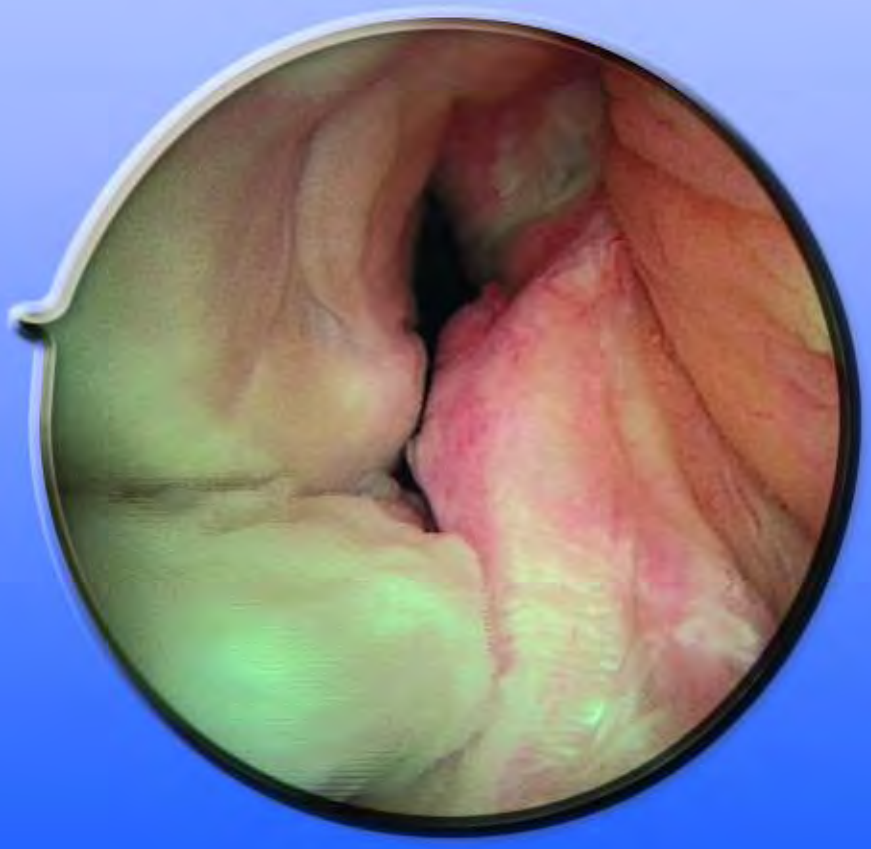
ARTHROSCOPIC RECONSTRUCTION OF THE ANTERIOR CRUCIATE LIGAMENT

SURGICAL TECHNIQUE ATLAS



Piero Volpi

IN COOPERATION WITH

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PREFACES

The guidebook of Prof. Volpi shows with brilliant pictures all the steps, how he performs Anterior Cruciate Ligament (ACL) reconstructions with either hamstring or patella tendon grafts using the DePuy Mitek Rigidfix resorbable cross pin system. The advantages of the technique are clearly illustrated:

1. Good fixation strength.
2. Central fixation, which is especially important to prevent tunnel widening in hamstring grafts.
3. No tunnel widening due to interference screws.
4. Full circumferential ingrowth of the graft in both tunnels.

A small but important detail is the additional bone block onto the BTB graft, to fill the tibial tunnel completely with bone. Thus preventing tibial tunnel widening.
Hopefully this guidebook helps illustrate the Rigidfix cross pin system technique.

Heinz Georg Laprell
Kiel, Germany

Arthroscopic reconstruction of the cruciate ligaments is a proven technique widely used in several qualified orthopedic surgical departments.

Piero Volpi created this Surgical Technique manual with an aim towards ease of use. The major features of this manual are the clear images and the simplicity of the sequence, describing two of the most frequently used techniques to treat these injuries.
In my opinion, this quick reference guide may be very useful for those who want to use the two described methods.

Paolo Rossi
Turin, Italy

At the beginning of the surgical technique for the reconstruction of the anterior cruciate ligament, the cross pin fixation was used at a tibial level. Surely our younger colleagues cannot remember the first attempts that were made with a simple cortical screw. As it often happens, after having been completely forgotten for several years, this technique has been proposed again with appropriate changes to the fixation of the tendon grafts, both to the femur and to the tibia. After this proposition, cross pin fixation slowly, but increasingly, again gained surgeons' interest.

The **absence of foreign material in the bone tunnel, the biomechanical efficiency, and a complete biological fixation of the graft** were the reasons that led me, ten years ago, to the use of transverse fixation. Currently the surgeon can choose among different fixation systems, all of which can be traced back to the same principles and all of which have the same advantages that are mentioned above.

I willingly accepted the opportunity to introduce this valuable Surgical Technique manual, resulting from Piero Volpi's experience. I appreciated his commitment and professional discipline from his first approach to arthroscopic surgery.

The manual is characterized by its concrete tone and by its use of easy to follow text that guides the reader step-by-step to an appreciation of the advantages of the cross pin technique. It explains how this technique can either be used with the patella tendon or the flexor tendons. Every single surgical phase is shown in detail. Additionally, the pictures contained in this manual are so rich, precise, and of such high quality that they give the reader the image of being in the Operating Room.

Pier Paolo Mariani
Rome, Italy

Prof. PIERO VOLPI

Born in Milan on June 9th 1952.
Graduated in Medicine and Surgery in 1979 specialised in Orthopaedics, Traumatology and Sports Medicine.
Lecturer at Milan University.
Manager of Sports Traumatology and Arthroscopic Surgery Department of Galeazzi Orthopaedic Institute in Milan.
President of the Sports Committee of the Italian Society of Knee Surgery, Arthroscopy, Sports Traumatology, Cartilage and New Orthopaedic Technologies (SIGASCOT) since 2004.

Member of the Italian Society of Orthopaedics and Traumatology (SIOT).
Member of the Italian Society of Arthroscopy (SIA).
Member of the Italian Sports Medicine Federation (FMSI)
Member of the Society of Shoulder and Elbow Surgery.
Member of the European Society of the Knee Surgery and Arthroscopy (ESSKA).
Member of the European Federation of National Associations of Orthopaedic Sports Traumatology (EFOST).
Secretary of the Italian Society of Sports Traumatology (S.I.Tra.S.) until 2004.
Founding member of the Italian Group for the Study of Osteocartilaginous Tissue Repair Processes (GIRC).
Member of the International Cartilage Repair Society (ICRS).
Member of the editorial committee of the "European Journal of Sports Traumatology and related research".
Advisor to the Technical Department of the Italian Football Federation (FIGC) from 1989 to 1995.
Healthcare consultant of the Italian Footballers' Association (AIC).
Chief physician of FC Internazionale di Milano (i.e. the "Inter" football team) from 1995 to 2000.
FIFA Medical instructor since 1999.
Member of the Antidoping Commission of the Italian Football Federation since 2001.
Speaker in many National and International Conferences.
Author of more than 200 scientific publications.

INTRODUCTION

Based on recent epidemiological studies, the anterior cruciate ligament (ACL) injury, both isolated and associated to other joint structures of the knee, represents a recurrent possibility mainly affecting patients who participate in sports activities.

The natural history of ACL injuries is well known and consists of a progressive deterioration of the joint in all its components. In the presence of an ACL injury, the major indication to be followed is surgical repair, nowadays performed under arthroscopic assistance. The surgical techniques proposed and used over the years by knee surgeons are various, and during this time they've improved and have become more consistant.

A good result for an arthroscopic reconstruction of the ACL depends upon many factors, but mainly upon the accurate execution of a surgical procedure and a strict and scrupulous compliance with its different steps.

A good and well-followed post-operative rehabilitation program cannot compensate, correct, or change any errors made during surgery.

Among the various surgical steps: arthroscopic evaluation, graft choice, preparation of the tunnels, and secure graft fixation in the femoral and tibial tunnels which still represents a controversial key point in its technical execution.

Among the different possibilities made available to orthopedic surgeons by various companies: the femoral and tibial cross pin fixation with absorbable pins, made with high precision instruments, is today a valuable solution in view of its biological and biomechanical aspects. It offers a solid fixation and its biological potentialities are convincing: In the two most often used grafts, 4 strand semitendinosus and gracilis or patella tendon, the grafted tissue contained in the tunnels, consisting of soft tissue or bone block (BTB), is entirely in contact with the bone wall. In this way, the implant has the possibility to completely employ the biological capacities of bone-integration between the different tissues that are in complete contact with each other. It is, however, certain that despite the number of works and documents recently published, a number of problems, mainly of a surgical nature, remain unresolved. As usual, a careful monitoring of the results over time will eventually supply us with useful indications about the effectiveness of the technical choices we are making today.

