Technical Note

Three-Point Contact Repair Technique for Partial Subscapularis Tears Using U-Stitch and Cow Hitch Knot Loaded on a Single Knotless Anchor: Simple, Reliable and Quick Method

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Abstract: The importance of repairing the subscapularis tendon to facilitate restoration of the rotator cuff force couple is obvious. However, identifying and repairing subscapularis tears can be challenging for surgeons. In this technical note, we present our preferred surgical method for Lafosse type 1, 2, and 3 and Yoo and Rhee type 1-2A and 2B subscapularis tears, providing a 3-point suture contact achieved with FiberTape (Arthrex) and knotless anchors. In this technique, fiber suture is placed into the superolateral edge of the subscapularis tendon as a traction stitch (cow hitch knot). Second, the FiberTape is passed through the medial upper and lower parts of the tendon, just perpendicular to the fibers, using a suture passer. The FiberTape's free ends remain on the tendon's anterior side, shaping a U form. The U-shaped FiberTape and traction suture are loaded to a knotless anchor and placed on the footprint area. This creates a 3-point contact between the FiberTape U-suture and the cow hitch knot on the area. We believe that this technique provides fast and reliable fixation due to its 3-point contact application and simplicity.

For many years, tears of the supraspinatus tendon, infraspinatus, and teres minor tendons, known as the posterosuperior rotator cuff, have been the focus of rotator cuff repair. Due to the increased use of shoulder arthroscopy and imaging techniques, the identification and recognition of subscapularis tendon tears have increased significantly.[1]

A review of the history of modern orthopaedics reveals that a study published by Gerber et al. in 1991,[2,3] which described 16 isolated subscapularis tears and their open repairs, drew attention to subscapularis repair. Later, Burkhart and his colleagues[4,5] published the first arthroscopic technique. It is now recognized that subscapularis tendon tears are an important aspect of rotator cuff tendon tear management. The subscapularis is the largest and most powerful rotator cuff muscle.[6] It acts as an internal rotator, but it also contributes to the dynamic stability of the glenohumeral joint with the posterior rotator cuff muscles by creating a force couple effect in the transverse plane.[5-7] With the understanding of the force couple theory, repair of the subscapularis becomes essential. It has been shown that neglecting a subscapularis tendon tear can lead to dysfunction following repair of a posterosuperior rotator cuff tear.[8] Tears typically originate from the articular surface of the upper insertion of the tendon and have a tendency to extend inferiorly.[9] There is a close relationship between the upper part of the subscapularis tendon and the medial sling of the biceps tendon.[5] For this reason, there is an association between instability of the biceps tendon and a tear of the subscapularis tendon. Disruption of the medial sling of the biceps and the tear of the subscapularis tendon results in the formation of a pathoanatomic landmark known as the "comma sign," which can be observed by arthroscopy.[10]

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Rotator cuff tears are generally classified according to size or number of tendons involved. A useful classification system has been identified by Lafosse et al.[9] This includes both the type of tear progression and the surgical repair strategy. However, it is more appropriate for isolated subscapularis tears, which account for around 10% to 25% of all subscapularis tears.[9,11,12] Therefore, Yoo et al.[13] developed a classification system based on footprint anatomy. This classification accurately represents the anatomy of the 4 facets and provides 3 comprehensive classifications for first facet tears, which account for 80% of all subscapularis tears.[13]

The surgical technique discussed in this study targets Lafosse type 1, type 2, and type 3 tears. Additionally, subscapularis tears, which are categorized as type 1, type 2A, 2B, and type 3 in the Yoo and Rhee classification, including the first facet and only the beginning of the second facet, are addressed.

