"Double-Row Rip-Stop" Technique for Arthroscopic Rotator Cuff Repair

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Abstract: Rotator cuff repair depends on both the fixation strength of the chosen repair construct and the local healing response of the repaired tissue. Among a growing discussion surrounding the superiority of one surgical technique over another, the surgeon's ability to complete a rotator cuff repair with technical acuity in a timely manner remains paramount. Double-row repairs as well as rip-stop configurations have been proposed to limit failures found after arthroscopic rotator cuff repairs. Implementation of both techniques during arthroscopic shoulder surgery may represent a technical challenge for the average orthopaedist. The purpose of this article is to give simple instructions for reproduction of an arthroscopic double-row rip-stop repair for rotator cuff fixation.

Numerous reports show that rotator cuff pathology exists in the general population in both symptomatic and asymptomatic shoulders and that the incidence increases with age. Historically, rotator cuff pathology has been seen as a continuum through stages of tendon edema, tendon tendonitis, and finally tendon tearing. Although the orthopaedic community disagrees on the indications and timing of repair, both tear size and symptoms have been shown to often progress with nonoperative treatment.[1,2]

Large tears involving one or more of the rotator cuff tendons are more commonly encounterd in individuals older than 50 years. These tears have also been shown to have higher rerupture rates owing in part to the poorer healing response found in degenerative tissue. For this reason, a focus on restoring an adequate rotator cuff footprint at the time of rotator cuff repair has been recently emphasized in the literature.[3,4] Although multiple biomechanical studies have suggested superior results for restoration of the footprint with double-row repair over single-row techniques,[5,6] long-term superior clinical data remain unclear.[7-10] Some of these data are difficult to intrepret given the multiple methods for constructing a double-suture row, and some authors have focused research on technical pitfalls found in double-row techniques.[11,12]

A type 2 rotator cuff repair failure is encountered when the rotator cuff tendon detaches from the medial fixation row, which is often located at the musculotendinous junction.[13,14] Rip-stop techniques have been shown to adequately reduce suture tendon pullout[15,16] when compared with traditional transosseous double-row repairs in biomechanical studies. If an additional horizontal "rip-stop" suture can be added to previously described techniques designed to restore a secure tendon-bone interface, a higher incidence of cuff healing can potentially be achieved. The following described technique is commonly employed by the authors to secure rotator cuff tears and allows not only for double-row fixation but also an interlocking double-row suture construct that improves security and fixation strength (Table 1).

Surgical Technique

The surgical technique described is indicated for large, multitendon tears with rotator cuff tendon mobility to allow for near anatomic reduction. With the patient positioned in the beach chair position following

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Table 1. Indications and Contraindications

Use with … Large multi-tendon rotator cuff tears with adequate lateral tendon.
Do not use when … Significant retraction of the tear or inadequate lateral tendon is encountered.

induction of anesthesia, the operative arm is prepared and draped in sterile fashion. A diagnostic arthroscopy using a 30° arthroscope is performed using a standard posterior portal. In the video provided, a partial subscapularis tendon tear is repaired prior to introduction of the arthroscope into the subacromial space (Video 1). Once all glenohumeral joint pathology is addressed, the arthroscope is introduced into the subacromial space. It is important to perform all necessary soft tissue releases as well as to debride the bony footprint prior to rotator cuff tendon reapproximation and stabilization to the greater tuberosity footprint insertion. In the video provided, one can see a large tear involving both the supraspinatus and infraspinatus tendons being reduced with the aid of a grasper to their respective bony attachments prior to anchor placement. A grasper is useful to assess the reducibility and orientation of the detached tendon prior to placement of suture anchors as can be seen in Figures 1 and 2. The ability to reduce the mobilized rotator cuff tissue to the lateral footprint without undue tension should be confirmed prior to using this described double-row technique for fixation to reduce the risk of repair failure due to excessive strain.

