Technical Note

Single AnteroMedial Bundle Biological Augmentation: SAMBBA Plus Technique for Combined ACL Repair and Reconstruction

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Abstract: This technical note presents the single—anteromedial bundle biological augmentation (SAMBBA)—plus technique, which is a combined anterior cruciate ligament (ACL) repair and ACL reconstruction. Preservation of the native ACL fibers improves vascularity by encircling the ACL graft with synovium that is abundant in vascular-derived stem cells. Retaining the proprioceptive fibers of the native ACL can improve the recovery of joint positioning.

Preservation of the anterior cruciate ligament (ACL) remnant at the time of ACL reconstruction (ACLR) offers several advantages including better graft vascularization, preservation of proprioceptive nerve fibers, and potentially reduced rates of graft rerupture.[1-4] Although preservation of the ACL remnant offers several potential advantages, it is not a technique that is widely adopted around the world and the remnant is often debrided to improve visualization.

Nonetheless, the single—anteromedial bundle biological augmentation (SAMBBA) technique has been described, which completely preserves the ACL remnant and maintains the tibial attachment of the hamstring autograft to prevent avascular necrosis. This technique positions the graft within the ACL stump, thereby providing excellent circular synovial coverage with abundant vascular-derived stem cells that may contribute to ligament regeneration and repair.[5]

Indeed, there has been a renewed interest in primary repair of the ACL in recent years as a result of improvements in arthroscopic instrumentation and rehabilitation protocols, in addition to an enhanced understanding of ACL healing. Several techniques have been described with an improvement in outcomes when compared with the historical literature.[6-9]

Surgical Technique

This technical note presents the SAMBBA-plus technique, which is a combined ACL repair and ACLR (Video 1). Pearls and pitfalls of this procedure are described in Table 1, and advantages and disadvantages are listed in Table 2.

Patient Positioning and Landmarks

The patient is placed in the supine position on the operating table with a lateral support at the level of a padded tourniquet and a foot roll positioned to maintain 90° of knee flexion. The injured leg is prepared and draped with the surgeon's preferred method, similar to any arthroscopic procedure around the knee. Appropriate landmarks are palpated and marked.

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Table 1. Pearls and Pitfalls

Pearls
Minimal debridement of the proximal notch is required until visualization is achieved. This is facilitated by the use of outside-in drilling.
A tibial guide that is ring shaped should be used to aid emergence of the guide pin inside the remnant.
When reaming the tibial tunnel, the surgeon should ensure that the tip of the reamer has passed the intra-articular surface by visualizing the samba dancing effect.
Pitfalls
The surgeon should use sequential reamers to avoid damaging the remnant when reaming the tibial tunnel.
The surgeon must ensure that overstuffing of the notch is avoided because this will lead to impingement.

Graft Harvest and Diagnostic Arthroscopy

The semitendinosus tendon is harvested with an open-ended tendon stripper using the surgeon's preferred method, and a quadrupled semitendinosus graft is created. The tibial insertion is preserved to improve fixation and vascularity.[10] The graft is then wrapped in vancomycin-soaked swabs to reduce the risk of septic arthritis.[11]

High anterolateral and anteromedial portals are established. A diagnostic arthroscopy is performed, and the ACL is probed to assess its suitability for the SAMBBA-plus technique. Indications for this technique are proximal ruptures of the ACL with enough remnant for reattachment to the femoral footprint, equating to type I and II tears in the modified Sherman classification.[12] Meniscal and cartilage lesions are then addressed before the combined ACL repair and reconstruction (Fig 1).

Femoral Tunnel

A femoral outside-in ACL guide (Arthrex, Naples, FL) is inserted into the knee via the anteromedial portal and positioned over the femoral origin of the ACL at a mid–anteromedial bundle position. A guidewire is introduced, followed by a 6-mm reamer to allow any adjustments when the appropriately sized reamer (based on graft size) is used (Fig 2).

Table 2. Advantages and Disadvantages

Advantages
The graft is positioned within the remnant, providing circular synovial coverage with blood vessels, neural elements, and fibroblasts to improve ligament regeneration and repair.
Preservation of the native mechanoreceptors occurs, leading to improved proprioception.
The technique is reproducible with other drilling and fixation techniques.
Disadvantages
The technique is technically more difficult than standard ACLR techniques because of the reduced visualization of the notch.
The technique is only suitable for proximal ACL tears with enough remnant to reattach to the femoral footprint.

ACL, anterior cruciate ligament; ACLR, anterior cruciate ligament reconstruction.