Surgical Technique

The procedure is performed under general anesthesia and interscalene block. The patient is placed in a beach-chair position with an arm holder (Trimano Fortis; Arthrex) and the shoulder is prepared and draped in a sterile fashion. A standard posterior viewing portal is established. This is followed by detailed diagnostic arthroscopy to look for any underlying intra-articular pathology. Then, an anterior portal is established just lateral to the coracoid process and anterior to the acromioclavicular joint (Crystal Cannula; Arthrex). At this step, the location of the anterior portal is critical. If a subscapularis repair is planned, it may be positioned laterally to facilitate access to the footprint area. At this stage, biceps tenotomy is performed (depending on the surgeon's preference, tenodesis can be performed later). Next, the anterolateral portal is placed as the working portal, just anterior to the anterolateral corner of the acromion with a spinal needle. Then, debridement is performed around the subscapularis tear area using an arthroscopic shaver (APS II; Arthrex). If the tendon is retracted and adherent, release can be achieved through the tendon medially. Also, the middle glenohumeral ligament, located just above the tendon, can be resected if it has become adherent and interferes with tendon mobilization. The retractability and tension of the tendon are assessed, at which point coracoidoplasty may also be required to decompress in limited cases. However, it should be noted that the brachial plexus is anatomically close.

Next, the 30° optic can be switched to a 70° angle to provide a better view of the subscapularis footprint repair area from the posterior portal. Then the shoulder is placed in the position of forward flexion and external rotation. The footprint area on the lesser tuberosity should be decorticated and revitalized with a bone cutter (Arthrex) to ensure proper fixation. This process continues until small bleeding areas (strawberry appearance) appear on the bone surface. If necessary, it can be revived using microfractures. Before beginning the repair, the anterior cannula is replaced with a wider cannula or a passport cannula (TripleDam Twist-In Cannula; Arthrex). In the repair phase, the No. 2 FiberWire suture (Arthrex) is folded in half, and the U-shaped end is passed through the superolateral part of the tendon (Fig 1 A and B) and the loop is made on itself and locked (Fig 1C) (cow hitch). A cow hitch is used as a traction stitch (if the retraction is excessive and more releasing is required, medial release can be done further by using this traction suture). Next, FiberTape (Arthrex) is passed through the medial lower part of the tendon just perpendicular to the fibers using a suture passer(Fig 2 A and B) (FastPass Scorpion SL; Arthrex) from the anterolateral portal. The FiberTape is then transferred to the anterior portal (Fig 2C). The other end of the FiberTape, which is left in the anterolateral portal, is reloaded into the suture passer and transferred to the anterior portal by passing through the medial-superior part, just above the previously passed point (Fig 3). The free ends of the FiberTape remain on the anterior side of the tendon, forming a U shape (Fig 4A). Additionally, both sutures must be perpendicular to the fibers to enhance the carrying force. The cow hitch knot is then transferred into the anterior portal (Fig 4B). After that, the point at which to insert the anchor is determined. It is aimed to be placed lateral to the footprint area and just medial to the biceps groove (Fig 5A). The U-shaped FiberTape and cow hitch knot are loaded to threaded knotless anchor together (Fig 5B) and placed in the footprint area (SwiveLock SP; Arthrex). This creates a 3-point contact between the FiberTape U-suture and the cow hitch knot on the footprint area (Fig 5C). Table 1 provides a clear and concise summary of the surgical technique.

A video presentation, accompanied by a voiceover, illustrates the surgical technique described in the following text (Video 1).

Rehabilitation

Following surgery, the patient is placed in a 30° abducted arm sling. The postoperative protocol for repairing the rotator cuff is followed. Rehabilitation begins immediately after surgery with core exercises and tabletop activities without a sling. However, the patient's active internal and external rotation is restricted for 4 weeks. The arm sling is used for 4 weeks postoperatively. Then, around 4 to 5 weeks postoperatively, active assistive range of motion and rotation exercises are started. Once full range of