Using the described technique, 2 double-loaded biocomposite anchors (Healicoil Reginasorb 5.5 mm; Smith & Nephew, Andover, MA) are placed at the most medial aspect of the rotator cuff footprint adjacent to the humeral head articular cartilage. As seen in the video and viewed through the lateral portal, each limb of alternating sutures from the anterior double-loaded anchor is passed through the rotator cuff tendon in a horizontal mattress configuration (Fig 3) using a 60° retrograde suture passer through the anterior portal (IDEAL suture grasper; DePuy Mitek, Raynham, MA). The posterior anchor sutures are then passed and retrieved in similar fashion using a posterior portal (Fig 4A). Of note, it is advisable that these sutures broadly incorporate all detached rotator cuff tissue to maximize the tendon bone interface during the subsequent steps (Fig 4B).

Once all medial row sutures have been passed, a third triple-loaded anchor (Healicoil Reginasorb 5.5 mm; Smith & Nephew) is placed into the lateral border of the greater tuberosity footprint. As seen in the video provided and viewed through the lateral portal, each of the 3 lateral row sutures are passed and retrieved in a simple orientation medial to the medial

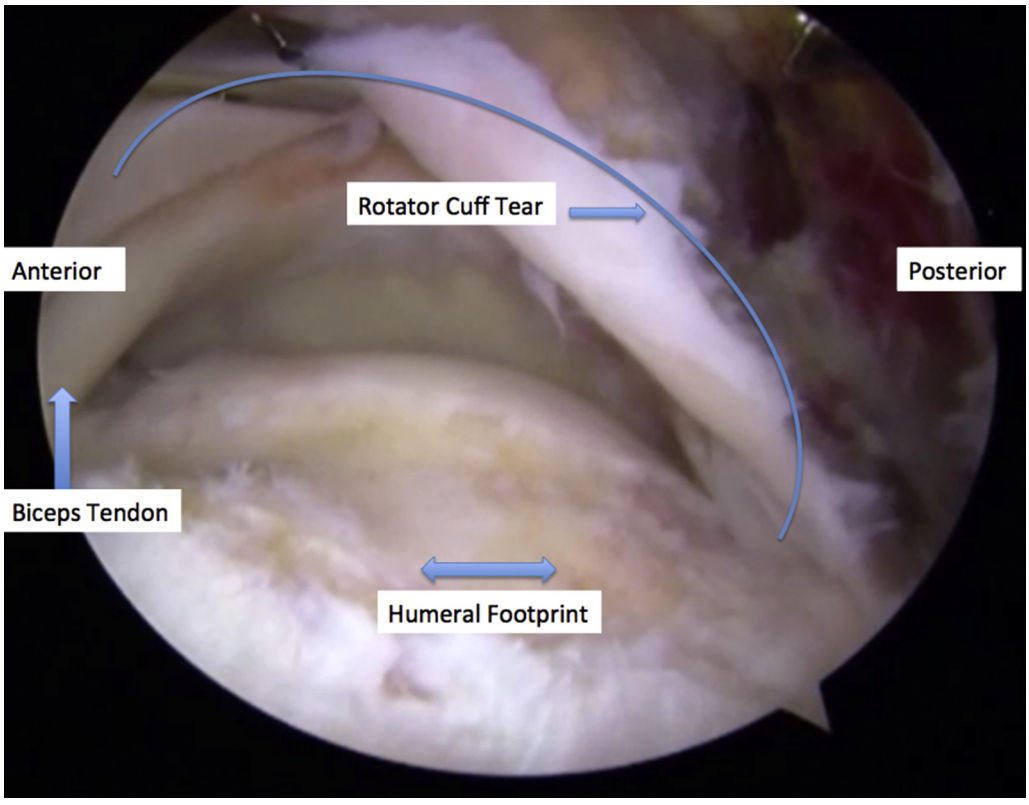

Fig 1. A tear involving the rotator cuff can be seen from the lateral portal in a left shoulder in the beach chair position. Biceps tendon is in view anteriorly. The rotator tendon is elevated using a grasper, showing the humeral footprint insertion.

