Technical Note

Arthroscopic Repair of the Acetabular Labrum Using an Anchor-First Modified Toggle Suture Technique

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Abstract: The goal of acetabular labral repair is to restore stable contact between the labrum and acetabular rim while maintaining the anatomic suction seal. One of the challenges of labral repair is achieving proper in-round repair, so that the labrum contacts the femoral head in the native position. This technique article presents a repair method that allows for enhanced inversion of the labrum to assist with anatomic repair. Our modified toggle suture technique utilizes an anchor-first method and has various distinct technical advantages. We present an efficient and vendor-agnostic technique that allows for straight or curved guides. Similarly, the anchors may be all-suture or hard-anchor designs that accommodate suture sliding. This technique also utilizes a self-retaining hand-tied knot construct to facilitate preventing knots from migrating toward the femoral head or joint space.

Introduction

The labrum is a ring of fibrocartilaginous tissue that lines the acetabular rim. It is inverted and rests on the femoral head in its native position. This creates a suction seal that is necessary for proper hip biomechanics with roles in stability, nociception, proprioception, and fluid regulation.[1-3] Tearing of the labrum can cause pain and disrupt these processes. Labral repair is the current gold standard for treatment of tears, showing improved efficacy over debridement and reconstruction due in part to improved restoration of native anatomy.[4,5] One challenge when recreating this anatomy is performing an "in-round" repair that results in labral inversion and corresponding suction seal (Fig 1A). Various techniques aiming to anatomically reattach the labrum have been described, with newer techniques invariably featuring suction seal restoration as a primary goal.[6-8] However, an optimal technique has not been established. Some techniques can evert the labrum, disrupting contact with the femoral head and suction seal.[1,9] Similarly, anchor devices placed further from the rim can also evert the labrum, creating an "out-of-round" repair (Fig 1B) during tensioning. An optimal technique results in an "in-round repair" and anatomic restoration.[10] The technique presented here utilizes a modified toggle suture construct that allows for labral inversion and restoration of the suction seal.

Surgical Technique

This arthroscopic labral repair technique is indicated for patients with signs and symptoms of a labral tear who have failed conservative management.

Patient Positioning, Portal Placement and Acetabular Recession

The patient is placed under general anesthetic and is positioned on a hip traction specific table with bony prominences padded. Prepping and draping are performed in the standard fashion, and the patient's feet are secured in distraction boots. After adequate distraction of the joint is confirmed, arthroscopic portals are created, including anterolateral and modified anterior portals per surgeon discretion. A diagnostic examination is performed to confirm and fully inspect the labral tear and other central compartment pathology. An interportal capsulotomy is then created. The acetabular rim is then recessed using a round burr

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through the mid-anterior portal to correct pincer morphology and create a bed of bleeding bone to facilitate labral healing after fixation.

Labral Fixation Using Modified Toggle Suture Technique

A cannula is inserted through the working portal to facilitate anchor placement and suture passage. A curved drill guide is placed an appropriate distance from the acetabular rim and tapped into position. The anchor hole is then drilled while visualizing from within the joint to confirm no cartilage or joint injury occurs. A nitinol wire is then placed through the drill guide to confirm a bony base and that the drill did not pass the far cortex while drilling. The nitinol is removed, and a Stryker all-suture Iconix anchor is then placed through the guide and into the drill hole. The anchor is gently tensioned to set the all-suture anchor. Although a Stryker anchor is used in this technique, any anchor that allows for suture sliding can be used. The surgeon pinches the two strands of sutures coming out of the cannula to maintain their orientation. A Stryker Nanopass is then used to grasp one free limb of the suture from outside the cannula and pass the suture through the Transport (Stryker) cannula in the mid-anterior portal. The suture limb is then passed through the chondrolabral junction and released, and the Nanopass is retracted back through the tissue.

