Technical Note

Anterior Cruciate Ligament Reconstruction Using Combined Graft of Hamstring and Fascia Lata With Extra-articular Tenodesis. A Technique in Case of Insufficient Hamstrings

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Abstract: A technique for augmentation of the anterior cruciate ligament (ACL) with hamstring graft and lateral extra-articular tenodesis is presented. The patient is positioned supine with the knee flexed 90°. First, intra-articular injuries are addressed arthroscopically, and then autologous hamstring tendons are harvested and measured; the present technique is a resource for cases with a very small graft diameter (less than 8 mm), due to thin tendons or to tendon breakage, even after tripling the hamstring graft, which is prepared using a facia lata strip long enough to fit the lengths of the femoral tunnel, the anterior cruciate ligament graft, and the tibial tunnel. A single femoral tunnel is performed and only 2 interference screws are needed for fixation.

Graft selection is a continuous topic of debate in anterior cruciate ligament (ACL) reconstruction,[1] with a lack of a clear superiority of one over the other. However, the addition of an anterolateral ligament reconstruction or a lateral extra-articular tenodesis has demonstrated a biomechanical improvement[2,3] and better clinical survival.[4]

Hamstring tendons are one the most popular grafts for ACL reconstruction worldwide. One of the main concerns when using these grafts is the diameter of the graft: the semitendinosus and the gracilis tendons can be torn or spoilt during their harvesting, or they can be too thin to achieve a diameter of at least 8 mm, which has been shown to be the threshold for ACL reconstruction survival.[5] Furthermore, if a lateral reinforcement is decided, a small graft could be insufficient for the complete reconstruction.

Several resources could be employed to increase the diameter of the hamstring graft.[6,7] These maneuvers provide a shorter but wider graft; however, in a few cases, the diameter of the graft may still remain small. The aim of this article is to describe a technique for ACL reconstruction and lateral extra-articular tenodesis (LET) using a triple hamstring graft and a long strip of fascia lata for LET and ACL hamstring graft augmentation.

Technique (With Video Illustration)

Position of the Patient

The patient is positioned supine under regional or general anesthetic. An ischemia cuff is employed on the proximal end of the thigh and the limb is supported on a leg holder with the knee flexed 90° (Fig 1; Table 1; Video 1).

Arthroscopic Exploration

The authors use a central transtendinous portal as the main vision portal for cruciate ligament reconstruction. All intra-articular injuries are assessed and treated with the aid of an anteromedial portal (an additional

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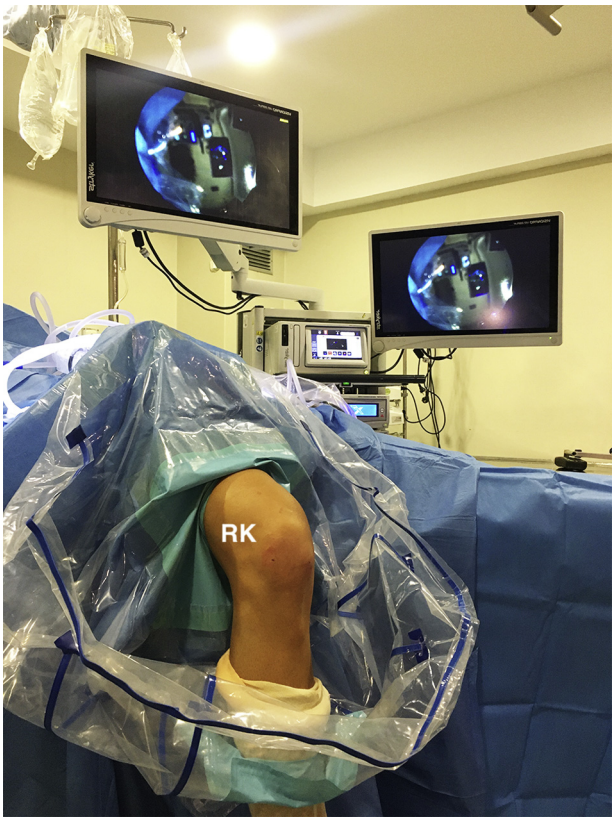

Fig 1. Extra-articular view of the lateral aspect of the right knee (RK). The patient is positioned supine with the thigh in a leg holder and the knee flexed 90°.

anterolateral portal can be used if necessary). The ACL remnants are removed and the lateral wall of the medial femoral condyle is prepared using a radiofrequency probe and a synovial resector.

