TECHNICAL NOTE

Anterior cruciate ligament reconstruction with fascia lata using a minimally invasive arthroscopic harvesting technique

F. Khiami*, A. Wajsfisz, A. Meyer, E. Rolland, Y. Catonné, E. Sariali

Department of Orthopaedics and trauma Surgery, La Pitié-Salpêtrière Hospital, 47-83, boulevard de l’Hôpital, 75013 Paris, France

Accepted: 7 September 2012

KEYWORDS
Anterior cruciate ligament; Ligament reconstruction; Fascia lata; Arthroscopy; Minimally invasive surgery

Summary
Anterior cruciate ligament (ACL) reconstruction using the fascia lata has undergone a number of technical modifications since the work of Hey-Groves, Macintosh, and Jaeger. Arthroscopy has simplified this technique, notably in the positioning of the tunnels. Minimally invasive harvesting through two lateral proximal and distal approaches considerably reduces cosmetic problems. The femoral tunnel is made from the outside to the inside using a specific targeting device, and the transplant harvest site is closed using the Jaeger procedure so as not to weaken lateral knee stabilizing structures. This procedure consists in opening the lateral intermuscular septum 1 cm from the femur to let it shift laterally and allow the transplant harvesting area to be closed. This technique uses a fascia lata transplant, the harvesting of which has shown few iatrogenous complications but requires rigorous adherence to certain rules.

© 2012 Elsevier Masson SAS. All rights reserved.

Introduction

Anterior cruciate ligament (ACL) reconstruction using the fascia lata was first described by Hey-Groves in 1917 [1]. A few notable technical modifications were contributed by Macintosh in 1972 [2] and more recently by Jaeger [3,4]. This technique presents a number of technical and functional advantages. The fascia lata is a transplant material with high biomechanical resistance, comparable to other currently used transplants [5] and the preservation of the distal insertion on the Gerdy tubercle is a natural fixation that no other fixation system would be able to replace. In the original technique, the graft strip slides in the femoral tunnel with no fixation and then requires a single fixation to the tibia. The femoral tunnel was initially retrocondylar, which facilitated ligament repair revision in case of femoral cavitory enlargement. According to the promoters, the "combined" extra- and intra-articular effect of the reconstruction efficiently controls the pivot shift, as demonstrated by Lemaire [6,7] in a purely extra-articular technique. More recently, the development of arthroscopic
techniques has promoted the rapid expansion of patellar ligament and hamstring reconstruction and relegated the fascia lata to the rank of outdated and outmoded techniques whose residual scars were imposing and unsightly [8], but whose functional results were nonetheless highly satisfactory [9]. The authors have used the ACL reconstruction technique with fascia lata since 1993. Anteromedial arthrotomy has been replaced by an arthroscopic phase since 2004 and harvesting of the reconstruction material, which requires a 15- to 20-cm cutaneous incision has been replaced by two minimally invasive approaches since 2009. We present the arthroscopic ligament reconstruction technique using minimally invasive fascia lata harvesting.

**Surgical technique**

**Arthroscopic phase**

The arthroscopic phase is comparable to more conventional techniques. Cleaning the foot of the ACL preserves a remnant provided it is not in conflict with the roof of the lateral femoral condyle notch. Femur preparation is classic. The intra-articular exit point of the femoral tunnel is placed on the posterior part of the medial side of the lateral condyle (the most posterior quadrant according to the Bernard method [10,11]). The tibial tunnel procedure (diameter, 8 mm) is strictly identical to other single-bundle reconstruction techniques. Its intra-articular exit point is placed between the two tibial eminences, slightly in front of the lateral tibial eminence, which corresponds to Tsuda’s [10] 25 to 50% tibial quadrant.

![Figure 1](image1.png) **Figure 1** Identifying the cutaneous incisions. The total subcutaneous harvesting of the fascia lata should measure between 18 and 20 cm.

