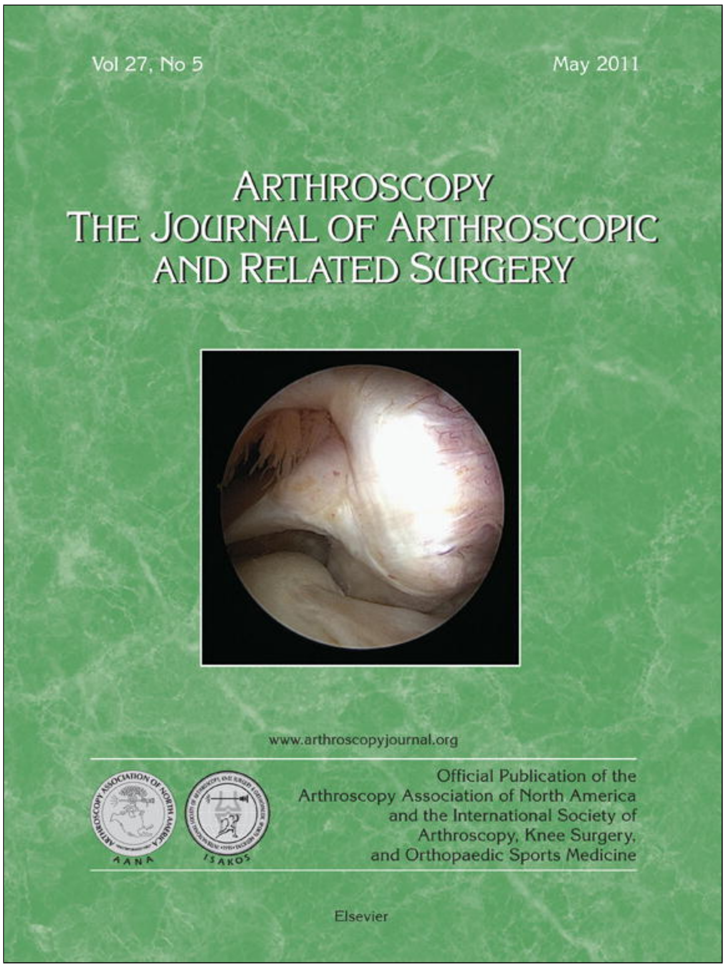
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Technical Note With Video Illustration

All-Inside Anterior Cruciate Ligament Graft-Link Technique: Second-Generation, No-Incision Anterior Cruciate Ligament Reconstruction

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Abstract: We describe an anatomic, single-bundle, all-inside anterior cruciate ligament (ACL) graft-link technique using second-generation Flipcutter guide pins (Arthrex, Naples, FL), which become retrograde drills, and second-generation cortical suspensory fixation devices with adjustable graft loop length: femoral TightRope (Arthrex) and tibial ACL TightRope–Reverse Tension (Arthrex). The technique is minimally invasive using only four 4-mm stab incisions. Graft choice is no-incision allograft or gracilis-sparing, posteriorly harvested semitendinosus material. The graft is sutured 4 times through each strand in a loop and linked, like a chain, to femoral and tibial adjustable TightRope graft loops. With this method, graft tension can be increased even after graft fixation. The technique may be modified for double-bundle ACL reconstruction.

There is an old orthopaedic adage: "The techniques that I use in the operating room now are different from the techniques I learned during my training." When it comes to modern anterior cruciate ligament (ACL) surgery, it seems that the techniques we use in the operating room in 2011 may be different from the techniques we used only 5 years ago. Five years ago, in 2006, all-inside ACL reconstruction by use of the no-incision technique was described, with transtibial drilling of the ACL femoral socket.[1] Unfortunately, the transtibial technique for creating the ACL femoral socket is known to be a risk factor for anatomically mismatched posterior tibial tunnel placement and high anteromedial (AM) femoral tunnel placement.[2-6] Thus, over the last 5 years, some surgeons made the transition to the AM portal technique for creating the ACL femoral tunnel,[3,5,7-16] yet this technique is associated with potential pitfalls.[3,7,8,11-14,17,18] Therefore, in 2011, although the AM portal technique is anatomic, we recommend, as an alternative, creating the ACL femoral socket using an outside-in technique.[2,4,13,19-22]

Historically, the outside-in technique for creating the ACL femoral socket fell out of favor because the requirement for a lateral-distal femoral muscle-splitting dissection results in a more invasive "2-incision" technique.[2,4,19,22] However, new technology, specifically narrow-diameter guide pins that may be transformed into retrograde drills,[13,20] allows "no-incision" outside-in techniques for creating the ACL femoral socket. Advantages of the outside-in technique for creating the ACL femoral socket are that it is performed in the comfortable

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and familiar position of 90° of knee flexion (unlike the AM portal technique, which requires knee hyperflexion); it is unconstrained, allowing independent anatomic positioning of the femoral socket (unlike the transtibial technique for drilling the femoral socket); and it may result in a longer socket (compared with the AM portal technique).[13] In addition, outside-in drilling allows measurement of the femoral interosseous distance before socket creation, by use of standard outside-in femoral guides and guide pin sleeves. Pre-measurement is a safety feature of the outside-in technique because a short distance may require that less graft tissue be contained within the femoral socket.[23]

In addition to retrograde-drilling pins, 2 additional technical developments simplify all-inside ACL reconstruction. The first represents an evolution of cortical suspensory fixation button devices. First-generation cortical suspensory fixation buttons have fixed-length graft loops, whereas second-generation buttons have graft loops that are adjustable in length, such that after the button flips and becomes fixed on the cortex, the graft loop may be tightened, pulling the graft into the socket in a manner that completely fills the socket with graft substance. Furthermore, first-generation cortical suspensory fixation buttons were designed for femoral fixation, whereas second-generation adjustable–graft loop buttons are effective for tibial (as well as femoral) fixation. Finally, second-generation adjustable–graft loop buttons are unique in that when the graft loop is tightened, graft tension increases. Thus, for the first time, ACL surgeons may increase graft tension after the graft is fixed.

