5 Anterior Cruciate Ligament Reconstruction: Surgical Technique

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Introduction

Reconstruction of the anterior cruciate ligament is the method of choice for the treatment of chronic anterior laxity. Differences exist in surgical technique, graft choice, and how surgeons choose graft position.

We prefer to use a bone-patellar tendon-bone autograft for this reconstruction. This technique was initially described by Lambda in 1937 and popularized by Kenneth Jones. In the procedure described by Kenneth Jones, the patellar tendon-bone graft remained attached at its tibial insertion. Franke followed by Dejour and Clancy promoted of the use of a free graft. To guide our treatment strategy, we use the classification as proposed by the Henri Dejour school. This classification takes into account associated lesions and degree of anterior laxity.

Kenneth Jones Surgical Technique

Although we have modified the technique to utilize a free bone-patellar tendon-bone graft, we continue to call this operation a KJ procedure. Our technique was largely inspired by Pierre Chambat.

Setup and Clinical Examination

The setup we use to perform an ACL reconstruction is the same that we use for nearly all types of knee surgery (Fig. 5.1). After the patient is under anesthesia and the extremity sheet has been applied but prior to inflation of the tourniquet, the knee is once again tested for anterior laxity with the Lachman-Trillat test and the pivot-shift test.

Fig. 5.1 Setup

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Harvest of the Bone-Patellar Tendon-Bone Graft

We generally harvest the graft prior to arthroscopy in order to avoid swelling of the soft tissues. The skin incision starts at the inferior pole of the patella and continues 2 cm distal to the tibial tubercle (Fig. 5.2). In total, the paramedian skin incision is 6–8 cm in length and situated on the medial border of the patellar tendon. Dissection is performed down to the tenosynovium, which is vertically incised down the lateral aspect of the patellar tendon and carefully elevated from the anterior aspect of the tendon. The lateral and medial borders of the tendon are exposed as well as its insertion on the tibial tubercle and its origin on the distal pole of the patella.

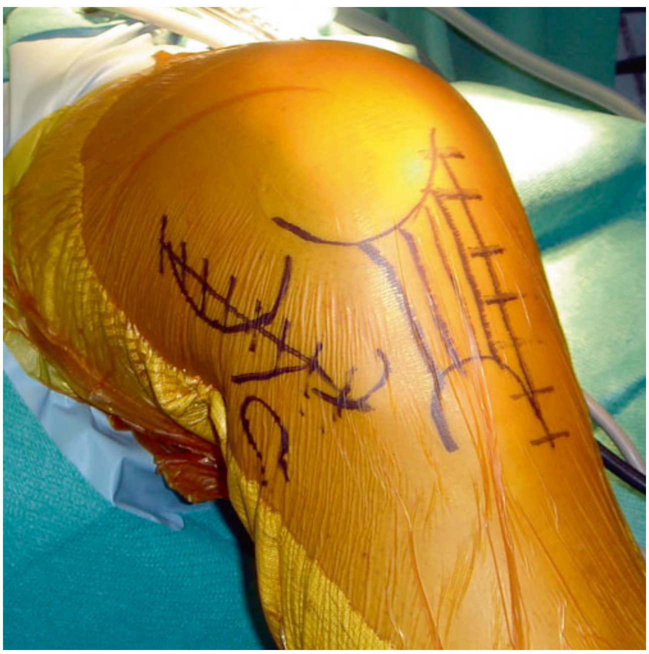


Fig. 5.2 Incision landmarks

Preparation of the Patellar Tendon Part

Harvest of the graft starts with the tendinous part. We use a specifically designed double-blade scalpel (Fig. 5.3). The graft width is 10–11 mm. The tendon is incised in the direction of its fibers (Fig. 5.4). The proximal and distal osteotendinous transition zones of the tendon are marked with a 23 blade. The bone blocks are marked by incising the periosteum with the blade.

Fig. 5.3 Double-blade scalpel

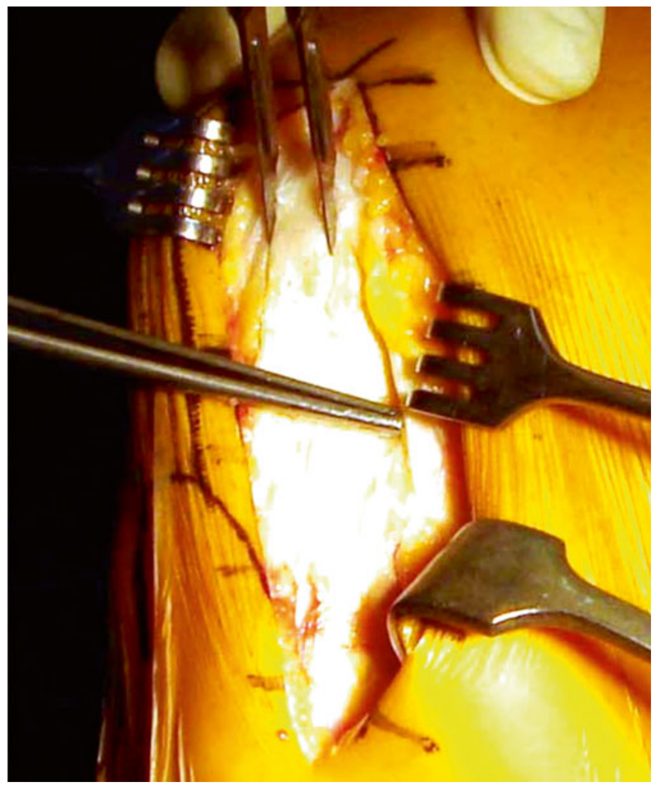


Fig. 5.4 Medial and lateral sides of the patellar tendon

Perforation of the Bone Blocks

Before the bone blocks are cut (Fig. 5.5) three holes are drilled with a 2 mm drill in the future bone blocks. Two holes are created proximally in the patella and one distally on the tibial tubercle. We find it easier to drill these holes prior to graft harvest rather than on the back table.

Harvest of the Bone Blocks

In order to facilitate the harvest of the bone blocks, the longitudinal incisions in the patellar tendon are opened up using a Farabeuf retractor (Fig. 5.6). A small-angled blade saw with a stop, to avoid cutting deeper than 10 mm, is used for the harvest.

Fig. 5.5 Bone blocks drilling

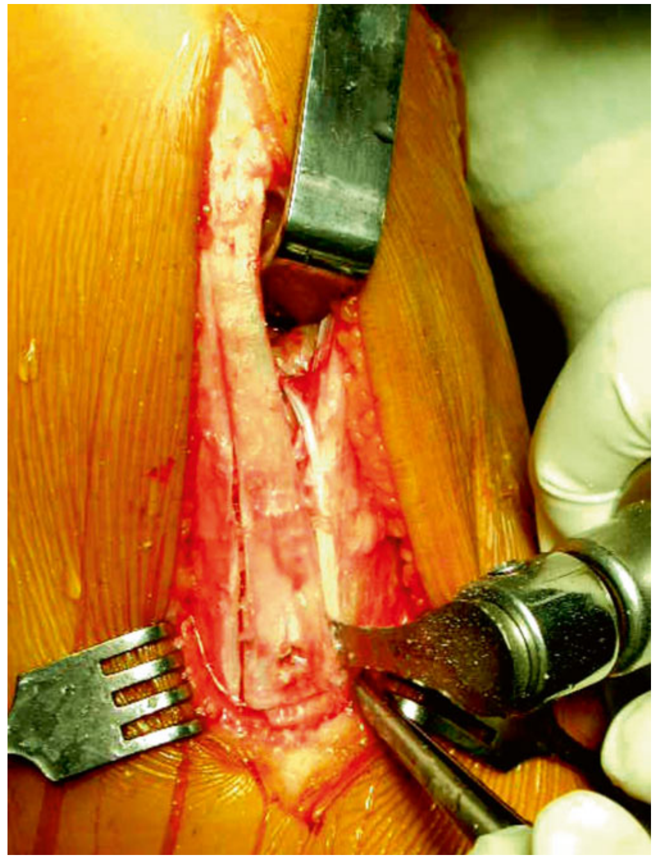


Fig. 5.6 Saw cutting (tibial side)

Tibial Bone Block

The tibial bone block is shaped in a specific way. It is trapezoidal in the shape of a champagne cork. The width is 10 mm proximally, widening gradually to 12 mm in the distal 10 mm of the block. The overall length of the tibial bone block is 25 mm and it is 10 mm thick (Fig. 5.9). The tibial bone block is then detached using a curve osteotome starting proximally.

Patellar Bone Block

The patellar bone block is prepared using a small blade saw. The dimensions of the patellar bone block are 10 mm in width and 15 mm in length. The tibial bone block and distal portion of the graft are lifted out of the harvest site and pulled proximally. The adhesions between tendon and Hoffa fat pad are dissected until the inferior pole of the patellar is clearly visible. A small osteotome of 10 mm in width is used to detach the patella bone block; its thickness should be between 5 and 8 mm. The osteotome should be introduced parallel to the anterior cortex of the patella (Fig. 5.7). One must take care not to fracture the patella when detaching the bone block. Any effort to detach it by prying with the osteotome must be avoided. The free graft is then prepared by the surgeon of the back table (Figs. 5.8 and 5.9).

The defect in the tendon is closed with interrupted resorbable stitches. The tenosynovium is carefully closed above the tendon and remaining periosteum closed over the bony defects (Fig. 5.10).

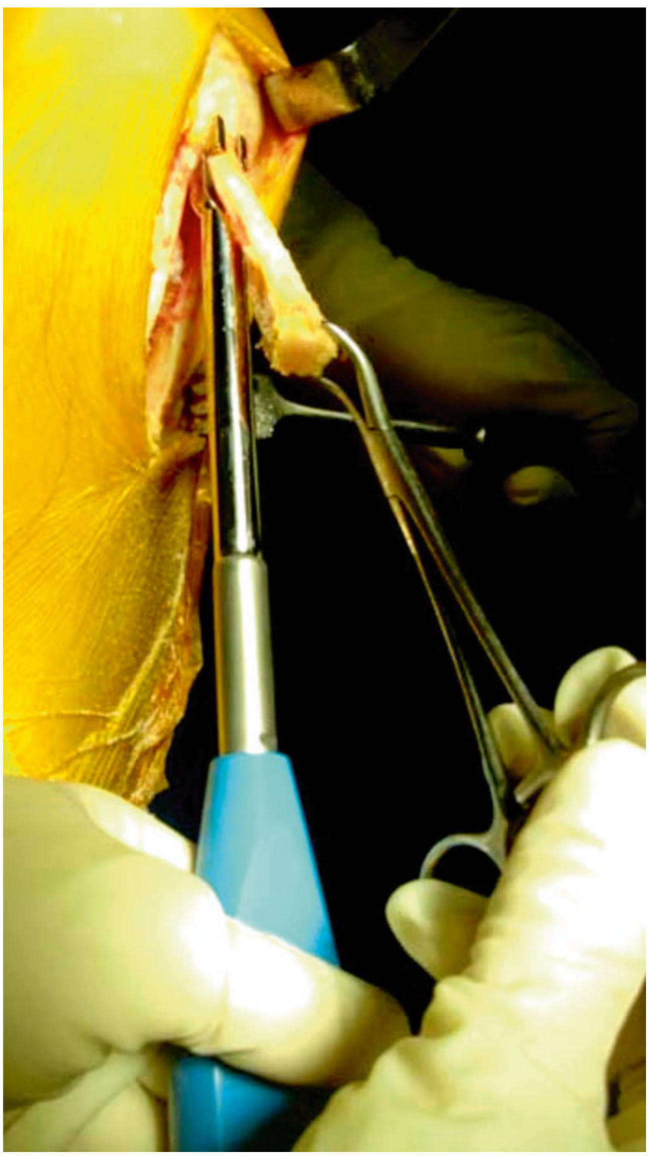


Fig. 5.7 Patellar bone block detachment

Fig. 5.8 Patellar tendon graft

Fig. 5.9 Transplant shape and size

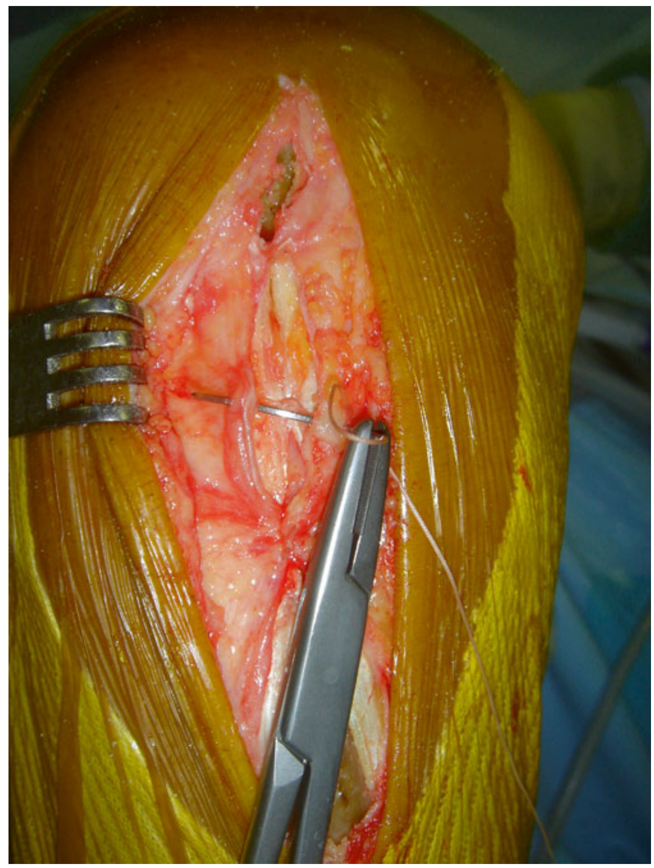


Fig. 5.10 Periosteum suture

Preparation of the Bone-Patellar Tendon-Bone Graft

This step of the procedure can be performed by an assistant while notch preparation and tunnel drilling continue. The first step in the preparation of the bone-patellar tendon-bone graft is the sizing of the bone blocks (Fig. 5.11). The edges and corners of the patellar bone block should be rounded using Liston scissors and cutting scissors. It should pass easily through the 9 mm hole of the graft-sizing block (Fig. 5.12). The proximal end of the tibial bone block should engage in the 10 mm hole of the graft-sizing block but should not completely pass. This illustrates the press fit that will be obtained on the femoral side. Pull sutures are introduced into the patellar bone block to aid in graft passage.

Through the two drill holes in the patellar bone block, a FiberWire suture is introduced in a figure of "8." This strong suture allows axial traction on the graft during passage. A number 5 resorbable suture is placed in the tibial bone block (Fig. 5.13). This suture will allow the retraction of the bone block in case of problems with the femoral fixation. The prepared graft is subsequently kept in a physiological solution. The graft should not be covered with gauze as it increases the risk of finding the graft in the trash together with the gauze.