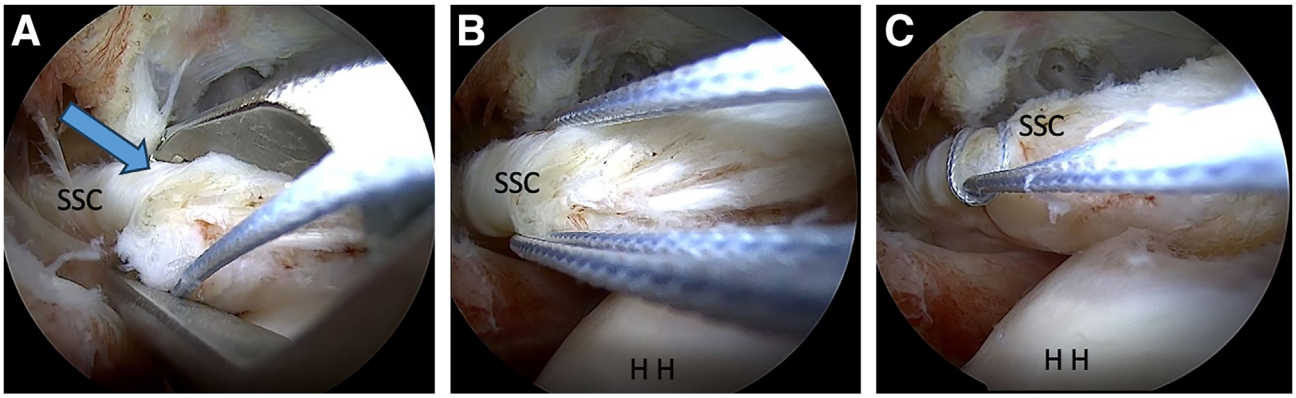

Fig 1. (A, B) The No. 2 FiberWire suture (Arthrex) is folded in half, and the U-shaped end is passed through the superolateral part (blue arrow) of the tendon. (C) The loop is made on itself and locked by using a traction stitch. Right shoulder, with a beach-chair position and posterior portal for viewing with a 70° optic. (HH, humeral head; SSC, subscapularis.)

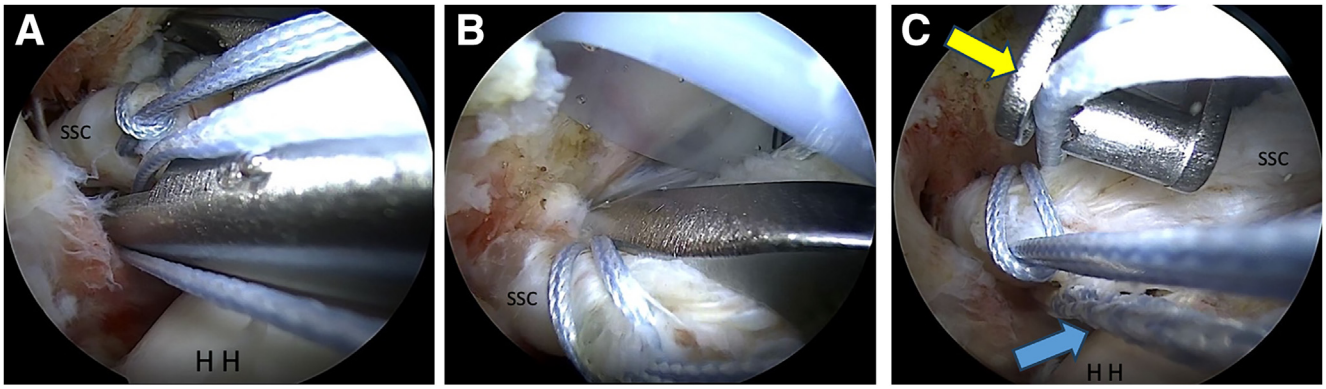

Fig 2. (A, B) Using a suture passer (FastPass Scorpion SL; Arthrex) from the anterolateral portal, the FiberTape (Arthrex) is passed through the medial lower part of the tendon perpendicular to the fibers. (C) Transportation of the upper end (yellow arrow) of the FiberTape to the anterior portal. The blue arrow shows the lower end of the FiberTape, which still remains in the anterolateral portal. Right shoulder, with a beach-chair position and posterior portal for viewing with a 70° optic. (HH, humeral head; SSC, subscapularis.)

