# Anatomic Fibular Collateral Ligament and Anterior Cruciate Ligament Reconstruction With Concomitant Biceps Femoris Avulsion Repair

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**Background:** Injuries to the fibular collateral ligament (FCL) seldom occur in isolation and may present with a concomitant injury to the biceps femoris tendon and anterior cruciate ligament (ACL). Injuries to structures of the posterolateral corner (PLC) lead to varus and rotational instability of the knee, subjecting the cruciate ligaments to increased forces that may result in graft failure. Therefore, reconstruction of these structures should be performed concurrently with the ACL.

**Indications:** Grade III FCL injuries heal poorly without operative treatment and often result in residual varus instability of the knee that increases medial knee compartment forces, and forces on both the native ACL and the graft status post ACL reconstruction. Therefore, preservation of biomechanical stability and long-term health of the knee are reliant on addressing injuries to the PLC surgically.

**Technique Description:** A key concept of this surgical technique is a meticulous peroneal nerve neurolysis in the setting of altered biceps femoris anatomy, and the proper order of the surgical steps for tunnel creation, graft passage, and fixation and suture anchor insertion to achieve optimal patient outcomes. The described technique involves a lateral surgical approach, peroneal neurolysis, and preparation of fibular and femoral FCL tunnels, followed by a Bone-patellar tendon-bone graft (BTB) graft harvest. Attention is then turned to intra-articular work including the diagnostic arthroscopy, femoral and tibial tunnel preparation, passage of the ACL graft, and fixation of the grafts in femoral tunnels. Last, fixation is achieved in the following order: FCL graft on fibula, ACL graft on tibia, and biceps femoris tendon to fibular head.

**Results:** Compared with the preoperative state, Moulton et al reported significant improvements in the average Lysholm and Western Ontario scores at 2.7 years postoperatively following anatomic FCL reconstrution. Furthermore, Thompson et al reported on primary suture anchor repair of distal biceps femoris in 22 elite athletes and reported that all patients had returned to their preinjury level of sporting activity at 2-year follow-up.

**Discussion:** Anatomic reconstructions of the FCL and ACL, such as the one described in our technique, effectively restore near native knee biomechanics and offer superior clinical outcomes compared with nonanatomic-based FCL reconstructions.

**Patient Consent Disclosure Statement:** The author(s) attests that consent has been obtained from any patient(s) appearing in this publication. If the individual may be identifiable, the author(s) has included a statement of release or other written form of approval from the patient(s) with this submission for publication.

**Keywords:** FCL; PLC; peroneal neurolysis; biceps femoris; multiligament knee injury

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## VIDEO TRANSCRIPT

This is a video presentation depicting the anatomic reconstruction of the anterior cruciate ligament (ACL) and fibular collateral ligament (FCL), along with repair of an ipsilateral biceps femoris tendon avulsion.[7,9]

Shown here are the disclosures for the authors involved.

Multi-ligament knee injuries result in significant knee instability with devastating effects on tibiofemoral biomechanics and long-term degenerative changes.[5,6] These reconstruction techniques are aimed at accurately restoring the native anatomy and therefore native biomechanics. Given the complex multi-step processes involved in these reconstructions, the order of the surgical steps and a firm understanding of anatomy are crucial to achieving satisfactory outcomes. When addressed appropriately with good technique, these patients can obtain good subjective and objective outcomes.

This operation was performed on a 23-year-old man with an unremarkable past medical history who originally presented with a chief complaint of left knee pain and instability. The patient was a collegiate hockey goalie who reported immediate pain and instability after attempting to save a shot during competition.

While he was able to finish his season following his injury, he endorsed having recurrent bouts of instability, pain, and joint effusions around his left knee.

Examination of the patient's left knee was notable for a grade 2 Lachman test, a 2 + pivot shift, a 1 + varus stress test at 0° and 3 + varus stress test at 20°. Overall, his physical examination findings were consistent with tears of the ACL and FCL.

Stress radiographs confirmed increased varus gapping of 4 mm of the left knee compared with the right knee. Select sagittal and coronal magnetic resonance imaging (MRI) findings are displayed. The sagittal cut demonstrates a complete ACL rupture with associated anterior tibial translation. The coronal MRI cut demonstrates laxity of lateral sided structures and notably a periosteal avulsion of the biceps femoris at its insertion on the fibula.