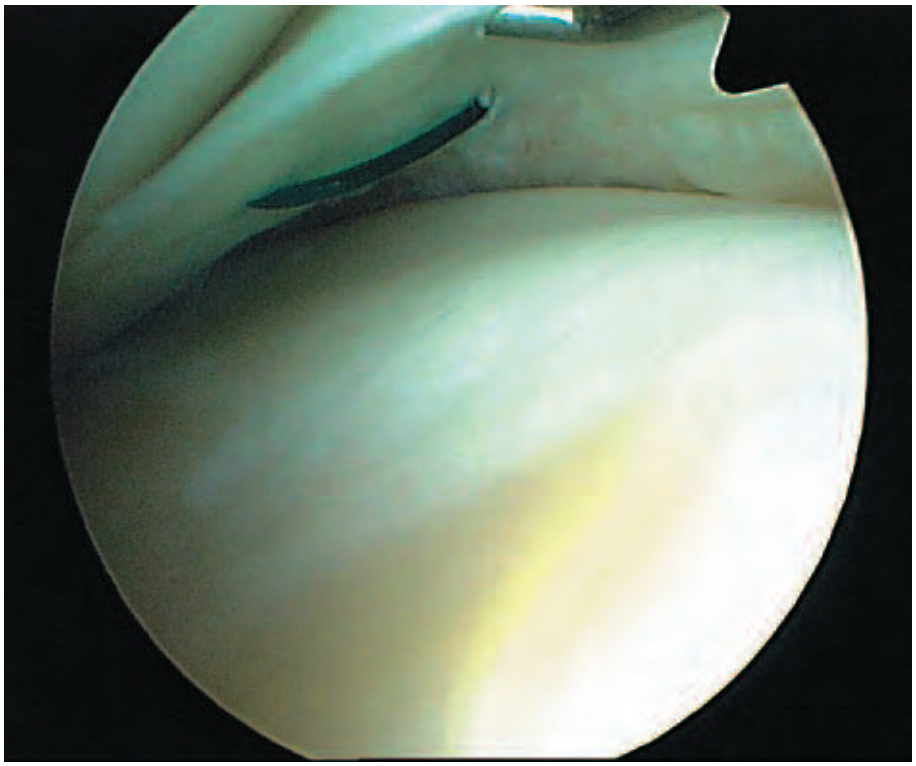
Piero Volpi

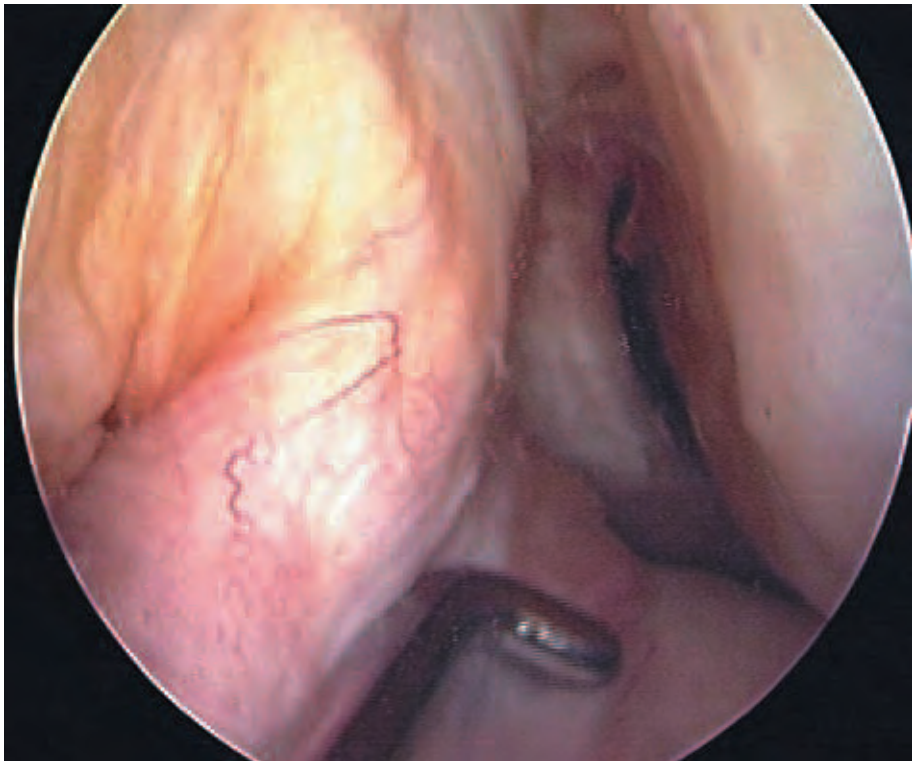
RECONSTRUCTION OF THE ANTERIOR CRUCIATE LIGAMENT WITH SEMITENDINOSUS AND GRACILIS GRAFT

Preparation of the surgical field: The patient is under regional or general anesthesia. The thigh is held by a support allowing for a 0° – 90° minimum motion and a tourniquet band is applied.

Perform a routine arthroscopic examination to determine joint status. Confirm the ACL injury and treat any associated meniscus and cartilaginous injuries.

Longitudinal injury of the posterior horn of the medial meniscus: outside-in suture with spinal needles on the meniscal tibial surface.



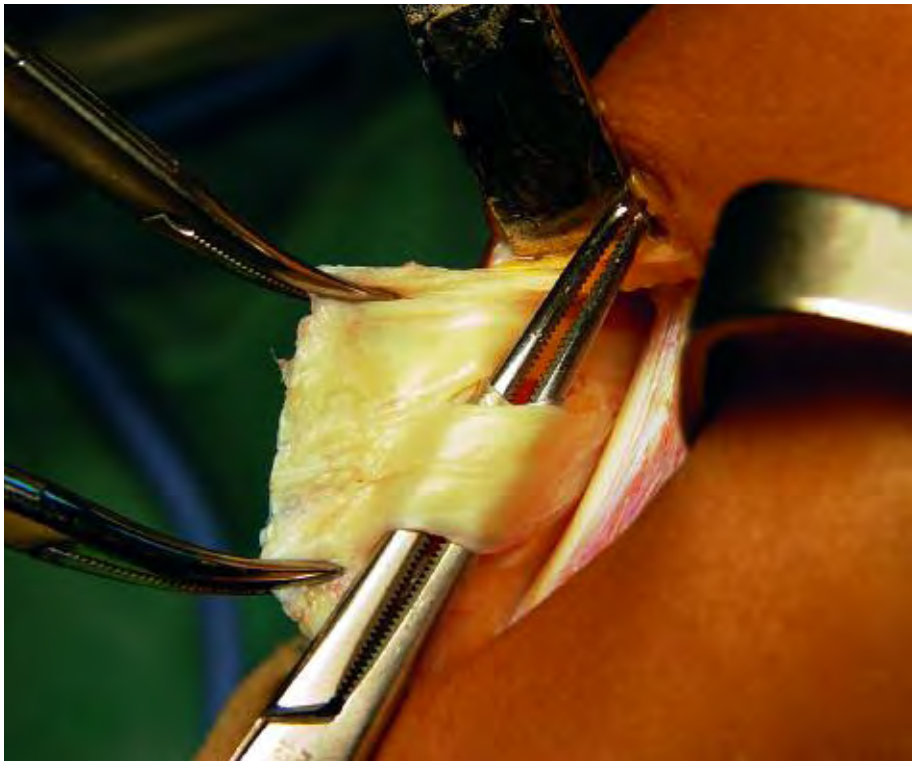


Injury of the anterior cruciate ligament of the left knee, is seen.

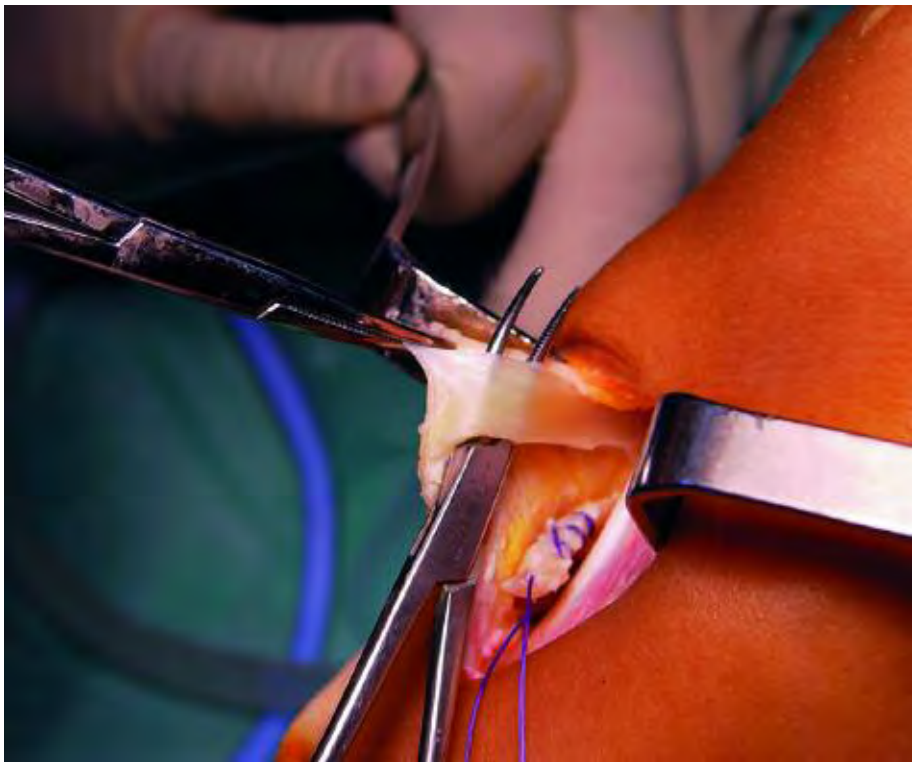
Remove the arthroscope and begin to harvest the semitendinosus and gracilis tendons. Make a 3–4cm longitudinal incision in the skin, from proximal to distal, starting from the medial border of the tibial tubercle.

After having separated the subcutaneous tissue of the sartorius fascia, the insertion of the semitendinosus and gracilis appears.

Sharply detach the sartorius fascia from its insertion on the tubercle. Then retract the fascia upwards, so that the gracilis and semitendinosus may be visualized from the deep surface. In the background, you can see the medial collateral ligament.

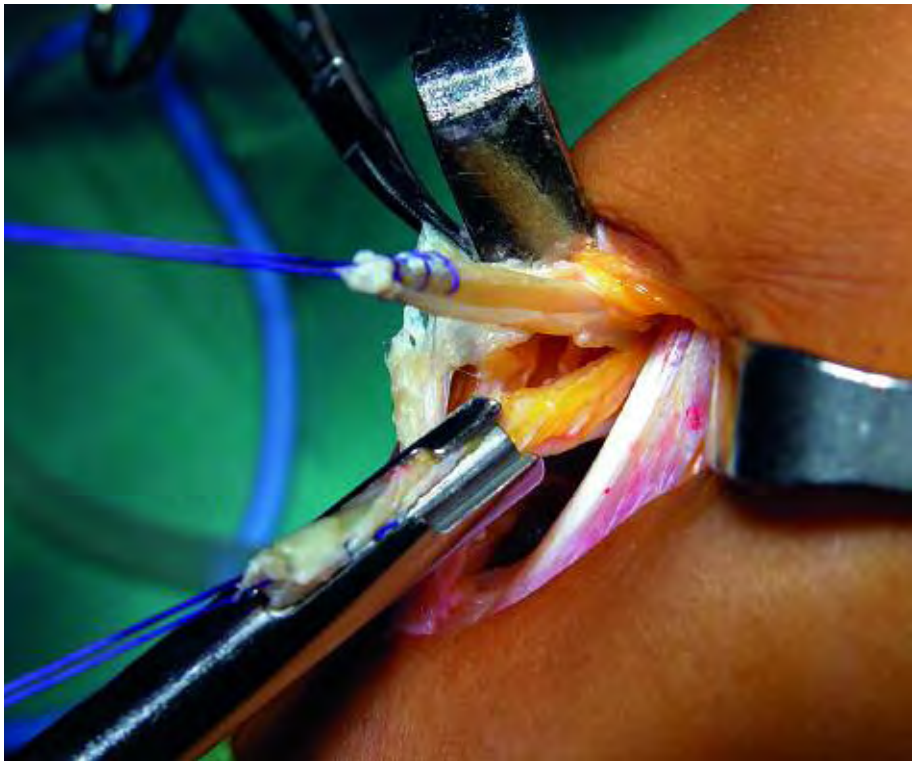


Detach the semitendinosus from the distal insertion, dividing it from the common septum with the gracilis and secure it with an absorbable suture at the end by means of four double passes.