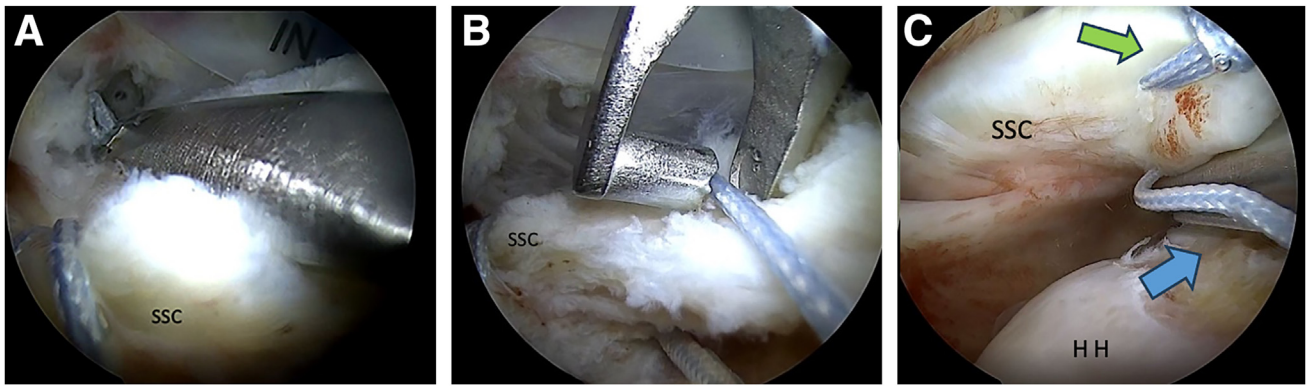

Fig 3. (A, B) Passing the lower end (Fig 2C, blue arrow) of the FiberTape (Arthrex) loaded into the suture passer through the medial-upper part of the tendon just above the previously passed point. (B) Transport of the lower end of the FiberTape to the anterior portal. (C) Under the traction suture (green arrow), the loop part of the fiber suture is seen with the lower and upper ends (blue arrow). Right shoulder, with a beach-chair position and posterior portal for viewing with a 70° optic. (HH, humeral head; SSC, subscapularis.)

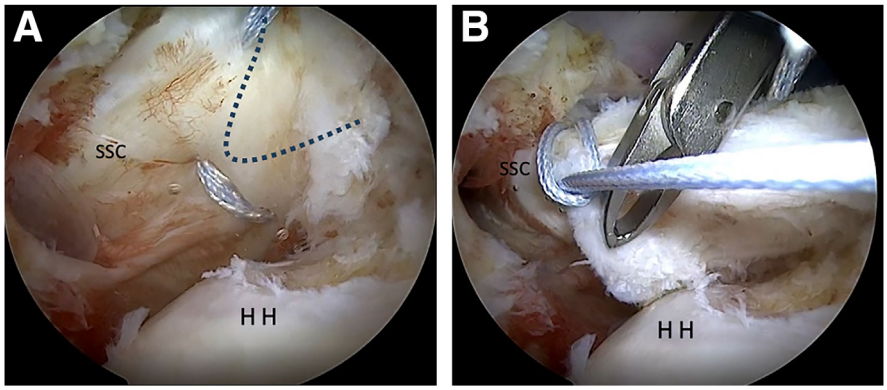

Fig 4. (A) Posterior view of the tendon and U-shaped formation of FiberTape (Arthrex). The upper and lower ends of the FiberTape, which is passed through the tendon shown in the dashed area, are located anterior to the subscapularis tendon. (B) Transport of the traction suture to the anterior portal. Right shoulder, with a beach-chair position and posterior portal for viewing with a 70° optic. (HH, humeral head; SSC, subscapularis.)