![Figure 2](image2.png) **Figure 2** Proximal and distal subcutaneous detachment.
Harvesting the graft strip

The distal cutaneous incision begins opposite the lateral femoral epicondyle and continues along the posterior part of the lateral side of the thigh for 5 to 6 cm (Fig. 1). The subcutaneous tissue is released from the fascia lata in the incision area and then pulled upward for 6 to 7 cm and downward to the Gerdy tubercle (Fig. 2). A 2- to 3-cm proximal cutaneous incision completes the approach, continuing the first incision, and begins precisely at the spot where the harvest material will be resected 16 cm above the Gerdy tubercle. The fascia strip should be between 18 and 20 cm long. It is harvested respecting a 2-cm width in the distal direction (the thickest area) and 4 cm at its proximal portion, which is thinner, making it possible to increase the volume of the transplant on the part that will be used for the intra-articular portion (Fig. 3). To guarantee sufficient width, the two harvesting incisions are widened toward the proximal part; the incision line must remain parallel to the thigh’s axis, contrary to the anterior incision line, which joins the middle of the lateral side of the thigh. An endoscopic exam can improve the view of the harvest zone. The fascia lata incision depth is an important step in harvesting. The scalpel should not damage the vastus lateralis muscle proximally (to prevent muscle bleeding), nor the joint capsule or the lateral collateral ligament (LCL) distally. There is a detachment layer between the fascia and the joint capsule that determines the safety limit so as to avoid capsule penetration. The harvest material is carefully detached from the joint capsule of the vastus lateralis. The proximal part is tubulized using reverse stitches to facilitate gliding within the tunnels and to increase the graft strip volume. A pull-through suture is positioned (Fig. 4). Using a finger, the vastus lateralis is detached from the lateral intermuscular septum, which separates the anterior and posterior compartments of the thigh (Fig. 5). This septum is opened longitudinally from the distal end to the proximal end using a long chisel, leaving 1 cm of septum inserted at the femur. The opening is lengthened to the proximal end of the fascia lata harvesting zone. This technique was introduced by Jaeger and allows sliding and lateral translation of the intermuscular septum, which will facilitate closing the strip harvesting site at the end of the procedure (Fig. 6). It is useful to localize the “Lemaire’s” vessels, consistent landmarks near the extra-articular isometry zone described by Lemaire [7] (Fig. 7). Identification of the lateral collateral ligament and the lateral femoral epicondyle allow one to define the most isometric extra-articular area, situated approximately 1 cm above and behind the lateral epicondyle [12]. An arthroscopic aimer from the outside to the inside allows precise positioning of a guidewire (Fig. 8). The tunnel is generally drilled 9 mm from outside in. We recommend oversizing the femoral tunnel by 1 mm compared to the distal diameter of the strip so that it does not jam, particularly since no femoral press-fit effect is sought. The pull-through stitches are inserted into the femoral tunnel from outside to inside and then retrieved under arthroscopy in the notch and then at the tibial tunnel (Fig. 9). Insertion of the strip under the LCL has been removed from the procedure, an improvement of the technique that no longer requires LCL dissection. Gentle turning allows one to stretch the strip. This tension is checked with a finger at the entrance of the femoral tunnel as the limb is extended. This step confirms that the strip is not blocked.
within the tunnels. The strip is attached at 30° flexion using a tibial double fixation with an interference screw and a staple, with the foot in neutral rotation. There is no femoral fixation. The tourniquet is released before closing, which allows hemostasis. Closing begins with suturing the harvest area. The intermuscular septum is transferred laterally and closed by an overcast stitch (Fig. 10). The skin is closed using an intradermal overcast stitch. Two non-suction drains are positioned, one in the joint, the second in the muscle detachment space. Postoperative recovery requires no particular care compared to more conventional techniques, although the authors recommend moderate and very progressive rehabilitation in the first month after the procedure. Weight bearing is aided by two crutches, extension is complete and flexion limited to 70–80° during the first month. This restriction of the mobility sectors seems warranted so as to limit joint stiffening by early work but in limited sectors to facilitate healing of the muscle and subcutaneous layers.

