Tips and Tricks for Anatomic ACL Reconstruction With Soft-Tissue Quadriceps Tendon and Remnant Repair

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Background: Quadriceps tendon (QT) autograft represents an excellent option for anterior cruciate ligament (ACL) reconstruction (ACLR), with minimal donor site morbidity and failure rates comparable with bone-patellar tendon-bone (BPTB) autograft. This video aims to provide technical tips for ACLR using all-soft-tissue QT autograft.

Indications: ACLR with QT autograft is indicated in young, active ACL-injured patients who desire a return to sport. It represents a viable option in both primary and revision ACLR, as well as in skeletally immature patients. It is particularly indicated in those who kneel frequently, such as wrestlers or laborers, due to the lower incidence of postoperative anterior knee pain.

Technique Description: A vertical incision is used to harvest a 10 mm × 70 mm partial thickness, all-soft-tissue QT graft. Care is taken not to violate the capsule or musculature. If necessary, graft size is modified based on preoperative magnetic resonance imaging (MRI) measurement of the notch width. The graft is then prepared with continuous loop suspensory fixation on the femoral side and draw sutures on the tibial side. The lateral femoral notch is debrided to allow for visualization of the posterior wall to enable anatomic tunnel placement. When possible, the tibial stump is preserved. The femoral tunnel is drilled via an anteromedial portal and the tibial tunnel via a tibial guide. The graft is then passed through the tibial stump into the femur. It is fixed on the tibial side with a PEEK interference screw in full extension with application of a posterior drawer.

Results: Outcomes following ACLR with QT autograft are excellent, with laxity and patient-reported outcomes comparable with those following ACLR with BPTB and hamstring autograft. Furthermore, QT ACLR has been shown to result in less donor site morbidity than BPTB autograft, and lower rates of failure and infection compared with hamstring autograft.

Conclusion: ACLR with QT autograft is a good option in young, active patients in both the primary and revision settings. Advantages of QT ACLR include less donor site morbidity than BPTB, and lower rates of failure compared with hamstring autograft in young patients.

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: anterior cruciate ligament; ACL reconstruction; quadriceps; autograft; tendon

VIDEO TRANSCRIPT

This is a presentation on tips and tricks for anatomic anterior cruciate ligament (ACL) reconstruction (ACLR) with soft-tissue quadriceps tendon (QT) and remnant repair by Sahil Dadoo, Laura Keeling, Armin Runer, and Volker Musahl from the University of Pittsburgh.

There are no relevant disclosures to this presentation.

This is the overview for the presentation. We will talk about patient anatomy. We position the patient using a leg holder. The portal placement is key. It is an accessory anteromedial portal can sometimes be used in this technique. The graft harvest will be described in detail, using a regular incision with forceps and a knife. The graft is prepared using a continuous loop suspensory fixation endobutton, and tibial stump preservation is performed whenever possible.

This is a case of a 17-year-old female high school field hockey player who is very active, nearly at the professional level, who sustained a noncontact pivoting injury during a game. On examination, there was an effusion present, positive Lachman test, positive medial joint line tenderness, and no varus or valgus instability. The magnetic resonance imaging (MRI) showed a complete ACL tear. Using MRI, we do preoperative measurements such as notch width, which is particularly small at 14 mm in this patient.

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This has implications for choosing the appropriate graft size.

Here is the clinical examination under anesthesia. Again, the patient had a positive Lachman test. We put 3 markers on the side of the knee for ease of visualization and quantitative evaluation of the pivot shift.[2] There is also a positive grade 2 pivot shift test and positive anterior drawer test as well.

The planned incisions include a vertical incision for the QT, a standard anteromedial skin incision for the tibial insertion, and portal sites as marked.

This video demonstrates the graft harvest.

A 1-inch anterior skin incision is made centered over the distal QT. Using a periosteal elevator, the soft tissue on top of the QT can be removed. The first incision is exactly in parallel with, and adjacent to, the vastus medialis oblique muscle, and the second incision is made freehand, trying to stay parallel to the first incision. The tendency is to be divergent here, because the quadriceps curves quite broadly at the superior pole of the patella. We then do a partial thickness harvest of the QT. It is okay if the suprapatellar pouch is violated; however, this should be avoided if possible to make arthroscopy easier afterward. We put a provisional suture into the patellar side of the graft, which will later be removed. We measure approximately 7 cm of tendon before amputation.