The second technical development that simplifies all-inside ACL reconstruction is the use of cannulas. Arthroscopic shoulder and hip surgeons have long understood the importance of cannulas for maintaining portals and preventing soft tissue from becoming intertwined in sutures. First, we recommend the use of a cannula in the AM arthroscopic instrumentation portal to prevent soft-tissue interposition. Second, we introduce a unique guide pin sleeve that transforms into a cannula and maintains access to the narrow-diameter guide pin tracks used to create all-inside sockets, allowing suture passage and, later, graft passage after ACL socket retroconstruction.

SURGICAL TECHNIQUE

No-tunnel, all-inside ACL reconstruction by use of graft link requires learning new graft preparation, socket creation, and graft fixation techniques. Graft preparation requires consideration of no-incision cosmesis when selecting graft source, ensuring that graft length is less than the sum of socket lengths plus intra-articular graft distance so that the graft will not bottom out in the sockets during final graft tensioning, and learning the graft-link preparation technique. Femoral and tibial socket creation is performed with second-generation retrograde-drilling guide pins. Femoral and tibial fixation is established with second-generation cortical suspensory fixation devices with pull sutures tensioning an adjustable graft loop. Video 1 (available at www.arthroscopyjournal.org) shows our preferred technique.

SPECIAL EQUIPMENT

Graft-Preparation Station and High-Strength Suture

High-strength sutures (FiberWire; Arthrex, Naples, FL) secure the graft in a loop.

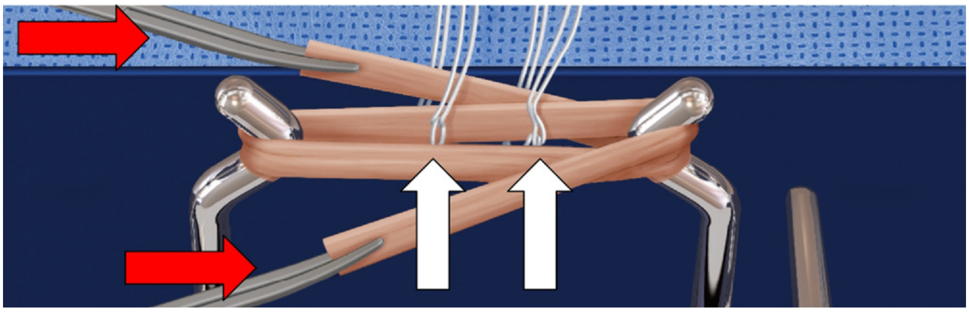

FIGURE 1. The graft is loaded in linkage with ACL femoral and tibial TightRopes (white arrows). Graft free ends are held by hemostats (red arrows) and then wrapped around hooks (silver) of graft-preparation station set to graft length (before tensioning) of approximately 60 mm.