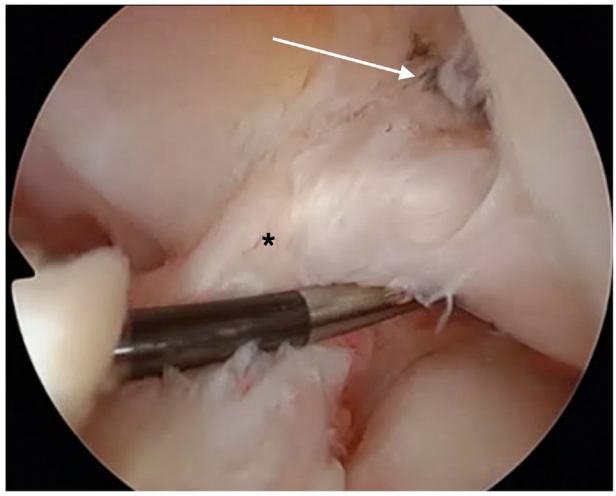

Fig 1. Diagnostic arthroscopy. Arthroscopic view of left knee. The anterior cruciate ligament (ACL) is probed to assess its suitability for ACL repair. A proximal rupture (arrow) is observed with enough remnant (asterisk) for reattachment to the femoral footprint.

Tibial Tunnel

A tibial ACL guide (Arthrex) is set at 65° to be placed just above the hamstring insertion and then introduced into the knee via the anteromedial portal. It is positioned over the ACL footprint so that the guidewire is inserted within the center of the ACL remnant. A 6-mm reamer is initially used to allow any adjustments with the appropriately sized reamer based on graft size. The reamers remain within the ACL remnant to preserve all residual tissue. A shaver is then passed through the tibial tunnel, emerging from the proximal aspect of the remnant, creating a channel for easy graft passage (Fig 3).

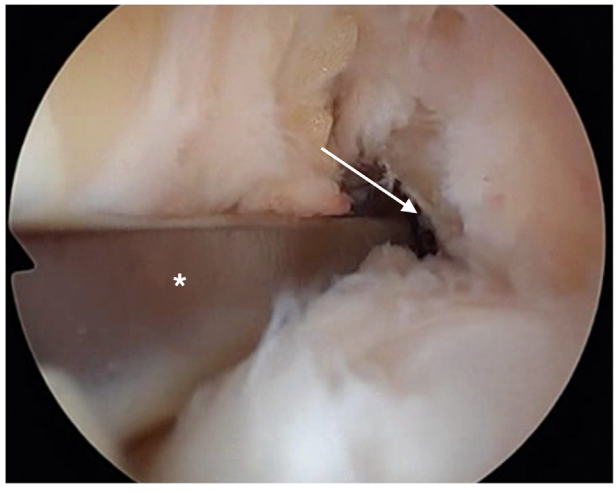

Fig 2. Femoral tunnel. Arthroscopic view of left knee. The femoral guide (asterisk) is positioned at the femoral origin (arrow) of the anterior cruciate ligament.

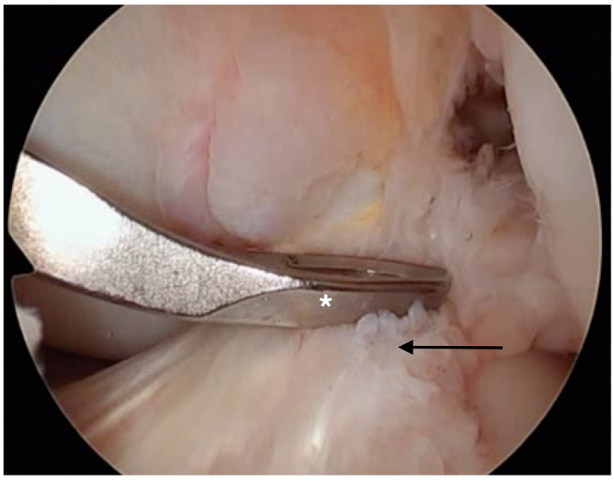

Fig 3. Tibial tunnel. Arthroscopic view of left knee. The tibial guide (asterisk) is positioned over the anterior cruciate ligament footprint (arrow), and a guidewire is inserted.

Preparation for ACL Repair

A 25° suture passer (QuickPass SutureLasso; Arthrex) loaded with a No. 0 monofilament suture (polydioxanone [PDS]; Ethicon, Somerville, NJ) is positioned around the ACL remnant. A suture grasper is then inserted through the anterolateral portal and placed through the suture loop to grasp the other end of the suture and create a knot. A No. 2 passing suture (Polysorb; Covidien, Mansfield, MA) is inserted through the femoral tunnel and taken through the tibial tunnel via the channel created within the ACL remnant. An additional No. 2 suture (Polysorb) is then inserted through the femoral tunnel prior to passage of the ACL graft to facilitate the ACL repair (Fig 4).