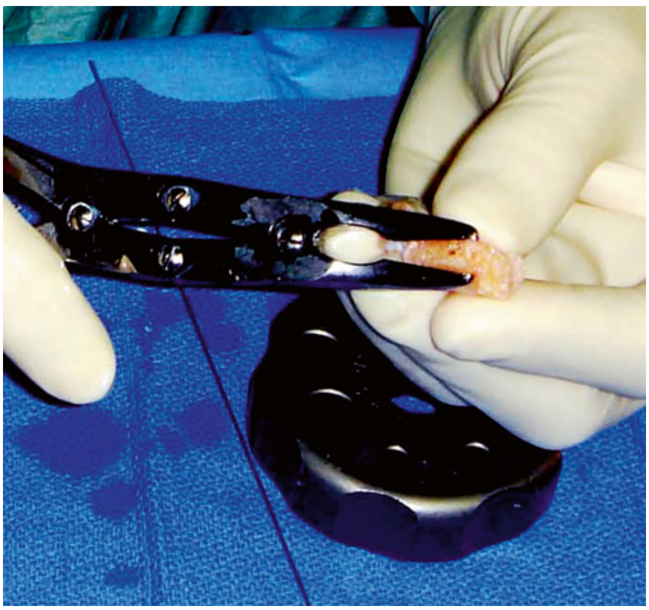


Fig. 5.11 Bone block calibration

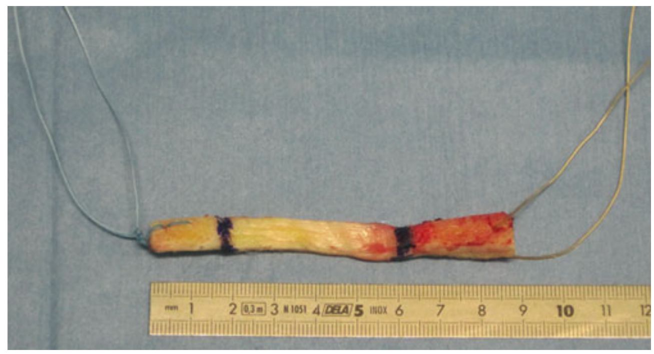


Fig. 5.13 Bone-patellar tendon-bone graft after preparation

Fig. 5.12 Graft-sizing block

Arthroscopy

Intercondylar Notch Preparation

The scope is introduced through the anterolateral portal. The instruments are introduced through the anteromedial portal (cf. chapter on arthroscopy) (Fig. 5.14). Possible meniscal lesions and cartilage lesions are evaluated and treated (Fig. 5.15). If a meniscal repair is considered necessary, the repair should be performed prior to the anterior cruciate ligament reconstruction (cf. chapter on arthroscopy). In case of any concern about a posterior meniscal lesion that is poorly visualized, a posterior compartment view must be obtained via either the Gillquist maneuver or the creation of a posteromedial portal to evaluate the posterior part of the meniscus.

First, the remnant of the anterior cruciate ligament is visualized as well as the morphology of the intercondylar notch. Preparation of the intercondylar notch is done in a systematic way. While in the past we removed the remaining fibers of the ACL, we now carefully analyze the remaining footprint to determine the insertions sites of the ACL and try to preserve the remaining fibers unless they obscure visualization. If there is any impingement of the old fibers on the anterior part of the notch once the graft is passed, these fibers are resected. Overzealous clearing of the wall of the notch limits the blood supply to the Healing graft. We generally prefer to do any resection with electrocautery as it preserves underlying osseous anatomy better than a shaver. In spite of the desire to preserve remnant tissue in the notch when possible, obtaining clear visualization is essential to avoid the most frequent error of malpositioning: a too anteriorly positioned femoral tunnel (Fig. 5.16).

Fig. 5.14 Arthroscopic exploration

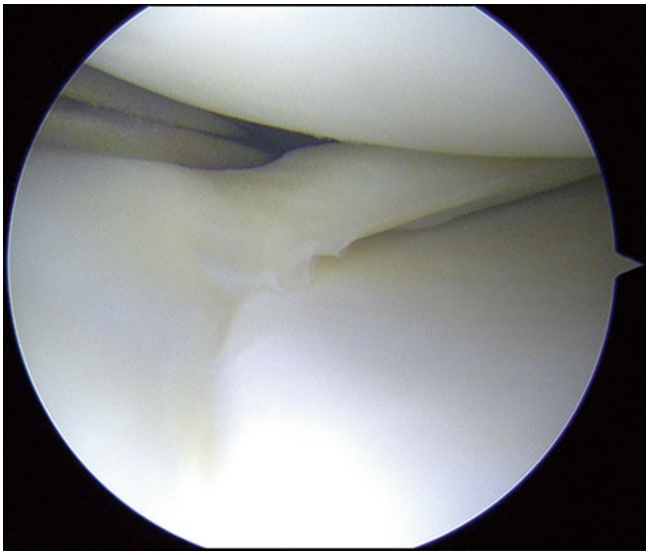


Fig. 5.15 Arthroscopic view of a medial meniscus tear

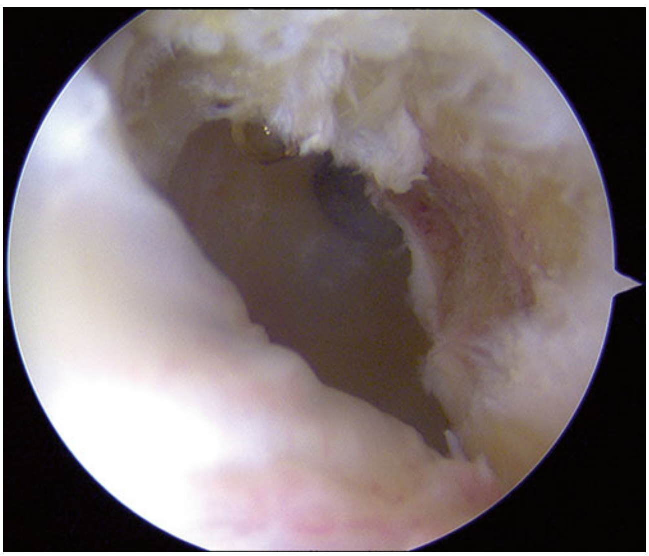


Fig. 5.16 Posterior edge of the intercondylar notch (arthroscopic view)

Notch Plasty

In our hand a notch plasty is rarely needed. We decide to perform a notch plasty when an impingement of the graft is observed in the intercondylar notch. This most frequently involves the superior part of the intercondylar notch and less frequently the lateral side.

To perform a notch plasty, the knee is placed in semi flexion. The zone of impingement is removed using a curve osteotome. This osteotome is positioned on the cartilage bone transition zone. By gently tapping it with a hammer, the osteotome easily removes the zone of impingement. The bony debris should be carefully removed and the remaining notch smoothed with a shaver or burr.

The Femoral Tunnel

Accurate femoral tunnel positioning is key to successful ACL reconstruction. The appropriate tunnel location is below and posterior to the lateral intercondylar (Resident's) ridge (Fig. 5.17). For single-bundle reconstructions, we prefer to place the tunnel in the area of the lateral bifurcate ridge (when visualized) and take care that it is below the resident's ridge. Once the appropriate tunnel position has been identified, the femoral drill guide (Fig. 5.18) is introduced through the anteromedial portal to the desired location. The bullet is subsequently introduced into the jig. This indicates the position of the lateral skin incision. The skin incision should be situated on the lateral surface of the lateral condyle anterior and proximal to the lateral collateral ligament. The incision must be sufficiently lateral to avoid opening the suprapatellar pouch.

The skin and the fascia lata are incised and the bullet is introduced through the guide until it is in contact with the bone. A guide pin is subsequently introduced into the bullet and driven across the lateral condyle and into the intercondylar notch. The guide is removed and the pin should be driven 4–5 mm into the notch (Fig. 5.19). At this point the position of the guide pin is checked while viewing through the medial portal. The surgeon now introduces a specially designed curette with a small hole in the middle. This curette is placed over the guide pin and is used to prevent inadvertent guide pin advancement during over-drilling. A femoral tunnel

6 mm in diameter is drilled over the guide pin (Fig. 5.20). The direction of the cannulated drill should be perfectly parallel to the guide pin. The progression of the cannulated drill should be progressive and smooth. If abnormal resistance is noted, the drill should be retracted immediately and its direction should be checked. In case of misdirection, metal debris is produced. Subsequently, a 10 mm cannulated drill is introduced over the guide pin and the femoral tunnel is enlarged. The guide pin is retracted and the debris from the tunnel are carefully removed (Figs. 5.21, 5.22, and 5.23). Preparation of the femoral tunnel in two steps has two advantages:

- Firstly, smooth progression of the drill without the need to use excessive force
- Secondly, the tunnel position can be adjusted by 2–3 mm if necessary. This correction is done by moving the guide pin with the curette. The direction of the 10 mm drill can thus be adjusted by 2–3 mm in the previously drilled 6 mm tunnel (Fig. 5.24a–c).

All debris should be removed from the tunnel (if one forgets to perform this step, one will be confronted with the presence of bony debris on the lateral side of the condyle visible on the post-op X-ray). Next, the tunnel is inspected with the scope to verify the circumferential presence of cancellous bone (Fig. 5.25). The corner of the femoral tunnel can be rounded with the curette to lower the risk of graft erosion. Finally, a plug is placed in the tunnel to avoid leakage of the irrigation fluid during tibial tunnel preparation.

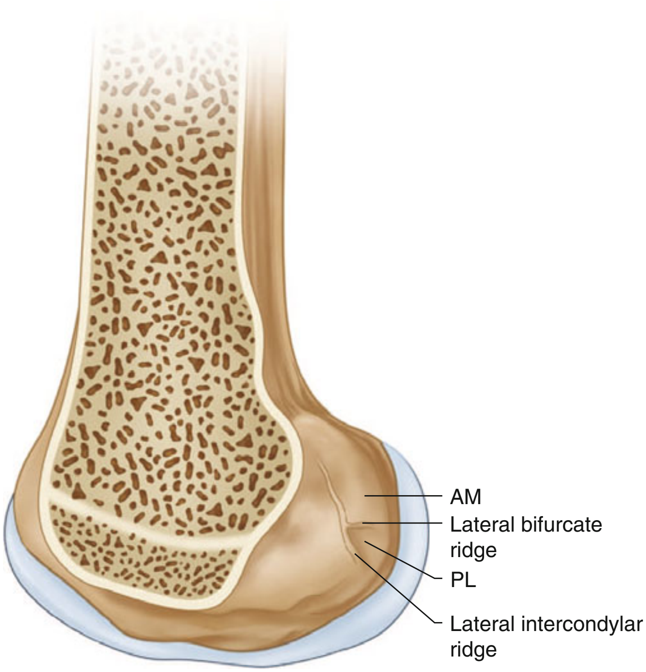


Fig. 5.17 Femoral insertion sites

Fig. 5.18 Femoral guide

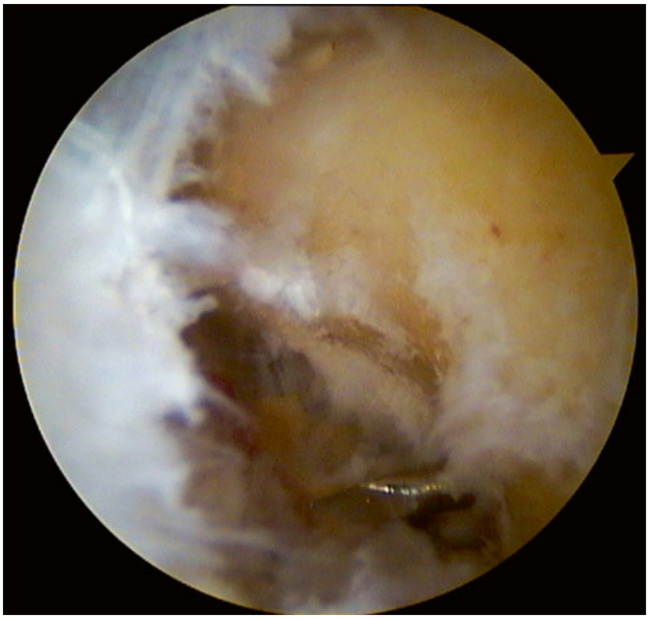


Fig. 5.19 Pin appearance

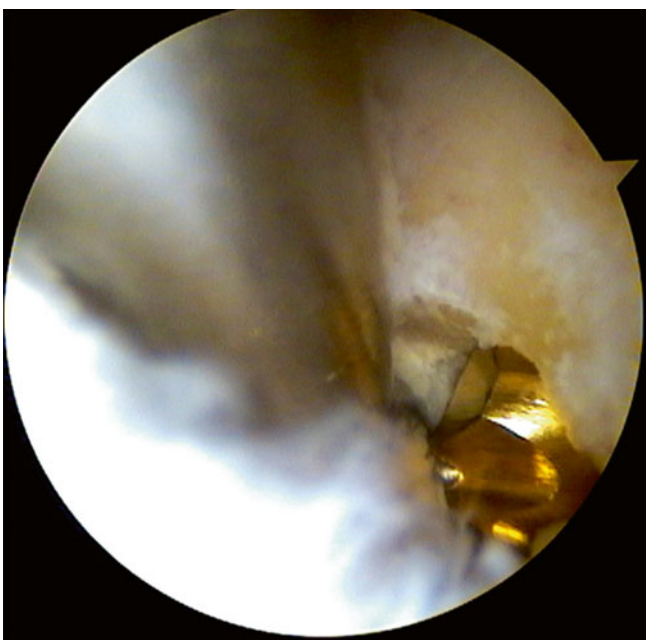


Fig. 5.20 Femoral tunnel drilling (6 mm drill first)

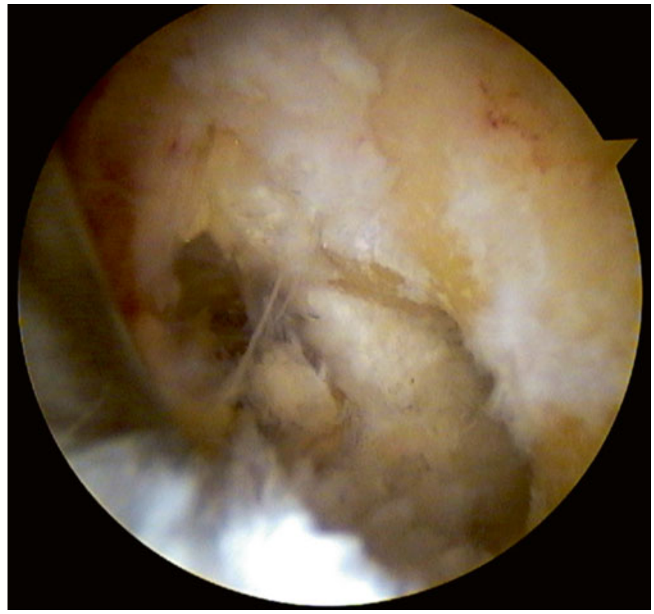


Fig. 5.21 Femoral tunnel (anterolateral portal view)

