Technical Note

A Technique for Optimizing Hip Labrum Suction Seal With a Double-Limb, Oblique Inverting Mattress Stitch: The "X" and the "M" Configurations

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Abstract: Classic techniques in arthroscopic hip labral repair use circumferential or intrasubstance suture secured with anchors typically placed behind the labrum (capsular side). The primary goal of labral repair is to re-establish the hip suction seal and is often achieved via fixation techniques that invert viable labral tissue to restore or improve contact with the femoral head. Many repair techniques use only 1 suture limb either passed circumferentially around the labrum or passed in an intrasubstance manner, resulting in smaller purchase of labral tissue and lack of a strong inverting vector. In some cases, this may evert the labral tissue, compromising the suction seal. We describe a technique in which both suture limbs are passed in a mattress, figure-of-8 configuration, through the labral tissue, and tied on the capsular side to yield an inverting, double-limb repair. Therefore, each anchor results in a wider, more impactful repair footprint while reliably inverting the labral tissue.

Restoring the hip suction seal is paramount to achieving normal hip biomechanics and treating symptomatic instability attributable to the incompetent labrum.[1-6] The primary mechanical goal of labral repair and reconstruction, therefore, is to re-establish the role of the labrum not only as an extension of the acetabulum to augment containment of the femoral head but also as a soft-tissue gasket conforming intimately to the femoral head. Labral repair, when technically performed correctly, restores the suction seal, creating a negative-pressure intra-articular environment for optimal fluid dynamics.[3,5,7] Multiple surgical techniques use suture anchors docked in the bony acetabulum that are passed either around the labrum or in an intrasubstance manner through the labrum to invert it, thereby improving its position relative to the femoral head.[2,6,8,9] Most techniques in hip arthroscopy use a pass of a single suture limb through or around existent labral tissue for repair.[2,8,10] This is secured either via knotted or knotless methods on the capsular side of the labral tissue. We present a technique that uses both suture limbs passed in an intrasubstance manner through the labral tissue and at the labral base to create a double-limb, inverting, wide-oblique mattress repair.

Technique

Technique pearls and pitfalls are listed in Table 1, and advantages and disadvantages are presented in Table 2. The patient is placed supine at a few degrees in the reverse Trendelenburg position with both feet secured in well-padded snug boots. After an air arthrogram disrupts the suction seal of the hip, the patient is placed under traction using a post-less table (Pivot Guardian; Stryker, Englewood, CO)[11] and the more posterior portal (in line with the vastus ridge slightly proximal to the level of the greater trochanter) is established.

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Table 1. Technique Pearls and Pitfalls

The suture should be passed using a loop technique to avoid tension on the labral tissue during suture passage.
Knot pushers should be used to assess fixation and the suction seal before one commits to tying.
The knot should be tied to invert the labrum with the hip on traction using a past-pointing technique, but the tails should not be cut until an extra-articular position of the knot is guaranteed.
A sliding-locking knot should not be used because the multiple passes through tissue may cause tissue cut-through and the suture may not slide.
Smaller-diameter suture should be used for lower-volume labra or poor-quality labral tissue.
Using an offset suture passer may assist with an extremely anterior anchor; however, this may also increase the risk of suture cutout through the labral tissue.
Using a 70° scope may allow for better visualization of passes through to the articular side of the labrum.
Using a 30° scope may allow for better visualization of the capsular side of the labrum.

A modified anterior portal is established 2 to 3 cm distal to and at least 6 cm away from the starting portal more medially. A 2- to 3-cm interportal capsulotomy is made, and the labrum is assessed for appropriate repair.

Anchor Placement Techniques

Anchors (Nanotek [Stryker] and SutureFix [Smith & Nephew, Andover, MA]) are drilled as close as possible to the labral base using a curved drill guide with C-arm verification for optimal trajectory, with care taken to ensure that the anchors are directed away from the subchondral bone. A Nanopass device (Stryker) passes 1 limb of suture adjacent to the anchor from the capsular side of the labrum (Video 1, Figs 1 and 2), at the labral base (or in a "near" position), into the intra-articular side. This suture limb is then retrieved more peripherally (or in a "far" position) through the labral tissue from the articular side to the capsular side. The other limb is passed in a diagonal fashion across and more peripherally (far) into the labral tissue toward the chondral side and is subsequently pulled from The labral base (near) on the articular side to the capsular side. Once tied, this will appear as an "X" on the top of the labrum (Figs 3A and 4A).