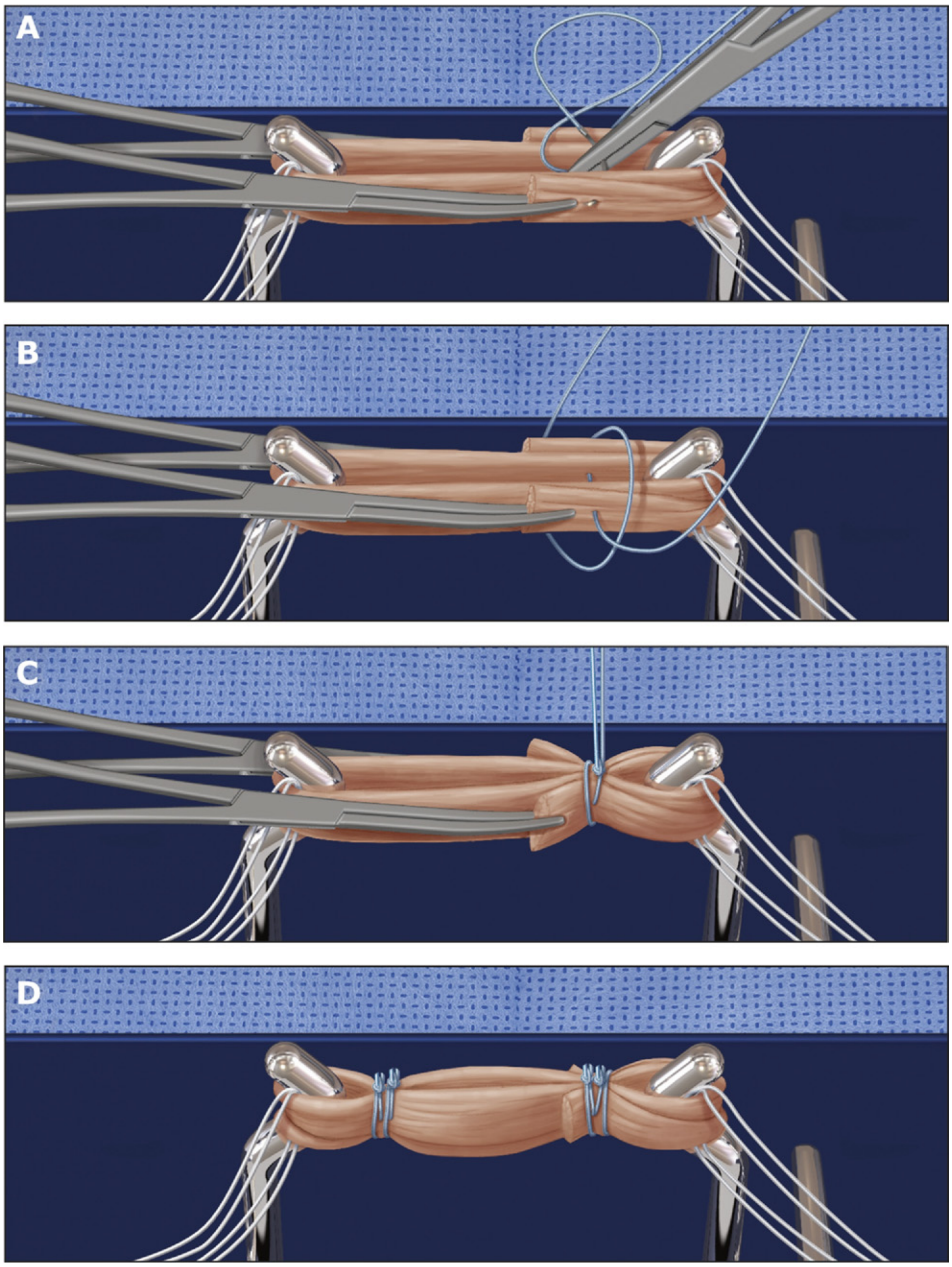

Figure 2. Graft-link suture technique. (A) The graft is loaded in linkage with ACL femoral and tibial TightRopes (white suture loops at far left and far right of graft loop). Graft free ends are held by hemostats and wrapped around hooks (silver) of graft-preparation station. High-strength suture (No. 2) is passed through the center of each strand of the looped graft. (B) Suture-free ends are crossed and wrapped around the graft. (C) The first wrapped suture is tied in a wrapped cinch. (D) A second suture is tied in a similar manner immediately next to the first suture (both shown tied and cut). Two additional sutures are placed, cinching the other side of the graft (far left). The final construct shown is a graft linked with ACL femoral TightRope on the left and ACL tibial TR-RT on the right.

The loop is sewn in linkage with an ACL femoral TightRope adjustable graft loop (Arthrex) and an ACL tibial reverse TightRope adjustable graft loop (Arthrex) (Figs 1 and 2).

A graft-preparation station facilitates suturing the graft at a specific length (approximately 60 mm). After suturing, pre-tensioning of the graft construct results in an ultimate graft length of approximately 75 mm (Fig 3).

Flipcutter

The Flipcutter (Arthrex) is a second-generation retrograde drill. The Flipcutter guide pin becomes a retrograde drill by flipping a switch on the pin handle. Then, after socket creation with clockwise drilling and retrograde pressure, the Flipcutter retrograde drill is switched back into a guide pin and removed.

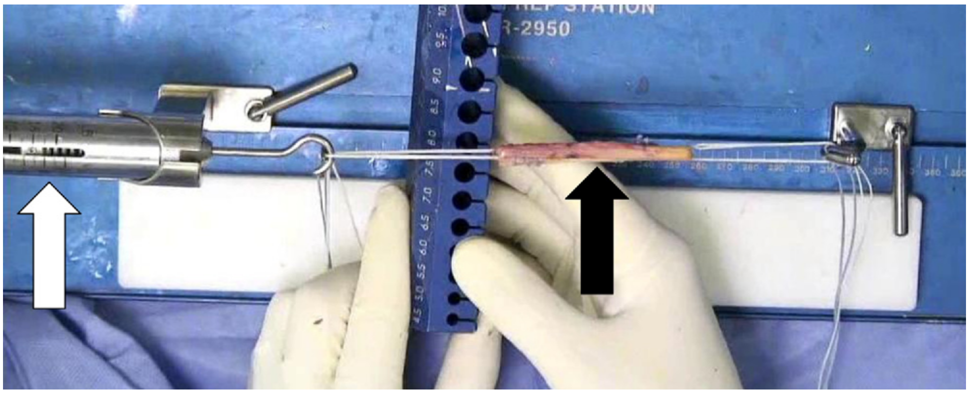

FIGURE 3. The final construct is attached to a spring-loaded tensioning device (white arrow). The tension is set to approximately 40 N. The typical ultimate graft length (black arrow) is 75 mm after tensioning. The construct shown is a graft linked with an ACL femoral TightRope on the hook of the tensioning device (left) and with an ACL tibial TR-RT on the fixed hook of the graft-preparation station (right). The surgeon holds the graft diameter sizing block, measuring 0.5-mm sizing increments.

The Flipcutter measures 3.5 mm in diameter, allowing femoral (Figs 4 and 5) and tibial (Figs 6 and 7) socket creation through portal-sized "stab incisions," a cosmetic all-inside technique.