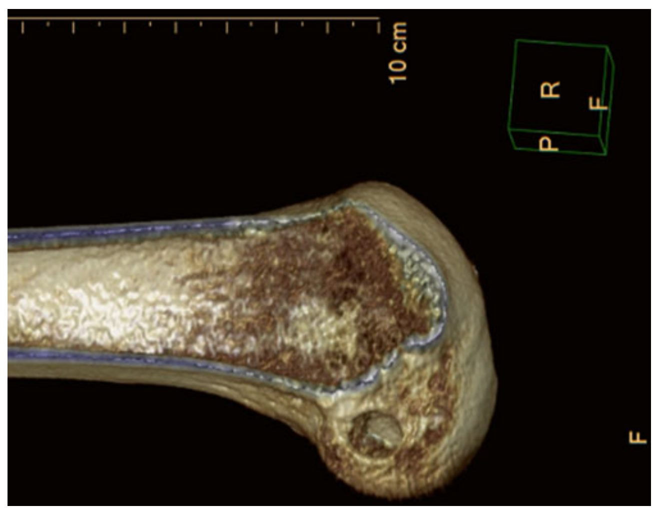


Fig. 5.22 Well-positioned femoral tunnel assessed on a 3D CT scan (AM bundle)

Fig. 5.23 Femoral tunnel (anteromedial portal view)

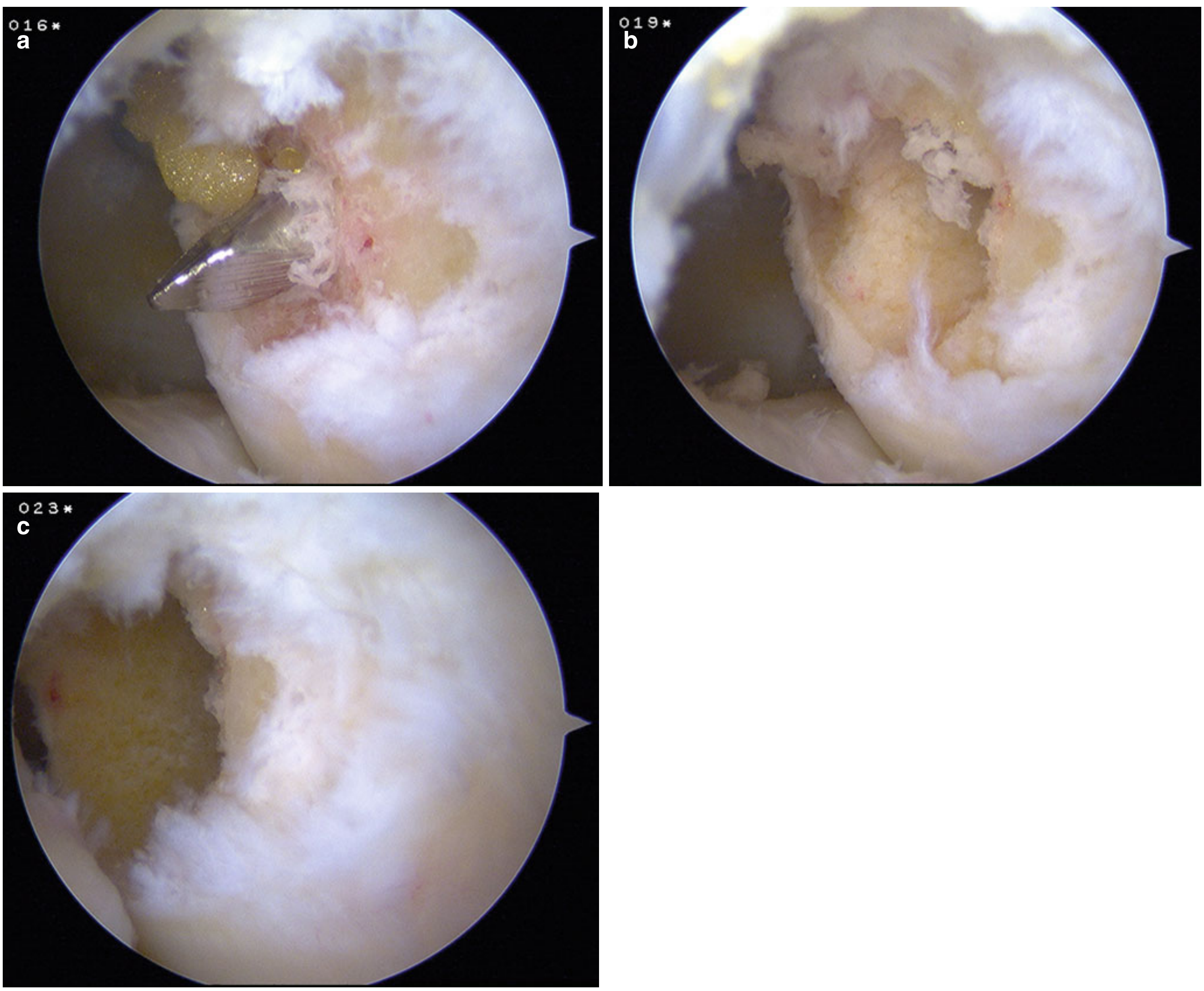


Fig. 5.24 **(a–c)** A precise positioning can be obtained with a progressive enlargement of the tunnel diameter (6 and 10 mm diameter)

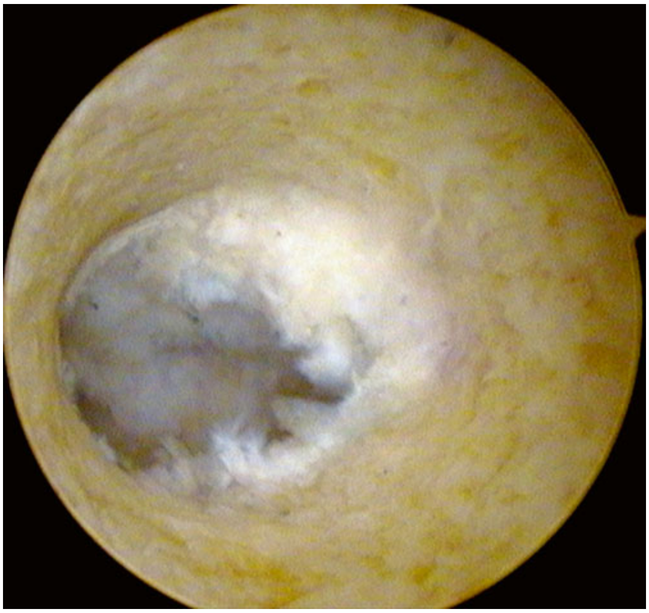


Fig. 5.25 Femoral tunnel inspection (outside view)

The Tibial Tunnel

The tibial drill guide (Fig. 5.26) is introduced through the anteromedial portal. The guide should be positioned in front of the posterior cruciate ligament just lateral of the cartilage of the medial tibial plateau, just behind the anterior horn of the medial meniscus, and medial to the anterior horn of the lateral meniscus (Fig. 5.27). This position is usually in alignment with the two femoral condyles in 90° of flexion. This point corresponds with the footprint of the original anterior cruciate ligament. The guide is set at 45° and the entry point on the tibial metaphysis is medial to the tibial tubercle. The bullet is subsequently introduced, the guide pin is driven into the knee, and its position is checked first in flexion (Fig. 5.28).

The knee is then extended and the position of the guide pin is checked to ensure that no impingement occurs between the notch and the guide pin. A 3 mm minimal distance should be present between the guide pin and the intercondylar notch in order to avoid any conflict between the notch and the graft. This concept is called graft clearance and was introduced by R. Jakob. Once the final position is checked, the curette is placed over the guide pin and the 6 and 9 mm cannulated drills are introduced over the guide pin (Fig. 5.29). It is very important to respect this sequence (first 6 followed by 9) because a 9 mm drill could induce a fracture of the tibial spine if used straight away. Moreover, as for the femoral tunnel, the position of the tibial tunnel can be adjusted by 2–3 mm if necessary when moving from the 6 mm drill to the 9 mm drill. Tunnel debris (Fig. 5.30) are aspirated and the entry hole of the tunnel is cleared from soft tissues which could block the entrance of the bone block. Because the graft will be passed from proximal to distal, this step is key to ensuring smooth graft passage.

Fig. 5.26 Tibial guide

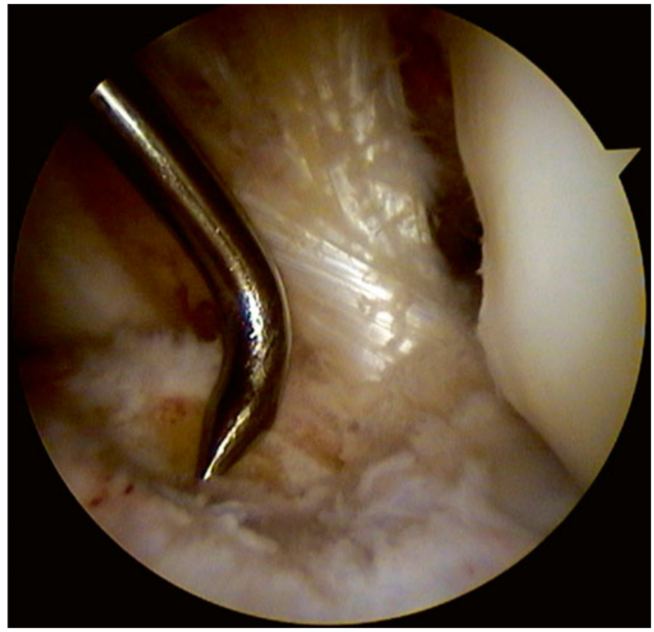


Fig. 5.27 Tibial guide positioning

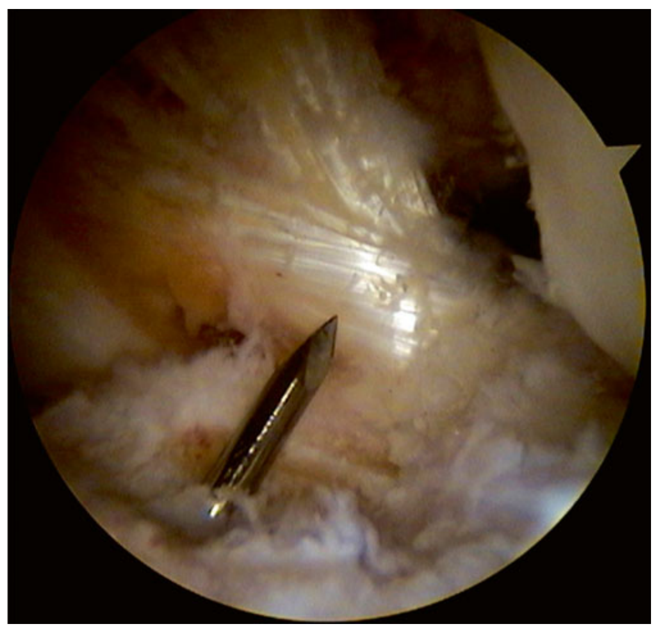


Fig. 5.28 Pin appearance

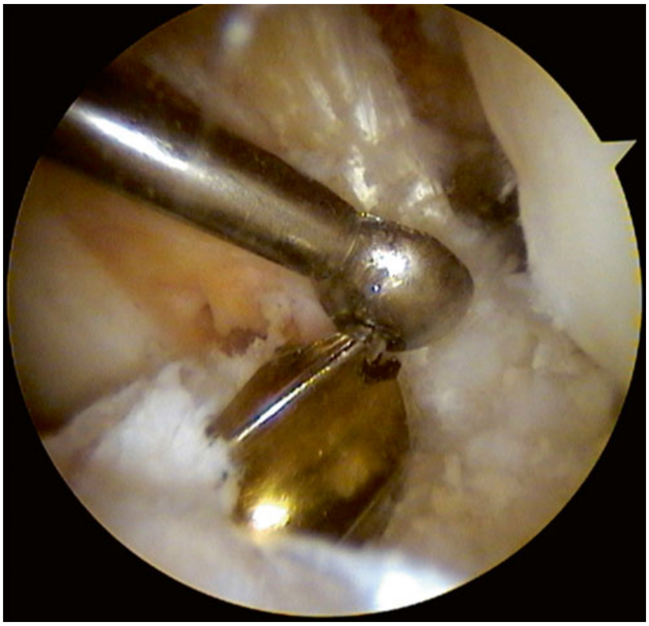


Fig. 5.29 Tibial tunnel drilling (6 mm drill fist)

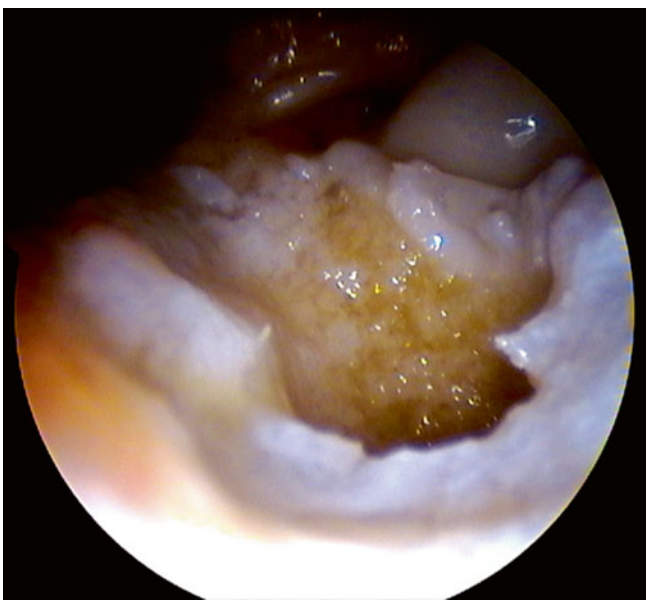


Fig. 5.30 Tibial tunnel (anterolateral portal view)

Introduction of the Bone-Patellar Tendon-Bone Graft

With the knee flexed to 30°, a pull suture is introduced through the tibial and femoral tunnel in a retrograde fashion with a suture guide. We verify arthroscopically that the suture guide does not perforate the posterior cruciate ligament. The pull suture is captured in the intercondylar notch with a grasper introduced through the femoral tunnel. The traction sutures from the graft are fixed to the pull suture (Figs. 5.31 and 5.32). This allows the introduction of the graft in an antegrade fashion first through the femoral condyle, into the intercondylar notch, and then through the tibial tunnel. It is sometimes possible that the passage of the patella bone block in the notch is difficult, particularly if the bone block is too long. In these cases, a Wolff grasper (Fig. 5.33) is introduced through the anteromedial portal to guide the bone block through the notch. Once the graft is introduced in the tibial tunnel, impaction of the bone block in the femoral tunnel can be initiated (Fig. 5.34). The orientation of the bone block in the femoral tunnel should be controlled. The tendon attachment site should be positioned posteriorly in the femoral tunnel. During impaction it is essential to exert some traction on the graft and to assure that the graft progresses into the tibial tunnel. The risk on the femoral side exists for invagination of the block into the tendinous portion of the graft like an accordion, resulting in a paradoxical situation: The more the bone block is impacted on the femoral side, the less the graft progresses into the joint (Figs. 5.35, 5.36, and 5.37).

