Combined Reconstruction of the Anterior Cruciate Ligament and Posterolateral Corner With a Single Femoral Tunnel

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Abstract: Combined injuries involving the anterior cruciate ligament (ACL) and posterolateral corner (PLC) occur in approximately 10% of complex knee injuries. The current tendency is to reconstruct both the ACL and the structures of the PLC. In injuries involving multiple ligaments, a potential problem in the reconstruction is the convergence of tunnels in the lateral walls of the femur. As a solution to this problem, we propose a combined technique for reconstruction of the ACL and PLC with a single tunnel in the lateral femoral wall. Combined ACL/PLC reconstruction is performed with 2 semitendinosus tendons and 1 gracilis tendon. The technique consists of making a tunnel in the lateral wall of the femur, from the outside in, at the isometric point, for reconstruction of the collateral ligament and popliteus tendon, and emerging in the joint region at the anatomic point of the ACL reconstruction. The graft is passed from the tibia to the femur with the double gracilis tendon and the simple semitendinosus tendon; the remaining portions are left for reconstruction of the structures of the PLC. This technique is very effective in terms of minimizing the number of tunnels, but it does rely on having grafts of adequate size.

Combined injuries involving the anterior cruciate ligament (ACL) and posterolateral corner (PLC) occur in approximately 10% of complex knee injuries. Patients with these injuries have a high level of knee instability, even for day-to-day activities, and tend to place too much burden on the medial compartment. This problem can be resolved with surgical treatment. The current tendency is to reconstruct both the ACL and the structures of the PLC, rather than repairing the latter. In injuries involving multiple segments, a potential problem with reconstruction is the convergence of femoral tunnels in the lateral walls in the case of ACL and PLC reconstruction and in the medial walls in the case of posterior cruciate ligament and medial collateral ligament reconstruction. As a solution to this problem, we propose a combined technique for reconstruction of the ACL and PLC with a single tunnel in the lateral femoral wall.

Description of Technique

Combined reconstruction of the ACL and PLC is performed with 2 semitendinosus tendons (1 in each knee) and 1 gracilis tendon (in the knee with the ligament injury). The tendons must be at least 27 cm in length. For departments that have a tissue bank at their disposal, this may be an option for reducing morbidity.

Posterolateral access is made in the knee, from a point 2 cm proximal to the lateral epicondyle to 2 cm below the head of the fibula. The fibular nerve is identified, dissected, and protected. Dissection is performed between the biceps and lateral gastrocnemius, to gain access to the posterior region of the tibia. It is necessary to identify the lateral epicondyle, head of the fibula, and Gerdy’s tubercle and gain sufficient access to the posterolateral region for local palpation.

After exposure of the previously mentioned structures, arthroscopy is initiated with anterolateral and anteromedial portals. At this moment, treatment of any meniscal and chondral lesions is carried out, and the lateral wall of the intercondylar notch is prepared. It is necessary to have a clear view of the lateral region of...
the intercondylar notch up to the distal and posterior femoral joint cartilage.

Preparation of the tunnels starts at the head of the fibula for reconstruction of the lateral collateral ligament (LCL). A tunnel is made at the widest diameter of the head of the fibula, in the anterolateral to posteromedial direction, approximately 0.5 cm below the tip of the fibular head. Great care should be taken to protect the fibular nerve.

The second tunnel will be the one used for the popliteus muscle-tendon reconstruction. This tunnel starts at the Gerdy’s tubercle, passing in the anterior to posterior direction and ending in the posterior region of the tibia, immediately above and medial to the tip of the head of the fibula, at the myotendinous junction of the popliteus muscle. The tunnels for the PLC reconstruction can be made with guidewires or freehand, the latter being our preferred technique.

The ACL reconstruction is performed by the outside-in technique, as recommended by Garofalo et al.7 The femoral tunnel is initially made using a ACL guide which is inserted through the anterolateral portal and is placed in the posterior region of the lateral condyle, next to the femoral cartilage, at approximately the 9- or 10-o’clock position for the left knee or 2- or 3-o’clock position for the right knee. The guidewire in the external lateral cortex should be inserted at the isometric point for reconstruction of the LCL and popliteus tendon, as recommended by Stannard et al.8 To find it, we can use the anatomic method, in which it is located immediately anterior to the point at which the LCL and the popliteus tendon cross, or the radiographic method, in which the extension of the line that passes along the anterior border of the posterior cortex of the femur crosses the Blumensaat line in the image, in the absolute profile of the distal femur. Our preferred method is the anatomic method (Fig 1).

After inserting the guidewire, we pass the drill through the lateral cortex of the femur to the joint region of the lateral wall of the intercondyle, taking care to protect the posterior cruciate ligament. The tibial tunnel of the ACL is made 7 mm anterior to the posterior cruciate ligament in the extension of the anterior horn of the lateral meniscus or slightly medial to this point, between the tibial spines. After insertion of the guidewire, the knee should be extended to check that there is no impact on the intercondylar roof.

Both femoral and tibial tunnels can be made with a standard ACL tibial guide, requiring no special equipment to perform this technique. After preparation of the 4 tunnels, the graft is passed from the tibial to the femoral tunnel of the ACL.