Flipcutter Guide Pin Sleeve

The Flipcutter guide pin is drilled through a unique graduated-tip guide pin sleeve. The tip of the drill sleeve is "stepped" with a 7-mm-long narrow tip. The tip of the cannula is tapped into the distal-lateral femoral cortex over the Flipcutter and, subsequently, into the proximal AM tibial metaphysis. When the tip is advanced to the 7-mm mark, it reaches palpable resistance to further tip advancement. In addition, laser marks on the guide pin sleeve allow observation

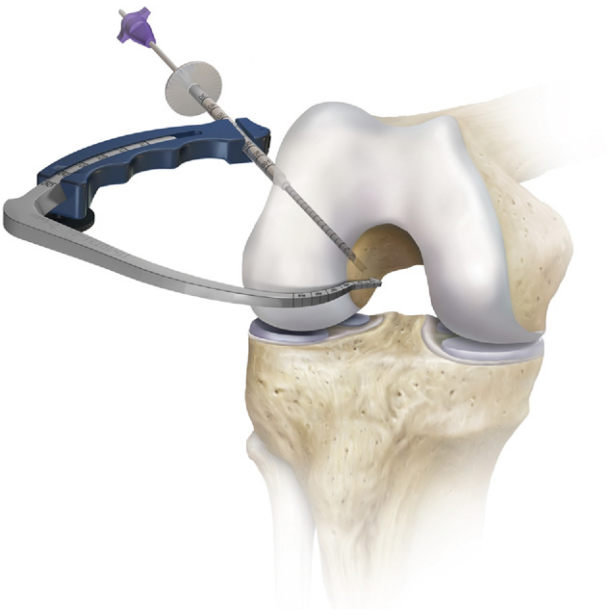

FIGURE 4. Second-generation retrograde drill (Flipcutter) and ACL femoral guide with marking hook in a right knee. The guide is shown in the anterolateral portal position. It should be noted that the guide pin sleeve has a 7-mm step-off tip, which is impacted over the pin into the bony cortex. Flipping a switch on the handle (top) of the Flipcutter will change the guide pin into a retrograde drill.

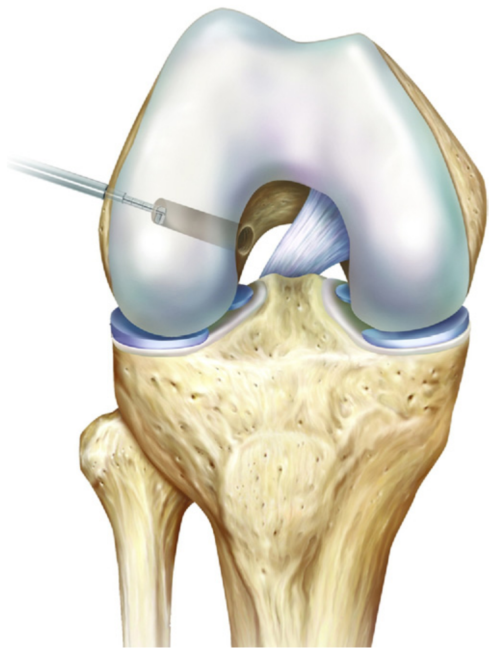

FIGURE 5. Second-generation retrograde drill (Flipcutter) creates ACL femoral socket in a right knee. It should be noted that the guide pin sleeve has a 7-mm step-off tip impacted over the pin into the bony cortex. Once socket creation is complete, flipping a switch on the handle of the Flipcutter will change the retrograde drill back into a guide pin.

of the 7-mm tap-in distance. The 7-mm sleeve protects and preserves a 7-mm cortical bridge (resulting in sockets, not full tunnels, at both the femoral and tibial graft sites), because during the retrograde socket formation, the Flipcutter is withdrawn until it stops at the tip of the metal guide pin sleeve. Cortical preservation is required for cortical suspensory fixation by use of a second-generation adjustable graft loop (Figs 4-7).

After the Flipcutter is removed, the sleeve is left in place, facilitating simple and reproducible passage of graft-passing sutures for later graft passage, because the sleeve also serves as a cannula (Fig 8).

Passport Cannula

The use of a flexible silicone cannula (Passport; Arthrex) in the AM arthroscopic portal facilitates all-inside ACL reconstruction by preventing soft-tissue interposition. Inner and outer flanges with dams maintain cannula position and minimize fluid leakage from the larger-than-usual portal required for all-inside ACL graft passage, where the graft is passed through the AM portal (Fig 9).

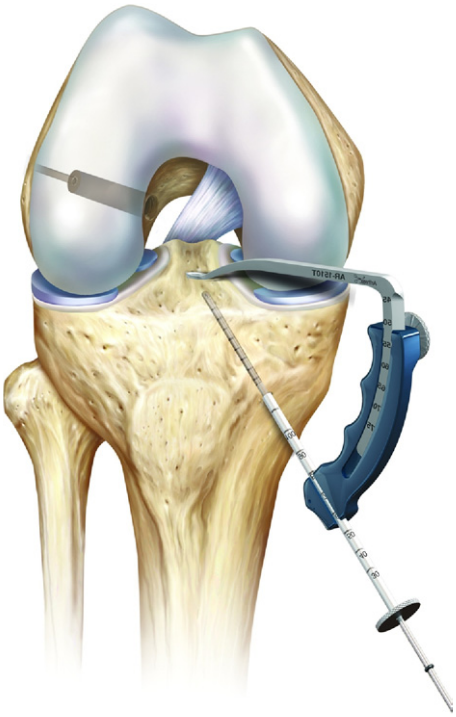

FIGURE 6. Second-generation retrograde drill (Flipcutter) and ACL tibial guide with marking hook in a right knee. The guide is shown in the AM portal position. A cannulated guide pin sleeve with a 7-mm step-off tip is impacted over the pin into the bony cortex. Once socket creation is complete, flipping a switch on the handle of the Flipcutter will change the guide pin into a retrograde drill.