Graft Harvesting and Preparation

A 3-cm oblique incision is made medial to the anterior tibial tuberosity to harvest the hamstring tendons (semitendinosus and gracilis) and to create the tibial tunnel. The tendons are harvested with a standard tendon stripper. Both tendons are prepared on an auxiliary table: the 2-strand graft is bent in a tripled fashion and both ends are sutured together using a no. 2 absorbable suture (Video 1; Fig 2).

Then, a 10-cm longitudinal incision is performed on the lateral aspect of the knee, beginning 1 cm distal to the lateral epicondyle (Video 1). A 1-cm-wide central strip of fascia lata is obtained (it could be wider if needed) (Fig 3). Sharp dissection is performed subcutaneously in caudal direction from the lateral epicondyle to the Gerdy's tubercle. Then, the dissection is continued proximally from the lateral epicondyle under direct view using surgical scissors; the length of the graft is calculated measuring the sum of the lengths of both the tibial and femoral tunnels and the length of the intra-articular track of the ACL: this length is added to the distance of the fascia lata from the Gerdy's tubercle to the lateral epicondyle (Fig 4). The proximal end of the fascia lata graft is prepared with two no. 2 absorbable sutures using Krackow stitches, leaving long threads for traction (Fig 5). After that, the conjoint graft is measured and the adequate diameter obtained is checked (Fig 6). Both grafts (hamstring and fascia lata) are wrapped in independent gauzes soaked with a solution of vancomycin[8] while tunnels are performed.

Tunnel Performance

Both the femoral and tibial tunnels are made using an ACL tibial guide (Stryker Endoscopy, Kalamazoo, MI). Starting with the femoral tunnel, the arthroscope is placed through the anteromedial portal and the guide is set through the central transtendinous portal at an angle that allows the correct positioning of the guide pin just proximal and posterior to the lateral epicondyle (usually 70-75°). A guide pin is set transecting the

Table 1. Step-by-Step Details of the Technique

Patient Positioning and Intra-articular Exploration
Patient positioned supine with the limb in a "L"-shaped leg holder at 90° of knee flexion.
General or regional anesthetic is provided and a femoral ischemia cuff is applied.
Transtendinous and anteromedial portals are used.
Arthroscopic exploration is performed to identify ACL rupture.
Graft harvesting and preparation
Semitendinosus and gracilis autologous tendons are harvested.
Both tendons are doubled or tripled and both ends are sutured together.
A long fascia lata strip is harvested through a longitudinal approach over the lateral epicondyle and its proximal end is prepared with a double Krackow suture.
The diameter of both grafts together is measured.
Both grafts are wrapped in a gauzed soaked with a solution of vancomycin.
Intra-articular preparation
Remnant cleaning
Footprint of ACL identification
Femoral tunnel
Outside-in direction
A regular tibial guide for ACL reconstruction is employed.
Same diameter of the graft (usually 8-9 mm)
Extra-articular entrance: just posterior and proximal to lateral epicondyle
Intra-articular exit: ACL footprint
Tibial tunnel
Outside-in direction
Same diameter of the graft (usually 8-9 mm)
The same tibial guide is employed with 55° guide opening.
Intra-articular end in the center of the ACL footprint
Graft passage and fixation
Passage of fascia lata graft in outside-in direction, from femur to tibia
Passage of hamstring graft in outside-in direction, from femur to tibia
Femoral fixation in full extension
Tibial fixation in 30° of knee flexion

ACL, anterior cruciate ligament.

Fig 2. An insufficient 6-mm hamstring graft is obtained after harvesting and preparing the tendons (tripled).

lateral condyle in outside-in direction, starting on a spot just proximal and posterior to the lateral epicondyle extra-articularly and exiting the lateral condyle intra-articularly on the center of the femoral ACL footprint. The tibial tunnel is performed by returning the arthroscope to the central portal and introducing the same guide through the anteromedial one, at an angle

Fig 3. Extra-articular view of the lateral aspect of the right knee. The width of the fascia lata (FL) is measured through a lateral longitudinal approach to the distal femur.