To perform the modified toggle stitch, the next step is critically important. The two sutures coming out of the anchor should be held together outside the cannula and visualized from within the joint (Fig 2). The free suture limb that was just passed through the labrum is now going up and out of the cannula to where the surgeon is pinching the two sutures together, and back down into the anchor creating an arch. The Nanopass must now be brought under or through this arch (Video 1). The end result is the Nanopass moving through the suture arch in a different path than how the suture was initially placed. The Nanopass must move around the labrum to retrieve the suture and pull the free limb through the arch. The free limb of the suture deep in the acetabulum is then grasped, brought around the free edge of the labrum, and under the suture arch. This can be performed around the free edge and include the entire labral tissue, or in a vertical mattress fashion by piercing the labral tissue a second time. However, in either method, the suture passing device needs to pass under or through the created arch to retrieve the suture (Fig 3A). This path under the suture arch of the proximal suture is what creates the modified toggle stitch with suture retrieval and tensioning (Fig 3B).

The retrieved suture can then be brought out of the cannula. Once the passed suture is retracted through the cannula, slack is removed by pulling on the free

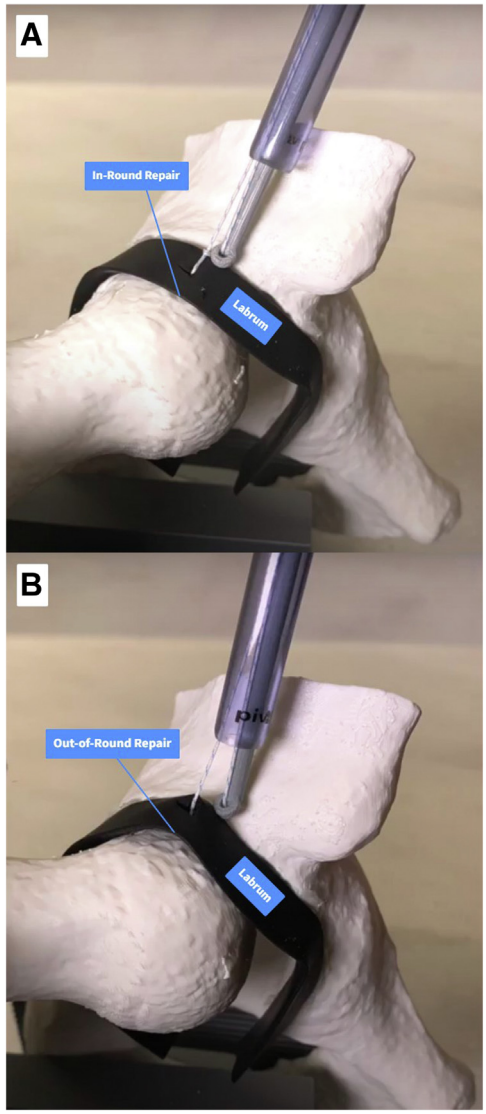

Fig 1. (A) Dry lab of a right hip with labral repair demonstrating successful creation of the modified toggle stitch. Black triangular weather stripping is used to represent the labrum, and 3D-printed polylactic acid femur and acetabular models are used. This "labrum" was repaired with proper modified toggle suture technique. The critical step for this method is the retrieval of the suture limb through the proximal suture arch after passage through the labrum during repair. This results in labral inversion and in-round repair contact between the labrum and femoral head. This is demonstrated by the lack of gapping between the femur and labrum models in the image. Inversion of the labrum results in restoration of the native suction seal that is necessary for proper hip biomechanics. Restoring the suction seal is a component of an optimal repair. (B) This image demonstrates an unsuccessful attempt to create the modified toggle stitch in which the passed limb of the suture was not brought through the arch of the proximal suture. This results in eversion of the labrum, an out-of-round repair, and disruption of the contact between the labrum and femoral head. This is demonstrated by the creation of a gap between the femur and labrum models.