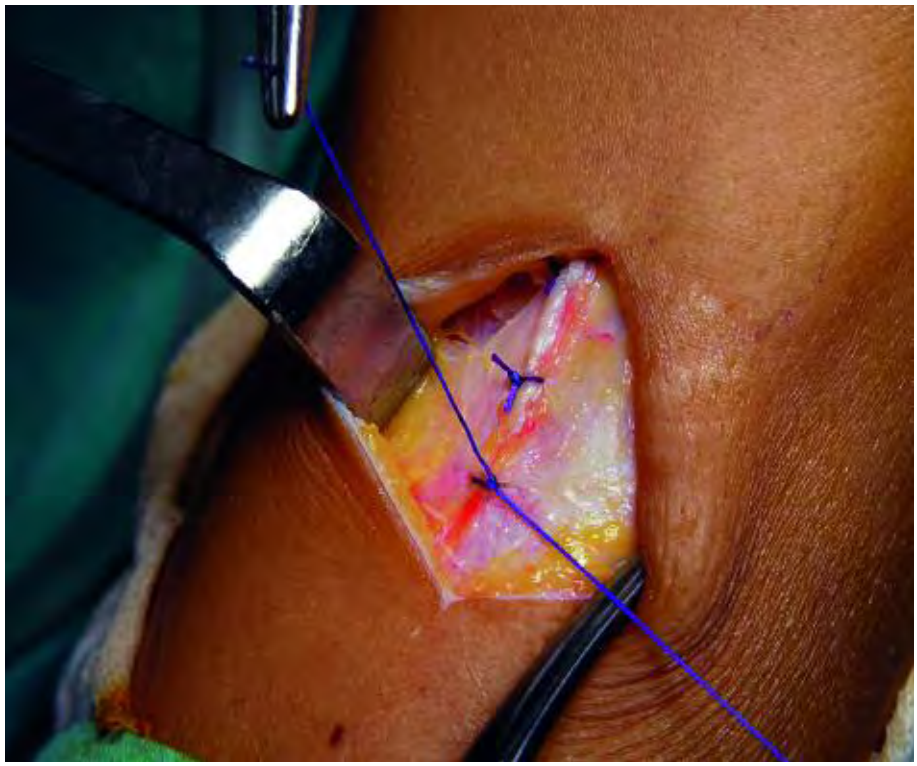


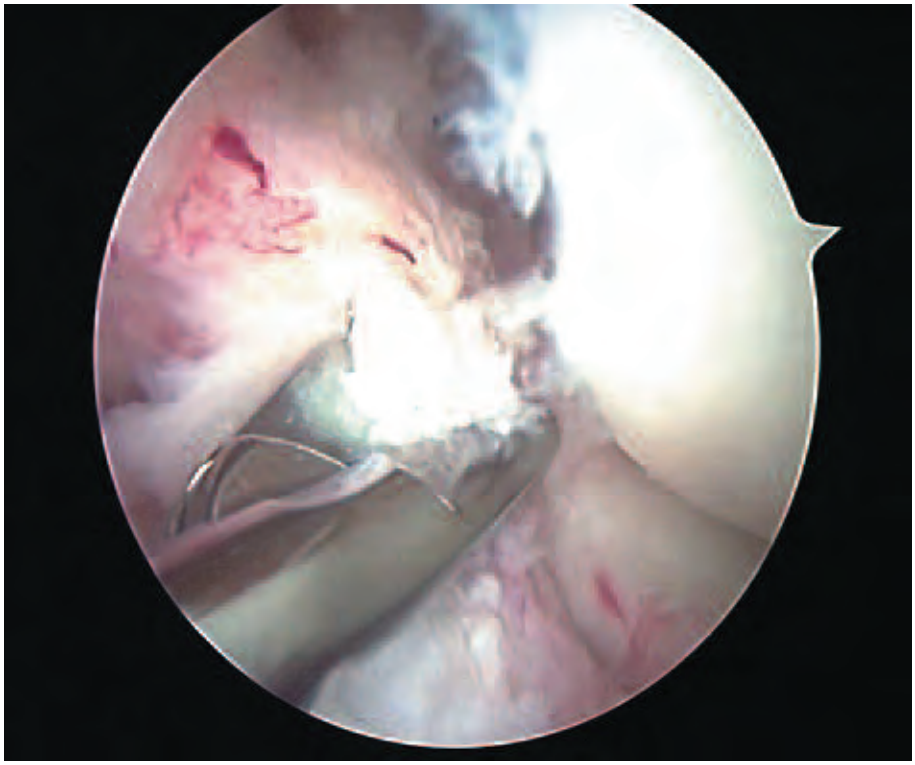
Dissect and suture the gracilis in the same way.

Using a common tendon stripper-harvester, carefully harvest the two tendons to reach a length of 20–22cm.

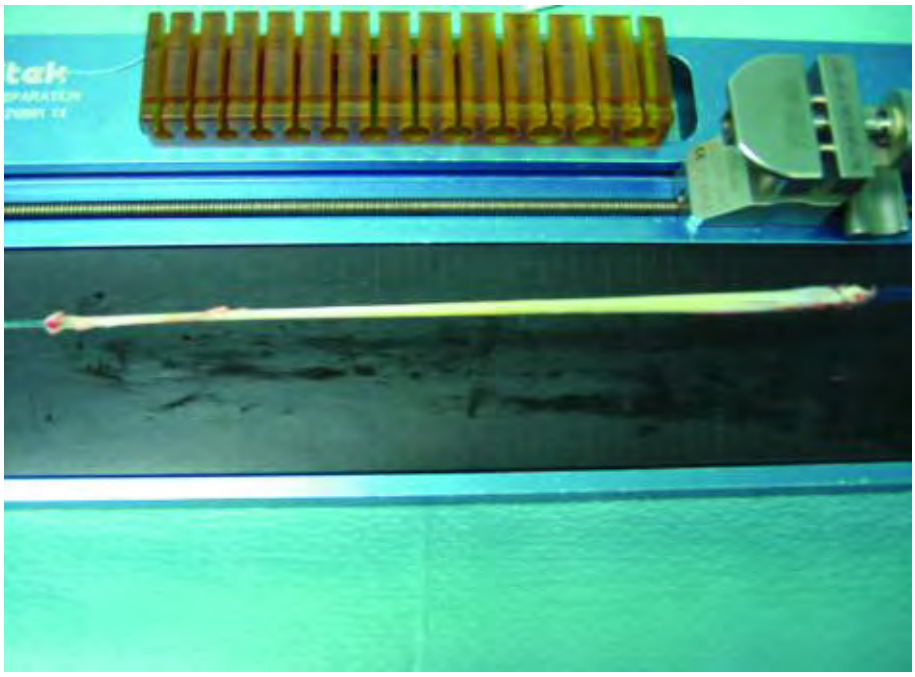


Suture the sartorius fascia.





Reintroduce the arthroscope and clean the intercondylar notch, trying to preserve as much as possible of the periligament tissues and the base of the ACL.

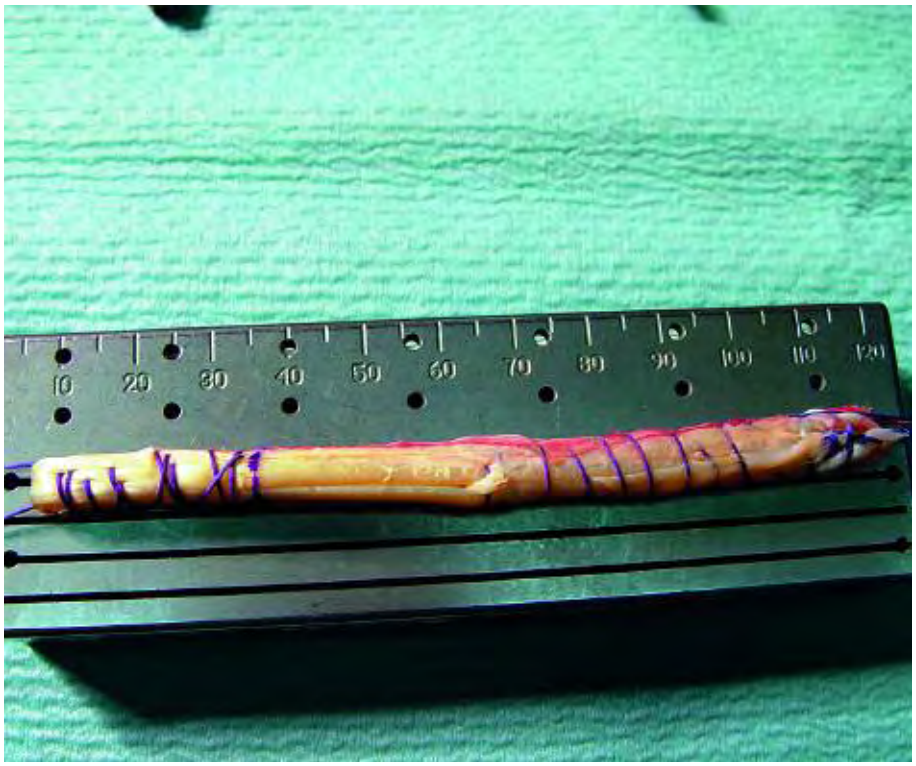


While the surgeon prepares the joint, the assistant places the tendons on the workstation and cleans them of any muscle tissue. Next he doubles them, sutures them together, and puts them under tension.

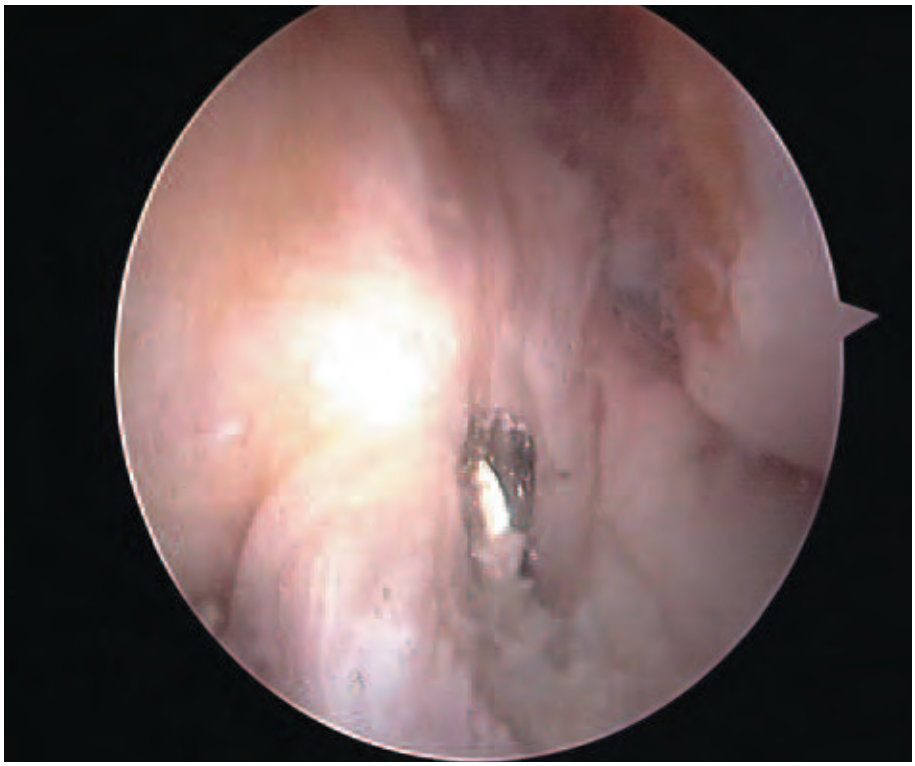
Prepare the femoral end by joining each of the double bundles of tendons and suturing them with a #0 absorbable suture, 1mm up to 30mm, corresponding to the depth of the femoral tunnel.