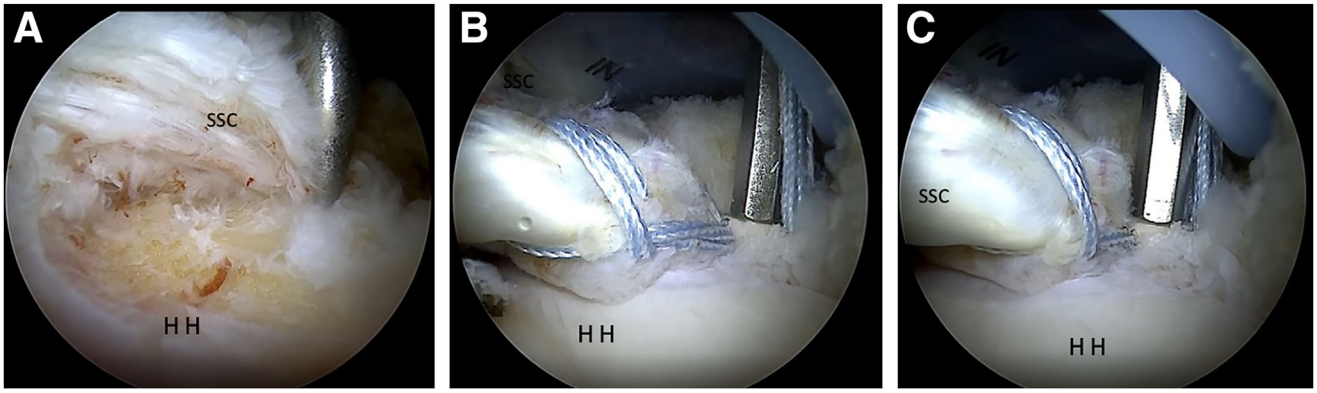

Fig 5. (A) Determination and preparation of the anchor entry point just lateral to the footprint and medial to the bicipital groove. (B) The appearance of the anchor, which is loaded with sutures before the tightening of the FiberTape (Arthrex). (C) The appearance of FiberTape after tightening. Right shoulder, with a beach-chair position and posterior portal for viewing with a 70° optic. (HH, humeral head; SSC, subscapularis.)

Table 1. Steps of the 3-Point Contact Repair Technique for Partial Subscapularis Tears Using the U-stitch and Cow Hitch Knot Loaded on a Single Knotless Anchor

1. A standard posterior viewing portal is established.
2. Diagnostic arthroscopy is started with a 30° optic.
3. The anterolateral portal is placed as the working portal, just anterior to the anterolateral corner of the acromion.
4. A 30° optic can be switched to a 70° angle to provide a better view of the subscapularis footprint repair area from the posterior portal.
5. The footprint area on the lesser tuberosity should be decorticated and revitalized with a bone cutter. This process continues until small bleeding areas (strawberry appearance) appear on the bone surface.
6. In the repair phase, the No. 2 FiberWire suture (Arthrex) is folded in half, and the U-shaped end is passed through the superolateral part of the tendon, and the loop is made on itself and locked (cow hitch).
7. FiberTape (Arthrex) is passed through the medial lower part of the tendon just perpendicular to the fibers using a suture passer (FastPass Scorpion SL; Arthrex) from the anterolateral portal.
8. The FiberTape is transferred to the anterior portal.
9. The other end of the FiberTape, which is left in the anterolateral portal, is reloaded into the suture passer and transferred to the anterior portal by passing through the medial-superior part, just above the previously passed point.
10. The cow hitch knot is then transferred into the anterior portal.
11. The point at which to insert the anchor is determined.
12. It is aimed to be placed lateral to the footprint area and just medial to the biceps groove.
13. The U-shaped FiberTape and cow hitch knot are loaded to the threaded knotless anchor together (SwiveLock SP; Arthrex).
14. After loading the FiberTape into the anchor and placing it in the prepared footprint area, all the FiberTape should be tightened to the final tension.

motion has been achieved, patients can begin active resistance and strengthening exercises after 3 months. After 6 months, patients can return to full activity, including heavy lifting, overhead work, and exercise. If it is a desk job, it is usually possible to return to work 4 to 5 weeks after the surgery. If the profession is suitable to work with an arm sling, it is possible to return to work as early as the second or third week after the surgery.

