Anatomic Graft Passage in Remnant-Preserving Posterior Cruciate Ligament Reconstruction

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Abstract: Posterior cruciate ligament (PCL) reconstruction with preservation of the remnant PCL fibers has been performed under the assumption that preserving the fibers contributes to knee kinematics, grafted tendon healing, and recovery of proprioception. This technical note presents a single-bundle, transtibial PCL reconstruction with anatomic graft passage between the remnant PCL fibers. The operation is performed using the posterior trans-septal portal, which can provide excellent visualization while preserving a large amount of remnant PCL fibers. In addition, this technique allows for anatomic graft passage without soft-tissue impingement, and it minimizes the risk of nonanatomic positioning of the PCL grafts.

Surgical Technique
Establishing Posterior Trans-Septal Portal
Under general anesthesia, the patient was placed in the supine position, and the affected knee joint was flexed at 90°. First, routine arthroscopic examination of the knee joint was performed using the standard anterolateral and anteromedial portals. The arthroscope was redirected toward the posteromedial compartment from the anterolateral portal through the intercondylar notch with the knee at 90° flexion. In a PCL-deficient knee, it is easy to pass the arthroscope from the anterolateral portal to the posteromedial compartment through the intercondylar notch because the space between the PCL and the medial femoral condyle is widened. The posteromedial and posterolateral portals were established under direct arthroscopic visualization by transillumination and were marked by a spinal needle. The posterior trans-septal portal was made at the central portal of the posterior septum behind the PCL without disrupting the remnant PCL bundle.

The tibialis anterior allograft was used as the PCL graft. The graft was folded into a 2-strand graft (9 to 10 mm in diameter and 14 to 15 cm long). The end of each strand was sutured in whipstitch fashion with a No. 5 Ethibond suture (Ethicon, Somerville, NJ).

Tibial Tunnel Preparation
From the posteromedial portal, the PCL tibial attachment site was completely exposed by detaching the posterior capsule from the PCL using a motorized shaver, which was introduced from the posterolateral portal through the posterior trans-septal portal. In addition, a right-angle rasp (Arthrex, Naples, FL) was introduced through the anteromedial portal, exposing...
the PCL medially and inferiorly approximately 1 to 1.5 cm. After placement of the arthroscope in the anterolateral portal, the remaining anterolateral bundle of the PCL femoral attachment site was exposed from the synovial coverage using a motorized shaver. The hook of the PCL tibial drill guide was introduced from the anteromedial portal through the space between the remnant PCL bundles and was advanced into the PCL tibial attachment (Fig 1A). This is a good method for reaching the tip of the drill guide at the distal-lateral portion of the PCL tibial attachment. While visualizing the PCL tibial drill guide through the posteromedial portal, the surgeon (J.H.A.) inserted a guide pin into the distal-lateral portion of the PCL tibial attachment site, approximately 1 cm below the joint line, by placing the drill guide at a 50° to 55° angle. Fluoroscopy was used to confirm proper positioning of the guide pin tip. Under the fluoroscope, a tunnel was made from the hamstring insertion site using a cannulated drill. The hook of the PCL tibial drill guide should be positioned to protect any neurovascular structures during the process of drilling and reaming with the transtibial technique. Finally, the rasp was used to create a smooth acute angle at the anterior margin of the tibial tunnel.

Femoral Tunnel Preparation
To prepare the femoral tunnel, a 3- to 4-cm longitudinal skin incision was made along the medial border of the vastus medialis at the level of the patellar superior pole. The guide pin for the PCL femoral tunnel was inserted 7 to 8 mm posteriorly to the distal border of the articular cartilage of the medial femoral condyle, which was between the 1- and 2-o’clock positions in a right knee and between the 10- and 11-o’clock positions in a left knee. While protecting the tip of the guide pin, the surgeon (J.H.A.) made a tunnel without damaging the remnant PCL through the medial femoral condyle using a cannulated drill with an outside-in method.

Graft Passage and Fixation
To pass the graft through the proper position, a curved pituitary forceps was introduced through the anteromedial portal and was passed through the space between the remnant PCL bundles. After placement of the arthroscope through the posteromedial portal, the wire loop was inserted into the posterior compartment through the tibial tunnel and was passed through the anterior compartment between the PCL remnant bundles using the curved pituitary forceps (Fig 1B). Then, the wire was pulled out through the femoral tunnel (Fig 2A). The graft
was attached to the wire loop and was pulled out from the tibial tunnel to the femoral tunnel, passing through the joint through the wire loop. After fixation of the femoral tunnel with a bio-interference screw using post-tie fixation, the graft was fixed to the tibial tunnel with a bio-interference screw and an additional post-tie. The sagged tibia was reduced to its anatomic position with the knee at 80° to 90° of flexion (Figs 2B and 3).

Discussion

The remaining PCL structures have the potential benefits of enhancing revascularization, preserving proprioceptive function through the mechanoreceptors in the original PCL, and adding to the knee’s mechanical stability.1,2 Therefore several techniques for reconstructing the PCL while preserving the remnant PCL fibers have been advocated by various authors.5-7 When one is preserving the remnant PCL fibers, it is difficult to ensure the correct position of the guidewire for femoral tunnel preparation, especially on the tibial side. In our technique the hook of the PCL tibial drill guide is passed through the space between the remnant PCL bundles and is advanced through to the PCL tibial attachment. This is an excellent method for reaching the tip of the drill guide at the anatomic position of the tibial tunnel to place the PCL graft. We believe that the posterior trans-septal portal provides excellent visualization of the PCL tibial attachment with the remnant PCL fibers and it provides easy access for establishing the tibial tunnel without injuring any neurovascular structures.

Regarding graft passage, the graft is usually passed through the space between the medial femoral condyle and the remnant PCL fibers during remnant-preserving PCL reconstruction. However, a recent cadaveric study showed that the passage of graft over the PCL increased the intra-articular length and achieved better isometry compared with passing it straight under the PCL path during remnant-preserving PCL reconstruction.8 One technical report proposed PCL graft passage between the remnant PCL fiber and the Wrisberg ligament.7 However, this passage can stretch or be curved by the remnant PCL fibers, and it is difficult to define the spaces between the fibers and the ligament. To establish an anatomic PCL graft passage without soft-tissue impingement, the space between the remnant PCL fibers should be obtained by careful dissection using a shaver before graft passage, and the anterolateral viewing and posteromedial portals should also be confirmed.

The advantages of our technique are as follows: (1) it can preserve the maximal amount of remnant PCL fibers; and (2) the graft is passed anatomically, preventing impingement between the graft and the remnant PCL fibers. However, this procedure also has several disadvantages. First, more research is warranted to prove the benefits of performing remnant preservation using the described passage. Second, the remnant PCL bundle causes poor visualization, and it is inconvenient to pass equipment through it when establishing the tibial tunnel. Finally, it is difficult to determine the exact position of the graft passage in the remnant PCL fibers.

References