When the lengths of both tunnels and the intraarticular portion of the graft are known, apply a suture to the tibial portion of the prepared tendons, taking care to pre-tension the four bundles in a uniform way.

Example:
Femoral portion 3cm + intraarticular portion 2.5cm + tibial portion 4.5cm = 10cm, the total length of the new ACL.



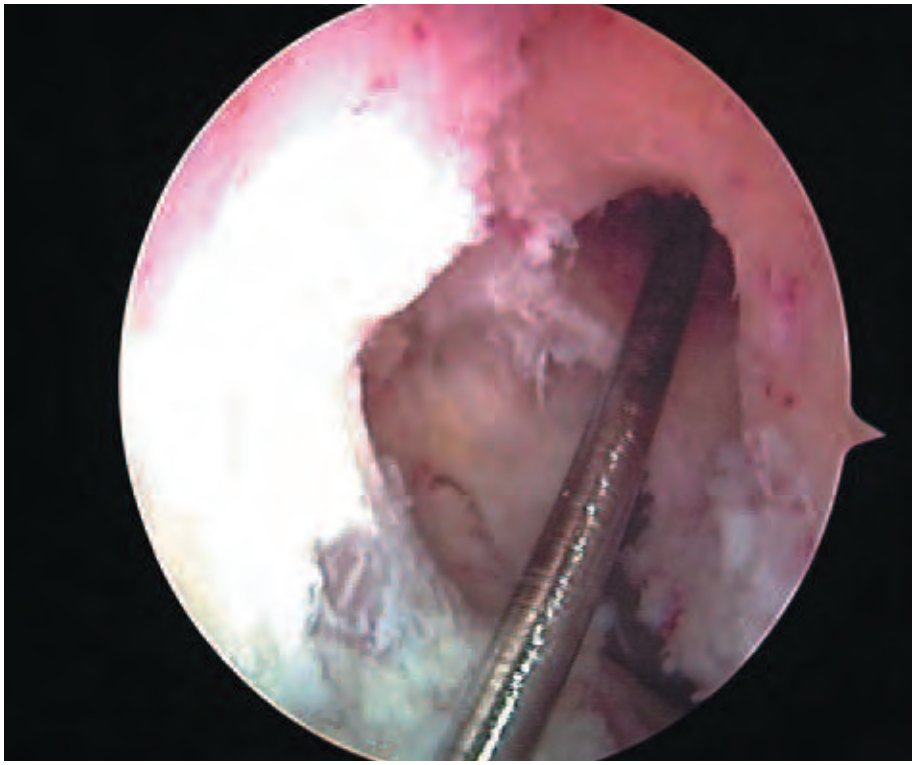
From an anterior-medial portal, and using a 50°-angled tibial guide, place a guide wire behind the insertion of the old ACL, trying to stay 20° medial with respect to the tibial longitudinal axis.



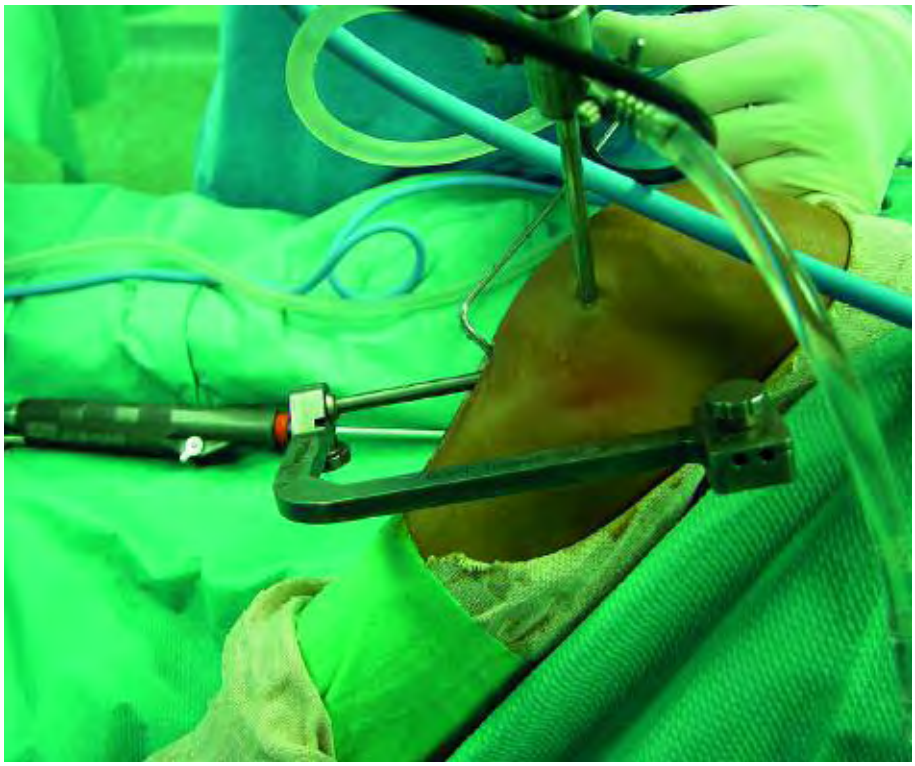
Arthroscopic view of the guide wire in the joint.

Confirm the correct position of the guide wire and drill a tibial tunnel with a 7mm fluted reamer.

Through the tibial tunnel, look for the correct femoral insertion point with the help of the guide wire.



Identify the femoral point (at 1:00–1:30 o'clock, left knee) and make a tunnel (the same diameter of the graft) through the tibial tunnel, reaching a depth of 30mm.



Position the DePuy Mitek Rigidfix™ femoral guide.

Note that the arm of the guide is positioned lateral to the knee.

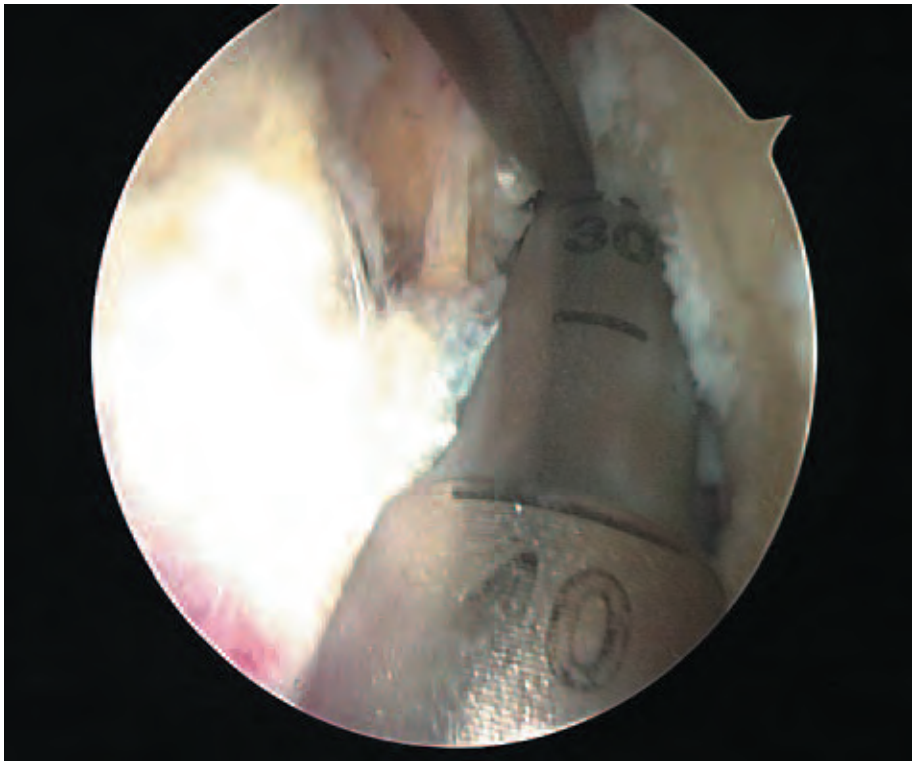
Intraarticular view of the positioning of the femoral guide. The guide has bottomed out at 30mm.

Introduce the guide, then drill into place two cannulated sleeves, assembled with the appropriate interlocking sharp trocar. These sleeves have a diameter of 3.3mm.

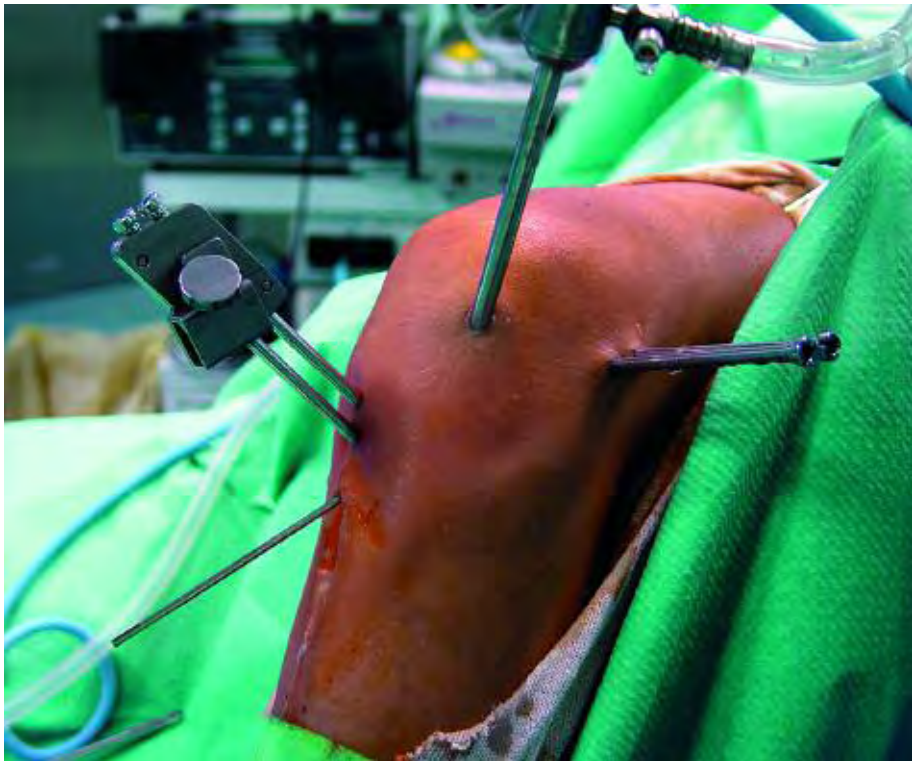
Remove the femoral guide leaving the sleeves in position.

Place the Rigidfix tibial guide, with a rod which is the same diameter as the tunnel, with the tip at the inferior most aspect of the femoral tunnel.