Alternatively, another inverting configuration can be achieved by passing each suture limb in a divergent manner from the anchor. The first limb is passed obliquely and peripherally (far) from the capsulolabral side and exits the chondrolabral side closer (near) to the labral base. This is then passed back through the labral base (near) to the capsulolabral side and oriented away from the anchor. The second limb is passed symmetrically and obliquely away (far) from the first suture limb and anchor. The passes from the anchor to create an "M" pattern with the anchor at the center of the "M." When tied, the configuration has the appearance of an inverted "V" (Figs 3B and 4B).

Both suture limbs exiting the same portal are passed through a knot pusher, and the knot pusher is advanced to the base of the repair to check the vector or pull of the final repair. The hip is then taken off traction, relocating the femoral head into the acetabulum. The knot pusher provisionally holds the tension of the final repair while the hip is placed on traction again for dynamic and direct assessment of the suction seal. This can be replicated for every anchor placed simultaneously with the same concurrent number of knot pushers (e.g., 3 anchors and 3 knot pushers). Once the final repair configuration is confirmed, all knots are tied independently in sequence. The knots can be tied in any position that creates an inverting position of the labrum without risking intra-articular placement of the knots themselves (Fig 2).

Because of the orientation, as well as the number of times the suture is passed through or next to the labral tissue (4 times total), there would be more friction resulting from sliding the suture limbs and thus a sliding-locking knot is not recommended because it risks tissue cutout. The surgeon then ties the limbs in alternating throws of a square knot, which is then locked and cut. It is recommended that the knot be tied while the hip is on traction (hip dislocated) to optimize the inversion of the labral tissue (i.e., past-pointing the knots into the joint to generate better inversion) by past-pointing the knot pusher past the labrum toward the acetabular fossa.

Discussion

Biomechanical studies have shown that with progressive degrees of labral damage to complete labral resection, the hip joint endures increased levels of articular friction[12] and decreased hip stability to distractive forces.[3] Current techniques described in the literature advocate performing labral-based repair to minimize suture contact with the femoral head cartilage once the hip is relocated,[3,10] as well as inverting the labral tissue to optimize labral contact with the femoral head. Our technique achieves both goals with both

Table 2. Advantages and Disadvantages

Advantages	
	Use of decreased numbers of anchors
	Improved inversion of labral tissue compared with single mattress
	No need to identify inverting or everting suture limbs
	Mattress stitch allows for multiplanar stability
	Flexibility in knot stack placement
	No or minimal suture contact with femoral head because virtually all suture is contained within labral tissue
Disadvantages	
	More passes through labral tissue
	Decreased ability to use sliding knot
	Increased knot throws may create larger knot stack
	Passing suture close to tip of labrum may create some cutout risk

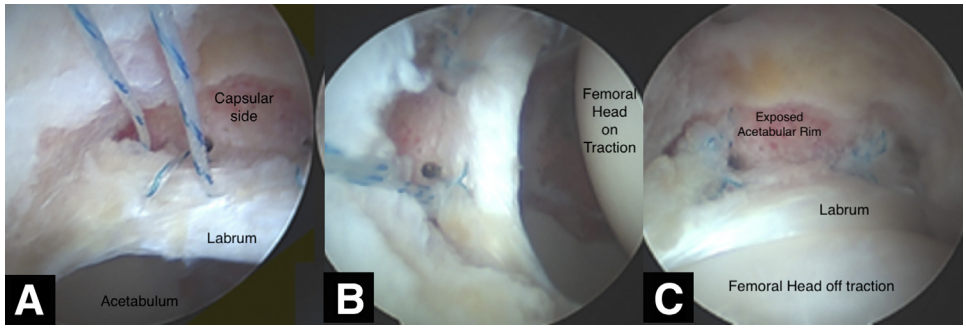

Fig 1. "X" mattress configuration shown from anterolateral portal from different perspectives (right hip in the supine position shown from the anterolateral portal). (**A**) After both suture limbs are passed through the labral tissue, the exiting strands are oriented with 1 strand at the labral base and 1 strand more peripherally in the labral tissue. This is shown with the femoral head on traction. (**B**) After testing the suction seal with the repair held provisionally with a knot pusher, the "X" configuration is tied with the hip on traction. (C) The femoral head is reduced off traction, showing the inverting suture configuration conforming the labrum against the femoral head.

suture limbs to optimize the amount of fixation gained by a single bony anchor.