ACL Graft Passage and ACL Repair

The graft is shuttled from the tibial tunnel through the channel created in the ACL remnant and then through the femoral tunnel using the passing suture. The monofilament suture around the ACL remnant is subsequently passed through the loop created by the additional passing suture and pulled through the femoral tunnel (Fig 5).

A nitinol guidewire is inserted into the tibial tunnel; then, with tension applied to the graft and monofilament suture where they exit the femoral tunnel, an interference screw (Biocomposite; Arthrex) is inserted into the tibial tunnel. A nitinol guidewire is subsequently inserted into the femoral tunnel, and an interference screw is inserted with the knee at 30° of flexion while tension is applied to the graft and monofilament suture.

Postoperative Rehabilitation

Postoperative rehabilitation consists of brace-free, immediate full weight bearing and progressive range-of-motion exercises, with restriction of range

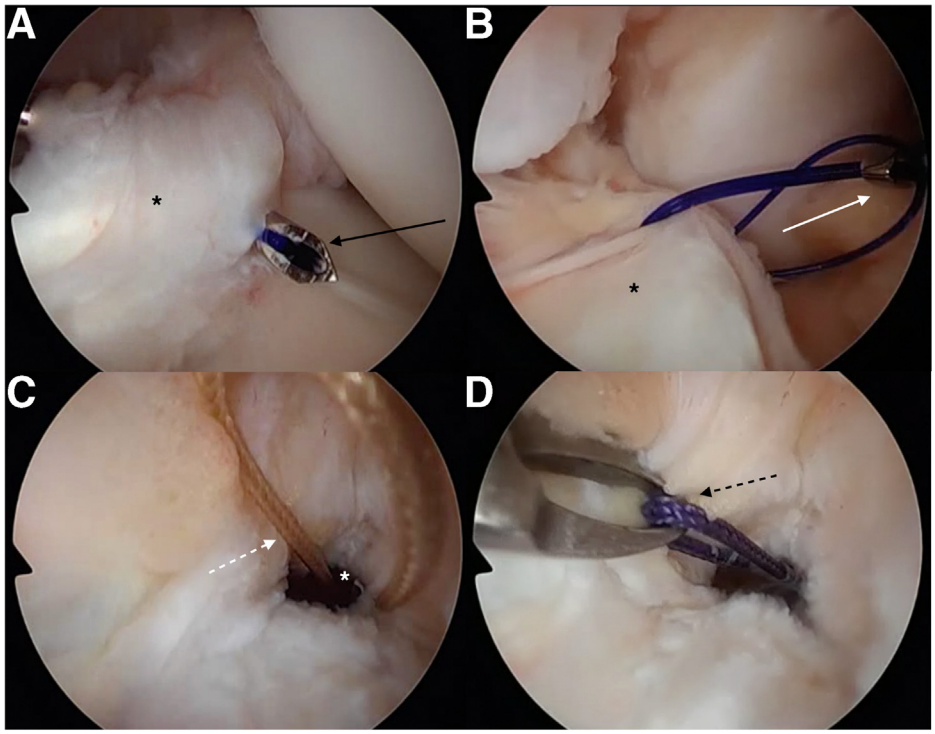

Fig 4. Preparation for anterior cruciate ligament (ACL) repair. Arthroscopic views of left knee. (A) A 25° suture passer (arrow) loaded with a monofilament suture is positioned around the ACL remnant (asterisk). (B) A suture grasper (arrow) is placed through the suture loop to grasp the other end of the suture and create a knot. (C) A passing suture (arrow) is inserted through the femoral tunnel and taken through the tibial tunnel via the channel created within the ACL remnant (asterisk). (D) An additional suture (arrow) is inserted through the femoral tunnel to facilitate the ACL repair. * = ACL remnant.