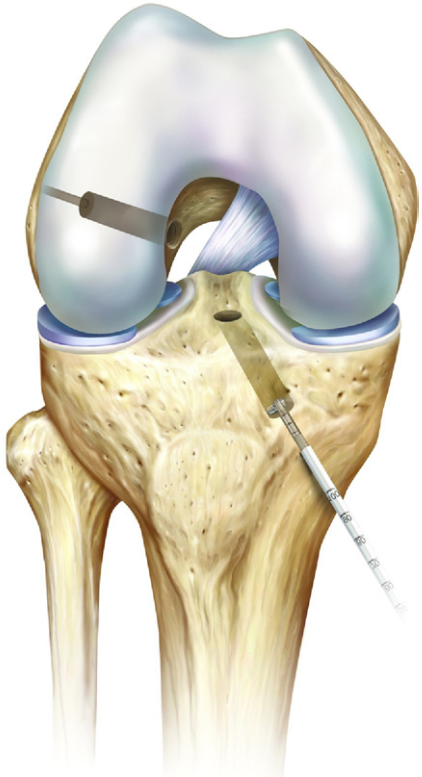

FIGURE 7. Second-generation retrograde drill (Flipcutter) creates ACL tibial socket in a right knee. It should be noted that that the guide pin sleeve has a 7-mm step-off tip impacted over the pin into the bony cortex. Once socket creation is complete, flipping a switch on the handle of the Flipcutter will change the retrograde drill back into a guide pin.

FIGURE 8. The femoral socket has been drilled in a retrograde manner in a right knee, and the Flipcutter has been removed. It should be noted that the Flipcutter guide pin sleeve has been impacted into the femoral cortex and is held in place (surgeon's gloved hand). FiberStick suture is loaded into the cannula (left). The FiberStick is passed into the joint and retrieved through the AM arthroscopic portal. The femoral graft–passing FiberStick is docked and then later retrieved for final ACL femoral graft passage.

FIGURE 9. A flexible silicone cannula (Passport, blue) in the AM arthroscopic portal prevents soft-tissue interposition in a right knee. Inner (not visible) and outer (shown) flanges with dams maintain cannula position and minimize fluid leakage from the larger-than-usual portal required for all-inside ACL graft passage through the AM portal. The arthroscope (silver) is in the anterolateral portal.

Femoral Fixation With ACL TightRope

ACL TightRope is a second-generation adjustable–graft loop suspensory fixation device. The adjustable graft loop has a 4-point, knotless locking mechanism relying on multiple points of friction to create self-reinforcing resistance to slippage under tensioning.

The adjustable graft loop decreases in size under tensioning of the free ends, or "pull sutures." The pull sutures tension the graft into the sockets. Because the TightRope loop is adjustable, "one size fits all," thus reducing inventory and eliminating first-generation calculations required for selecting loop length.

The second-generation adjustable–loop length technique allows optimal potential for graft-to-socket healing, because graft collagen is pulled fully into the socket as the graft loop is tightened.

ACL TightRope–Reverse Tension

ACL TightRope–Reverse Tension (TR-RT) is a second-generation adjustable–graft loop suspensory fixation device. The tibial TightRope is identical to the femoral TightRope with the exception of reversed pull sutures. After the tibial TightRope is reverse tensioned by use of the respective free ends of the pull sutures, the free ends can be tied over the tibial button with an arthroscopic knot–pushing device for backup fixation and protection of the implant when the pull sutures are cut. Figure 10 shows the ACL TightRope and ACL TR-RT devices.

Graft Length

An all-inside technique results in sockets, not full bone tunnels. Therefore, to tension the graft, it must not bottom out in the sockets. Thus one thing that has not changed in the last 5 years is the principal that graft length must be less than the sum of femoral socket length plus intra-articular graft distance plus tibial socket length.[1] This prevents bottoming out of the graft in the sockets, preventing graft tensioning. A graft length of no more than 75 mm, after tensioning, is a general guideline, and this distance is adjusted according to patient size (Fig 3).

Graft Selection

Single Semitendinosus: For autograft, we recommend the posterior hamstring harvest technique.[24] The technique is cosmetic, in keeping with a no-incision philosophy. We recommend sparing of the gracilis, because by using graft lengths as stated previously, the graft length generally may be tripled (or even quadrupled). In cases where the semitendinosus is short or of inadequate diameter when tripled (less than approximately 75 mm), the gracilis can be secondarily harvested.

Allograft: Indications for allograft continue to evolve; for proper indications, soft-tissue allograft may also be prepared for graft link as a cosmetic, "no-incision" graft choice with no harvest-site morbidity.

Graft Preparation

Graft selection and graft length determination are performed as described previously. The 2 posts of an ACL graft preparation stand are positioned so that the graft length equals the pre-tensioning graft length when the graft is tripled (or quadrupled) in loops around the posts and clamped. The posts should be set at a length of 60 mm (Figs 1 and 2), for an ultimate graft length of 75 mm after pre-tensioning (Fig 3).