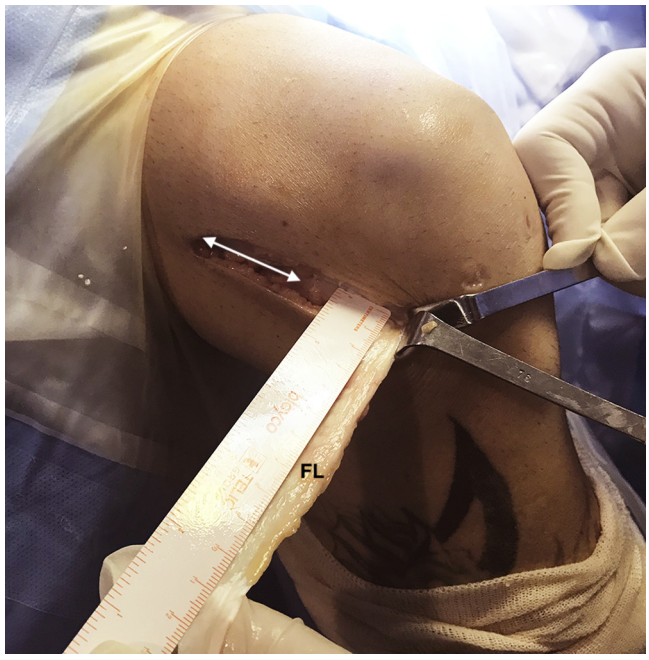

Fig 4. Extra-articular view of the lateral aspect of the right knee. The length of the fascia lata band (FL) is checked after harvesting the graft. The white arrow points to the length of the extra incision needed.

of 55°. A guide pin is inserted in outside-in direction starting extra-articularly at a spot proximal to the hamstring insertion and medial to the anterior tibial tuberosity and finishing intra-articularly on the center of the ACL tibial footprint. Both tunnels are then completed with the aid of a drill bit of the same diameter of the augmented ACL graft (Fig 6).

Graft Passage and Fixation

First, the lateral collateral ligament is dissected and the fascia lata graft is passed deep to it (Fig 7). Then, the traction threads of the fascia lata are introduced

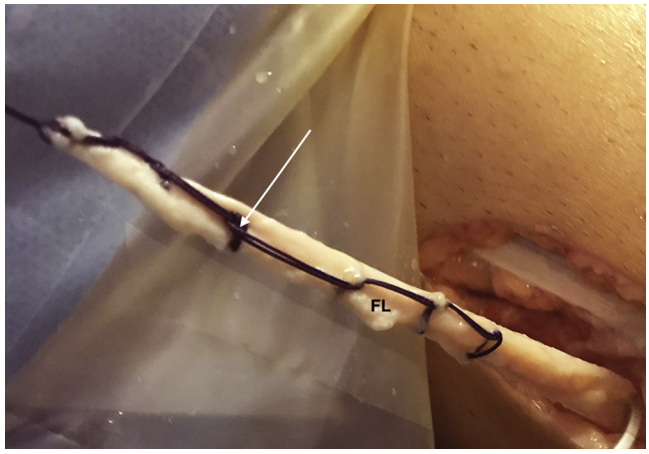

Fig 5. Krackow stitches (arrow) are employed to prepare the fascia lata graft (FL) with traction threads.

Fig 6. Extra-articular view of the lateral aspect of the right knee. The conjoint graft is measured with a caliper. A correct 9-mm diameter graft can be obtained associating both the fascia lata and the hamstring grafts. Red arrow: hamstring graft. White arrow: fascia lata graft.

through the femoral tunnel in outside-in direction with the aid of a grasper; then, they are retrieved intra-articularly with a clamp through the anteromedial portal (Fig 8); subsequently, a grasper is inserted

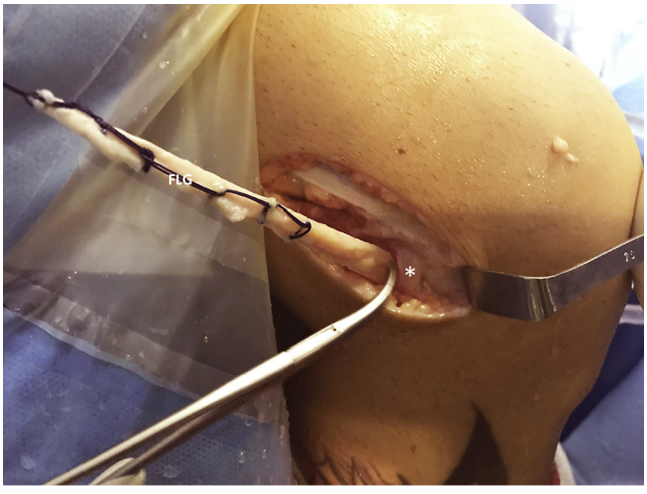

Fig 7. Extra-articular view of the lateral aspect of the right knee. The fascia lata graft is passed deep to the lateral collateral ligament to perform the lateral extra-articular tenodesis. Asterisk indicates the lateral collateral ligament. (FLG, fascia lata graft.)