Discussion

The subscapularis muscle exerts force on the posterior rotator cuff muscle (infraspinatus), increasing axial force—coupled balance through the glenohumeral joint. In recent years, due to its critical role in posterosuperior rotator cuff repair, advances have been made in the identification and repair of subscapularis tendon injuries. Yoon et al.[14] showed that 43.1% of patients undergoing revision rotator cuff repair had neglected subscapularis tears and that fatty infiltration of these initially neglected subscapularis tendons progressed during revision. Furthermore, the rate of retears after repair of neglected subscapularis tears was higher than expected (24%).[11] Another study highlighted the significance of an intact subscapularis for massive and irreparable rotator cuff tears. It has been shown that patients with an intact subscapularis muscle and compensatory teres minor hypertrophy require less surgery.[12]

In recent years, many arthroscopic repair methods have been described for subscapularis tears.[11,12,15] We have described our technique using a single knotless anchor. If a knotless anchor is unavailable or not preferred, this technique can also be used with a knotted anchor. Regarding knotless and knotted anchor reconstruction techniques for full-thickness tears of the upper subscapularis tendon, Sgroi et al.[16] found no significant differences between knotted and knotless groups at load stages from 10 N to 60 N. There were no differences observed between the knotted and knotless groups at any load levels for cyclic gapping and maximum load stiffness. Knotless anchors are simple, fast, and safe. This makes them our preferred choice for subscapularis repair.

Progression of typical rotator cuff failure starts with the failure of 1 fiber or group of fibers, putting more load on adjacent fibers and causing them to fail as well. This is known as the "zipper phenomenon." The technique presented here is highly resistant to the zipper effect by providing 3-point contact from the area where the tear begins.[17]

The most important point we have stated in our surgical technique is that it increases the pressure contact area in the footprint region by creating a 3-point contact and also enhances the holding strength. Also, of course, as with any surgery, it provides the convenience of doing these quickly during a surgery when time is of great importance. Pearls and pitfalls of our technique are further described in Table 2. There are comparisons between double-row and single-row arthroscopic subscapularis repair techniques in the literature.[14,18,19] It is indisputable that the double-row technique is biomechanically and clinically superior for massive tears. There is no disadvantage with the exception that it cannot be used in large subscapularis tears (Table 3). We have defined this technique for Lafosse type 1, 2, and 3 tears. Our technique is an alternative surgical technique to single-row repair used in subcapularis tears, which are frequently encountered and can be evaluated as small tears. We also prefer the double-row repair technique for larger subcapularis tears.

Until scientific data have been assessed in our study for long-term retear and tendon integrity, the technique appears to be at least as favorable as the traditional single-row repair method due to the larger contact area for healing and the secure fixation by making contact at 3 different points at right angles to the muscle fibers.

Disclosures

All authors (M.C., O.K., O.B., I.E., M.D.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Table 2. Pearls and Pitfalls of 3-Point Contact Repair Technique for Partial Subscapularis Tears Using the U-stitch and Cow Hitch Knot Loaded on a Single Knotless Anchor

Pearls
A 70° angle provides a better view of the subscapularis footprint repair area from the posterior portal. Switching to 70° optics before footprint debridement provides additional convenience.
Location of the anterior portal is critical in the subscapularis repair; it may be placed more laterally to facilitate access to the footprint area.
FiberTape (Arthrex) should be passed perpendicular to the subscapularis fibers to increase the strength of the repair.
Pitfalls
The placement of the anchor should be lateral to the footprint area and just medial to the biceps groove. At this point, it is necessary to ensure that the anchor is not in contact with the groove.
After loading the FiberTape into the anchor and placing it in the prepared footprint area, all the FiberTape should be tightened to the final tension. If not, tendon tension may not be maintained.

Table 3. Advantages and Disadvantages of 3-Point Contact Repair Technique for Partial Subscapularis Tears Using the U-stitch and Cow Hitch Knot Loaded on a Single Knotless Anchor

Advantages
The procedure is simple, and the learning curve is short.
The main point of this technique is to increase the pressure contact area in the footprint area, creating a 3-point pressure, and to increase the stability.
Disadvantages
Not suitable for large tears

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