The graft is inserted, with the 2 simple semitendinosus tendons and the double gracilis tendon, forming a quadruple graft for the ACL (Fig 2). The graft is fixed internally in the femur, with an interference screw that enters the lateral cortex of the femur, and posteriorly, with tibial fixation of the ACL performed with an interference screw after pretensioning the graft. For tibial fixation of the ACL, the

![Fig 1](A) Posterolateral access view showing start of femoral tunnel to reconstruct both ACL and PLC at isometric point in lateral region of lateral condyle. (B) Joint view from anterolateral portal with emergence of wire at point of anatomic positioning of ACL.

![Fig 2](A) Passage of graft of 2 simple semitendinosus and double gracilis tendons from tibia to femur, entering in ACL tibial tunnel. (B) Femoral outside-in fixation of triple graft with interference screw in lateral femoral condyle, leaving 2 remaining semitendinosus tendons to reconstruct PLC.
Table 1. Advantage, Indications, Contraindications, Tips and Pearls, Pitfalls and Risks, and Key Points to Reconstruct Combined ACL and PLC With Single Femoral Tunnel

| Description |
|-----------------|
| Advantage         | Avoid tunnel convergence in lateral femoral condyle |
| Indication        | Combined ACL and PLC injury |
| Contraindications | Limb malalignment (particularly varus) |
| Tips and pearls   | Dissect interval between biceps and lateral gastrocnemius to access posterolateral tibia |
|                   | Pass both semitendinosus tendons under iliotibial band to reconstruct PLC |
| Pitfalls and risks| Protruded femur screw can irritate iliotibial band |
|                   | Fibular tunnel must be in head center to avoid fracture |
| Key points        | Identify and protect fibular nerve |
|                   | Correct identification of fibular head, Gerdy’s tubercle, and lateral epicondyle and full access to posterolateral tibia |
|                   | Femoral tunnel must enter in isometric point of PLC in lateral femoral wall and exit in anatomic point of ACL inside lateral femoral condyle |

knee is placed at 30° of flexion, and posterior drawer testing is performed.

After fixation of the ACL, the remaining 2 semitendinosus tendons are passed below the iliotibial tract. Initially, a tendon is placed at the head of the fibula for reconstruction of the LCL, and it is passed from the anterolateral to posteromedial direction. The tendon is fixed with an interference screw in the head of the fibula. The remaining portion of the semitendinosus tendon will be used for reconstruction of the popliteus tendon. It will be inserted into the tibia, from the posterior to anterior direction, together with the remaining portion of the tendon used for the LCL reconstruction, which will be the popliteofibular ligament. The graft is fixed with the knee flexed at 40°, with internal rotation of the foot and slight valgus (Video 1).

After fixation of all the grafts, a gentle maneuver is performed to test the effectiveness of fixation. A review of homeostasis and suturing in layers is then performed, and the wound is dressed. No postoperative immobilization is required; the range of movement is stimulated, and crutches are used for protected weight bearing until the patient gains the confidence to walk unaided. Advantages, indications, contraindications, tips and pearls, pitfalls and risks, and key points are described in Table 1.

**Discussion**

Many techniques have been developed for fixation of both ACL and PLC injuries. Currently, anatomic reconstruction of the outside-in type, proposed by Garofalo et al.⁷ is the technique used for ACL reconstructions in our department. The outside-in technique is interesting when used with combined reconstruction of the PLC because a lateral route is essential for fibular nerve dissection, as well as identification of the structures to be reconstructed and bone markers.¹,²

Unlike ACL reconstruction, PLC reconstruction does not present such satisfactory results. Numerous techniques have been attempted, such as lateral advancement, tenodesis of the biceps, and repair or reconstruction of the structures.¹-⁴ According to Stannard et al.,³ better results have been obtained with reconstruction techniques.

![Fig 3](image-url) Postoperative (A) lateral and (B) front left knee radiographs showing combined ACL and PLC reconstruction with a single femoral tunnel. (C) Anatomic diagram of single femoral tunnel.
Combined injuries present less satisfactory results than isolated injuries.\textsuperscript{1,2,9} Besides care in the preparation and tensioning of the grafts, in reconstructions involving more than one ligament, a particular problem is convergence of the tunnels in the femoral condyles.\textsuperscript{5,6} Often, when convergence of the tunnels is being avoided it is not possible to place the grafts in the desired position. Shuler et al.\textsuperscript{5} showed that collision of the tunnels is very common, and its prevention depends not only on the surgeon’s skill but also on the patient’s anatomy. Even with the correct techniques, it is often not possible to prevent collision.\textsuperscript{5}

The technique described in this article, in a certain way, consists of an adaptation of 2 traditional techniques—the technique of Garofalo et al.\textsuperscript{7} for ACL reconstruction and the technique of Stannard et al.\textsuperscript{8} for PLC reconstruction—for reconstruction of combined injuries with anterior and posterolateral instability (Fig 3).

The main advantages of this technique are minimizing the number of femoral tunnels and avoiding convergence in the lateral femoral condyle, but it relies on having grafts of adequate size. Semitendinosus grafts smaller than 27 cm make the technique undoable because of the impossibility of reconstructing the PLC structures with adequate graft size. The use of cadaveric grafts minimizes the difficulty of obtaining grafts of sufficient length for the posterolateral reconstruction, but this technique is easy to perform in centers that do not have an available tissue bank, with minimum morbidity for the patient.

The technique described is an effective solution for reconstruction of combined ACL/PLC injuries. Studies are being carried out to evaluate the functional results of this technique.

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