In summary, the physical examination findings were consistent with a complete tear of the ACL and FCL, as well as an avulsion of the biceps femoris from its distal attachment to the fibular head.[1-3] The plan was made for a 1-stage surgery which would involve reconstructing both the ACL and FCL, a peroneal nerve neurolysis and reattaching the biceps femoris tendon to its fibular attachment.

The examination under general anesthesia of the left knee begins with a Lachman test, revealing a grade 2 Lachman. Next, a pivot-shift test reveals a 2 + pivot shift. Varus stress testing is performed while in 30° of flexion, which reveals 3 + varus gapping. Finally, a dial test is performed and found to be symmetric bilaterally. A high thigh tourniquet is placed, and the left knee is sterilely prepped and draped in the usual standard fashion.

The open portion of the procedure is undertaken first to avoid excess fluid extravasation, and a standard lateral hockey stick incision is then made along the lateral aspect of the knee. Subcutaneous dissection is then performed being sure to create full thickness musculocutaneous flaps. Using the inferior border of the biceps femoris tendon as our anatomic landmark, we carefully dissect in this area to localize the common peroneal nerve.

In this case, the nerve was found to be completely encased in scar tissue where it crosses the fibular head. A very purposeful and meticulous 6-cm long common peroneal nerve neurolysis is performed including the peroneus longus fascia. The biceps bursa is then localized and split. The distal portion of the torn remnant FCL is identified and confirmed to be very attenuated. A passing stitch is placed in the free end.

Using a scalpel, the remaining tissue adherent to the distal attachment site of the FCL is cleared from the lateral aspect of the head of the fibula. The distal attachment site is confirmed, and a fibular collateral instrument guide is then used to drill a 2.4-mm guide pin across the fibular head.

This is then followed with a 6-mm reamer while making sure to protect the neurovascular structures with a Chandler retractor. A passing stitch is then placed through this tunnel and held in place by a hemostat.

Next, the iliotibial band is split. Dissecting past the iliotibial band, a proximal remnant of the native FCL is appreciated by applying tension to a traction stitch placed in the FCL remnant in the biceps bursa. The proximal attachment site of the FCL is located just proximal and posterior to the lateral epicondyle which can be easily palpated. Using a femoral collateral instrument guide, a guide pin is drilled bicortically with an approximately 35° anterior trajectory starting at the FCL attachment site. This is followed with a 6-mm reamer, and then subsequently, this is followed by a 7-mm tap. A passing stitch is then placed through this tunnel and held in place by another hemostat. A channel is then cleared out deep to the iliotibial band through which the FCL graft will eventually be passed.

The biceps tendon is next confirmed to be torn off the fibular head and styloid. Using a rongeur, the scar tissue at the normal biceps tendon attachment on the fibular head is cleared to get down to the cortical bone of the fibular head to create a bony bleeding surface. A suture anchor will eventually be placed here later in the case.

We turn our attention to the patellar tendon graft harvest and an anteromedial incision is then made extending from the patella inferiorly to the tibial tubercle. Using a scalpel, full thickness flaps are again created, and the paratenon is carefully incised and preserved for closure. The central third of the patellar tendon was marked with a marking pen and a 10-mm-wide incision through the tendonous component was made using a scalpel. Using monopolar electrocautery, the patellar osseous component of the graft is scored down to cortical bone. An oscillating saw is then used to cut along the scored outline of the patellar component of the 10-mm-wide and 20-mm-long graft. An osteotome is then used to liberate the patellar component of the graft from the surrounding patella.

Once again, monopolar electrocautery is used to score the tibial component of the graft. An oscillating saw is then used to cut along the scored outline of the 10-mm-wide and 25-mm-long tibial component of the graft. An osteotome is then used to liberate the tibial component of the graft from the surrounding tibia. While holding the free tibial component of the graft with a hemostat, a scalpel is used to release any remaining areas where the graft is adherent to surrounding tissue. The graft is then brought to a back table and prepared and sized to fit through two 10-mm tunnels using 2 passing sutures in each bone plug.

The patient's semitendinosus tendon was then identified, mobilized, and harvested with an open hamstring harvester to serve as the FCL graft. Arthroscopic exploration of the knee is next performed, and a chronically torn ACL is observed and the remnant debrided with a shaver. Remnant tissue pertaining to the proximal portion of the native ACL is also cleared from the lateral interior wall of the femur using a combination of cautery and shaving to identify the proximal attachment site of the ACL.