The bone block on the femoral side is advanced with an impactor and mallet while the graft is kept under tension. The bone block on the femoral side should be well impacted and should not be palpable outside of the femoral condyle.

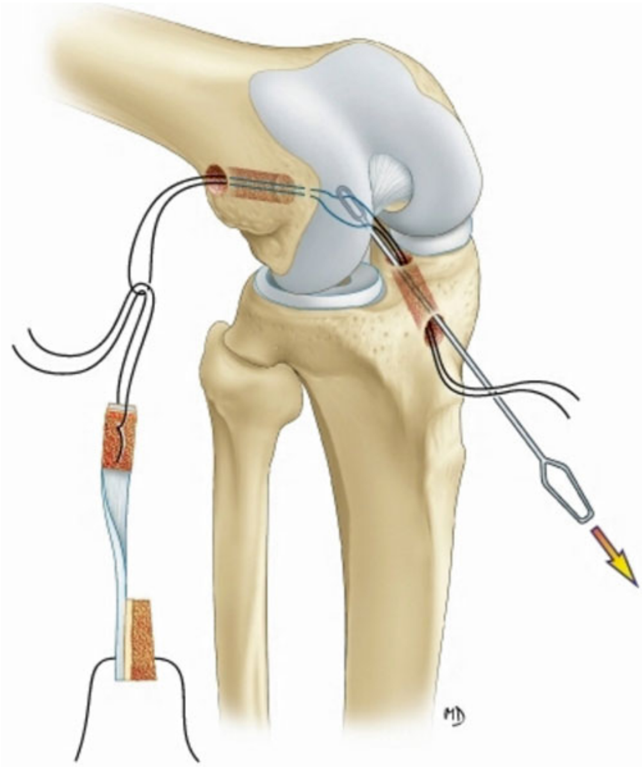


Fig. 5.31 Introduction of the bone-patellar tendon-bone graft (1)

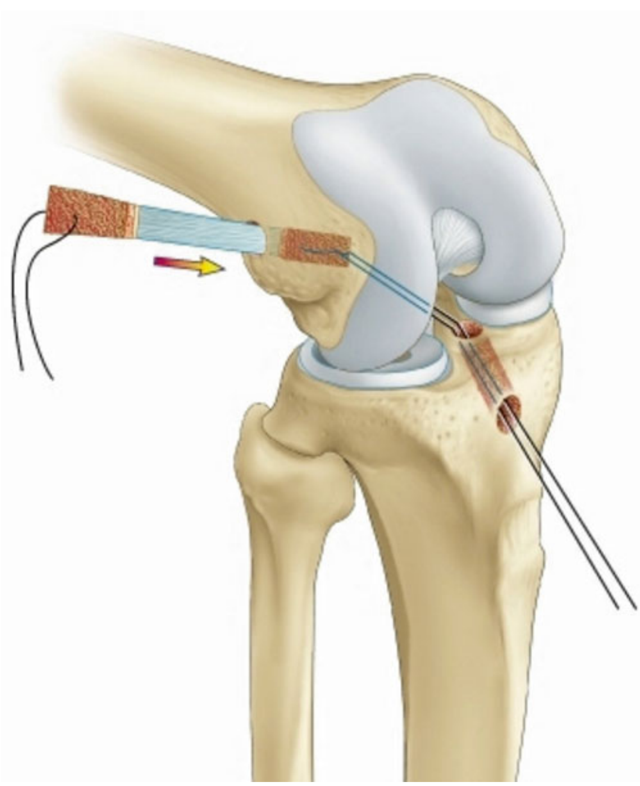


Fig. 5.32 Introduction of the graft (2)

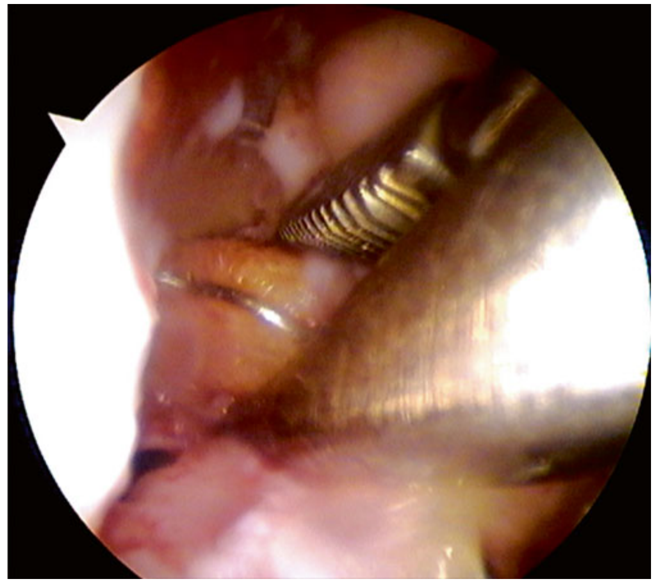
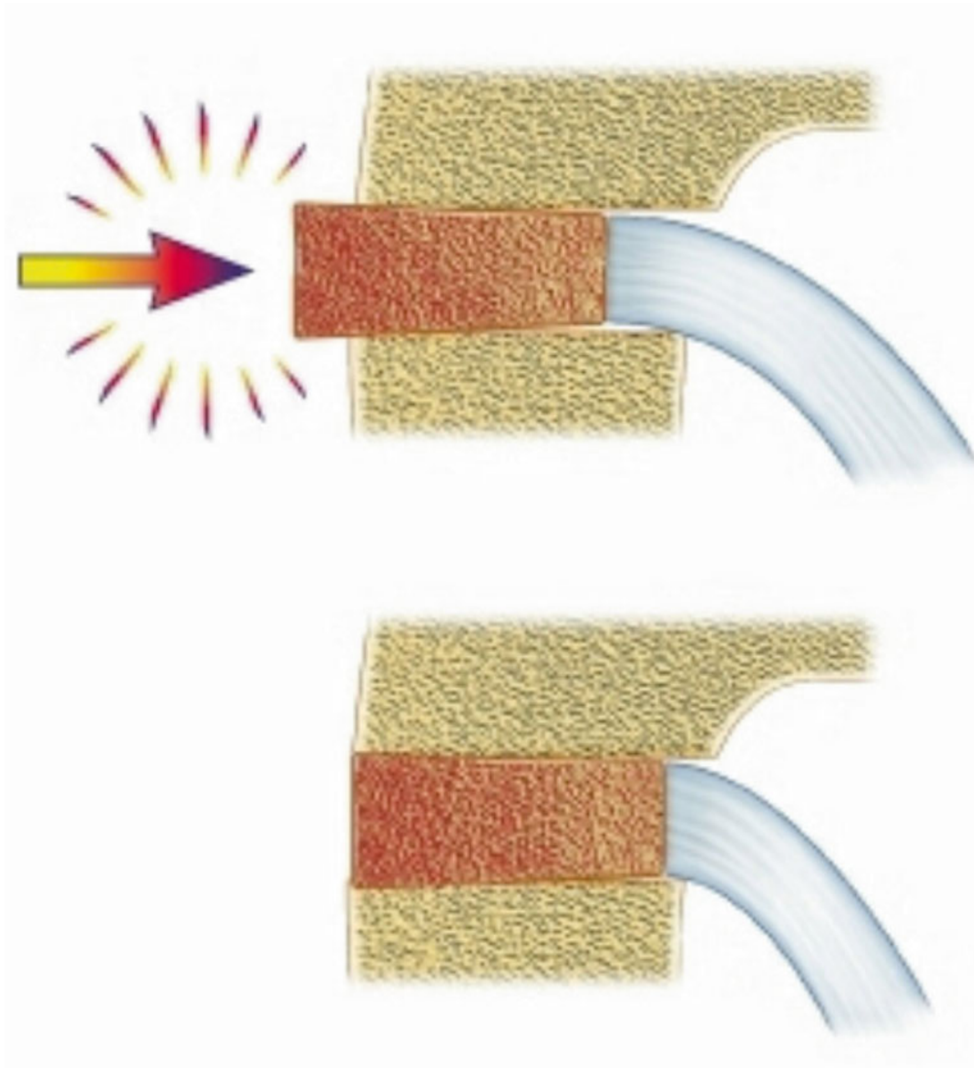
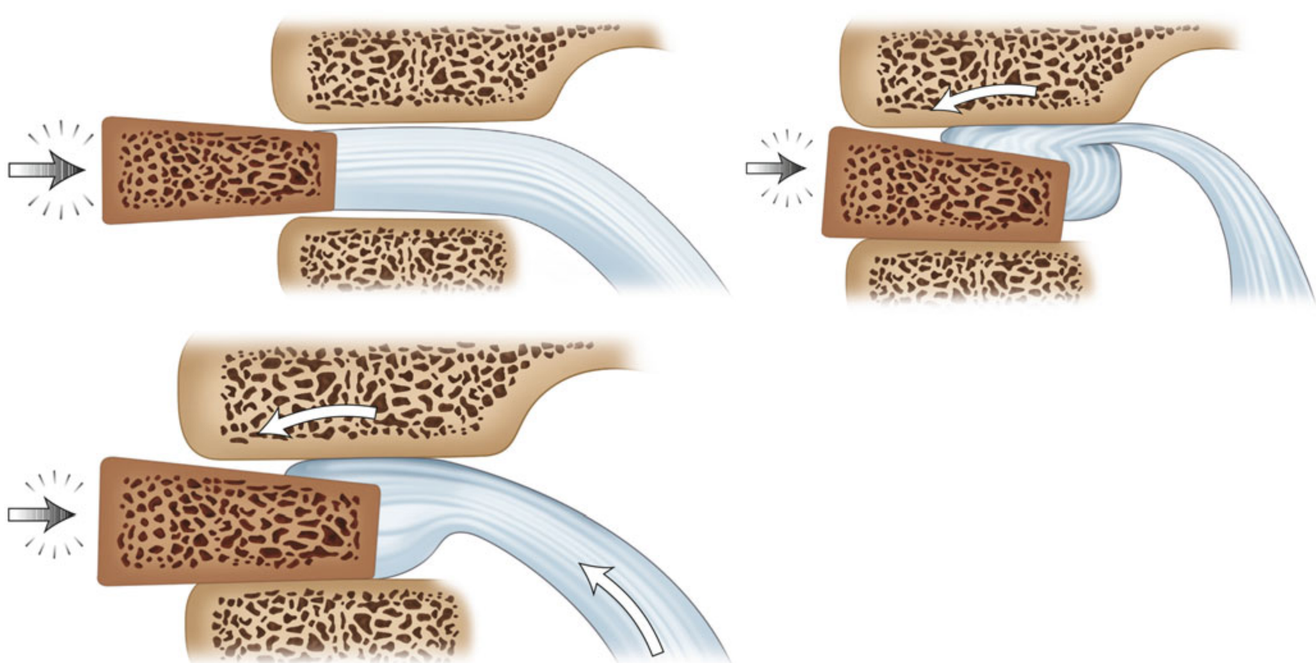


Fig. 5.33 A Wolff grasper is sometimes used to guide the bone block migration through the notch

Fig. 5.34 Graft impaction





Figs. 5.35, 5.36, and 5.37 "Accordion" paradoxical situation

Graft Fixation

Prior to fixation the following should be checked:

- Isometry of the graft during flexion and extension between 5 and 90° (Fig. 5.38)
- Possible impingement of the graft with an intercondylar notch
- Engagement of the bone block in the tibial tunnel

On the anteromedial side of the tibia, a 2 mm drill hole is made through cortical bone connecting the tibial tunnel and the graft harvest site. The FiberWire loop from the graft is then tied over this bone bridge providing the first tibial fixation. A guide wire is then introduced through the tibial tunnel inside the knee. The guide wire should be on the anterolateral border of the bone block in the tibial tunnel. If necessary the position of this guide pin can be modified. Its position is secured inside the knee with a grasper. A resorbable interference screw (Habilis, Phusis), 25 mm in length and 9 mm in diameter, is introduced as additional fixation over the guide wire (Figs. 5.39 and 5.40). The interference screw is introduced under arthroscopic vision until it reaches the level of the joint line. In case of a long graft, contact between this interference screw and the bone block is preferred over screw tendon contact. This combination of the suture over the bone bridge (Figs. 5.41, 5.42, 5.43, and 5.44) and interference screw allows for double fixation on the tibial side. We recommend double fixation in all cases.

Prior to closure, four variables have to be checked:

(a) The position of the screw with respect to the bone block in the tibial tunnel.

(b) The tension of the fixation and the tension of the graft; the posterior fibers should be tensioned in extension while the anterior fibers are somewhat slack.

(c) Absence of impingement within the intercondylar notch.

(d) A stable Lachmann-Trillat test

At the end of the procedure, the tourniquet is deflated and hemostasis is performed. An intra-articular drain is introduced through the anteromedial portal. The subcutaneous tissues are closed with a 3.5 resorbable suture, and the skin is closed subcuticularly or by using skin staples. An additional compressive bandage is applied that will be removed 1 h postoperatively. The knee is put into a brace with 20° of flexion in order to prevent patella infera.

- Immediately postoperatively AP and lateral plain X-rays are performed.
- Low molecular weight heparins are prescribed for 10–15 days.
- Prophylactic antibiotics are administered during a 24 h period.
- Skin staples or skin sutures are removed between day 12 and day 15.

A clinical follow-up is planned on day 45, 90, 180, and 360. Telos stress radiographs are requested at 1-year postoperative. When a young surgeon starts his practice, it can be useful to check the tunnel position using a 3D CT scan. Very quickly this surgeon will become very confident and improve his tunnel placement.