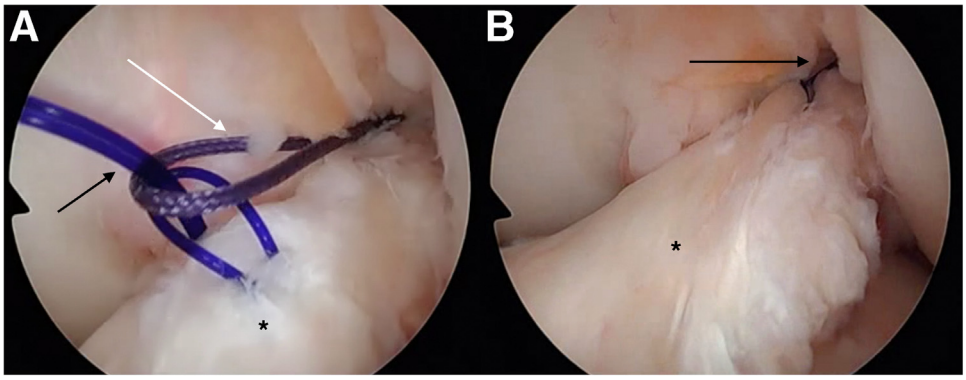

Fig 5. Anterior cruciate ligament (ACL) graft passage and ACL repair. Arthroscopic views of left knee. (A) The monofilament suture (black arrow) around the ACL remnant (asterisk) is passed through the loop created by the additional passing suture (white arrow). (B) The monofilament suture (arrow) is pulled through the femoral tunnel. * = ACL remnant.

of motion to 0° to 90° for 6 weeks for patients who undergo meniscal repair. Early rehabilitation focuses on maintaining full extension and quadriceps activation exercises. Return to sports is allowed at 4 months for non-pivoting sports, 6 months for pivoting non-contact sports, and 8 to 9 months for pivoting contact sports.

Discussion

This technical note describes the SAMBBA-plus technique, which combines ACL repair and reconstruction to ensure that a biological environment is maintained for the regeneration and repair of the ACL by retaining its native fibers. This technique can be used in conjunction with a lateral extra-articular procedure and can be replicated to accommodate other drilling and fixation methods (FlipCutter and TightRope; Arthrex). Undeniably, the ACL remnant has the capacity to improve ligamentization of the graft with the contribution of a population of vascular-derived stem cells, as illustrated in Fig 6.[5,13,14]

Furthermore, remnant-preserving techniques including the original SAMBBA technique show excellent clinical outcomes and potentially lead to lower rates of graft rerupture.[4,15,16] Additionally, complications associated with remnant-preserving techniques, such as the development of symptomatic cyclops lesions and an increase in the rate of tibial tunnel malposition, have been negated in the recent literature.[17,18]

Likewise, the renewed interest in ACL repair has led to a number of articles showing improved results in comparison to the historical literature.[7-9,19] However, there are higher rates of failure in younger and more active patients.[6,20] Our technique provides an alternative method to repairing the ACL with the addition of ACLR, which could potentially lead to better outcomes in this higher-risk population.

In summary, the SAMBBA-plus technique combines ACL repair and reconstruction, which retains the native fibers of the ACL, thereby providing several biological advantages. It is a safe and reliable technique and should be considered for proximal tears of the ACL.

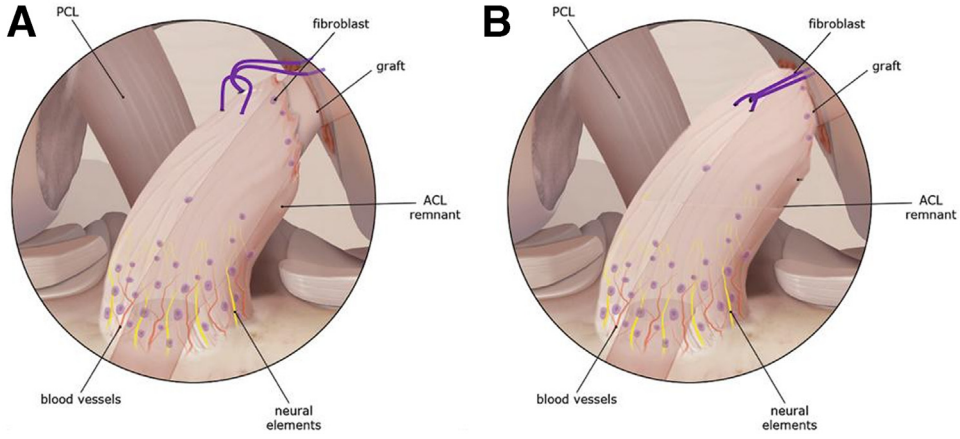

Fig 6. (A) Monofilament suture looped around anterior cruciate ligament (ACL) remnant, which contains blood vessels, neural elements, and competent fibroblasts. (B) Position of graft and monofilament suture after tensioning. (PCL, posterior cruciate ligament.)

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