

Minimally Invasive Quad Harvest Featuring Endoscopic Closure and Preparation With Adjustable Suspensory Fixation Device Incorporated With Braided Suture



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Abstract: The quad tendon has increasingly become a very common option for anterior cruciate ligament reconstruction. Minimally invasive approaches are one of the many advantages to the quad tendon graft. One of the issues with a small incision is assuring appropriate proximal closure. In this technique, we use the arthroscope to view proximally and a Scorpion (Arthrex) device to close our proximal quad harvest. We also describe the updated preparation of the quad tendon with FiberTag TightRope (Arthrex) and FiberTag ABS (Arthrex). These implants have FiberTag incorporated to the suspensory devices that creates a stable construct that is faster to incorporate into the quad with the slotted clamp. Together, these updates to the preparation and harvest should make the construct more reproducible and decrease donor-site morbidity respectively.

The “all-inside” anterior cruciate ligament (ACL) reconstruction technique has many advantages, including decreased bone removal, diminished surgical trauma, decreased postoperative pain, and improved cosmesis.¹ Many variations of this techniques exist, and graft options include bone–patellar tendon–bone (BPTB), hamstring, quadriceps, and allograft options. The quadriceps tendon is becoming a more popular option for use due to the possibility of harvesting a single-bundle, large-diameter graft with low donor-site morbidity. In addition, newer harvest tools have made quadriceps tendon harvest far less cumbersome than previously.² There have been disadvantages to quad tendon, some of which are quad weakness and inconsistency on preparation and fixation techniques. To counteract the quad weakness and

donor-site complications, we describe a more accurate proximal closure technique that will allow a tighter closure even through the smallest incisions. As we attempt to define a standardized quick preparation technique, we describe an updated technique that incorporates the FiberTag suture into the suspensory TightRope device and features a specialized slotted clamp.

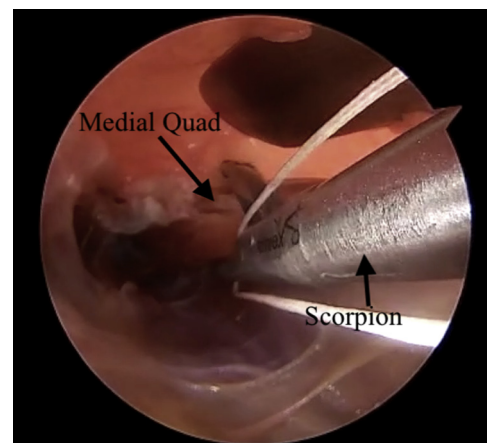


Fig 1. The 30° arthroscope with no flow is placed into the quad incision with the right knee flexed and you can see the medial quad with the Scorpion placing the first stitch.

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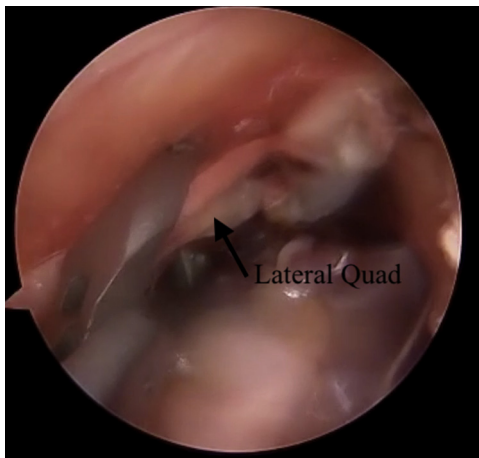


Fig 2. The 30° arthroscope with no flow is placed into the quad incision with the right knee flexed and the lateral quad is seen with the inferior limb suture being placed through the quad with the Scorpion.

Surgical Technique (With Video Illustration)

Graft Harvest

With the patient supine and the knee flexed, a small incision is made at the distal quad. After spreading the subcutaneous tissue, the distal quad is identified. A 9-mm cutting guide is used running distal to proximal. A knife is then used to lift the distal quad off the bone and a size 0 VICRYL (Ethicon, Somerville, NJ) is used to tag the quad tendon. The graft harvester (Arthrex Inc, Naples, FL) is used to cut the graft proximally (Video 1).