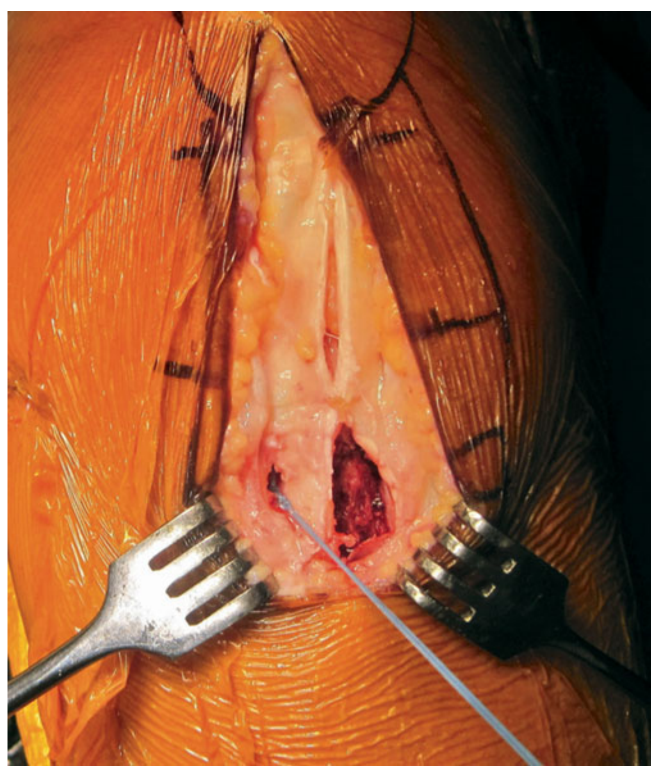


Fig. 5.38 Isometry of the graft is tested

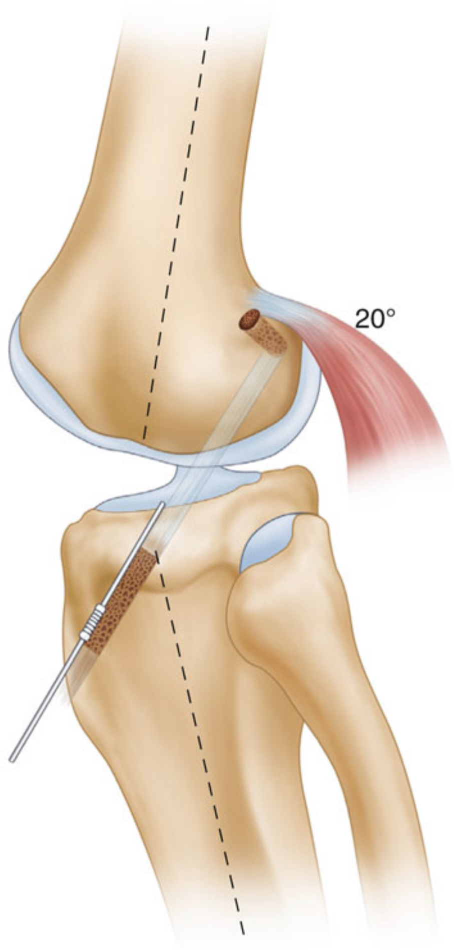


Fig. 5.39 Position of the graft and interference screw

Fig. 5.40 Position of the interference screw into the tibial tunnel

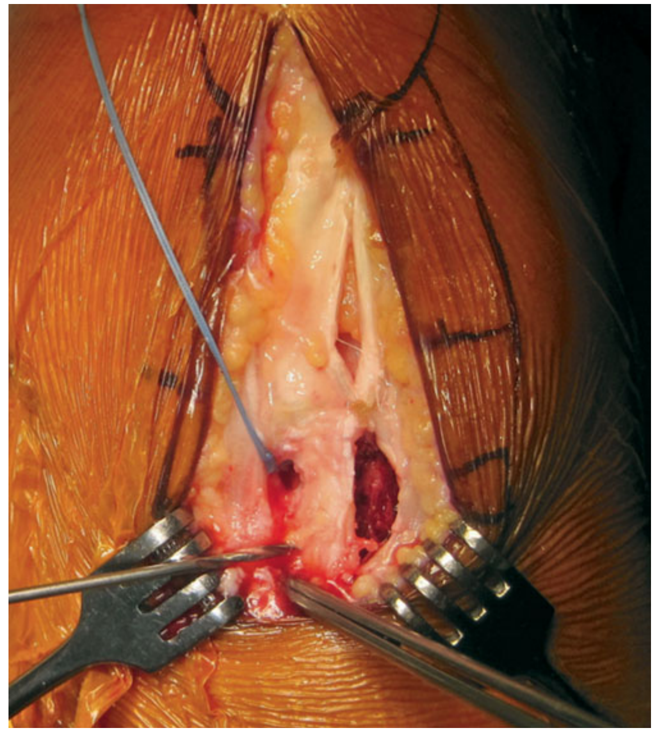
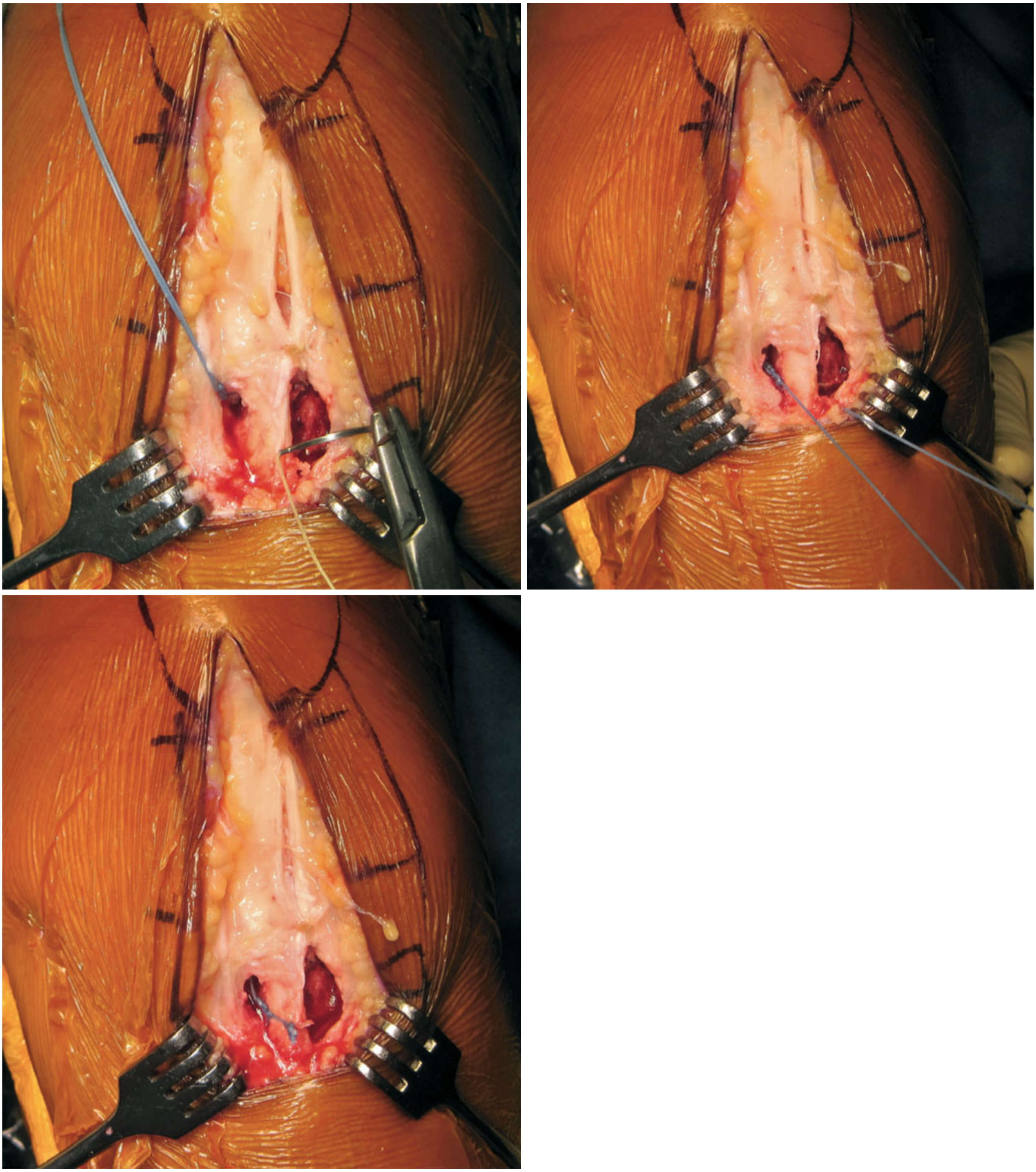


Fig. 5.41 Drilling of transosseous tunnel (additional tibial fixation)



Figs. 5.42, 5.43, and 5.44 The FiberWire is passed through the bony tunnel and sutured

The KJ Modification: The KJT

This surgical intervention combines both an intra-articular reconstruction using a bone-patellar tendon-bone graft and an extra-articular plasty with the gracilis or occasionally the semitendinosus tendon.

Harvest of the Bone-Patellar Tendon-Bone Graft

We start with the harvest of the bone-patellar tendon-bone graft as described above. The anteromedial skin incision, which is used for the harvest of the bone-patellar tendon-bone graft, is extended distally for about 2 cm.

Harvest of the Gracilis

For the extra-articular anterolateral plasty, either the semitendinosus or the gracilis tendon can be used. We prefer the semitendinosus. The pes anserinus is identified. The sartorius tendon is most superficial and covers the gracilis and semitendinosus tendons. Both can be seen and palpated under the sartorius fascia. The sartorius tendon is incised in the direction of the fibers proximally and then hockey-sticked at its insertion on the tibia. On its undersurface, the gracilis tendon can be identified proximally and the semitendinosus distally (Figs. 5.45 and 5.46). As the three tendons have a conjoint tendon insertion on the tibia, they can be more easily identified 4–5 cm proximally. The superficial fibers of the medial collateral ligament can be harmed during the dissection since they cross deep to the pes anserinus conjoint tendon. Once the gracilis tendon is identified, the tendon is isolated and a vessel loop is applied. If the semitendinosus is used, the vinculae of the semitendinosus (including one to the gastrocnemius aponeurosis) are dissected carefully. The distal part of the tendon is whip stitched using a no. 5 suture. Once this is done, the insertion of the tendon on the tibia is cut. Subsequently the tendon is harvested using a closed stripper (Fig. 5.47). The pulling sutures are passed through the eye of the closed stripper. The tendon is maintained under tension while the stripper is progressively pushed proximally with the knee in the figure of four position. Usually an increase in resistance is felt when the myotendinous junction is reached. The graft is usually at least 5 mm in diameter or at least 18 cm of its length.

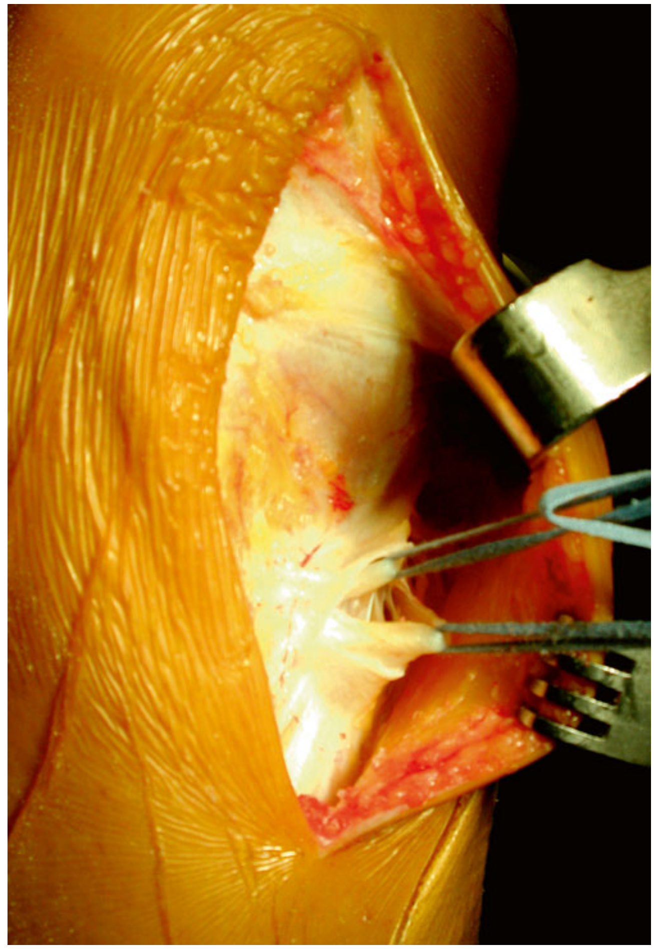


Fig. 5.45 Dissection of hamstring tendons (proximally, gracilis; distally, semitendinosus)

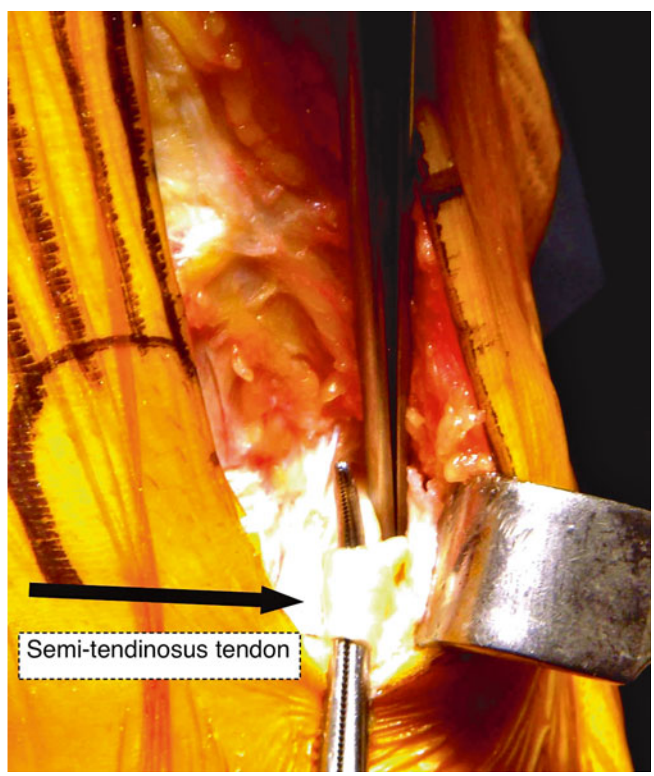


Fig. 5.46 Dissection of semitendinosus tendon in this case

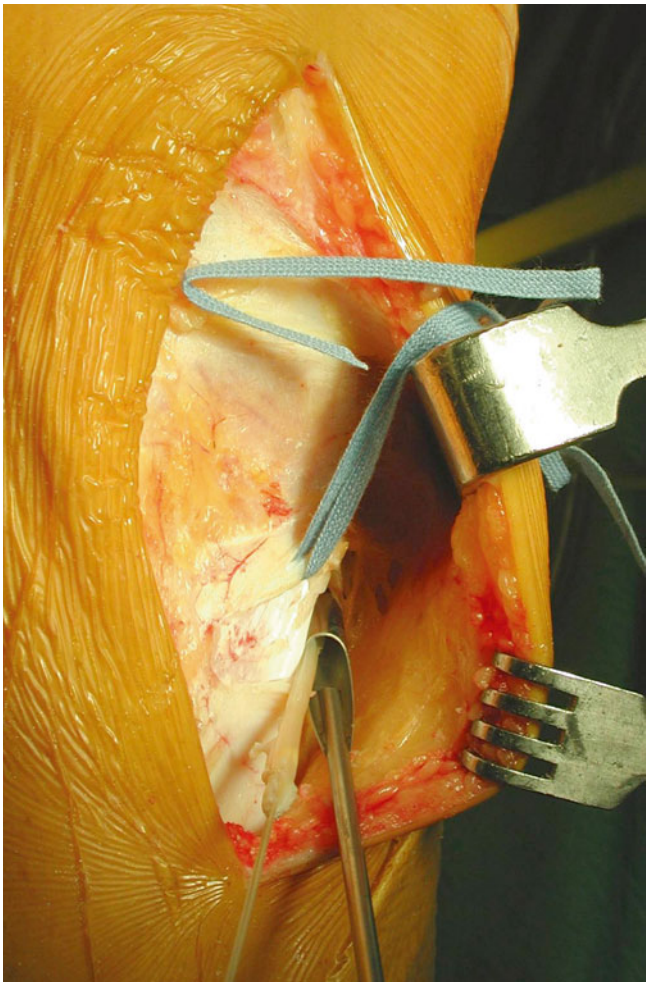


Fig. 5.47 Hamstrings harvesting using a closed stripper

Preparation of the Graft

The muscle fibers attached to the proximal end of the tendon are removed with the use of an osteotome or the back side of a blade. The proximal end of this tendon is usually wider and thinner as this is the muscle-tendon transition area. This side of the tendon is also whip stitched with a no. 5 suture. The tendon is then passed through the tibial bone block that was perforated with a 4.5 mm drill (Figs. 5.48 and 5.49). This construction allows for an intraosseous fixation of the extra-articular plasty when the bone block is impacted in the femoral tunnel.

