutic approach:

- Well-positioned implant

Between days 15 and 90	Manipulation under anesthesia
Between days 90 and 180	Arthroscopic arthrolysis
After day 180	Open arthrolysis

- Malpositioned implant
  Revision surgery is indicated in cases in which the posterior cruciate ligament is retained. Sectioning of the posterior cruciate ligament can be an option (the polyethylene should be changed to an ultracongruent polyethylene). In some of these cases, the prosthetic design has to be changed to a posterior cruciate substituting design. The surgeon should follow up his patients in the early postoperative period to observe the progression in the range of motion. If he is confronted with a stiff knee within 3 months post surgery, he can consider an MUA after the elimination of potential complications such as complex regional pain syndrome or infection.

Arthroscopic Arthrolysis (Fig. 36.11a–c)

Stiff total knee arthroplasties can be treated arthroscopically by sectioning the adhesions in the supra-patellar pouch, the condylar gutters, and the space in front of the knee. The articulating surfaces of the total knee arthroplasty should not be damaged. In some cases, it could be necessary to perform a medial and lateral patellar retinaculum release to obtain a better flexion.

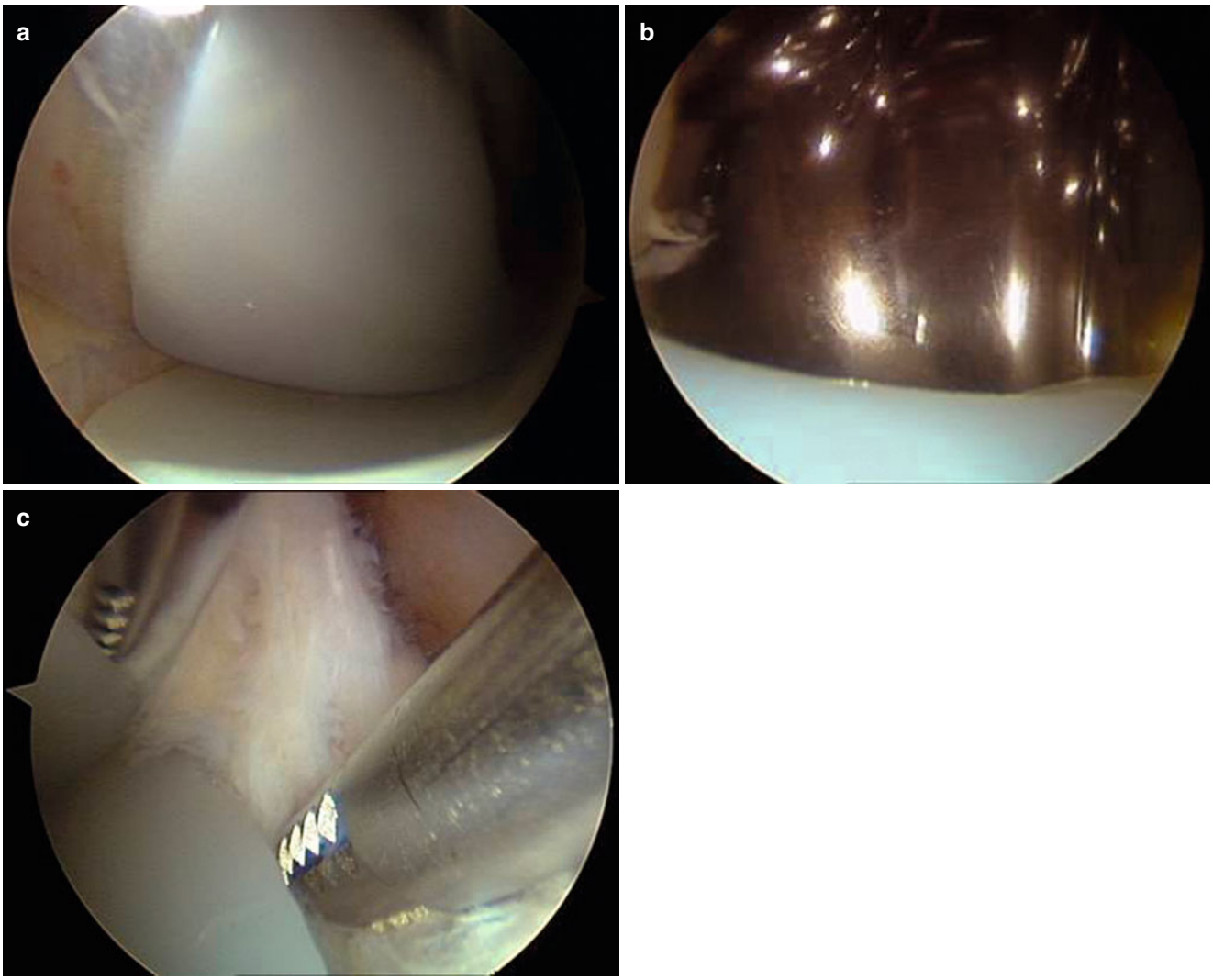

Fig. 36.11 (**a**–**c**) Arthroscopic arthrolysis on TKA

Adjuvant Treatments and Postoperative Guidelines

Full weight bearing is allowed with a brace in full extension (for 3–5 days).

Low molecular weight heparins are not prescribed. However, strong pain medication and muscle relaxants are indicated.

Flexion Deficit

At the end of the mobilization, a specifically designed cushion at 90° is applied to the knee for the first postoperative night and continued every 6 h thereafter (Fig. 36.5).

Fig. 36.12 Continuous passive motion

Continuous passive motion (Fig. 36.12) is started on the second or third postoperative day.

Extension Deficit

Routinely a brace in extension is applied to the knee before the end of the anesthesia. This brace should be worn initially until the next morning and should be continued during the night for another five to ten nights depending on the progression and the result that was obtained during surgery.