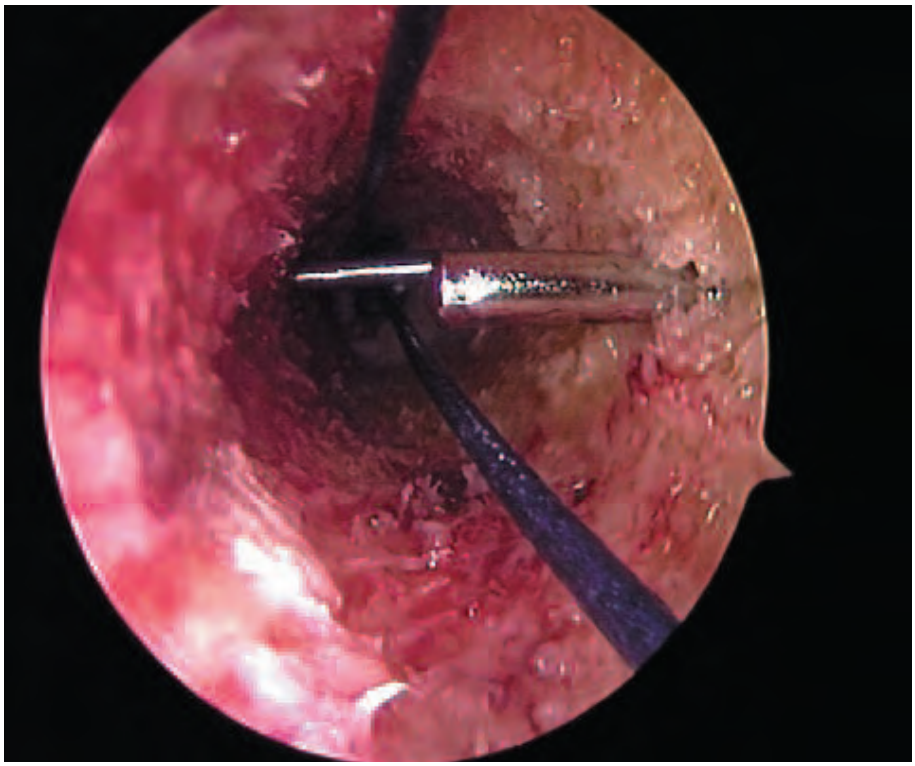
Arthroscopic view of the Rigidfix tibial guide. Measure the intraarticular portion.



Fasten the sliding guide to the corresponding intraarticular measure and place two sleeves, similar to the femoral ones, keeping the guide frame in anterior-medial position.



Place a suture passing pin, with an eyelet, which will be used to pull the graft into position. Use the arthroscope for a final view of the knee with the sleeves in place.

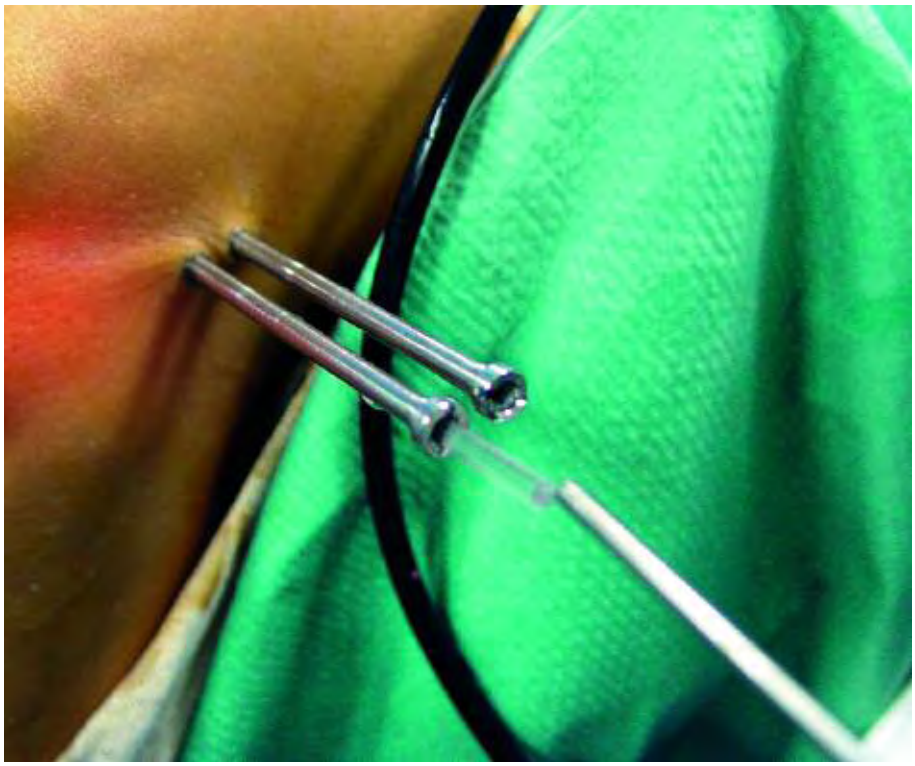


Arthroscopic check of the perpendicularity of the tibial holes.

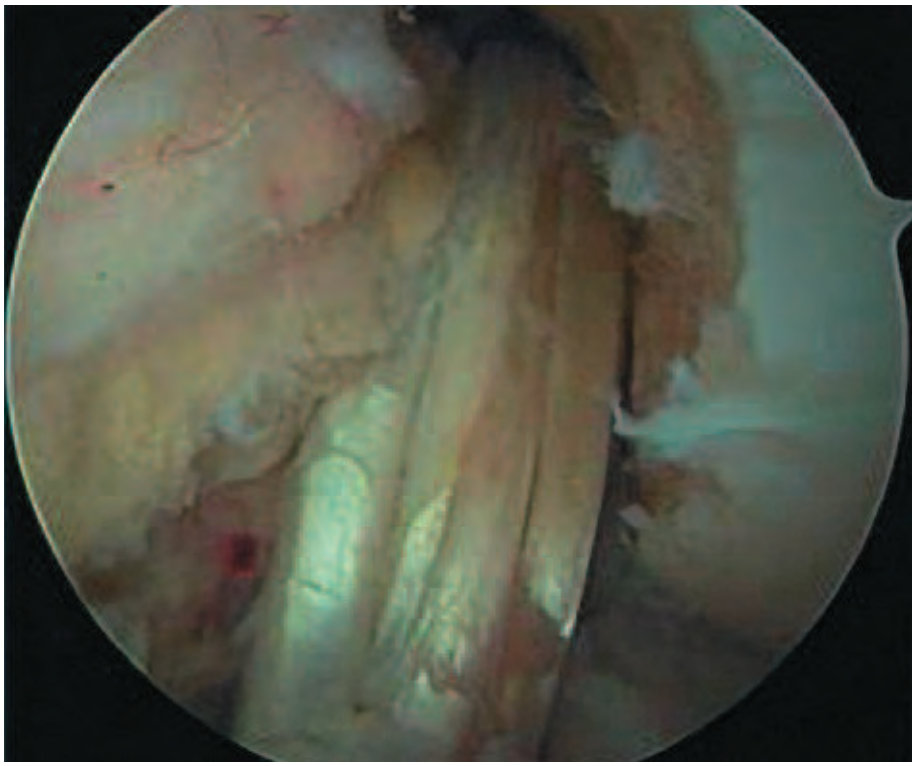
Pull the graft into place under visualization.

Femoral fixation takes place with Rigidfix absorbable pins (3.3mm diameter).

The proximal pin is inserted first, the distal second.



After both pins are inserted, remove the femoral sleeves and flex the knee at approximately 20°. Fasten the tibial portion of the graft with two additional Rigidfix cross pins, while maintaining manual traction.

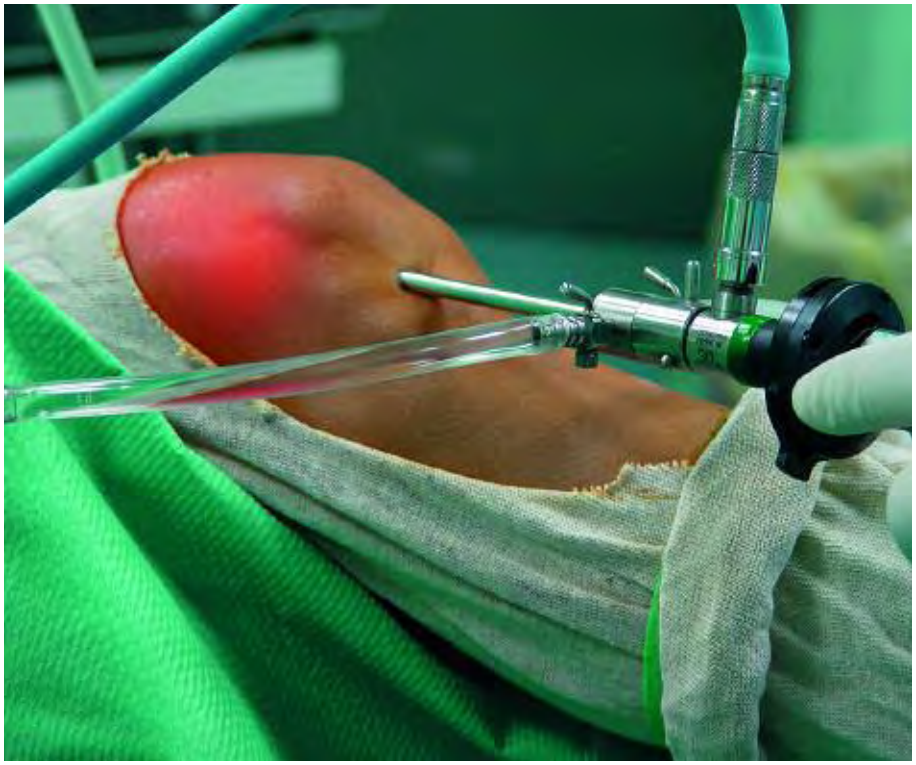


Final arthroscopic check of the graft.