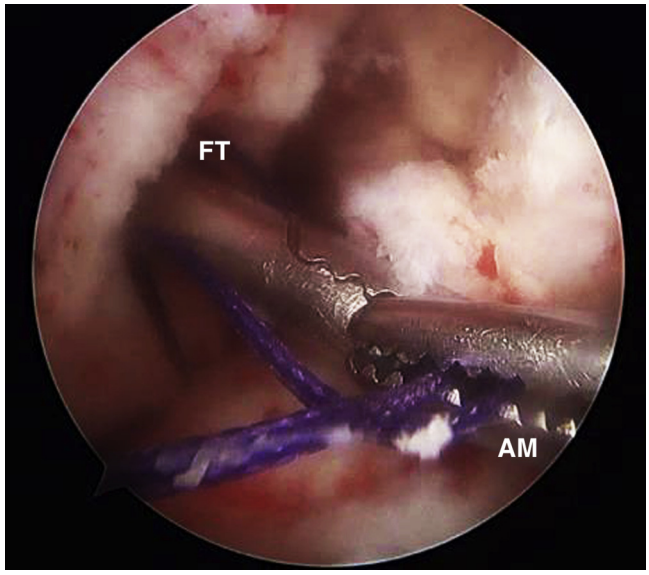

Fig 8. Intra-articular view of the right knee with the arthroscope set through the central portal. The traction threads of the fascia lata graft are introduced intra-articularly with the aid of an arthroscopic grasper through the femoral tunnel (FT), and they are retrieved using forceps introduced through the anteromedial portal (AM).

through the tibial tunnel to get the traction threads (Fig 9), which are introduced through the tibial tunnel in inside-out direction; the threads are pulled until the graft exits the tibial tunnel. Afterwards, the suture threads of the hamstring graft are inserted in the femoral tunnel in outside-in direction with the aid of a grasper, they are retrieved intra-articularly with a

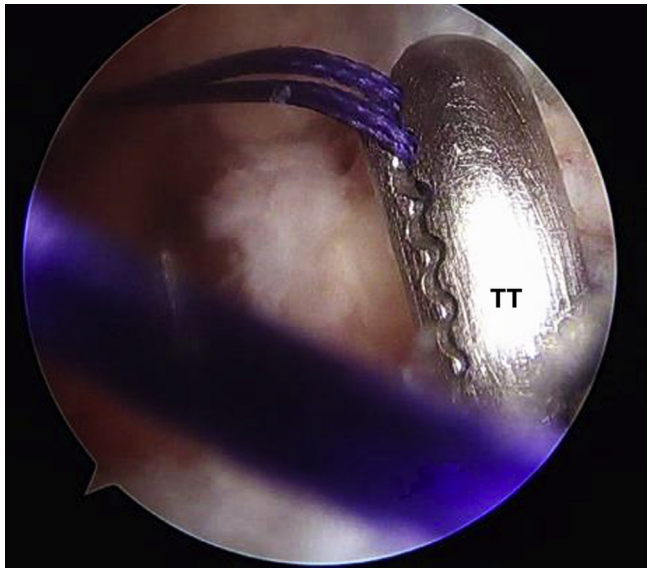

Fig 9. Intra-articular view of the right knee with the arthroscope set through the central portal. The arthroscopic grasper is now inserted through the tibial tunnel (TT) to retrieve the traction threads of the fascia lata graft.