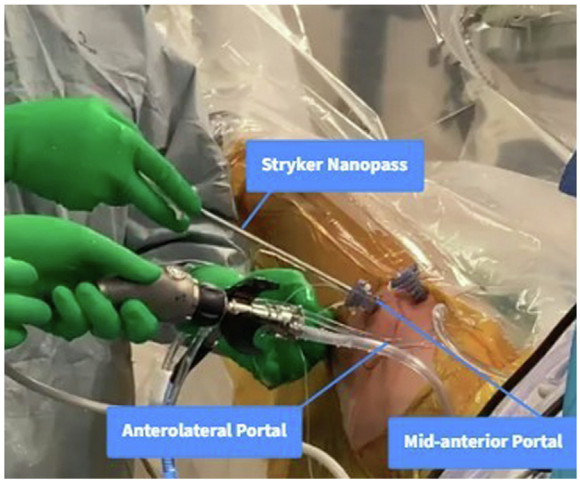

Fig 2. Intraoperative image of a left acetabular labral repair displaying the appropriate setup for performing the modified toggle stitch technique. The patient is placed in the Trendelenburg position. The camera is inserted into the anterolateral portal for viewing. In the mid-anterior working portal, the surgeon holds both strands of suture coming out of the anchor to one side of the cannula while passing the Stryker Nanopass down the far side of the cannula. This creates separation between the suture strands and the arch necessary for the modified toggle technique. After this suture limb is passed through the labrum, it is retrieved through the arch created by the proximal portion of the same suture. This configuration results in the modified toggle stitch, which allows for enhanced inversion of the labrum and restoration of its native suction seal.

limb that was not passed. The inversion and eversion of the labrum can then be fine-tuned as necessary by pulling on either end of the suture and observing the desired effect on the labral tissue (Video 1). This allows the surgeon to invert the labrum, as desired, to ensure proper positioning on the femoral head. Because the suture slides through the anchor, tensioning it inverts the labrum and pulls it downward against the femoral head, restoring the suction seal. This suture configuration results in a self-retaining half-hitch that is tensioned against the post-limb, which was uninvolved in the modified toggle stitch creation. Tying to the post limb ensures the knot stack is away from the labrum and prevents migration toward the femoral head or into the joint space. Once the desired alignment is achieved, the knot can be pulled down and secured with four alternating half-hitches. The technique can then be repeated for as many anchors as needed. Technical pearls are summarized in Table 1.

The remainder of the surgery is completed in the standard fashion. Hip traction is released, and the repaired labrum and peripheral compartment are evaluated. Impingement is corrected as needed, with osteoplasty of the femur in the peripheral compartment followed by closure of the capsule.