Here is a schematic view of the graft preparation. The graft is prepared on 1 side with two #2 whip stitches, and a continuous loop suspensory fixation for the femoral side.[3]

This video quickly demonstrates the graft preparation on the back table. The graft is prepared so that the insertion comes a little easier. A whip stitch is then placed on the tibial side, which is the myotendinous junction, so the graft actually gets flipped prior to insertion. A sizing of the graft is then performed, in this case, a 9 mm diameter should pass easily. The tendon is quite broad and rough, so it is important to remove the rough edges of the graft for ease of passage. Then, with a plan of having 15 mm in the femoral tunnel, the endobutton is passed through the tendon to create a continuous loop with very little room for elongation. To prevent ripping through, a ripstop stitch is placed, which is a continuous loop #2 ultrabraided suture. The graft is then marked prior to insertion (at 15 and 6 mm distal to the first marking).

The notch size should be measured intraoperatively to confirm that the MRI finding is appropriate. In this patient, the notch is 14 mm wide as measured via MRI. The tibial stump should be measured as well to get a broad idea of size—in this case, a 9-mm graft is appropriate. For the next step, we try to preserve the tibial stump as much as possible, but on the femoral side, we do a complete removing of the stump so that the bony ridges can be observed to achieve an appropriate posterior or deep tunnel placement. It is key to leave just a small wall on the posterior part of the femur. We then switch the scope to the opposite portal to better visualize the anatomic tunnel placement. A flexible drill guide is used for reaming, and the knee is hyperflexed to 120°, which provides at least 30 mm of tunnel length if done appropriately.

Here, the position of the pin is again checked by switching the portals. Now, a single-fluted flexible reamer is inserted, and a roughly 6-mm bone bridge is left in place. The tunnel length is measured outside-in with a measurement guide. Once all the bony debris is removed from the tunnel, you can see there is only about a 2-mm deep posterior ridge present, which is appropriate.

A draw suture is then passed for the tibial stump. If the stump is able to be preserved nicely as in this case, we actually use a knife and separate the stump so the graft can be delivered through it. We then use a standard tibial tip aimer and place a guide pin. The pin is reamed up to the second cortex, after which the pin is reamed by hand so as to not disrupt too much of the stump. Then, the draw suture is passed through the stump, and now the graft can be delivered through the stump. Admittingly, the QT is not the easiest to pass through a stump because it is a bit rougher and thicker compared with the hamstring tendon (HT).

Here, the endobutton is now flipped, and the graft is appropriately positioned. The split that was previously made in the ACL stump can be repaired if necessary to avoid the remnant further splitting and becoming a cyclops lesion. For this, we use an 0 vicryl stitch, and the final graft in appropriate position can be visualized. In the final step, we do a range-of-motion test to check for impingement. By preserving the stump, we avoid placing the graft too anterior and causing impingement, so we are content with this placement.

There are some complications of QT ACLR that must be mentioned, including hematoma, rectus femoris retraction, donor site pain which is rare, and QT rupture which is also very rare.[1,9] Postoperative rehabilitation is very similar to standard rehabilitation protocol, and there are really no restrictions in range of motion. The quadriceps needs to be engaged early on, with full active extension being achieved by 2 weeks, and full active flexion by 6 weeks.

Return to sport following ACLR is really a continuum, as published in 2021 from our 2019 Panther Symposium.[4,5] There is usually about 9 to 12 months of return to play time based on return to sport testing performance.

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With regard to patient outcomes, there is comparable laxity and patient-reported outcomes following QT ACLR when compared with HT and bone-patellar tendon-bone (BPTB) autograft.[10] There is less donor site morbidity, improved Lysholm scores, and lower failure rates as well associated with the QT when compared with HT and/or BPTB autograft.[6-8] Therefore, we feel the QT is an adequate graft for young athletes.

With that, I would like to paraphrase Dr Freddie Fu: "Learning is forever."

Here is the literature list, and I thank you very much for watching this video. I hope you found it instructive—thank you.

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