A spinal needle is introduced into the joint to localize positioning for an accessory medial portal. A bur hole is then made midway between the attachment sites of the anteromedial and posterolateral bundles of the ACL. A shaver is then used to clear remnant loose tissue around the bur hole site. The location of the bur hole is then confirmed to be anatomic before proceeding.

With the patient's knee maximally flexed, a Beath pin is then drilled anterolaterally out of his thigh and then over-reamed with a 10-mm low-profile reamer to a depth of 25 mm, maintaining a 1.5-mm back wall. A key pearl at this step is to ream to a depth of 10 mm to check the back wall and trajectory of the tunnel, and then to complete the tunnel reaming. A passing stitch is then placed.

The articular cartilage surfaces and the menisci are then examined and confirmed to be intact with no medial meniscal ramp or lateral meniscal root tears.

The tibial attachment site of the ACL is then identified adjacent to the anterior horn of the lateral meniscus, and remnant tissue of the native ACL is cleared using cautery. A guide pin is then drilled through the tibial attachment site of the ACL. This tunnel is then over-reamed with a 10-mm acorn reamer. The tibial tunnel apertures are then inspected arthroscopically, and a shaver is used to clear any remnant loose tissue from around the tunnel orifices. Using the passing stitch for the ACL graft, the ACL graft is then pulled through the tibial tunnel and secured in standard fashion in the femur with a 7 × 20 mm titanium screw.

The FCL graft is now fixed in the femoral tunnel using a 7 × 20 mm bioabsorbable screw and the graft is passed through the previously opened channel created deep to the iliotibial band and then subsequently through the fibular head tunnel created earlier.

The final tensioning and fixation of the FCL is undertaken prior to final tensioning and fixation of the ACL. This is due to prior biomechanical data demonstrating fixation of the ACL prior to structures of the posterolateral corner (PLC; including the FCL) would result in an external rotation deformity. Therefore, the next step is final fixation of the FCL achieved within the fibular head with a 7 × 20 mm bioabsorbable screw at 20° of knee flexion with traction on the graft and a valgus load applied.

Then, with the knee in near full extension and a posterior drawer applied, the distal portion of the ACL graft is then fixed to the tibia using a 9 × 20 mm titanium screw.

Using a Q-FIX anchor, the biceps femoris tendon is reattached to the anatomic attachment of the direct arm on the posterolateral edge of the fibular head just lateral to the fibular styloid.[10] The timing of the reattachment of the biceps can be before or after final ACL graft fixation, but it is crucial that it be performed after the final FCL fixation because fixation prior to placement of the FCL graft and screw in the fibular tunnel can result in suture anchor protrusion into the fibular tunnel and therefore impede graft passage. Once the sutures have been whip stitched into the biceps femoris tendon, they are tied in full extension while making sure to keep the common peroneal nerve retracted.

Here, we discuss 3 possible complications associated with this procedure. Peroneal nerve injury is a potential complication. Purposeful and meticulous dissection of the nerve during neurolysis is critical to avoiding injury. Next, the order of graft fixation and the specific forces applied to the knee during graft fixation are crucial to avoiding improper tibiofemoral positioning. The FCL graft should undergo final fixation first to avoid a possible external rotation deformity.[3,4] Finally, an early post-operative focus on range of motion and decreased swelling is the optimum method for minimizing the risk of post-operative fibrosis.

Postoperative rehabilitation guidelines include range of motion restriction of 0° to 90° for the first 2 weeks, to then be advanced as tolerated. The patient remains non-weight bearing for the first 6 weeks following the operation, followed by the introduction of partial protected weight bearing in a brace with the assistance of crutches until the patient is able to ambulate without a limp. Isolated hamstring activation is also to be avoided for the first 4 months, with a goal for return to sport at 9 to 12 months postoperatively. New stress x-rays should be obtained to guide this return.

Finally, this operation has been shown in prior literature to produce good patient outcomes. A study by Moulton et al assessing outcome scores for patients who underwent FCL reconstruction, a large proportion of whom also underwent concomitant ACL reconstruction, found that FCL reconstruction can achieve substantially improved outcome scores, both when performed as an isolated procedure and when performed in concert with other procedures, such as an ACL reconstruction, as demonstrated in this video.[6,8]

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