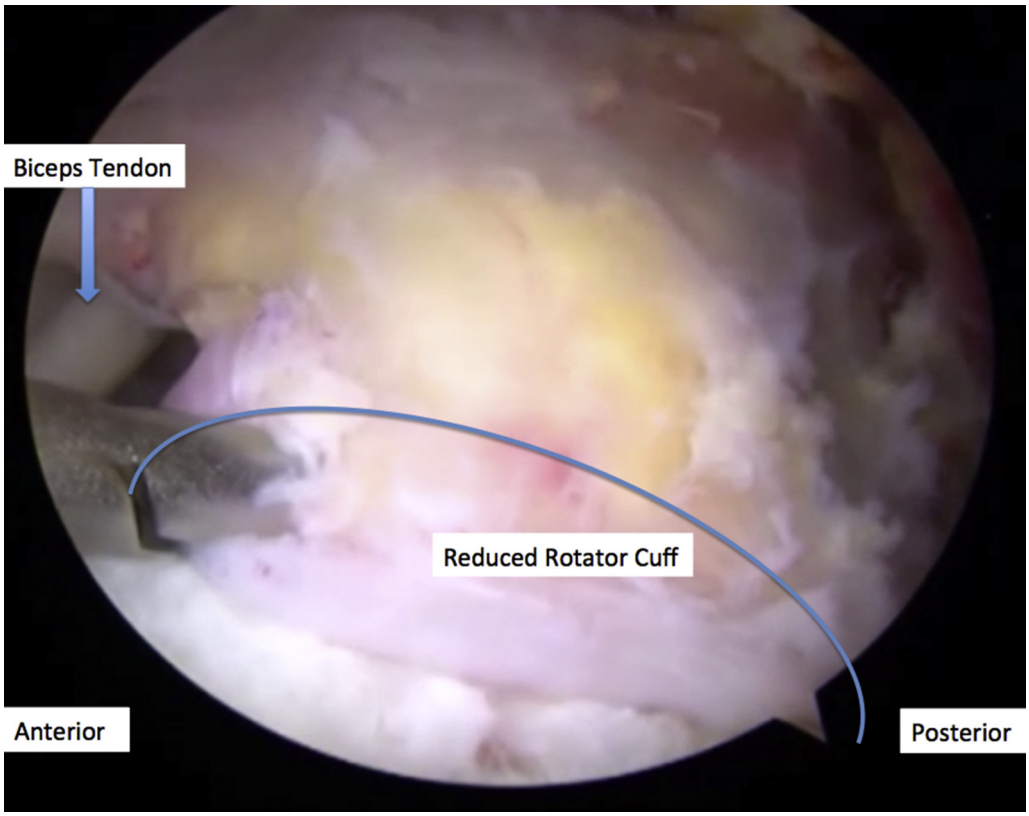

Fig 2. The rotator cuff tear is reduced using a grasper as seen from the lateral portal in a left shoulder with beach chair positioning. The grasper seen is inserted using an accessory anterolateral portal. The biceps tendon may be seen crossing through the biceps interval.

row horizontal mattress sutures (Fig 5A). Figure 5B illustrates use of a grasper during this step to lateralize the rotator cuff tissue and facilitate placement of lateral row sutures.

Following placement of all sutures, the medial row horizontal mattress sutures are securely tied prior to tying the lateral row anchor sutures so that the medial row sutures act as a rip-stop for these lateral row sutures and thus effectively increasing the strength of this double-row configuration (Fig 6). In the video provided, all lateral row sutures are tied in a sequential order, creating the double-row repair (Fig 7). After final arthroscopic photos are taken, a sterile dressing is applied and the patient is placed in a shoulder abduction brace. All patients are placed in a formal postoperative therapy regimen consisting of 4 to 6 weeks of immobilization followed by passive and active assisted range of motion protocol for 4 to 6 weeks. By weeks 10 to 12, patients are placed in a strengthening program and immobilization is discontinued.