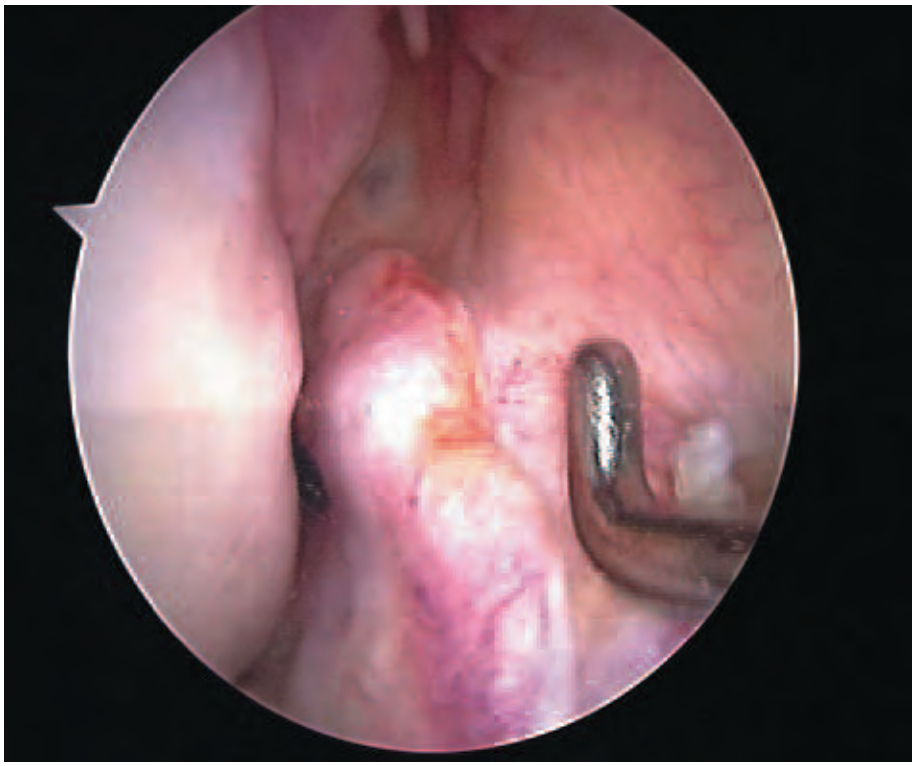
RECONSTRUCTION OF THE ANTERIOR CRUCIATE LIGAMENT WITH PATELLAR TENDON

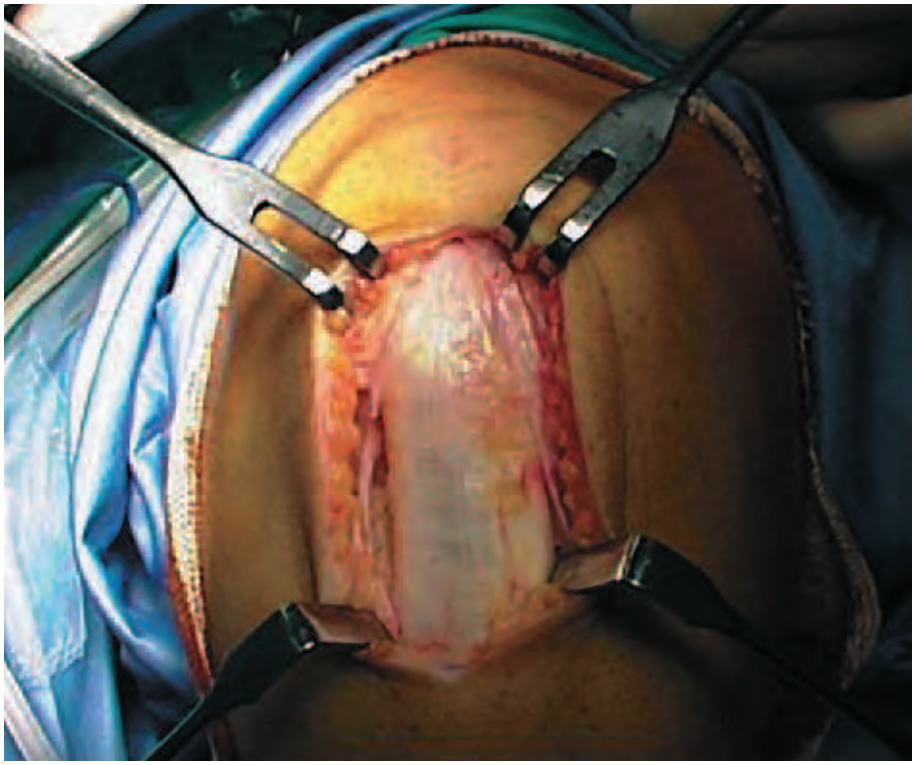
Preparation of the surgical field: The patient is under regional or general anesthesia.
The thigh is held by a support allowing for a 0° – 90° minimum motion and a tourniquet band is applied.

Routine arthroscopic examination to determine joint status. Confirm the ACL injury and treat any associated meniscal and cartilaginous injuries.



Injury of the anterior cruciate ligament is confirmed arthroscopically.





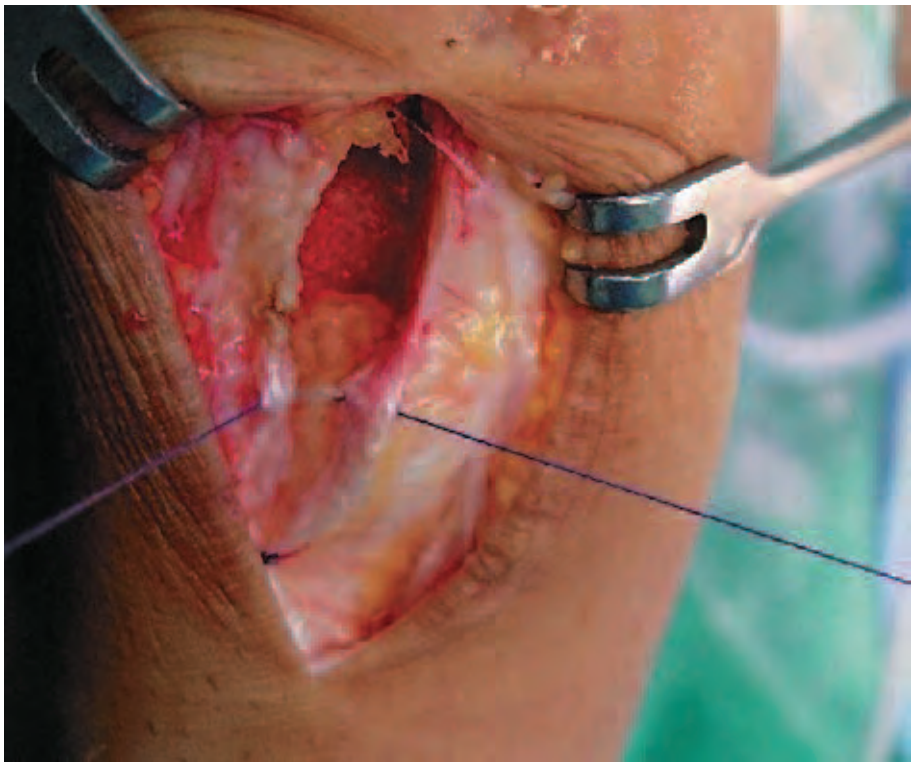
Make a longitudinal cut of approx. 4–5cm, dissect the periosteum and expose the patellar tendon.

Using a 10mm graft knife, incise the central third of the patella tendon from the patellar apex to the tibial tubercle.

Mark a portion of patella bone (approx. 20–25mm long) and tibial bone (approx. 25–30mm long) with a 10mm width and define two bone blocks with an oscillating saw.

Drill two small holes in the patella bone block (destined to fill the tibial tunnel) and a small hole in the tibial block (destined to fill the femoral tunnel).

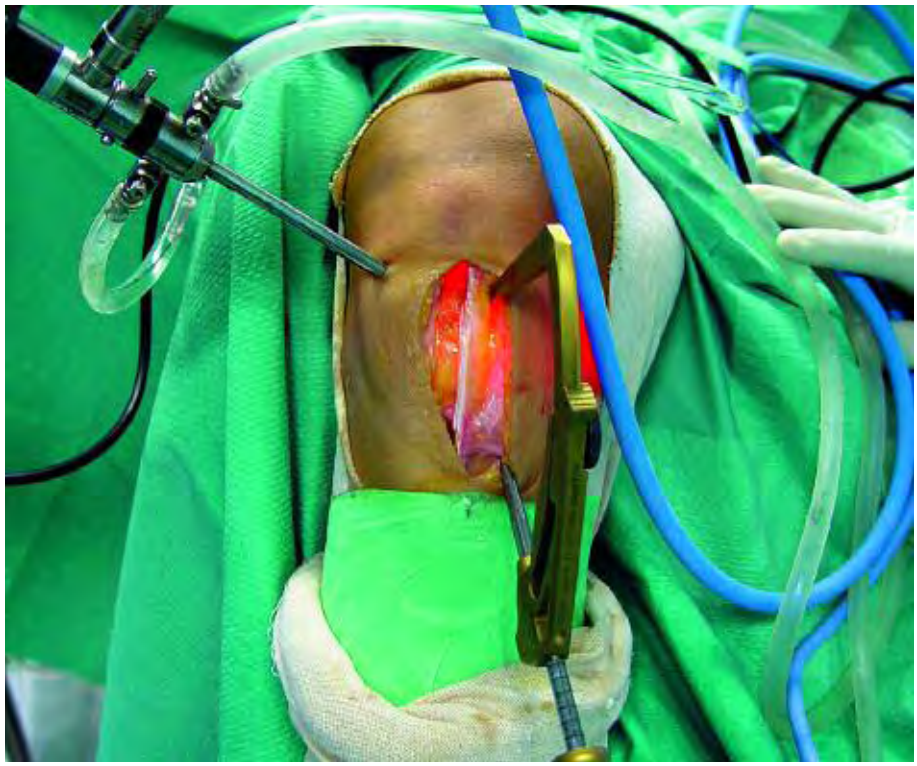
Detach the tendon using a 10mm width (3/8 inch) osteotome. From the tibia, harvest a larger portion of cancellous bone to be used later.



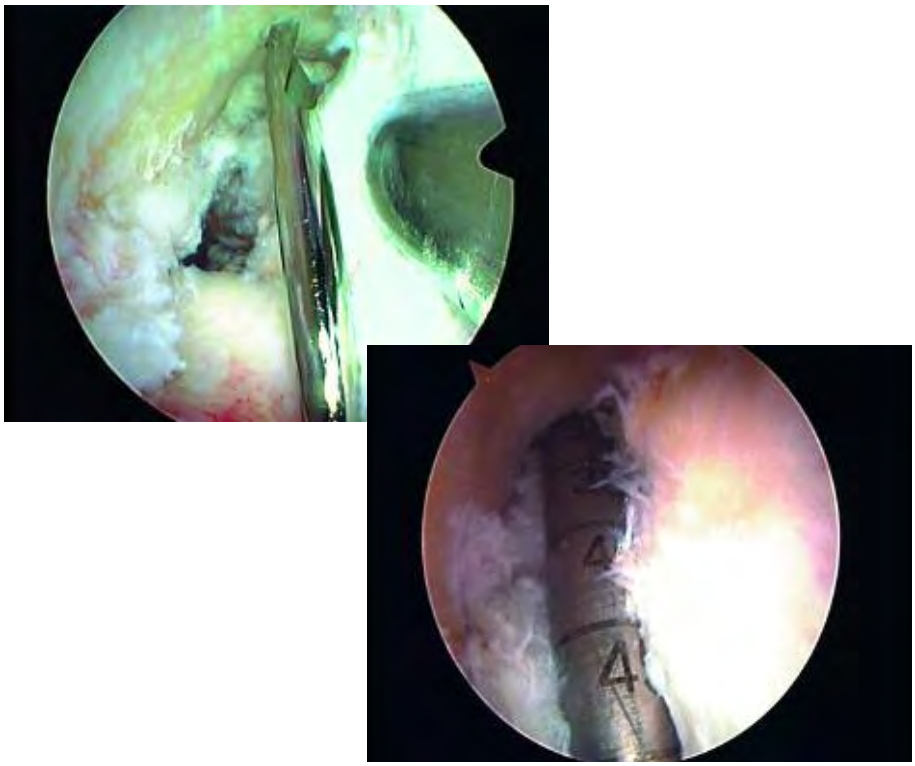
The closure of the tendon defect is postponed to the end of the surgical procedure. While the surgeon replaces the arthroscope in the joint, his/her assistant starts the preparation of the harvested graft.