The series

These technical improvements are based on a retrospective series of ACL reconstructions on 37 patients operated on with the classical technique before 2009, then a prospective series that included our technical modifications since 2009. Although the functional results at the last follow-up are satisfactory [9,13] and comparable to the more currently used techniques reported in the literature, the analysis of the postoperative recovery of patients operated before 2009 shows a few difficult cases. Among the complications found before 2009, we experienced four postoperative hematomas that did not require surgical drainage but that slowed functional recuperation. One patient judged her lateral scar sufficiently unsightly to request a consultation in cosmetic surgery. Even if the pivot test results were excellent (84% IKDC A), we found a mean postoperative anteroposterior laxity of 3.8 ± 1.7 mm with an IKDC laxity score classed as A in only 27% of the cases and B in 62%. Before 2009 a single tibial fixation was used, probably insufficient with only a single staple. Since 2009, the analysis of these complications and this residual laxity has allowed us to evolve toward a less invasive approach, a more reproducible technique given the use of more classical ancillary instrumentation and toward a double tibial fixation with an interference screw and a staple. The analysis of our first 37 cases with the minimally invasive technique has shown a reduction in hemorrhagic complications and an improvement in postoperative laxity. A single hematoma has occurred and is evolving favorably with local treatment, and the mean postoperative differential laxity has improved to 1.2 ± 1.1 mm. The IKDC laxity score was classed as A in 54% and B in 40% of the cases. The pivot test according to the IKDC score was classed

Figure 5 Opening the intermuscular septum according to the Jaeger technique. The vastus lateralis is retracted away from the strip harvest zone exposing the septum. This is opened longitudinally and a lateral translation of the septum allows one to close the harvest area.

Figure 6 Surgical view of opening the intermuscular septum. The vastus lateralis is retracted and the septum is progressively opened.
Figure 7  Entry point of the femoral tunnel. Locating Lemaire’s vessels aids in identifying the ideal zone, located 1 cm above and behind the lateral epicondyle (star).

Figure 8  Femoral tunnel preparation using an aimer from outside to inside.

Figure 9  Passage of the strip beginning with the femoral tunnel, then the tibial tunnel. This is done arthroscopically.
A in 89% of the cases. We have found no cases of sepsis.

**Discussion**

The fascia lata reconstruction techniques date from the beginning of the last century [1,2] but have been infrequently used. Anteromedial arthroscopy and the size of the harvest incision initially used sometimes resulted in unsightly scars [8], compared to more recent arthroscopic techniques and increasingly minimally invasive harvesting techniques [14]. From a technical point of view, the dissection phase of the lateral collateral muscle layer and passage of the posterior capsule could seem challenging and difficult to reproduce, as may the construction of a retrocondylar groove, which used no positioning ancillary instrumentation. Several improvements have simplified the technique to make it more reproducible.

The introduction of arthroscopy has made it possible to remove arthrometry and provides an arthroscopic exploration phase comparable to the more classical reconstruction techniques on all points. Creation of the femoral tunnel is facilitated since the use of a femoral aimer from outside to inside, which has done away with the construction of a retrocondylar groove [3,4] and has obviated the need for detaching the lateral gastrocnemius and opening the posterior joint capsule.

The main technical pitfalls reside in harvesting the transplant. This strip should be harvested in the posterior part of the iliotibial tractus, which is thicker and more solid, and reduces the size of the harvested strip near the Gerdy tubercle (2 cm). The resistance of this type of transplant is approximately 3266 N [5], which makes it a transplant material whose resistance is comparable to more widely used transplants. The risk of harvesting a transplant that is too short is limited if an 18- to 20-cm-long strip is harvested from the Gerdy tubercle. The incision depth should be controlled so as not to injure the vastus lateralis or the joint capsule and the LCL. The minimally invasive approach through two incisions provides the same exposure as a single longer incision, provided that long retractors or endoscopic viewing is available.

Opening the lateral intermuscular septum to facilitate closing [3,4] the harvest site involves detaching the vastus lateralis muscle, requiring detachment of supra- and subfascial layers, as well as the risk of injuring the third perforating artery or its anastomoses with the popliteal artery that run under the septum in the lower quarter of the thigh [15]. The authors recommend removing the tourniquet before closing the surgical site with detailed verification that there is no active bleeding. In our experience, given these muscle and subcutaneous detachment planes, we believe that the risk of hemorrhage can occur up to the 3rd postoperative week. Although the minimally invasive approach has considerably reduced the incidence of bleeding complications, the occurrence of postoperative hematoma has encouraged us to continue draining the harvest site and we recommend slow rehabilitation during the 1st postoperative month.

**Disclosure of interest**

The authors declare that they have no conflicts of interest concerning this article.

**References**

Ligament reconstruction with fascia lata using minimally invasive harvesting