Discussion

Suture management, soft tissue releases, and visualization are among the technical challenges making large rotator cuff tears a daunting task for the arthroscopic surgeon. Although rotator cuff failure occurs most often at the suture tendon interface for many reasons, tears can occur owing, in part, to the specific orientation of the sutures used to secure the detached tendon to the greater tuberosity.[13,17]

In their description of a rip-stop suture configuration using suture tape (FiberTape; Arthrex, Naples, FL) for rotator cuff repair, Denard and Burkhart suggest that the rip-stop technique reduces cinching found with more complicated stitch patterns while reducing the risk of suture cutout.[18] Cinching occurs when a suture loop tightens upon itself within a knot. The result is a loss of knot security between tendon and bone. Denard and Burkhart describe a technique in which a suture polyblend tape (FiberTape; Arthrex) is used as a medial horizontal rip-stop stitch in combination with multiple single loops of suture tied after the rip-stop suture is secured to a lateral anchor. Our technique differs by use of four overlapped loops of sutures acting as rip-stop horizontal mattresses while employing one triple-loaded anchor with simple stitches passed medial to this medial row and thus functioning as a double-row repair. Although we have no biomechanical data to suggest any added benefit using the described technique, we believe there exists potential biomechanical superiority in four loops of suture acting as multiple rip-stops (Table 2).

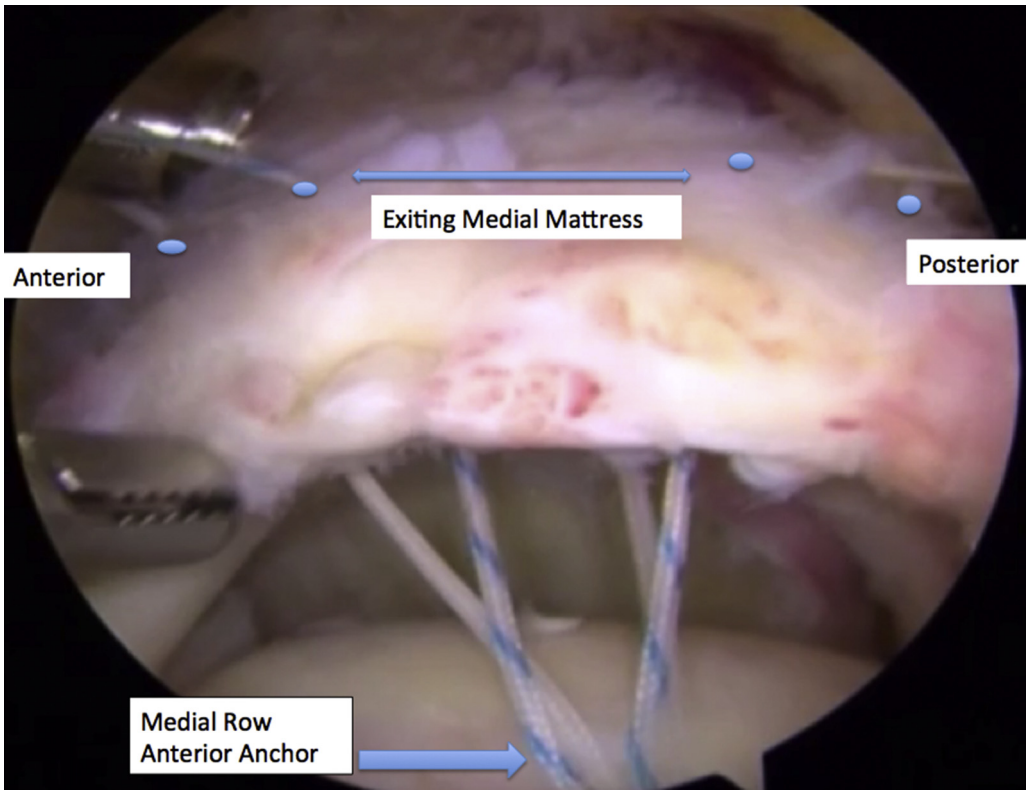

Fig 3. The first anchor of 2 medial row anchors is viewed from the lateral portal in a left shoulder in the beach chair position. All four sutures have been passed in a horizontal mattress configuration through the cuff tissue. A grasper can be seen positioned through an accessory anterolateral portal, and an outflow cannula is positioned in the anterior portal.