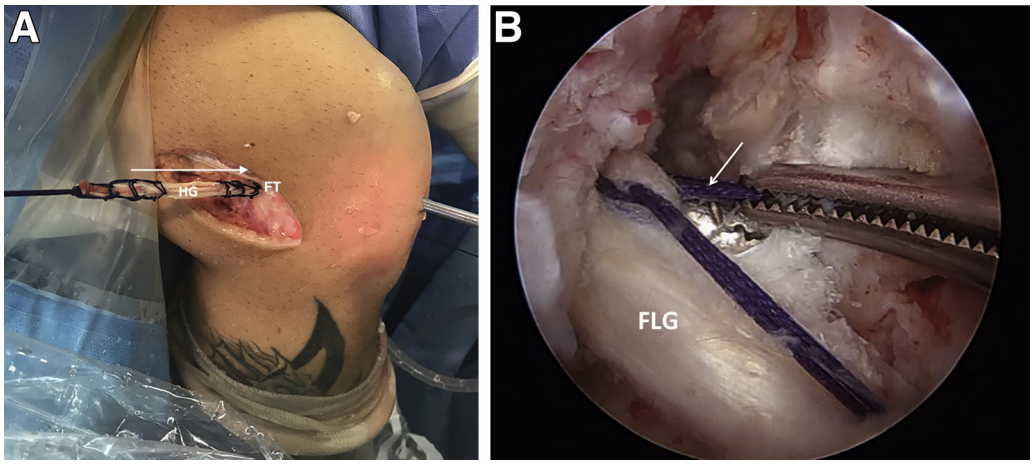

Fig 10. (A) Extra-articular view of the lateral aspect of the right knee. The hamstring graft (HG) is inserted through the femoral tunnel (FT) in cranio-caudal direction (arrow). (B) Intra-articular view of the right knee with the arthroscope set through the central portal. The traction threads of the hamstring graft are introduced intra-articularly with the aid of an arthroscopic grasper through the femoral tunnel, and they are retrieved using forceps introduced through the anteromedial portal. White arrow indicates the traction threads of the hamstring graft. (FLG, fascia lata graft.)

clamp through the anteromedial portal, and finally they are introduced through the tibial tunnel with the aid of a grasper in an inside-out direction; the threads are pulled until the end of the graft exits the tibial tunnel (Fig 10). Finally, femoral and tibial fixations are achieved with both interference screws (Biosteon; Stryker), which are 1 mm wider than the diameter of the augmented graft and the tunnel: first, the femoral screw is inserted in outside in manner, while applying traction from both ends of the fascia lata (from the tibial tunnel) and hamstring autograft (traction is applied from both ends of the graft to maintain tension), with the knee in neutral rotation and full extension (Fig 11); afterwards, the tibial screw is inserted in outside-in direction, while applying traction from the tibial end of the graft, in 30° of knee flexion (Fig 12). Once the graft is fixed, the final outcome is checked arthroscopically (Fig 13).

Discussion

The main advantage of this technique is the possibility to perform an anatomic ACL reconstruction of a

Fig 11. Extra-articular view of the lateral aspect of the right knee. The conjoint graft is fixed proximally in the femoral tunnel (FT) with an interference screw while traction is applied manually from both ends of the graft. Arrow indicates proximal traction threads; double arrow indicates distal traction threads.

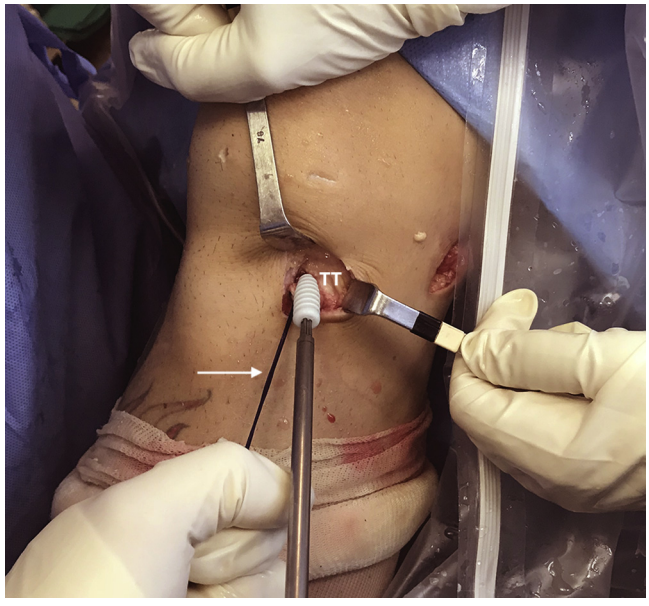

Fig 12. Extra-articular view of the anteromedial aspect of the right knee. Distal tibial fixation of the conjoint graft is achieved using an interference screw while pulling the traction threads (arrow). (TT, tibial tunnel.)