Endoscopic Closure

An arthroscope with no flow is then placed into the wound and the proximal edges of the medial and lateral quads are identified (Figs 1-3). A Scorpion device with a

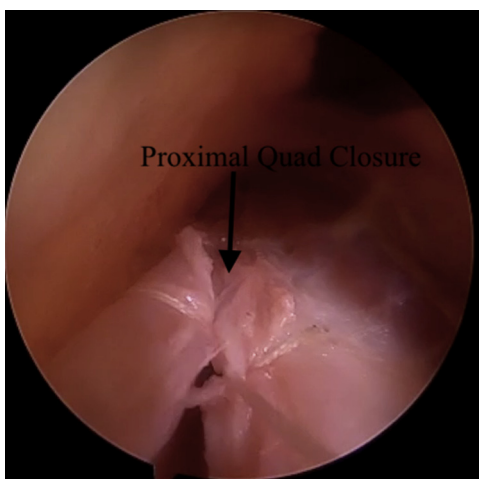


Fig 3. The 30° arthroscope with no flow is placed into the quad incision with the right knee flexed and you can see the proximal closure of the quad is tight and approximated.

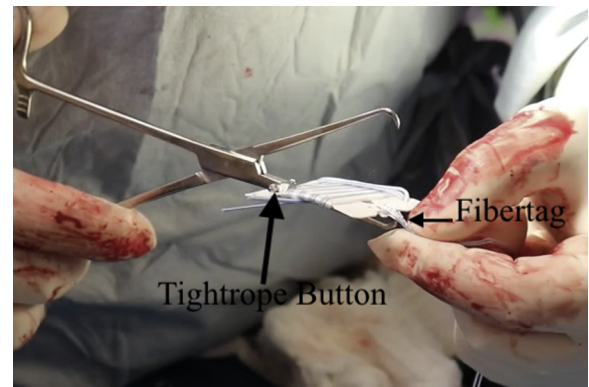


Fig 4. The FiberTag TightRope device is placed on the clamp with the button superior. The proximal part of the implant is placed into the inferior groove and the FiberTag stitch is in the groove of the pointed clamp.

size 0 VICRYL suture is used to pass a suture into the proximal medial quad. Next, the inferior limb of that suture is passed through the lateral quad. This suture is then passed medial and then laterally to give a figure 8 construct. The suture is tied and cut. Distal to that a second figure of 8 construct is performed and the quad closure is tensioned and tied.

Graft Preparation

The FiberTag TightRope (Arthrex) with the button superior is loaded into the inferior slot on the clamp. The inferior distal clamp is then threaded through the FiberTag to secure it to the clamp with the FiberTag in the groove (Fig 4). Care is taken to avoid the TightRope sutures. This construct is flipped and clamped to the last 2 to 3 mm of the quad. Do not place more proximal because of graft shortening. The needle is then placed superior inferior at 25 mm into the graft (Fig 5). Two sutures are placed superior inferior in locking fashion with the most distal suture going through close to the clamp (Fig 6). Next, the needle is taken up through the

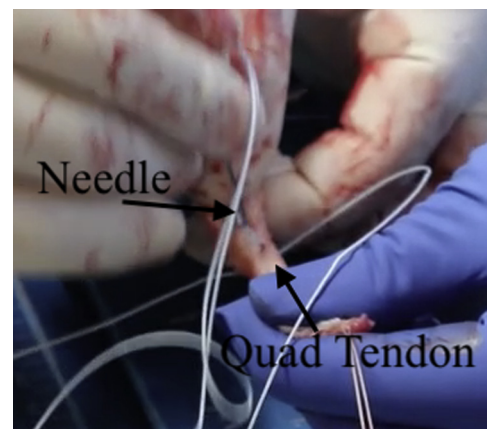


Fig 5. The quad tendon can be seen with the needle coming through superior to inferior 25 mm from the end of the graft.

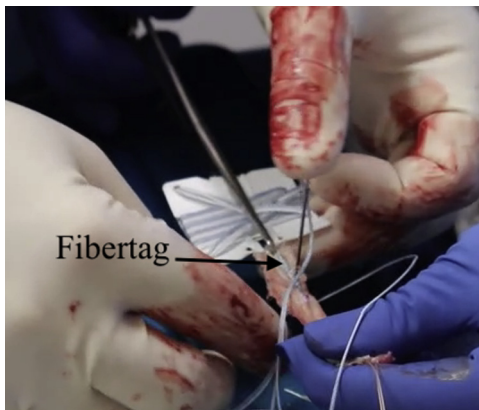


Fig 6. The needle of the implant is seen going superior to inferior through the FiberTag in the center of the graft.

small opening in the construct and back down through the FiberTag (Fig 7). Two more passes are made and the suture is cut and tied. The knot is then buried into the quad. The FiberTag ABS with the free suture superior is then placed into the clamp and tibial side of the graft is prepared in similar fashion (Figs 8 and 9).