The graft is stitched into loops by use of a traditional strand of No. 2 high-strength suture (Fig 2). Two sutures are placed on the tibial side of the graft and two on the femoral side. Each stitch must pass

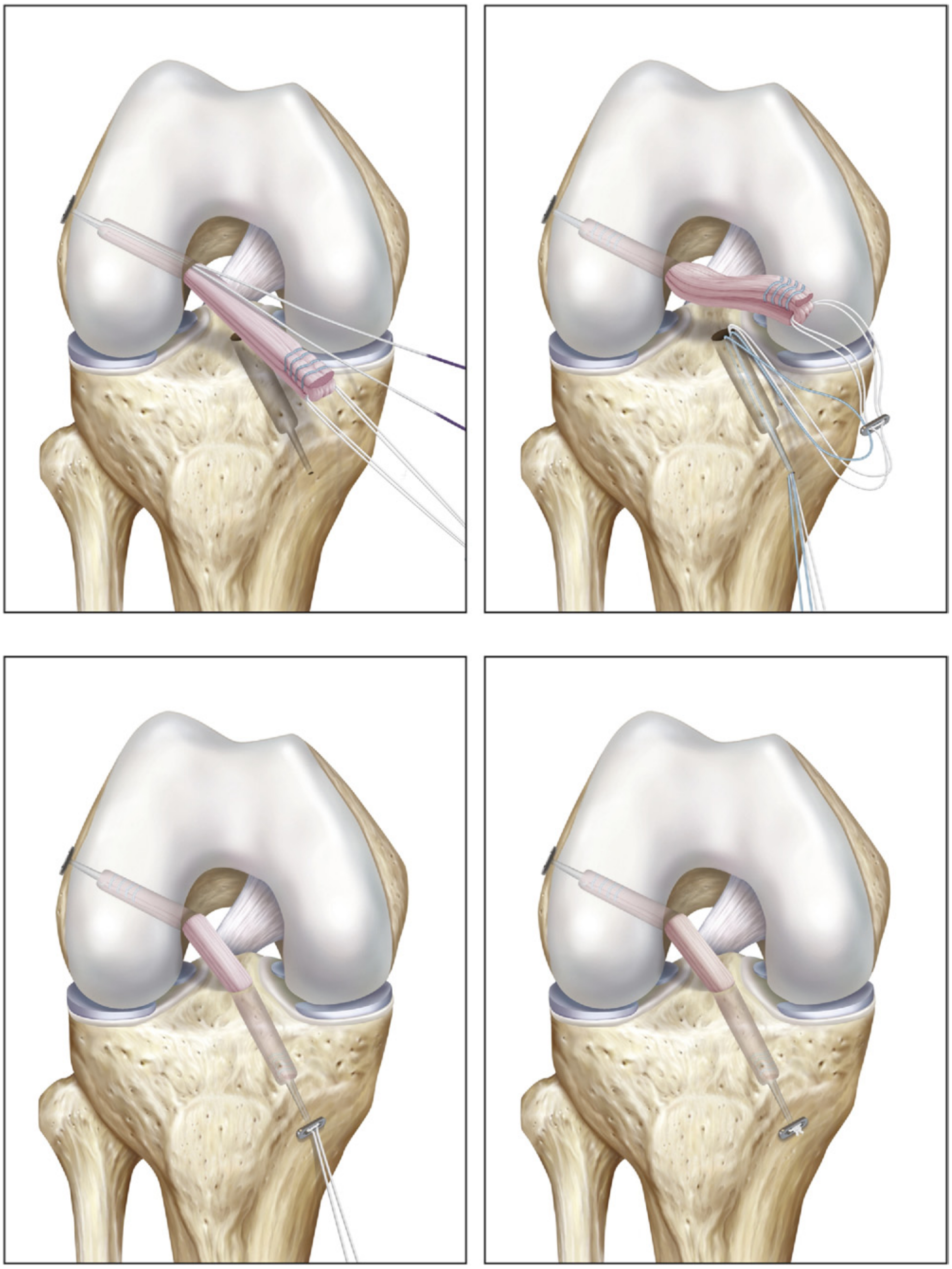

Figure 10. ACL TightRope and ACL TR-RT in a right knee. In all 4 illustrations, the lateral femoral cortical suspensory button is flipped. In the upper left drawing, graft is shown entering the joint through the AM portal. The tibial side of the graft loop is shown linked to ACL TR-RT (right) (white sutures). Emerging superior to the graft from the femoral socket are the ACL femoral TightRope pull sutures (white with dark-blue ends). The pull sutures remove the slack from the TightRope's adjustable graft loop, fully seating the graft in the femoral socket. In the upper right drawing, graft is shown entering the joint through the AM portal. Tibial ACL TR-RT passing sutures and pull sutures are passed into the tibial socket. As shown in the lower left drawing, emerging from the proximal AM tibial metaphysis (bottom right) are the ACL TR-RT pull sutures (white). The pull sutures have removed the slack from the ACL TR-RT's adjustable graft loop, tensioning the graft in the tibial socket over the cortical button (silver), which is shown flipped on the metaphysis. The lower right drawing shows an all-inside, graft-link, double-TightRope ACL reconstruction technique. The tibial ACL TR-RT pull sutures have been tied and cut.

through each strand of graft collagen, and the suture limbs are crossed and wrapped around the collagen bundles, creating a self-reinforcing suture noose when tied.

Graft Linkage

However, before the graft loop is clamped and sewn, it must be loaded, creating links like a chain (Fig 1). We create a graft-link construct, similar to the links in a chain, where a femoral ACL TightRope and tibial ACL TR-RT are linked within each end of the loop (Figs 1-3).