To achieve inversion, regardless of whether the anchor is knotted[8,13] or knotless,[3,10] most techniques tension 1 suture limb preferentially because tensioning the other will cause pathologic eversion (disrupting the suction seal) of the labrum. Moreira et al.[2] presented a technique in which the inversion and eversion limbs are clearly identified with respect to their exit point from the labral tissue and the capsulolabral junction, respectively, maintaining functional inversion while preserving labral triangular morphology after tissue tensioning. Because our technique uses twice the number of passes through the labral tissue to achieve double the amount of labral fixation and double the inversion vector, both suture limbs are simultaneously tensioned when the knot is tied, which obviates the step of identifying the "inverting" and "everting" limbs. Additionally, the knot can be tied in any position with respect to the anchor or labral tissue, aiming to avoid intra-articular placement of the knot ends, optimizing inversion under direct visualization.

Whereas Ye and Singh[14] used a "single-pass" and double-limb suture technique to secure the labral tissue at a single point using a girth hitch technique, which is subsequently anchored to the socket using a knotless anchor, the limbs enter and exit the labral tissue at the same point. Functionally, the same outcome can be achieved with a larger suture diameter. Our technique uses both limbs of suture to achieve fixation of the labral tissue at 2 points with a variety of widths per the quality and quantity of labral tissue, anchor location, and repair needs but with the use of a single bony anchor. This secures a broader segment of labral tissue

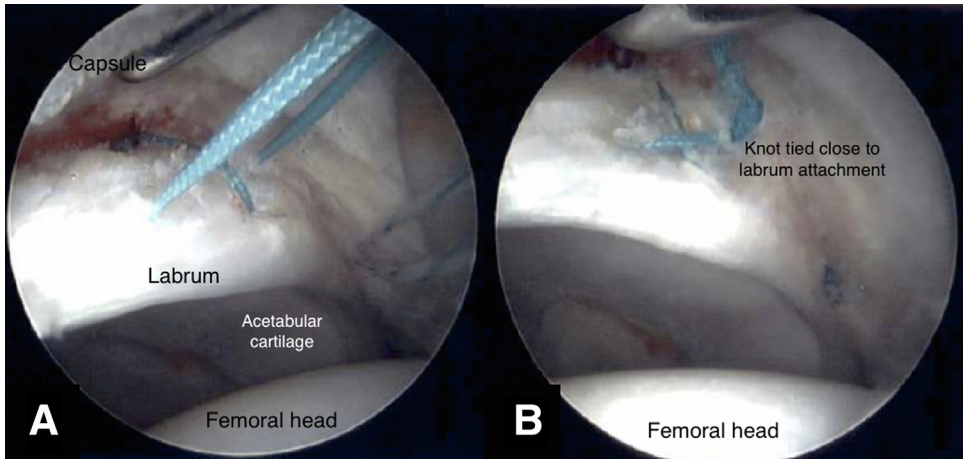

Fig 2. "X" double-mattress configuration originating from single anchor after all passes have been made (right hip in the supine position shown from the anterolateral portal). (**A**) "X" configuration prior to tying. (**B**) "X" configuration after tying showing excellent inversion of labral tissue. The knot is tied and cut at the base of the labrum adjacent to the acetabular rim to avoid contact between the knot and the femoral head.