Discussion

The current literature has continued to support the use of quadriceps tendon autograft and all-inside ACL reconstruction. A recent systematic review and meta-analysis demonstrated that patients with quadriceps tendon autograft ACL reconstruction had similar functional outcomes and graft survival rates when compared with BPTB and hamstring tendon autografts.³ They also found significantly less harvest-site pain in quadriceps tendon autografts compared with BPTB. When compared with ACL reconstruction with a



Fig 7. The needle is seen passing through the opening in the implant card to start running distal to proximal on the graft.

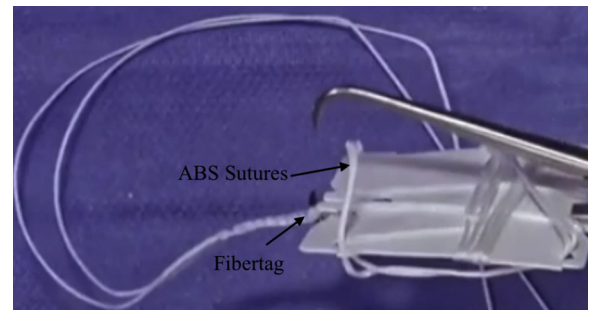


Fig 8. The ABS FiberTag implant is placed on the clamp with the ABS sutures superior and the fiber tag through the groove on the inferior clamp.

full tibial tunnel, all-inside ACL reconstructions demonstrated no decrease in functional outcome and decreased postoperative pain scores in a randomized control trial.⁴ Recently, long-term follow-up for quad tendon all-inside ACL reconstruction has shown good-to-excellent results.⁵ The all-inside technique also has been shown to have equivalent stability testing at 2 years' follow-up to BTB standard reconstructions.⁶ The quadriceps tendon graft has advantages, including its cross-sectional area, and has been shown to have as low as a 4.2% failure rate.⁷ Similar techniques have previously been described for partial-thickness quadriceps tendon harvest.^{1,2} In addition to being very comparable with hamstring grafts, the quad tendon lends itself as a perfect graft for the all-inside ACL reconstruction.⁸ Its advantages are numerous, including size and consistency. Performing the harvest from a minimally invasive incision is possible; however, closure 7 cm proximal can be difficult through the smallest incision. The closure technique presented here has the advantages of allowing the smallest incisions and assuring a tight closure, which should be stronger postoperatively. Although the endoscopic closure allows a better closure, it does add cost to the case (Table 1). The updated FiberTag TightRope and ABS devices used for

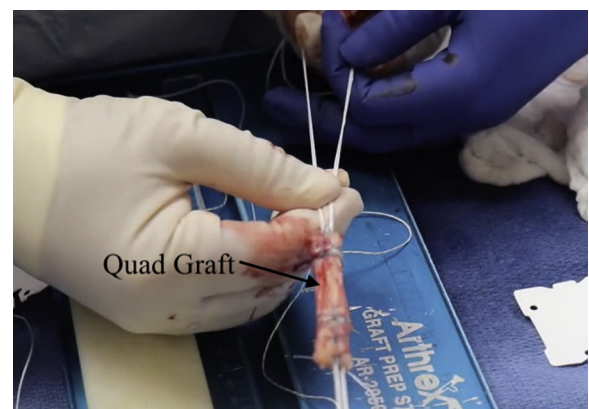


Fig 9. The finalized quad tendon is seen with implants on each end.

Table 1. Advantages and Disadvantages of Proximal Endoscopic Closure

Advantages
Ability to visualize your proximal closure even through a smaller incision
Faster closure with the Scorpion
Disadvantages
Cost of the Scorpion and needle
Additional time to load the Scorpion
Learning curve for surgeons not familiar with the Scorpion

graft preparation when added to the new slotted clamp improve the speed and security of the graft preparation from previous methods. In the technique described here, we feel the strength, security, and reproducibility of the preparation will improve results. Pearls of the technique are the button and free sutures should face superior when the implant is added into the slotted clamp. Also, when coming inferior to superior through the card, you must pass through the opening in the card. Care should be taken not to clamp the quad to far distal, which will shorten the graft (Table 2). Overall, both of these techniques should lead to improve all-inside ACL outcomes.

Table 2. Pearls and Pitfalls of Graft Preparation

Pearls
TightRope button and free ABS stitches should be superior when implant placed into the clamp
Clamp is turned upside down before placing onto the quad
First stitch should be 25 cm from the end of the graft
Tension each stitch independently
Pitfalls
Care should be taken not to clamp the quad to far proximal, which would shorten the graft
When coming inferior to superior at end of the graft, the suture must go through space in card

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