Upon wound closure it is advisable to close the extensions of the sartorius tendon and to have an extra drain positioned in this area.

Fig. 5.48 Bone-patellar tendon-bone. A 4.5 mm diameter hole is drilled on the tibial bone block

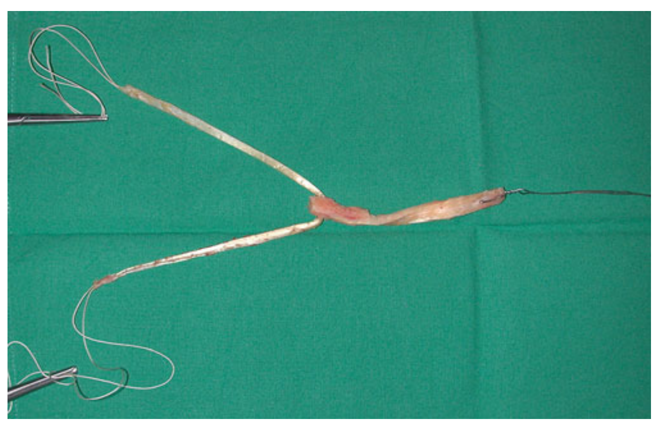


Fig. 5.49 Composite graft (patellar tendon and Hamstring tendon)

Surgical Approach for the Extra-Articular Tenodesis

After the patellar tendon and the hamstrings tendon harvest, the surgical approach for the lateral plasty is made. This approach is done prior to the arthroscopy. The anterolateral incision is 5–7 cm long (Fig. 5.50) and starts just proximal to the lateral epicondyle and ends at the level of Gerdy's tubercle. The iliotibial (IT) band is subsequently divided in the direction of its fibers (the distal part of the incision is somewhat more oblique) to the level of Gerdy's tubercle. Care has to be taken not to harm or transect the lateral collateral ligament since it crosses the undersurface of the IT band. The lateral collateral ligament is identified by palpating its anterior and posterior borders. Just posterior to the lateral collateral ligament, the lateral head of the gastrocnemius muscle can be palpated as well as the posterior lateral capsular structures. The posterolateral structures and the insertion of the lateral collateral ligament on the femur form a triangle. The undersurface of the lateral collateral ligament is dissected. However, one should stay extra-articular. We therefore prefer to do this last step of this procedure at the end of the intra-articular procedure in order to avoid leakage of arthroscopic irrigation fluid. The lateral entry point for the femoral tunnel is chosen just proximal to the insertion of the lateral collateral ligament on the femur. This entry point determines the biomechanics of the lateral extra-articular plasty. Therefore the direction of the femoral tunnel will be somewhat more horizontal than for the classic KJ (Fig. 5.51). Reconstruction of the intra-articular anterior cruciate ligament is as described in the previous chapter.

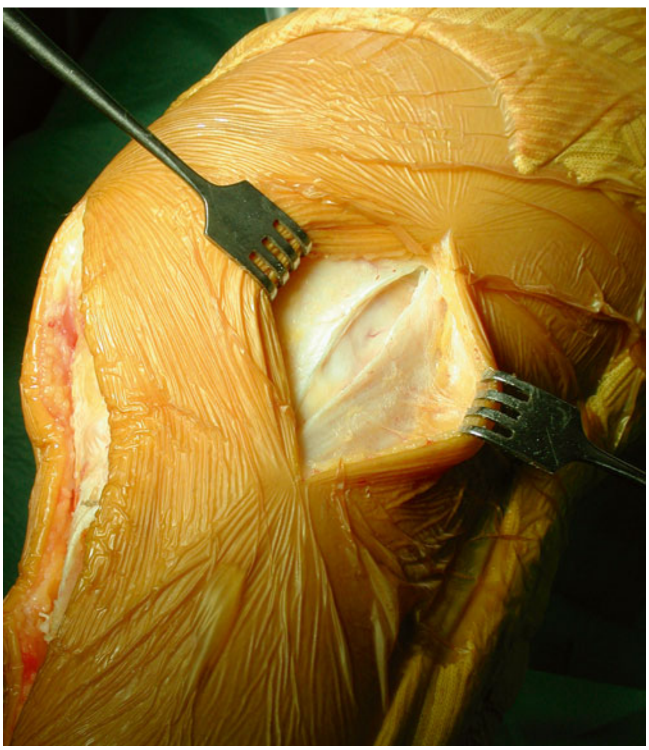


Fig. 5.50 Lateral approach

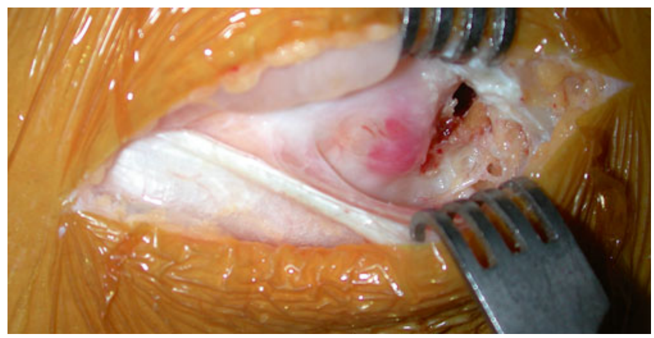


Fig. 5.51 Fascia lata incision

Fixation of the Lateral Plasty

Proximal graft fixation is obtained automatically when the bone block is impacted in the femoral tunnel (Fig. 5.52). The two free ends of the tendon are now passed under the lateral collateral ligament. Distal fixation of the tendon is achieved on Gerdy's tubercle. A bony tunnel is made at this location using an awl (Fig. 5.53). To achieve this, it can be useful to release a small amount of the origin of the tibialis anterior muscle on the lateral border of Gerdy's tubercle. The proximal, superior free end of the tendon is passed from superiorly to inferiorly across the tunnel. The inferior part is passed from inferiorly to superiorly in the same tunnel. To achieve this position, it must first be passed deep to the inferior part of the fascia lata (Figs. 5.54, 5.55, 5.56 and 5.57). The two ends of the tendon are sutured side to side, thus creating a solid fixation (Fig. 5.58). Tensioning of the extra-articular plasty is performed with the knee in 30° of flexion and neutral rotation after fixation of the intra-articular reconstruction.

Closure of the wound is done over a drain. The IT band is sutured with interrupted no. 5 sutures (Fig. 5.59).

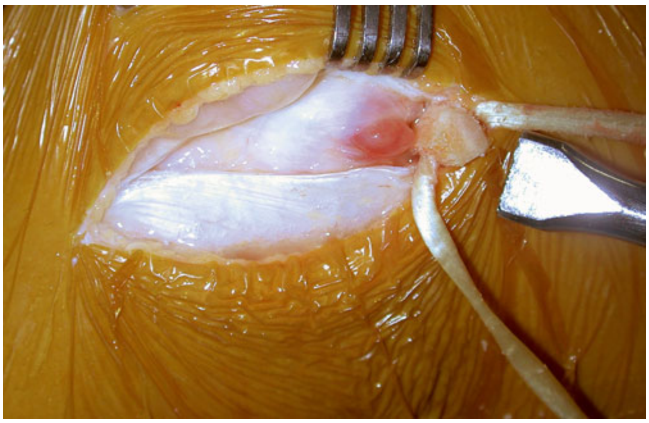


Fig. 5.52 Press-fit proximal fixation

Fig. 5.53 Bony tunnel on Gerdy's tubercle

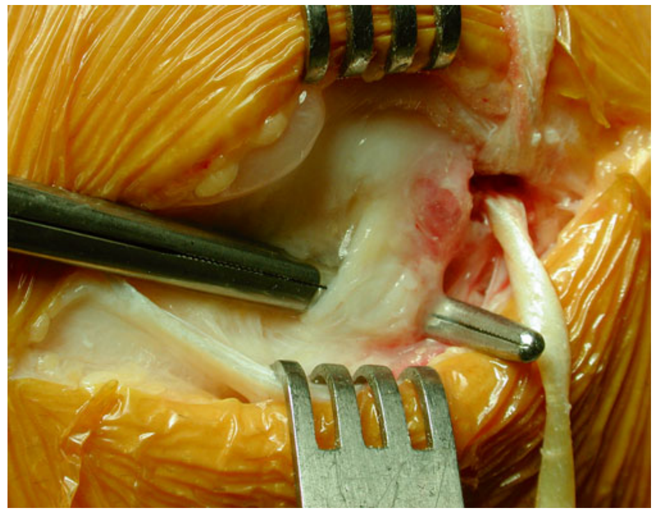
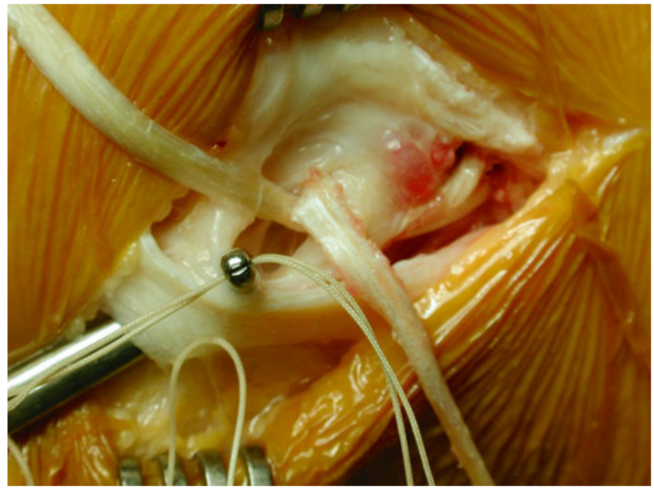
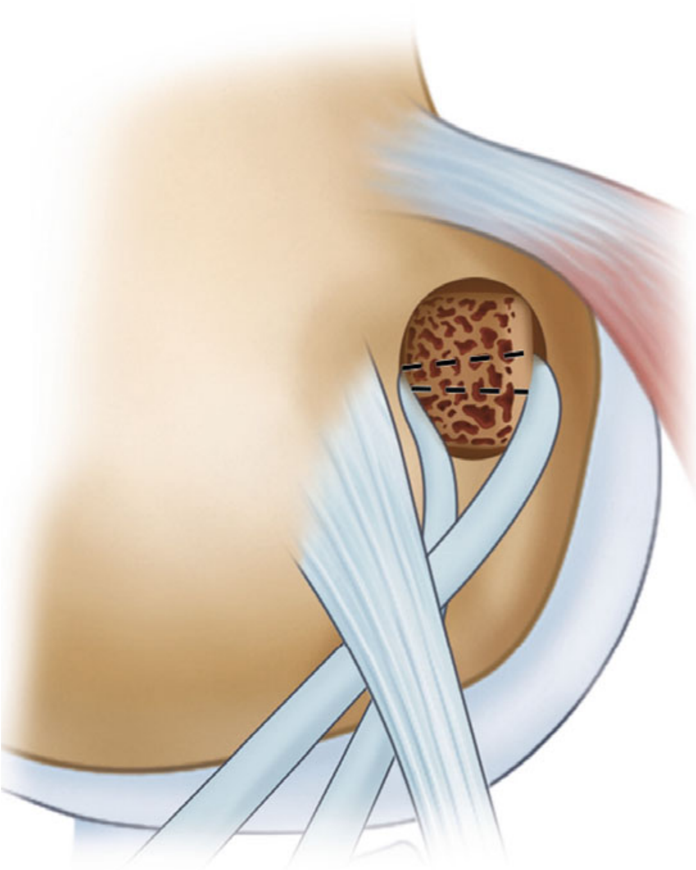
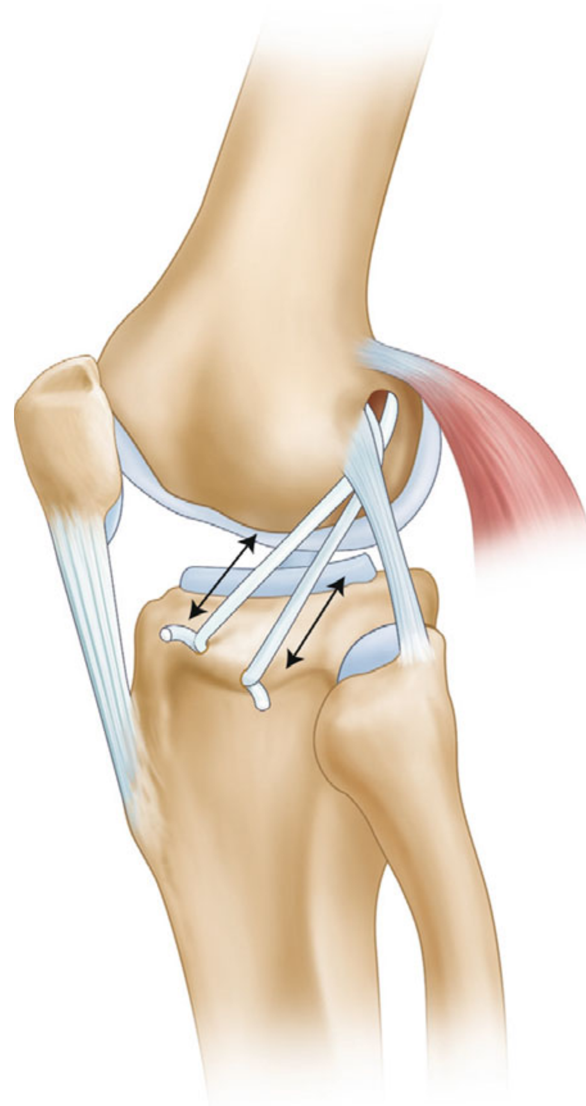