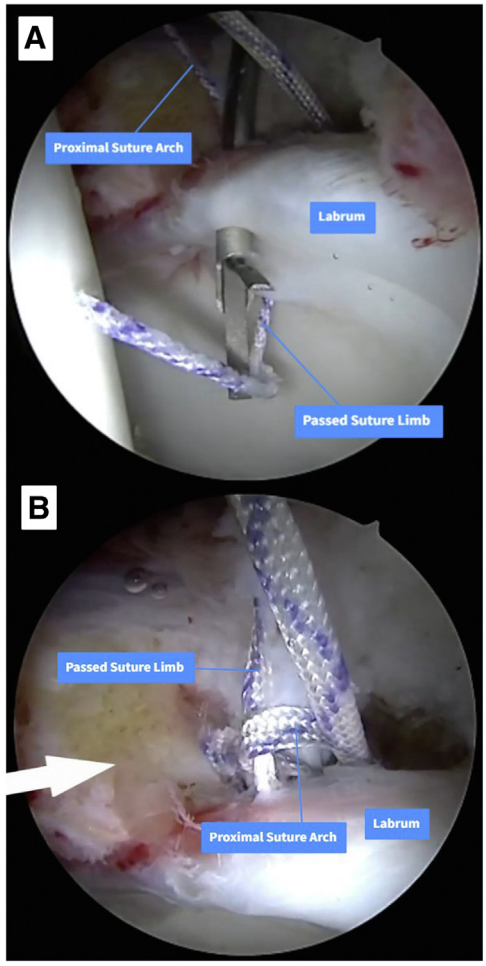

Fig 3. (A) Arthroscopic view taken during a left acetabular labral repair through the anterolateral viewing portal. This image shows the path that the Stryker Nanopass must take in order to create the modified toggle stitch. Prior to the capture of this image, the suture limb was passed through the labrum and Nanopass retracted back through the labrum. The Nanopass is then passed under or through the arch created by the proximal portion of the suture that was just passed through the labrum, as seen in the figure. This path is necessary when retrieving the passed limb in order to create the modified toggle stitch. The resulting suture configuration allows for enhanced inversion of the labrum and restoration of its native suction seal, and is self-retaining to facilitate keeping the knot away from the joint space and femoral head. (B) This image displays the correct path of the retrieved suture limb through the proximal arch. The image was captured immediately after Fig 3A once the suture was tightened. Once this limb is fully taut, the resulting configuration is the modified toggle stitch.

Discussion

Performing an in-round labral repair resulting in restoration of anatomic position and corresponding suction seal is necessary for an optimal repair, as an out-of-round repair disrupts the native suction seal and

Table 1. Technical Pearls and Pitfalls of the Modified Toggle Suture Technique

Technical Pearls	Technical Pitfalls
Hold sutures coming out of the anchor together outside the cannula to maintain suture management and orientation.	If the passed limb is not pulled under the suture arch, another suture passing device must be used to retrieve the suture through the loop.
Deliver passing suture down far side of cannula.	Caution not to over- or undertension the repair
When retrieving the suture, the passed limb must go between the sutures coming out of the anchor and the passed suture (this is the created arch made by the working suture coming up and out of the anchor via the cannula and back down through the labral tissue).	Before tying knots, slide the knot-passer down the post-suture to ensure the post-tying strand will be the suture un-involved in creating the modified toggle stitch. This facilitates keeping the knot stack away from the joint and labral tissue.
Slow down before final tensioning to ensure the passing suture was passed beneath the arch, creating the modified toggle stitch.	

Table 2. Advantages and Disadvantages of the Modified Toggle Suture Technique

Advantages	Disadvantages
Enhanced labral inversion and femoral head contact to ensure anatomic repair	Knotted construct may increase risk of adhesions and articular cartilage damage.
Vendor-agnostic application	Arch creation and suture pass-through can be technically challenging.
Anchor-first method	
Self-retaining knot construct away from the joint	

biomechanical properties that the labrum supports.[1,9] Carl Wierks presented a technique that utilizes a knotless PushLock method resulting in a toggle suture that allows for rotational adjustment of the labrum and in-round repair.[11] Our technique creates a similar toggle suture with a number of distinctions (Table 2). This technique begins with placing the anchor into the acetabular rim before passing the suture. This results in an efficient anchor placement procedure by eliminating the need to find the same anchor hole and trajectory twice in the limited space and visibility inherent to hip arthroscopy. Additionally, our technique requires passing a single suture limb through the labrum rather than the two-strand bulk of the suture. This minimizes the risk of intrasubstance tearing. Our technique also allows for the use of curved guides. This is an advantage compared to the technique described using a PushLock (Arthrex) anchor because that system requires a straight guide and commonly needs accessory portals to access the correct drill angle to the acetabular rim. Finally, our presented technique is a vendor-agnostic technique; as long as the anchor slides and is part of an anchor-first method, it can be used to create this modified toggle stitch.

A potential disadvantage of this technique is the use of a knotted construct, as it has been theorized that knots may cause adhesions or damage the articular cartilage if they migrate toward the femoral head or joint space. Although this has not been demonstrated in the literature, our self-retained knot technique of tying the working limb down to the post limb helps to prevent this migration because the modified toggle stitch is already secured in a locking half-hitch with the labral tissue. In summary, this technique has a number of advantages and provides enhanced labral inversion to achieve an in-round repair.

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