Prepare the intercondular notch in a minimally invasive way. From the anterior-medial portal, place the tibial drill guide between 50° and 60°, as a function of the length of the patellar graft.
Example:
Short patellar graft, (8–9cm) = drill guide at 50°
Medium patellar graft, (9–10.5cm) = drill guide at 55°
Long patellar graft, (10.5–12cm) = drill guide at 60°

Use the tibial guide to stay 20° medial with respect to the tibial longitudinal axis, trying to stay posterior the insertion of the original ACL, preserving its insertion as much as possible.

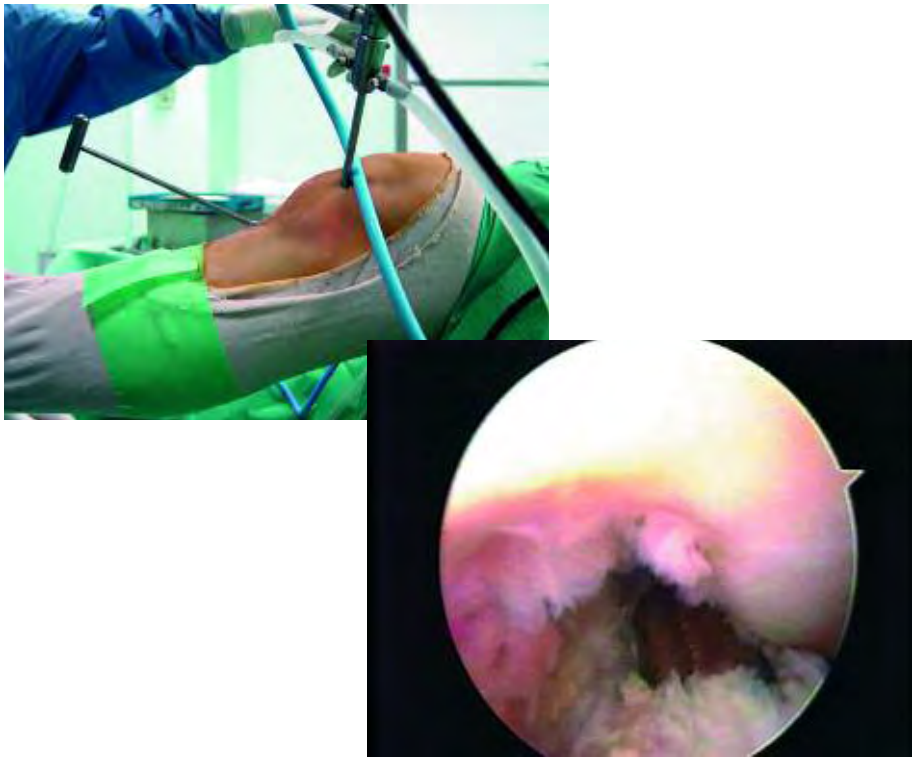


Drill the guide wire into place. Overdrill the guide wire with a 7mm cannulated fluted reamer, to create the tibial tunnel.

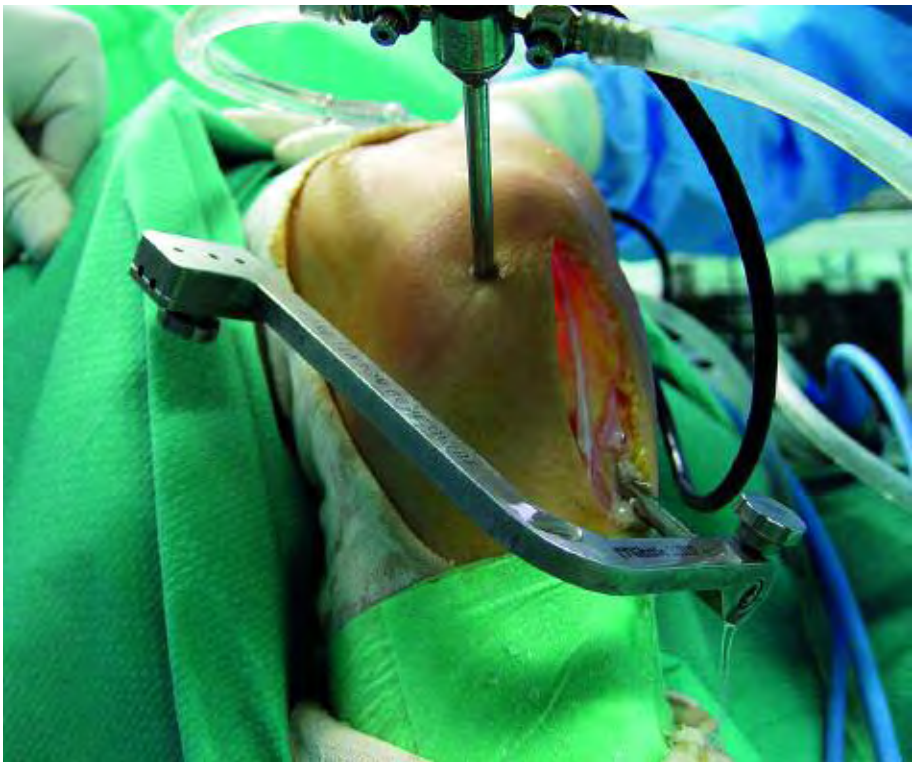


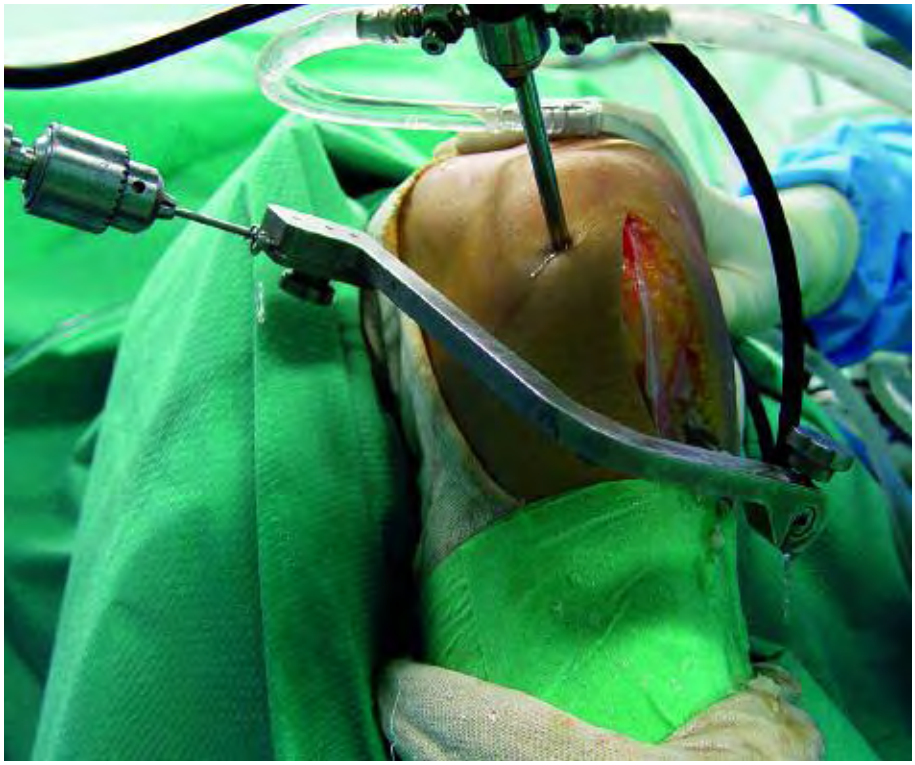
Identify a point on the femur that corresponds to the 10:30-11:00 position (right knee). Using a single incision, all-endoscopic technique, place the guide wire through the tibial tunnel so that the acorn reamer will leave 2-3mm of posterior cortex intact. Using a 9mm reamer, drill to a depth of 25-30mm, equal to the length of the bone block to be accommodated.

Dilate the tibial tunnel to 10mm diameter. Pass the dilator into the joint, gradually extend the knee, and observe for any graft impingment.



Introduce the Rigidfix femoral guide for the cross pin fixation (Rigidfix BTB Cross Pin System – DePuy Mitek) with a 9mm femoral rod.

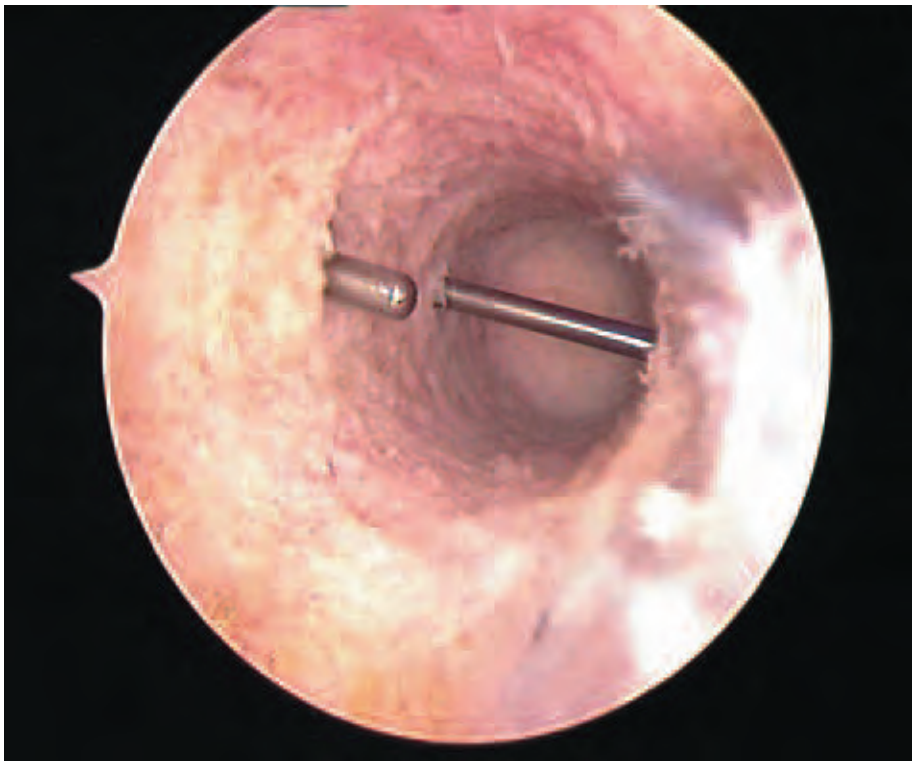




The sleeves (with a diameter of 2.7mm) are drilled into place with the appropriate interlocking trocar, which are all supplied with the bioabsorbable cross pins.