Fig. 5.54 The lateral tenodesis is first passed under the lateral collateral ligament

Fig. 5.55 The inferior bundle is passed under the fascia lata







Figs. 5.56 and 5.57 Lateral tenodesis

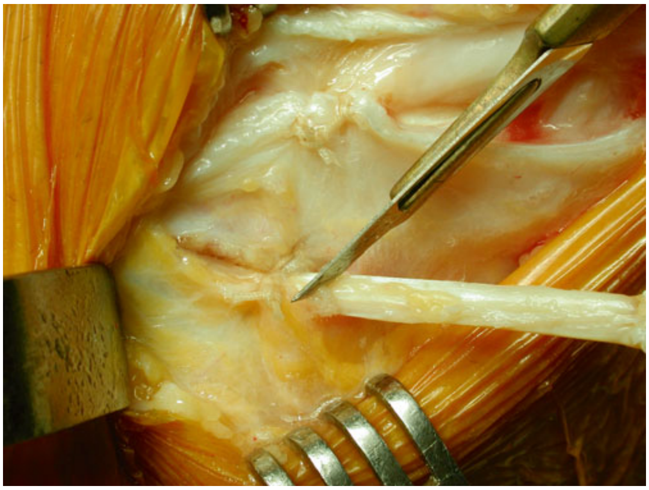


Fig. 5.58 Lateral tenodesis fixation

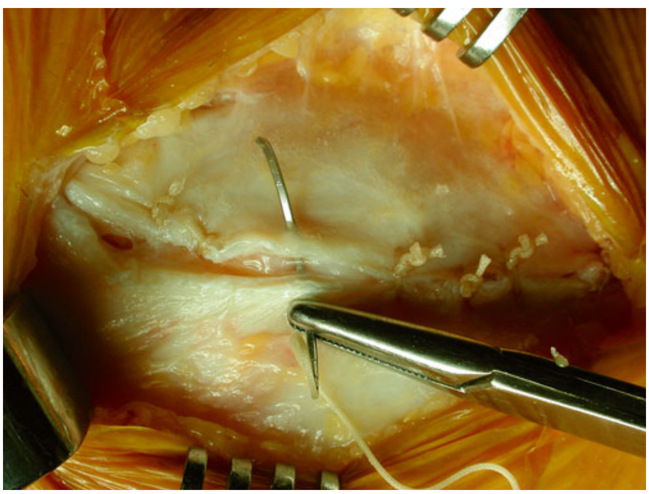


Fig. 5.59 Fascia lata suture

Anterior Cruciate Ligament Reconstruction with a High Tibial Osteotomy

The indication to combine a high tibial osteotomy with a reconstruction of the anterior cruciate ligament is prearthritis with varus alignment or associated with lateral side laxity. This surgical intervention combines two separate surgical interventions that are detailed in other chapters. In this chapter we will detail the sequence of the surgical steps. For over 10 years we have preferred the opening wedge osteotomy as it allows a precise correction to be obtained. Nevertheless, one should always be careful not to change the tibial slope.

The procedure starts with the harvest of the patellar tendon graft followed with the preparation of the femoral and tibial tunnel. Through the same anteromedial approach, the high tibial opening wedge osteotomy can be performed prior to the introduction of the tendon graft (Fig. 5.60). Once the osteotomy is performed (cf. chapter on osteotomies), one has to check (Fig. 5.61) the axis correction with the use of an image intensifier. The metal bar illustrates the mechanical lower limb axis (Fig. 5.62). Once an adequate correction is obtained, a cortical-cancellous iliac bone graft with the correct dimension is harvested. These grafts are introduced posterior to the medial collateral ligament in order to avoid an increase of the tibial slope. The osteotomy is fixed using 2–3 staples (Fig. 5.63). Once the osteotomy is checked and fixed, the bone-patellar tendon-bone graft is introduced into the femoral and tibial tunnels. The bone block in the tibial tunnel is fixed with a metal wire on a post (Fig. 5.64) or with FiberWire via a cortical bone bridge as described above. Isolated fixation on a post or over a bone bridge in combination with an opening wedge osteotomy is insufficient. Therefore we advise augmentation of the graft fixation with an interference screw.

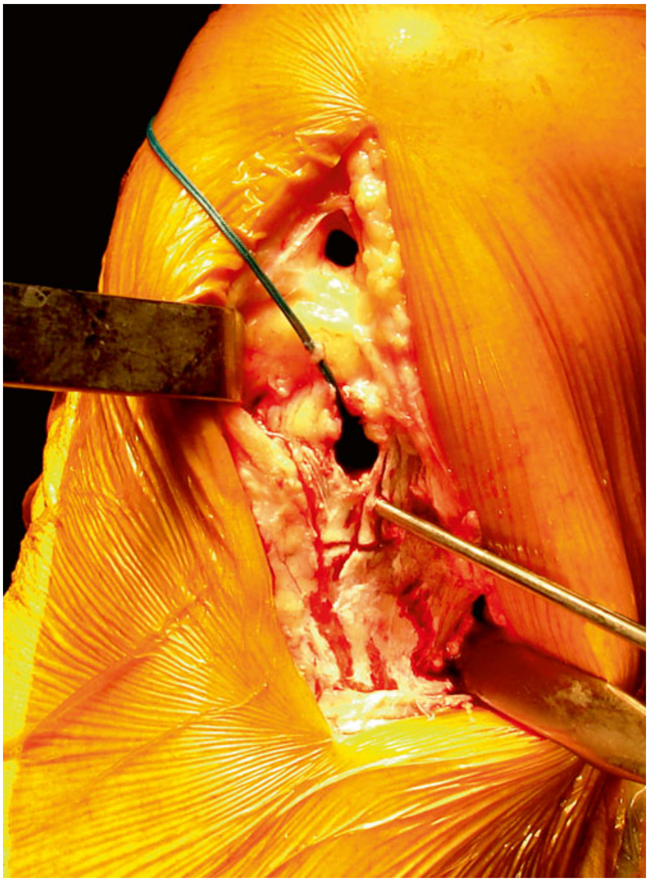


Fig. 5.60 Guide pin positioning

Fig. 5.61 Direction of the osteotomy controlled by fluoroscopy

Fig. 5.62 Lower limb axis assessed with fluoroscopy

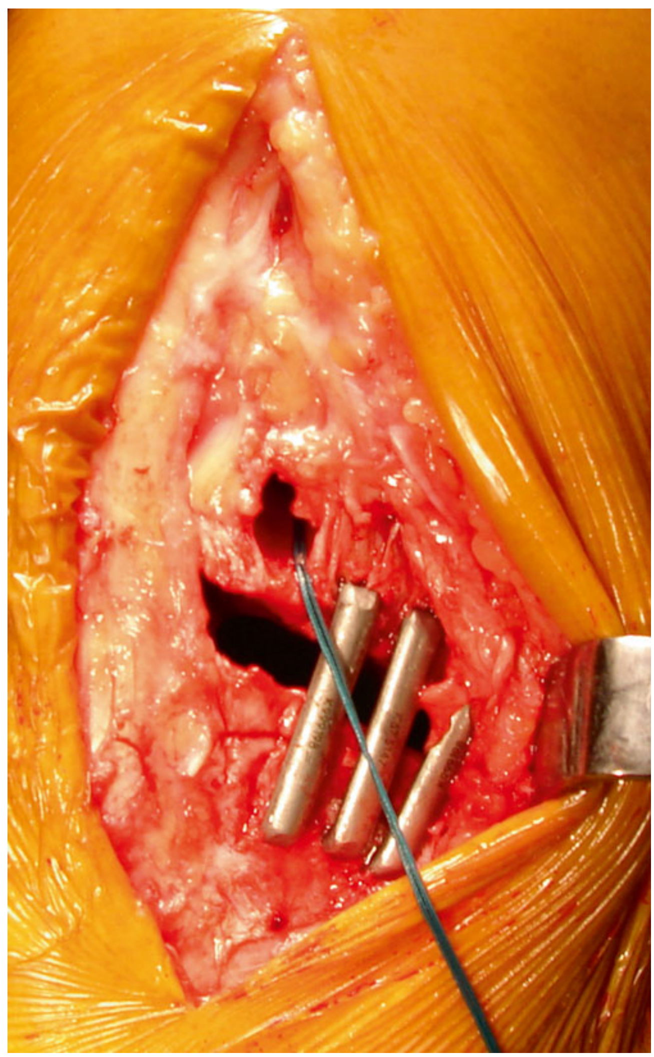


Fig. 5.63 Osteotomy fixation by staples

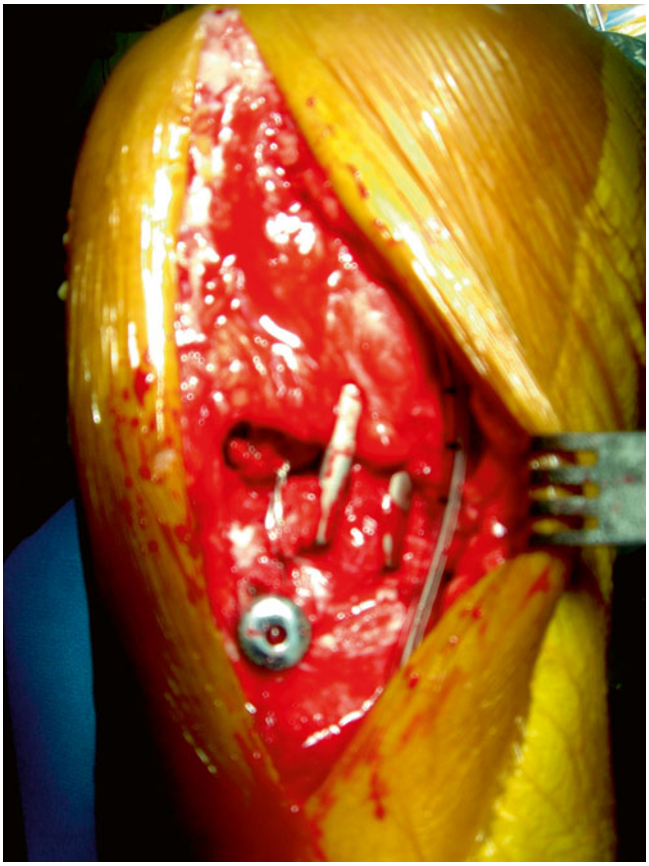


Fig. 5.64 Graft tibial fixation

Postoperative Care

Flexion is limited to 120° for 45–60 days and weight bearing is only allowed after 60 days. Range of motion exercises are allowed immediately in the postoperative setting. A brace in 20° of flexion is applied between the rehabilitation sessions.

Lemaire Extra-Articular Plasty

The extra-articular plasty using the fascia lata was described by Marcel Lemaire in 1967. This technique was modified in Lyon by Professor Dejour and has always been considered very useful in the treatment for rotational instability, specifically in the case of a clearly positive pivot-shift test. It does not control anterior tibial translation of the medial compartment.

Although usually used in addition to an anterior cruciate ligament reconstruction (KJT), this technique can be used on its own, although very infrequently. The indications include residual laxity of the lateral compartment after an isolated reconstruction of the anterior cruciate ligament and chronic anterior laxity in the older patient (55 years and up). The absence of the posterior horn of the medial meniscus is a theoretical contraindication to this procedure since the posterior horn of the medial meniscus serves at the central point of rotation in this procedure.

Positioning of the Patient

This procedure can be performed under general anesthesia or with regional anesthesia. The patient is placed in the supine position. A lateral vertical post is located high on the femur. The distal lateral post allows the knee to be flexed at 30°. The tourniquet is positioned high on the femur. A contralateral post can be applied and allows the surgical table to be inclined to the contralateral side (Fig. 5.65).

Approach

We use a lateral skin incision starting distally at the level of Gerdy's tubercle and continuing proximally 15 cm in the direction of the fibers of the IT band (Fig. 5.66).

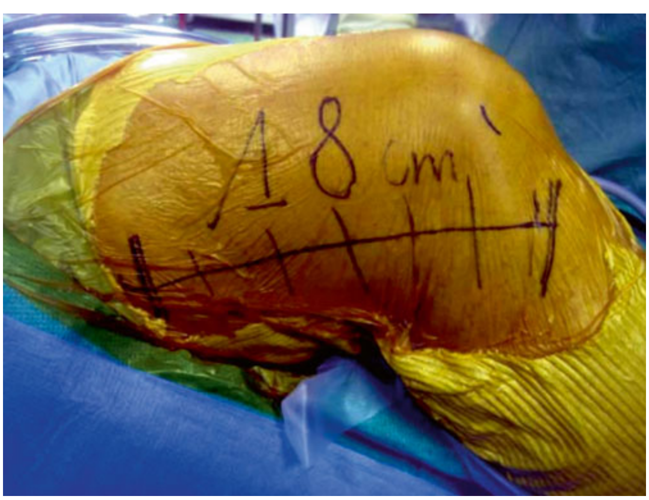


Fig. 5.65 Patient setup

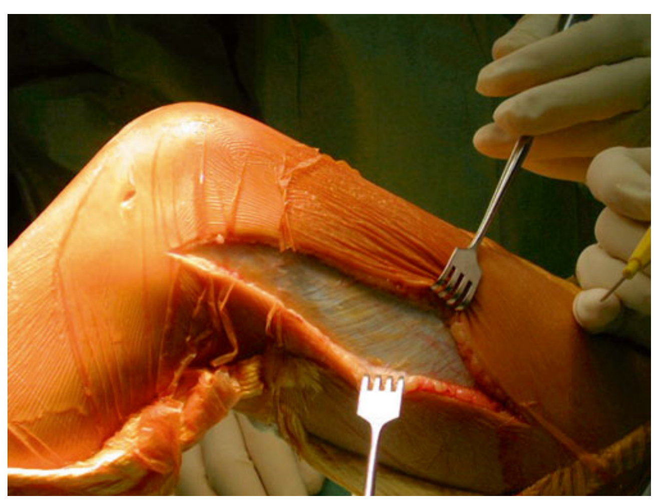


Fig. 5.66 Lateral approach according to Lemaire

Harvest and Preparation of the Fascia Lata Graft

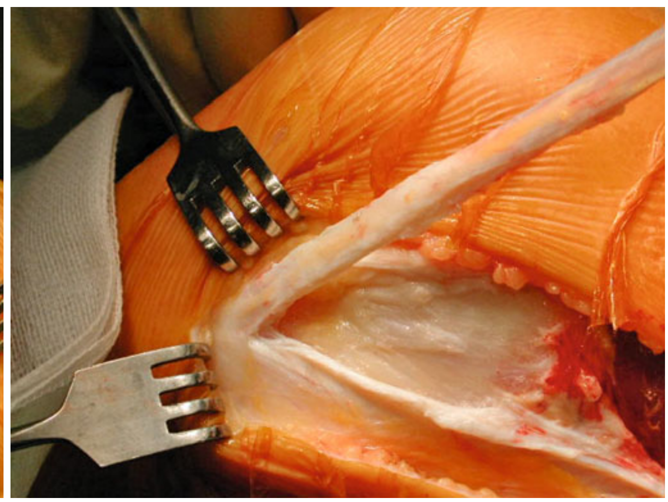
The fascia lata graft is 18 cm long and 1 cm in width and is harvested with the 23 blade (Figs. 5.67 and 5.68). Care is taken not to section or harm the lateral collateral ligament, which crosses the incision in distally. The dorsal border of the graft corresponds with the anterior border of the intermuscular septum. The graft remains in continuity distally with Gerdy's tubercle (Fig. 5.69).