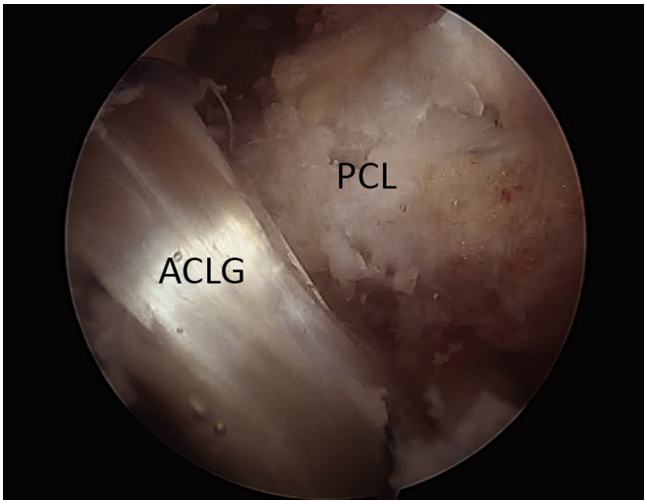

Fig 13. Intra-articular view of the right knee with the arthroscope set through the central portal. The final outcome of the anterior cruciate ligament graft (ACLG) can be checked. **(**PCL, posterior cruciate ligament.)

sufficient diameter and an LET with fascia lata (Table 2) when a small-diameter hamstring autograft is obtained without damaging any other autograft source and without the need for allografts or artificial grafts, and with a single femoral tunnel.

The diameter of the graft is an important issue that has been related to the survival of ACL reconstruction.[5] If a thin autograft is obtained after harvesting and preparing the patient's tendons, surgeons must make an effort to increase said diameter, at least, to 8 mm. Different resources have been described to solve this problem[6,7]; however, to our knowledge, this is the first technique to address the ACL graft augmentation and a LET with the same graft.

In the last few years, techniques for lateral extra-articular tenodesis have regained interest among orthopaedic surgeons due to the still suboptimal outcomes in ACL reconstruction. Lateral extra-articular tenodesis has recently demonstrated better clinical outcomes than ACL reconstruction alone.[4] The technique presented in this article provides the possibility of performing a lateral extra-articular tenodesis even in cases of small-diameter hamstring autograft, using a single femoral tunnel.

The main drawback of the technique is that a longer facia lata strip is needed, so harvest-site morbidity to the lateral aspect of the knee is increased. However, the integrity of the fascia lata is kept and the incision necessary is only a few centimeters longer than in regular lateral extra-articular tenodesis. Care must be taken to ensure a correct length of the fascia lata graft (Table 3), so the measurement of the full length of both tunnels and the intra-articular portion must be carefully done; if the fascia lata graft is too short, screw insertion could wrinkle and damage it irreversibly, so removal might be needed, making the extra site morbidity useless. The authors recommend to harvest a graft 1 cm longer than the length measured to avoid this situation.

Table 2. Advantages and Disadvantages

Advantages
The main advantage of this technique is that an anterolateral reinforcement during ACLR can be achieved even in cases with a too-thin hamstrings autograft, without the need for additional graft source damage.
ACLR can be achieved using only 2 arthroscopic portals.
The risk of tunnel convergence is avoided in the femur because only one tunnel is drilled.
This technique uses only 2 interference screws (one for femoral and one for tibial fixations), which are easily available and inexpensive.
Disadvantages
A long incision is needed in the lateral aspect of the knee.
Violation of the fascia lata is increased, although efforts should be made to minimize it.

ACLR, anterior cruciate ligament reconstruction.

Table 3. Tips, Pearls, and Pitfalls

Tips and Pearls
A central arthroscopic portal is recommended to ensure a clear view of the anatomic footprints of the anterior cruciate ligament.
Traction of the fascia lata graft once it exits the tibial tunnel is performed in slight lateral direction to push the graft to the lateral wall of both femoral and tibial tunnels, to allow a more fluent passage of the hamstring graft.
Pitfalls
The ends of both grafts should be prepared carefully, with blunt end, with no fringes, to avoid impingement in the tunnels and to facilitate a fluent passage of the graft.
The width of the conjoint grafts should be carefully made to ensure at least 8 mm of diameter. If the fascia lata strip is too thin to make enough augmentation of the hamstring tendon, an additional, thinner strip can be obtained and added to the former one.
The length of the fascia lata graft must be very well measured. A short graft may be useless, and removal might be needed. It is recommended to harvest a fascia lata graft 1 cm longer than the length measured.

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