Other investigators have demonstrated that tendon anchor gapping is best reduced with multiple anchors in a double-row configuration.[5,19] This is achieved using the described technique through the use of load distribution across the rotator cuff footprint. The presumed benefit of both a rip-stop suture configuration and multiple suture anchors in a double-row configuration as demonstrated in our described technique is reduced failure rates through maximizing footprint restoration and repair strength (Table 3).

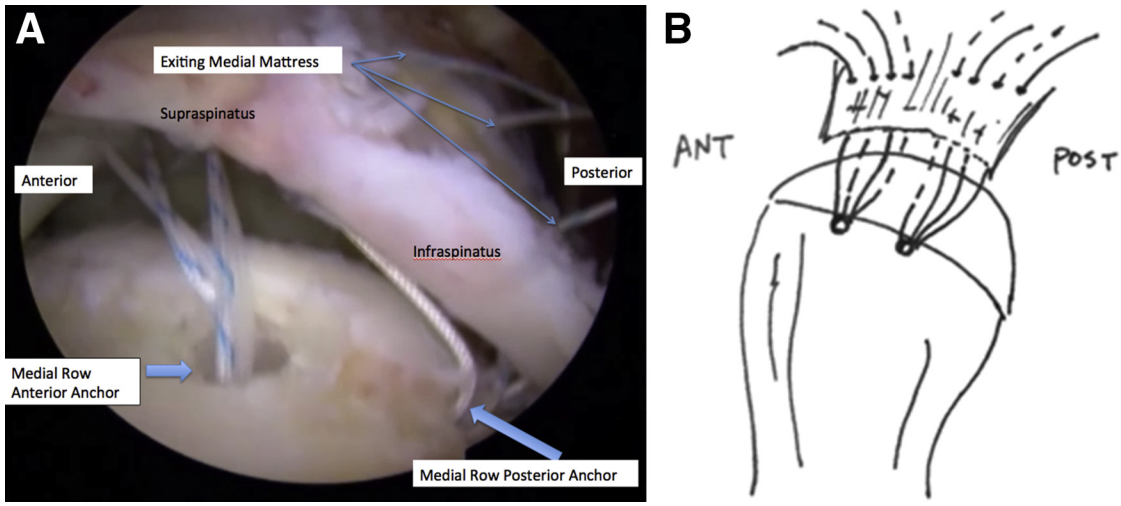

Fig 4. (A) Two medial row anchors can be seen from the lateral portal in a left shoulder in beach chair position. The four exiting suture limbs are marked with arrows passing through the tendon of the infraspinatus in horizontal mattress configuration. (B) An illustration of a left shoulder during the first step of the double-row rip-stop technique includes the passing of 2 double-loaded medial anchors in horizontal mattress configuration.