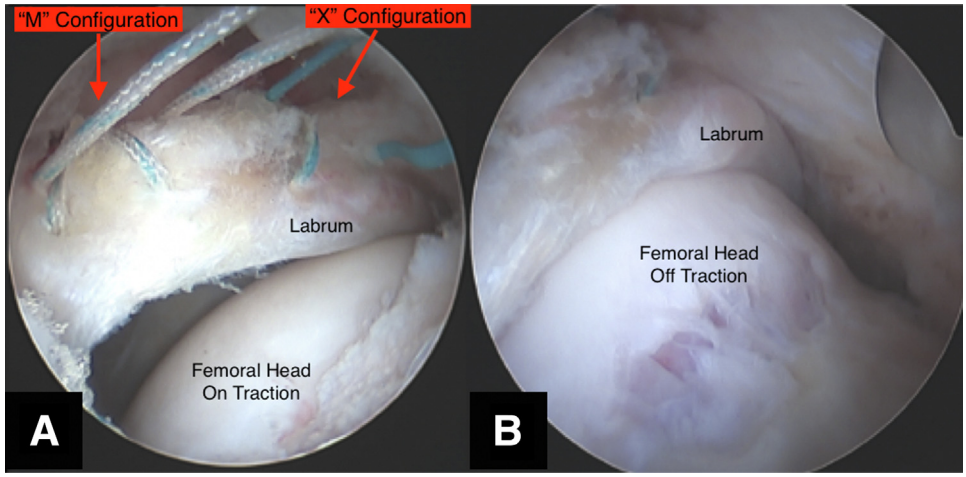

Fig 3. The 2 double-mattress configurations are seen side by side viewing from the anterolateral portal without necessitating full exposure of the acetabular rim (right hip in the supine position shown from the anterolateral portal). Each configuration originates from a single anchor. (**A)** Prior to being tied, the "M" and "X" configurations are seen on the left and right, respectively, with the femoral head on traction. (**B)** After both stitches are tied, the femoral head is taken off traction, and the labrum is in optimal contact with the femoral head, restoring the suction seal.

while reducing the number of bony anchors necessary and, therefore, minimizes the damage incurred by debriding the adjacent bony rim and capsulolabral tissue for anchor placement. This is especially beneficial for labral pathology necessitating multi-anchor use. Additionally, because fewer anchors are used, this technique decreases the costs associated with multiple anchors, as well as reduces the risks associated with anchor placement, such as iatrogenic intra-articular placement or outer-table penetration of anchors.

Obliquely oriented suture with respect to the labral fibers is reported in glenoid labral fixation[15] to mitigate potential in-line suture cut-through of poor-quality labral tissue. However, only 1 suture limb is passed through the labral tissue for the functional equivalent of a simple mattress repair. Conversely, our technique optimizes use of both suture limbs by placing them in 2 different intrasubstance locations without compromising the labral tissue once fixation is established. This allows for not only multiplanar stability but also less concern for labral tissue cutout given that the oblique nature of the suture limbs with respect to the labral fibers, which run parallel with the bony acetabulum, will not predispose to in-line cut-through.

Although techniques exist in which the bony anchor is established on the articular side of the labral base and the knot is tied on the capsular side for optimal tissue inversion,[13] it is not always possible to achieve

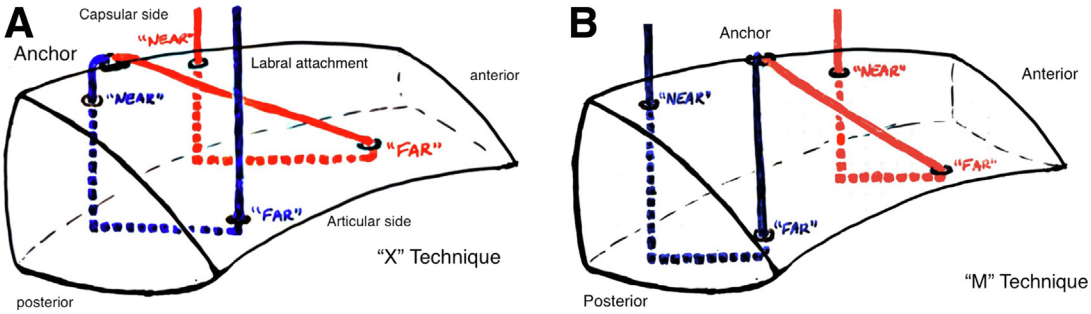

Fig 4. Diagrams showing oblique double-mattress "X" and "M" configurations using a single anchor. From a single anchor, each suture limb is advanced from the capsular side initially to the articular side and then back through the articular side to the capsular side, where the knot is subsequently tied to form an inverting mattress stitch. (**A)** For the "X" configuration, the blue suture limb is passed "near" to the joint and labral attachment to the articular side and back "far" from the joint to the capsular side. The red suture limb is passed far to the articular side and back near to the capsular side to form an "X" when the knot is tied. (**B)** For the "M" configuration, both the red and blue suture limbs are passed far from the joint to the articular side and back near to the joint to the capsular side to form an "M" when the knot is tied.

intraoperative placement of said anchors with existent portals and to avoid damage to the adjacent structures. Our technique therefore yields the same benefit of inversion of the labral tissue but with anchor placement on the capsular side of the labrum with the sutures tied over the labrum in either an "X" or "M" configuration. This technique works well even in cases in which the rim is not exposed and the drill guide is placed at the optimal location using tactile feel and C-arm verification.

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