Socket Diameter

Socket diameter should be a snug fit to ensure graft biological incorporation. However, if the graft is too large, the graft could become stuck at the socket orifices after the button is flipped, and this represents an intraoperative problem. Bailout solutions include use of tunnel dilators or curettes to enlarge the tunnel or, if the adjustable loop is visible, cutting the loop arthroscopically, which allows the button to be pulled out of the thigh with passing sutures; as a last resort, open button removal can be performed by extending the distal-lateral femoral stab incision. If the button is removed, the graft can be retrieved and trimmed or the socket can be re-drilled to a larger size, but prevention is clearly recommended. Therefore one should not undersize the socket diameter. A socket diameter sizing block with 0.5-mm sizing increments is shown in Fig 3.

Femoral Socket Creation

Soft-tissue notchplasty is performed. We perform minimal bony notchplasty, and we generally perform notchplasty only of the notch orifice if stenosis is present.

It is essential to precisely identify the anatomic ACL footprint centrum on both the femoral and tibial sides.[2-6,9-13,22,25-32] We use radiofrequency through the AM instrumentation portal to mark the ACL footprint centrum and observe the marks through both portals.

We then switch the arthroscope to the AM portal. AM portal viewing provides an improved perspective for analyzing the ACL femoral footprint anatomy. We assess and adjust our mark to ensure precise identification of the center of the footprint.

Then, the Flipcutter ACL femoral marking hook is locked in the Flipcutter guide ring at an angle of approximately 100° to 110°. The Flipcutter guide pin sleeve is advanced to the level of the skin at a point approximately 1 cm anterior to the posterior border of the iliotibial band and 2.5 cm proximal to the lateral femoral condyle. A stab incision is made through the skin and iliotibial band, and the cannulated guide pin sleeve for the Flipcutter is pushed hard to bone by use of a blunt trocar. A laser mark indicates the femoral intraosseous distance. The guide is adjusted to optimize the interosseous distance (a 32-mm distance results in a 25-mm femoral socket with a 7-mm cortical bone bridge). The Flipcutter is advanced with forward drilling into the knee. The Flipcutter handle is loosened, and a handle switch flips the guide pin tip into the retrograde drilling position.

Next, the Flipcutter cannulated guide pin sleeve with the graduated 7-mm stepped tip is tapped with a mallet and advanced until resistance is felt, when the step hits the distal-lateral femoral cortex, and the laser mark indicates 7 mm.

The guide pin sleeve is firmly held in place at the proper angle and not removed until femoral preparation is complete.

With continued forward drilling but with retrograde force, the femoral socket is drilled in a retrograde manner until the drill blade stops advancing when it contacts the guide pin sleeve tip. The Flipcutter is pushed back into the knee, flipped back into guide pin mode, and removed. The cannulated guide pin sleeve is not removed.

A FiberStick (Arthrex) is advanced through the cannulated guide pin sleeve, the arthroscope is placed back in the anterolateral portal, the FiberStick is retrieved through the AM portal, and the femoral graft–passing FiberStick is docked with a small clamp during tibial surgery (alternatively, the FiberStick may be docked through the AL portal). This femoral graft–passing suture is later undocked for graft passage, after the tibia is prepared. Femoral socket creation is illustrated in Figs 4, 5, and 8.

Tibial Socket Creation

With the arthroscope in the anterolateral portal, the Flipcutter ACL tibial marking hook is locked on the Flipcutter guide ring at an angle of approximately 55° to 60°. Guide position and angle are optimized to maximize tibial interosseous distance so that the graft will not bottom out during tensioning. A distance of at least 37 mm will result in a 30-mm socket depth with a 7-mm cortical bone bridge. Distance may be read before drilling by use of laser marks on the Flipcutter guide pin sleeve. As a preventative measure, if the distance is short, the guide should be readjusted before drilling.

Tibial socket creation is completed with the Flipcutter following the steps described in the "Femoral Socket Creation" section. Tibial socket creation is illustrated in Figs 6 and 7.

Marking the Graft

The first distance that should be measured and marked on the graft-link construct is the femoral interosseous distance. This distance should be marked on the adjustable graft loop, measuring from the tip of the cortical suspensory button, while the surgeon holds the button in a "pre-flipped" position. During graft passage, when the mark on the adjustable graft loop reaches the femoral socket orifice, this indicates to the surgeon that the button is in position to flip.

The second distance that should be measured and marked on the graft-link construct is the length of

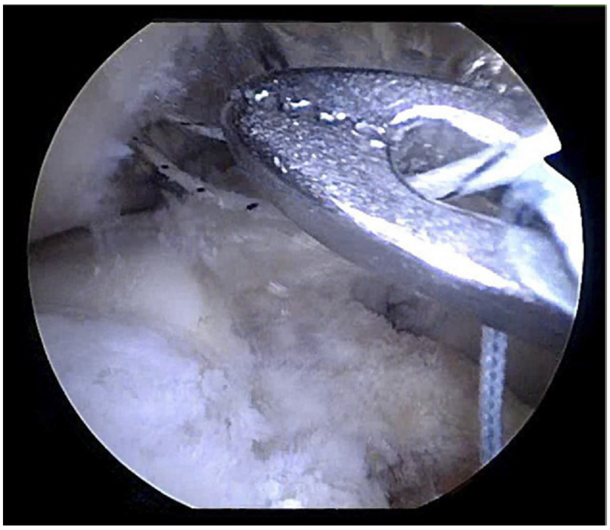

Figure 11. Arthroscopic view from anterolateral portal in a right knee shows open-loop suture retriever (CrabClaw, silver) grasping tibial FiberStick graft–passing suture loop (blue) and femoral graft–passing suture loop (white with dark stripe [Tigerwire]). The technical pearl is that the surgeon must retrieve the femoral and tibial graft–passing sutures from the AM arthroscopic portal at the same time, as shown, to avoid soft-tissue interposition during subsequent graft passage. Next, the open-loop suture retriever "runs" the length of the femoral and tibial graft–passing sutures, independently, from intra-articular to extra-articular. This doubly ensures that the sutures are not tangled.