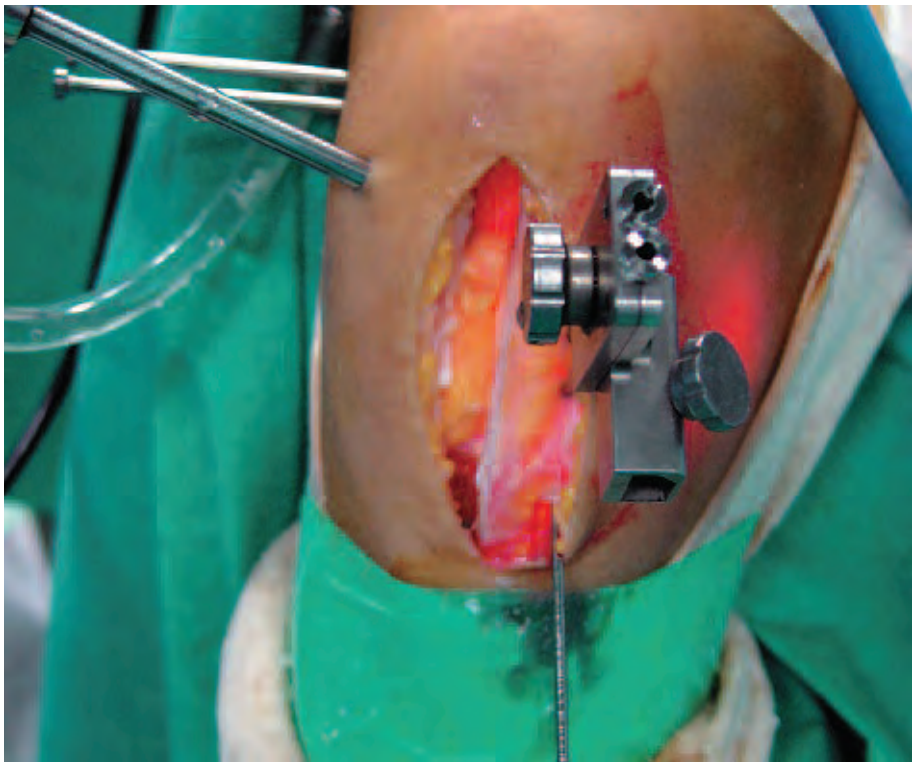
Remove the femoral guide and leave the two introduced sleeves in place. With the irrigation open, notice that water comes out. This confirms that the sleeves have been correctly drilled into the femoral tunnel.

Arthroscopic view of the correct position of the transverse holes in the femoral tunnel.



From the tibial tunnel, introduce the Rigidfix tibial guide for the distal cross pin fixation down to the bottom of the femoral tunnel and determine the intraarticular measurement.

Fasten the tibial guide on the intraarticular measurement corresponding to the sum of the femoral tunnel + the intraarticular portion (i.e. 60mm), then drill the two sleeves with trocar into place.

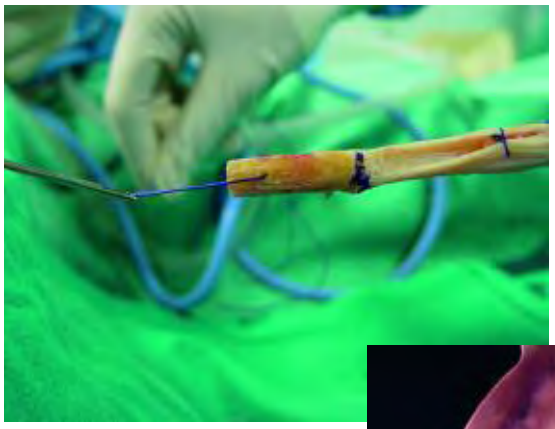


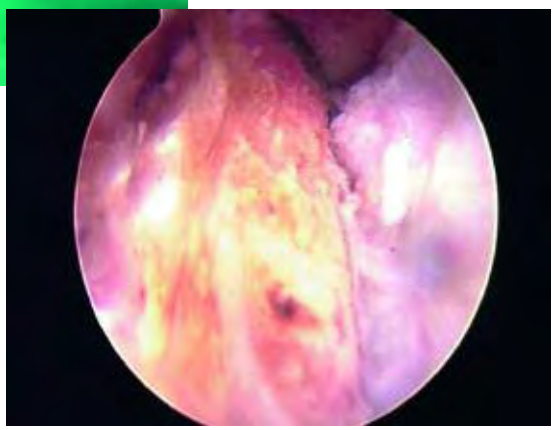
Remove the tibial guide. With the knee flexed to 90°, introduce a wire with an eyelet from the tibial tunnel and have it exit from the anterior-lateral portion of the thigh.

Meanwhile, the assistant has carefully prepared the harvested patella tendon portion and sized the femoral bone block to a diameter of 9mm and the tibial tunnel bone block to a diameter of 10mm.

To complete the length of the bone stock that will be accommodated in the tibial tunnel, use part of the cancellous bone you removed from the tibial bone plug and suture it carefully to the tendon.

The measurements taken by the surgeon during the arthroscopic examination of the joint allow preparation of the graft, dividing it into three portions: femoral bone block (30mm), intraarticular tendon portion (25mm – 28mm), and tendon component with cancellous graft and tibial bone block (45mm – 50mm).

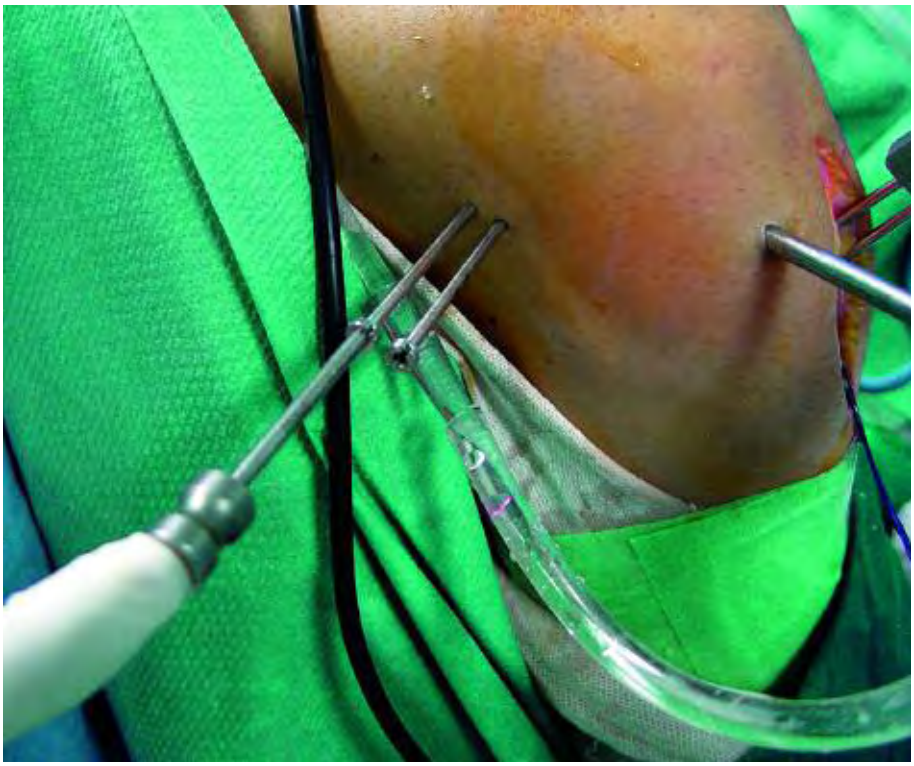




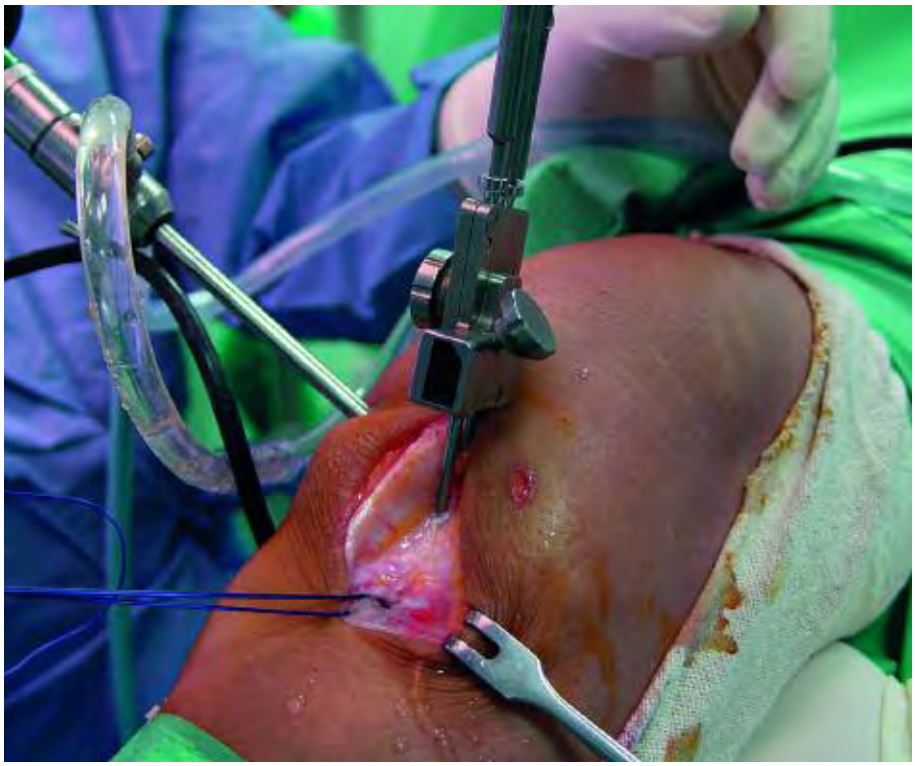
Use an appropriate passing #2 suture to slide the graft into the joint. To do so, place the femoral bone block in a vertical position so that the cortical part of the bone block is opposed to the cross hole.

With the graft pulled into place, drill through the graft using the trocar from the Rigidfix BTB Instrument Tray. Keep the graft under tension while drilling. Start with the distal sleeve first.

After drilling both cannulated trocar sleeves, introduce the first 2.7mm cross pin in the distal sleeve with an appropriate mallet. Complete the fixation by inserting the second cross pin into the proximal sleeve, in a similar fashion.



Prior to performing the tibial fixation, cycle the knee 10-15 times. This is done to make the tendon fiber tension uniform throughout the graft, thereby eliminating any graft elongation.



Obtain appropriate tension and place the knee at a flexion of approximately 20°-30°. With an appropriate trocar inserted through the proximal cannula, maintain traction and drill through the tibial bone block, while leaving the trocar in its position.

Perform the same procedure through the distal sleeve. Introduce the Rigidfix cross pin through the distal sleeve and insert. Remove the proximal trocar and place the second cross pin.

IN COOPERATION WITH

For more information, call your DePuy Mitek representative at 1-800-382-4682 or visit us at www.mitek.com. DePuy Mitek, Inc., 325 Paramount Drive, Raynham, MA 02767

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