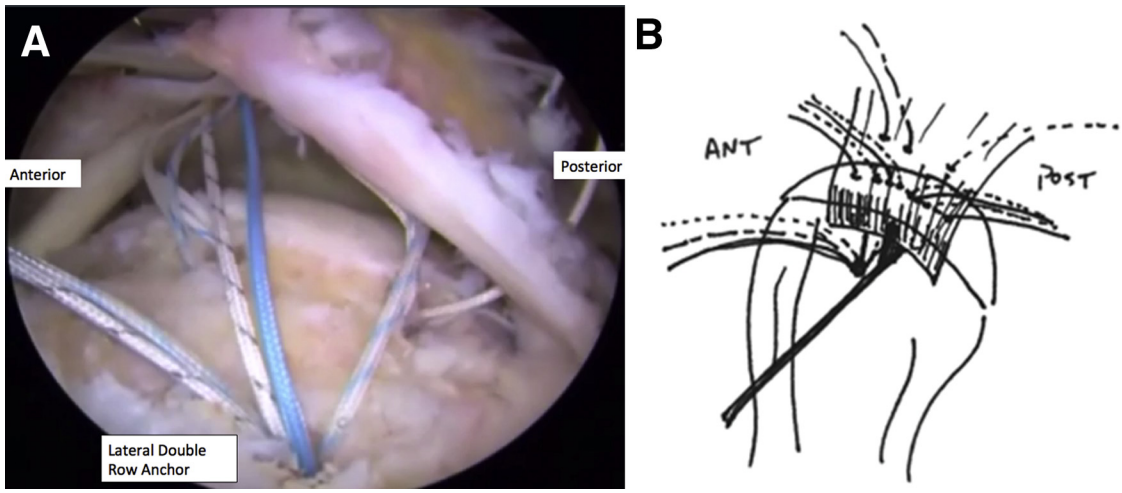

Fig 5. (A) As viewed from the lateral portal in a left shoulder in the beach chair position, 3 limbs of each suture from the lateral row triple-loaded anchor have been passed through the cuff tissue medial to the rip-stop horizontal mattress sutures from both medial row anchors. A grasper is used through an accessory anterolateral portal to manipulate the rotator cuff tissue. (B) An illustration of a left shoulder during the second step of the double-row rip-stop technique includes passing lateral double-row anchor sutures in a simple fashion medial to the horizontal mattress suture configuration of the medial anchors. A grasper is illustrated and is used to manipulate the rotator cuff tissue.