collagen within the femoral socket. The goal is to maximize collagen in the socket but ensure that the graft is not bottoming out during tensioning. A typical amount of collagen in the femoral socket is 25 mm. This distance is marked on the graft itself, measuring from the femoral graft end. During graft passage, when the mark on the graft itself reaches the femoral socket orifice, this indicates to the surgeon that femoral graft tensioning is complete. This is repeated for the tibial side of the graft.

Graft Passage

A cannula (Passport; Arthrex) (Fig 9) prevents soft-tissue interposition and is essential because the graft is passed through the AM arthroscopic portal. Femoral and tibial graft–passing sutures are retrieved. A technical pearl is to retrieve the femoral and tibial graft–passing sutures from the AM arthroscopic portal at the same time, to avoid suture tangling or soft-tissue interposition. To further ensure that the sutures are not tangled, a sliding, open-loop suture retriever (CrabClaw; Arthrex) then "runs" the length of the femoral and tibial sutures, independently, from intra-articular to extra-articular through the cannula (Fig 11). Once the sutures are absolutely not tangled, we shuttle femoral TightRope sutures through the AM portal, pass the graft through the AM portal, and fix the graft on the femoral side and then shuttle the tibial sutures and fix the graft on the tibial side (Fig 10).

Grafts up to 9.5 mm in diameter can be passed through the AM portal through a 10-mm-diameter Passport cannula. For larger-diameter grafts, the cannula should be removed before graft passage.

Graft Fixation

First, we flip; then, we fill.

We first shuttle the femoral graft–passing suture through the distal-lateral femoral stab incision and pull the femoral adjustable graft loop into the femoral socket through the AM portal until the mark on the graft loop reaches the socket orifice under direct arthroscopic visualization, indicating that the button has exited the femoral cortex proximally and is ready to flip.

Once the button flips, we pull hard on the graft to ensure solid femoral fixation. We next apply tension back and forth on each free end of the femoral pull suture, tensioning the graft up into the socket until the graft reaches the socket orifice.

An advanced technique is to partially seat the femoral side of the graft and then pass the tibial side so that graft depth in the sockets can be "fine-tuned" during tensioning.

The flip-then-fill technique is repeated on the tibial side. It should be remembered that the tibial ACL TR-RT pull-suture free ends are tied over the tibial button at the end of the case. The steps are illustrated in Fig 10.

Graft Tensioning

The femoral and tibial pull sutures tension the graft so long as the graft is prepared properly to prevent bottoming out. An overly long graft will bottom out on the socket floor and is not acceptable.

The knee is moved through its range of motion, and additional tension may be applied by pulling the femoral or tibial pull sutures by hand or using a tensioning device on the tibial side. A reverse Lachman maneuver is performed as tensioning is applied.

Cosmesis

The two 4-mm arthroscopic portals and the two 4-mm Flipcutter stab incisions are closed with No. 3-0 nylon. If autograft is used, the posterior hamstring harvest incision is 1 cm in length and hidden on the posterior aspect of the knee, and it is closed with multiple, interrupted, vertical mattress No. 3-0 nylon.

Rehabilitation

Rehabilitation is the same as standard ACL rehabilitation with any other technique.

SINGLE BUNDLE VERSUS DOUBLE BUNDLE

The all-inside ACL graft-link technique is versatile. The technique described in this report is for anatomic single-bundle ACL reconstruction and can be modified for double-bundle reconstruction. We hypothesize that fixation using 4 buttons may be simpler than a first-generation all-inside times two double-bundle ACL (AI x 2) reconstruction technique using cannulated interference screws.[16] In addition, the all-inside technique is bone sparing and the 4-button graft-link technique even more so; thus graft link may be an optimal, simple, and reproducible ACL double-bundle technique modification as a result of the advantages described previously.

FUTURE MODIFICATIONS

The technique, as described above, has been performed by each of the authors with excellent knee stability and return to sport at a follow-up of greater than 8 months. In addition, as suggested in the introduction, technology and techniques continue to evolve. Surgical and technical modifications in development include a buried-knot technique for graft preparation, use of the ACL TR-RT for femoral fixation and tensioning, and use of a buttonless TightRope for tibial graft passage where a separate and larger tibial button is attached after the TightRope is passed.

In summary, we have described an anatomic, single-bundle, all-inside ACL graft-link technique using second-generation Flipcutter guide pins, which become retrograde drills, and second-generation ACL cortical suspensory fixation devices with adjustable graft loop length (femoral TightRope and tibial ACL TR-RT). The technique is minimally invasive, using only four 4-mm stab incisions. Graft choice is no-incision allograft or gracilis-sparing, posteriorly harvested semitendinosus tendon. The graft is linked to femoral and tibial adjustable TightRope graft loops and sutured 4 times through each strand with a wrapped stitch to an ultimate graft length of 75 mm after pre-tensioning. The technique may be modified for double-bundle ACL reconstruction.

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