The graft is then prepared by removing all fatty tissue. The proximal end is whip stitched over a minimum distance of 2 cm using n° 5 resorbable sutures (Fig. 5.70).

Preparation of the Femoral Tunnels

The entry points for the femoral tunnel are marked. On the femur, the anterior entry point is situated exactly at the end of the lateral intermuscular septum on the lateral condyle. This point is easily identified by following the septum from proximally to distally carefully lifting the vastus lateralis muscle and reflecting it anteriorly together with the suprapatellar pouch using a Farabeuf or Homan retractor.

Care must be taken to obtain hemostasis of the perforating and metaphyseal vessels. The knee is now flexed by hanging the foot over the edge of the operating table. This maneuver relaxes the posterior margin of the fascia lata. The posterior tunnel is located exactly at the top of the triangle formed anteriorly by the lateral collateral ligament and posteriorly by the lateral head of the gastrocnemius muscle. The

Figs. 5.67 and 5.68 ITB harvesting


Figs. 5.69 and 5.70 ITB preparation

LCL is identified easily just below the epicondyle (Fig. 5.71). If difficulty is encountered in finding the ligament in this location, it can be traced from the top of the fibula. Nevertheless, the best landmark for tunnel location is the anterior border of the lateral gastrocnemius muscle.

The connective tissue and fatty tissue covering the LCL are stripped from both sides of the ligament, providing clear visualization. The interval between the deep surface of the proximal two-thirds of the LCL and the underlying synovium is carefully opened with fine dissecting scissors. The popliteus tendon can be palpated deep to the LCL.

The two tunnels are now made using a straight awl. Using "O'Shaughnessy" arterial clamps, the size of the tunnels is progressively increased (Fig. 5.72). A curved suture guide is passed through the femoral tunnel from anteriorly to posteriorly to insert a passing suture to guide the graft through the tunnel.

Tibial Tunnel Preparation

The tibial tunnel passes under Gerdy's tubercle. A 1 cm incision in the tibialis anterior muscle is made at the inferior border of the tubercle where the exit of the posterior tibial tunnel will be located (Fig. 5.73).

The anterior tibial tunnel is located anterior to Gerdy's tubercle. Again the entry holes are opened up with an awl and enlarged with the "O'Shaughnessy" arterial clamp. The

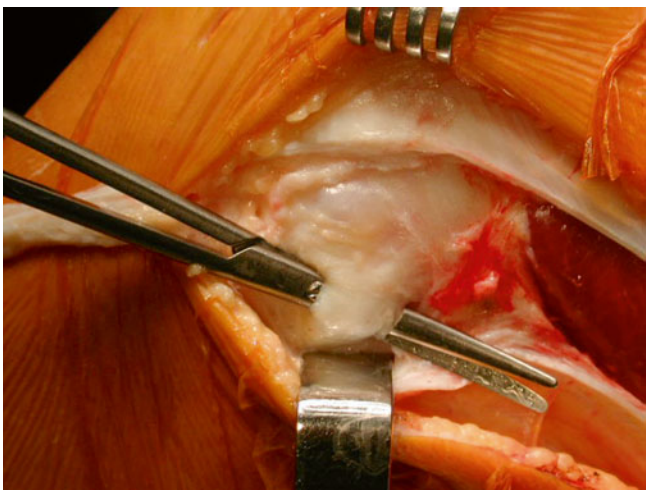


Fig. 5.71 LCL dissection

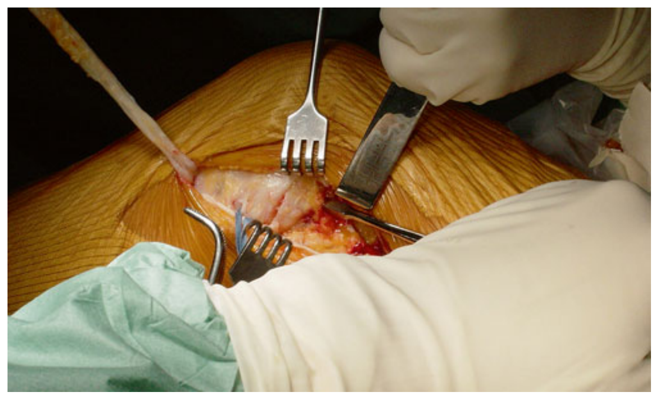


Fig. 5.72 Femoral tunnel preparation

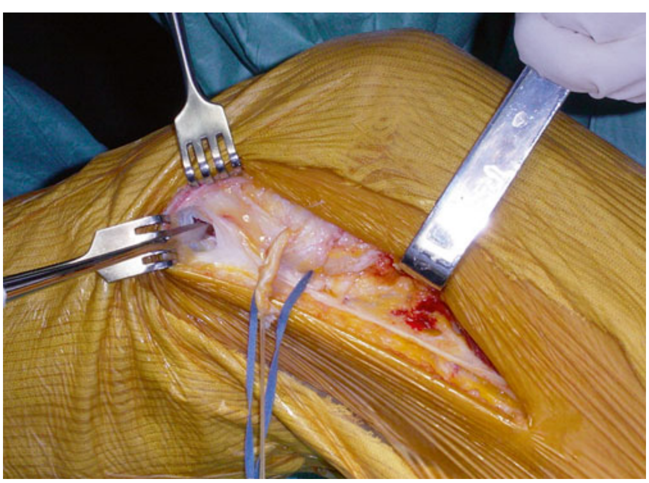


Fig. 5.73 Tibial tunnel

tibial passing suture is inserted from posteriorly to anteriorly using a curve suture passer.

Passage of the Graft

The graft is inserted using passing sutures (Fig. 5.74). It is first pulled underneath the lateral collateral ligament (Fig. 5.75) from distal to proximal taking care not to twist it. The graft should remain extra synovial when passing underneath the lateral collateral ligament but superficial to the popliteus tendon. It is then passed from posterior to anterior through the femoral tunnel (Figs. 5.76 and 5.77) using the previously placed passing suture. The graft is again passed from proximal to distal under the lateral collateral ligament (Fig. 5.78) and then through the tibial tunnel from anterior to posterior using the tibial tunnel passing suture (Figs. 5.79 and 5.80).

The knee is now positioned near extension and in neutral rotation, in contrast to the initial description by Lemaire where the foot was placed in external rotation.

Fixation of the Lateral Plasty

This graft is secured by suturing the ends together on either side of the tibial tunnel with two or three solid sutures using Ercedex no. 5 suture material (Fig. 5.81).

Distally, the two ends of the pull suture are passed through the edges of the IT band with a Reverdin needle to additionally secure the graft. The remaining IT band is closed with interrupted sutures to prevent herniation of the vastus lateralis muscle. The rest of the incision is closed as normal. A drain is inserted under the fascia lata.

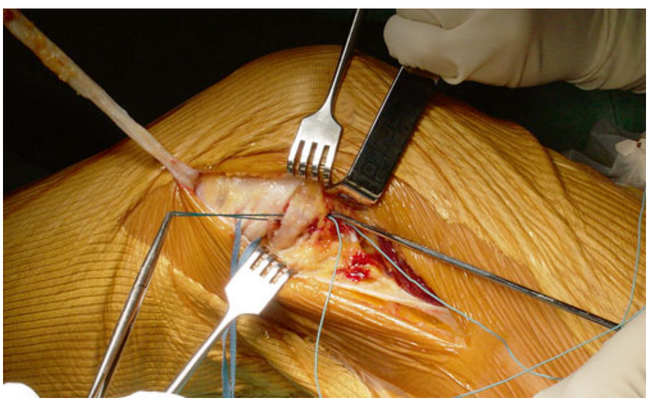


Fig. 5.74 Passing sutures

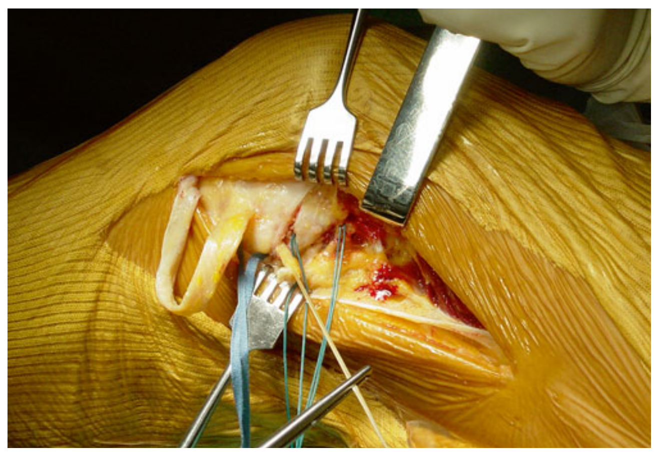
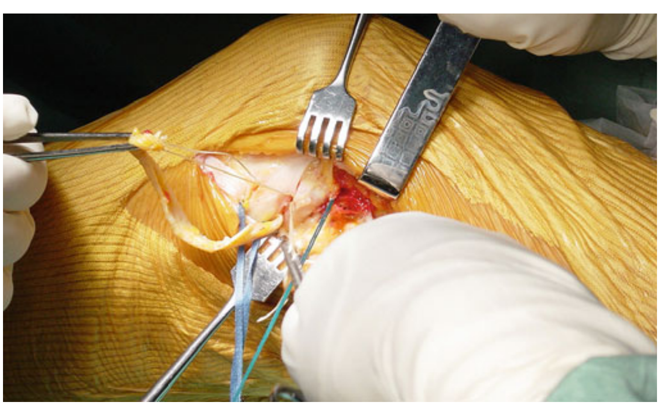
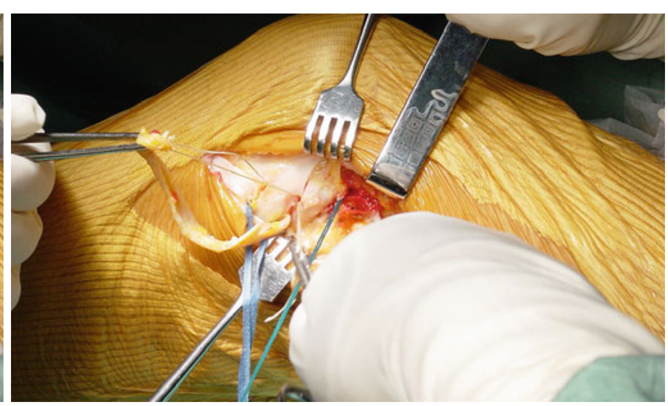


Fig. 5.75 The graft is pulled underneath the LCL 1





Figs. 5.76 and 5.77 The graft is passed through the tunnel femoral

Postoperative Guidelines

The patient is braced in 20° of flexion (full extension according to M. Lemaire). Range of motion exercises of the knee are commenced on the first postoperative day. Full weight bearing is allowed, but a heel of 1 cm should be worn for 2 weeks. This heel is shortened every 3 days by 1 mm. At the end of 45 days, the heel has been completely removed.

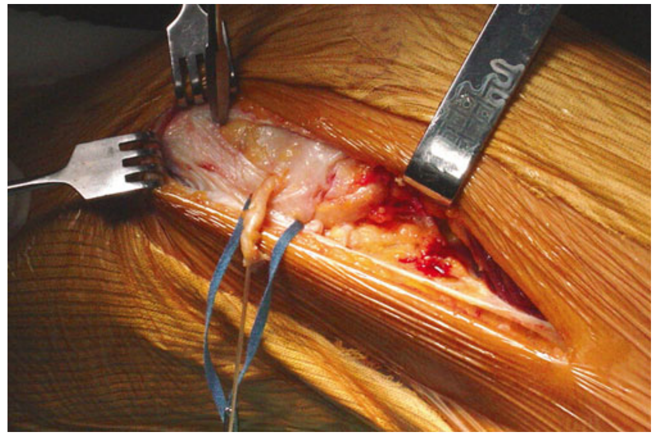
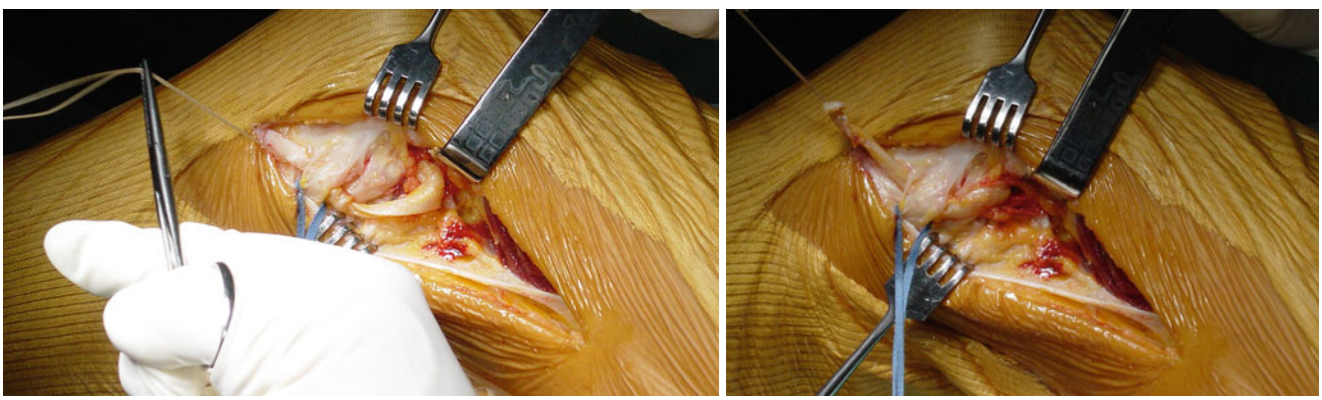


Fig. 5.78 The graft is pulled underneath the LCL 2



Figs. 5.79 and 5.80 The graft is passed through the tibial tunnel

Fig. 5.81 Lemaire extra-articular plasty fixation