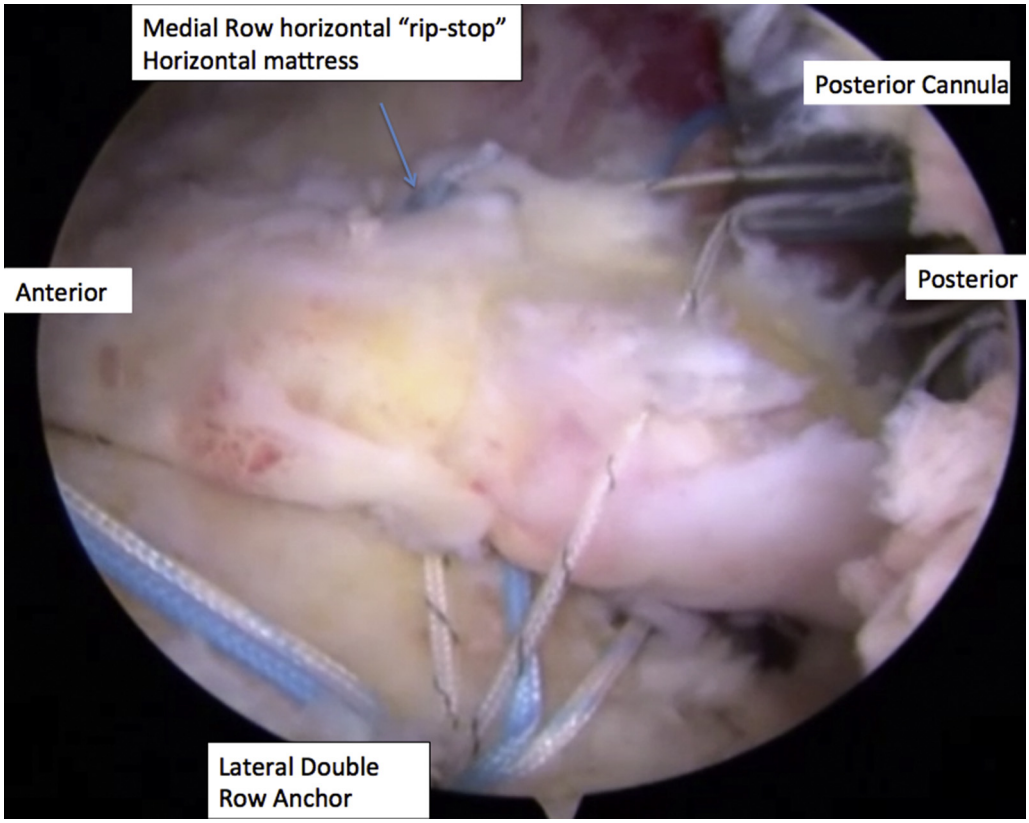

Fig 6. As viewed from the lateral portal in a left shoulder in the beach chair position, 3 limbs of each suture from the lateral row triple-loaded anchor have been passed through the cuff tissue medial to the rip-stop horizontal mattress sutures from both medial row anchors. A medial row rip-stop suture is seen tied reducing the rotator cuff tissue. A posterior cannula is seen with one of the 3 limbs from the lateral anchor.

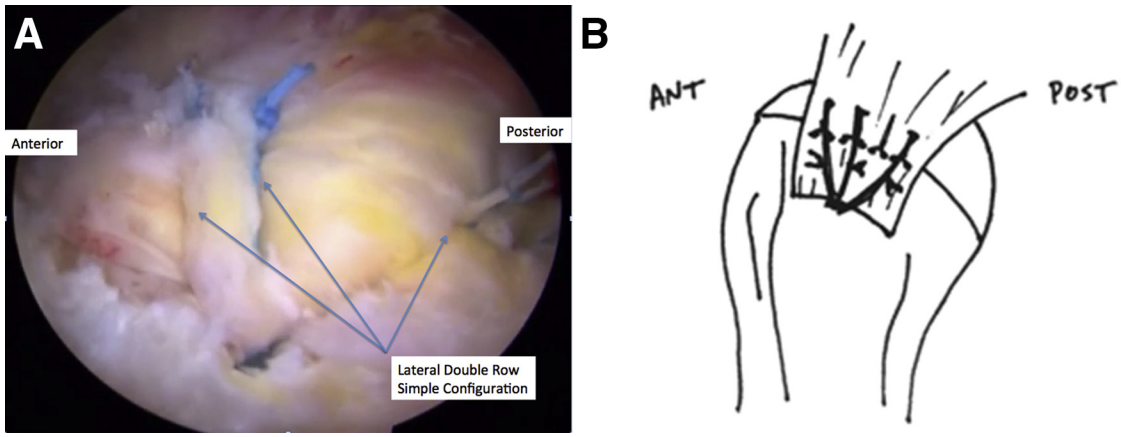

Fig 7. (A) The double-row rip-stop configuration as seen from the lateral portal in a left shoulder in the beach chair position. Note all of 3 simple sutures of the lateral row anchor have been tied after securely tying the more medial rip-stop sutures. (B) An illustration of a left shoulder after the third step of the double-row rip-stop technique includes the final construct.

Table 2. Pearls and Pitfalls

• Use the lateral portal for adequate viewing
• Adequate mobilization of rotator cuff tissue prior to anchor placement allows for better planning of medial and lateral row placement
• A grasper can be used through an accessory lateral portal for reduction of the rotator cuff tendon and assessment of repair tension
• Place medial row anchors close to the articular edge
• Pass all sutures from medial and lateral row anchors before tying
• Poor suture management makes this technique very difficult; try a retrograde suture passer through the anterior and posterior portal to keep sutures away from the viewing field

Table 3. Advantages, Disadvantages, and Limitations

Advantages
• Decreases suture synching found in other suture constructs
• Incorporates a rip-stop suture to decrease suture pullout
• Use of the double row increases bone to tendon contact
• Multiple anchors adds strength to the construct
Disadvantages and limits
• Overtensioning of tissue may lead to higher failure
• Increased difficulty due to suture management
• No biomechanical data is available for this technique
• A future study is needed for validation of superior outcomes

Although clinical data may still be lacking that decisively proves the superiority of the "double-row rip stop" repair construct, the biomechanical data remain a compelling argument for its use in rotator cuff repair. The authors recommend the described technique to reduce failures common to large rotator cuff tears.

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