Arthroscopic Shoelace Side-to-Side Repair Technique Using Ultratape for the Treatment of Longitudinal Midsubstance Rotator Cuff Tears

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Abstract: Shoulder arthroscopy is a promising tool for assessing and treating patients with a rotator cuff tear. Arthroscopic rotator cuff repair with suture anchor fixation such as the single-row, double-row, and suture bridge technique are popular procedures that can provide excellent clinical outcomes. On the other hand, longitudinal midsubstance, U-shape, or L-shape tears may benefit more from a side-to-side/margin convergence technique. Despite following the standard side-to-side/margin convergence technique, we continue to see disruption at the site of side-to-side suture margin even with strong sutures. Here, we show our preferred arthroscopic shoelace rotator cuff repair technique using the more durable body tape for a longitudinal U-shape rotator cuff tear.

Shoulder arthroscopy is an evolving tool for assessing and treating patients with rotator cuff tears.[1] A recent suture pattern classification study demonstrated that a suture anchor fixation technique is useful for short and side crescent tear.[2] It has been also recognized that a side-to-side/margin convergence technique for longitudinal U-shape and L-shape rotator cuff tears produces satisfactory outcomes.[3] Another recent study has reported that a margin convergence results in a pronounced reduction in overall strain, and a substantial decrease in gap size is associated with each additional suture.[4] However, in some cases with longitudinal L-shape or U-shape tears, residual tendon stump is significant.[2] If the residual portion of the lateral rotator cuff is thin, it has been generally managed by completing the tear and dissecting the tendon stump to allow a standard rotator cuff repair using suture anchors.[5] Restoring the normal insertional anatomy should promote healing and theoretically re-create the biomechanical properties of the shoulder's tendon-to-bone contact.[2] Despite performing the standard side-to-side/margin convergence technique with strong sutures, some patients experience disruption of the side-to-side suture margin at the surgical site. We devised a rotator cuff repair surgical technique for longitudinal tears that uses a smooth suture tape (Ultratape; Smith & Nephew, Andover, MA) while preserving the tendon stump (the shoelace technique). The purpose of this technical note is to describe an arthroscopic shoelace rotator cuff repair for treating a longitudinal U-shape rotator cuff tear.

Surgical Technique

Preparations for Rotator Cuff Repair

The patient was placed in beach chair position under general anesthesia. A posterior portal, anterior portal, anterolateral portal and posterolateral portal were created. First, we assessed the glenohumeral joint. A subscapularis tendon tear was observed. The subscapularis tear was addressed with 3 single sutures and

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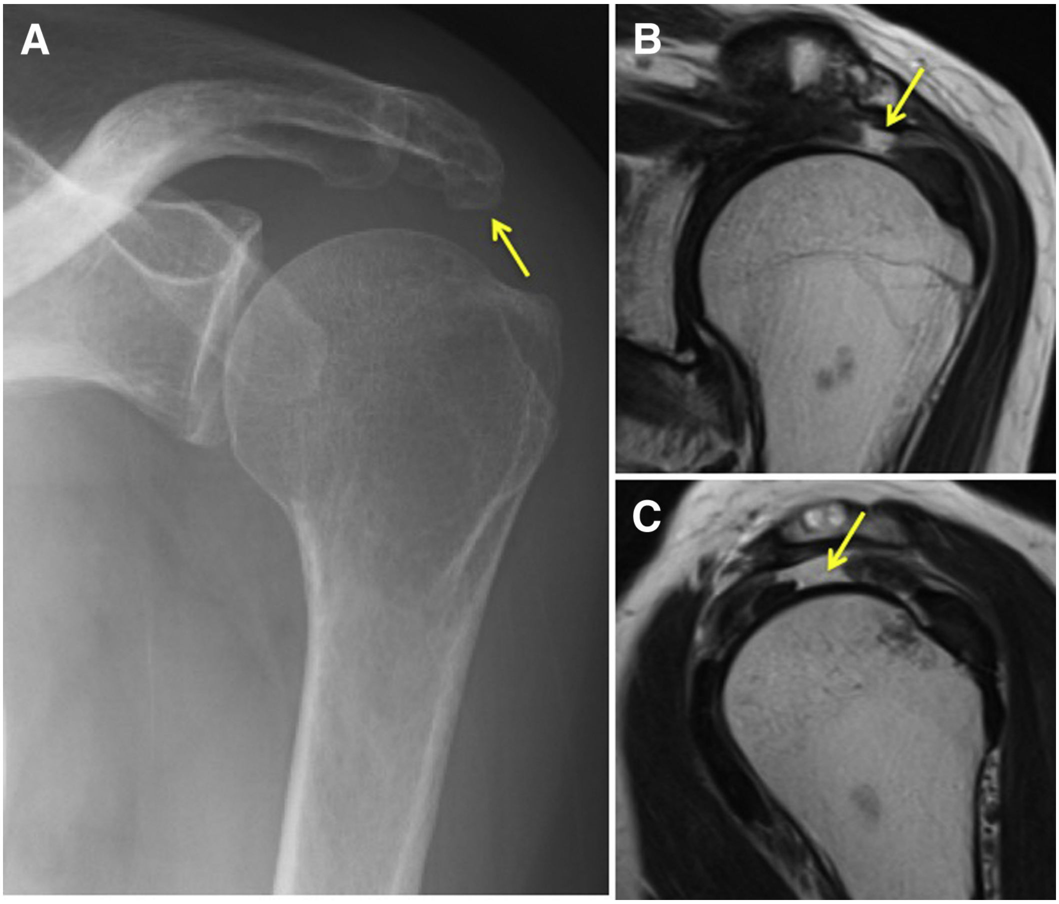

Fig 1. (A) A left shoulder anteroposterior radiograph showing osteophyte formation at the acromion (arrow) with sclerosis of the greater tubercle. (B) A T2 coronal view and (C) sagittal view on magnetic resonance image showing an area of high intensity suggestive of an SSP tear (arrows). (SSP, supraspinatus.)

suture anchors (Healix Advance BR; DePuy Mitek, Raynham, MA). The scope was switched into the subacromial space. Subacromial decompression was performed at this time if indicated based on preoperative imaging (Fig 1) and a thorough physical examination. Adequate subacromial decompression and

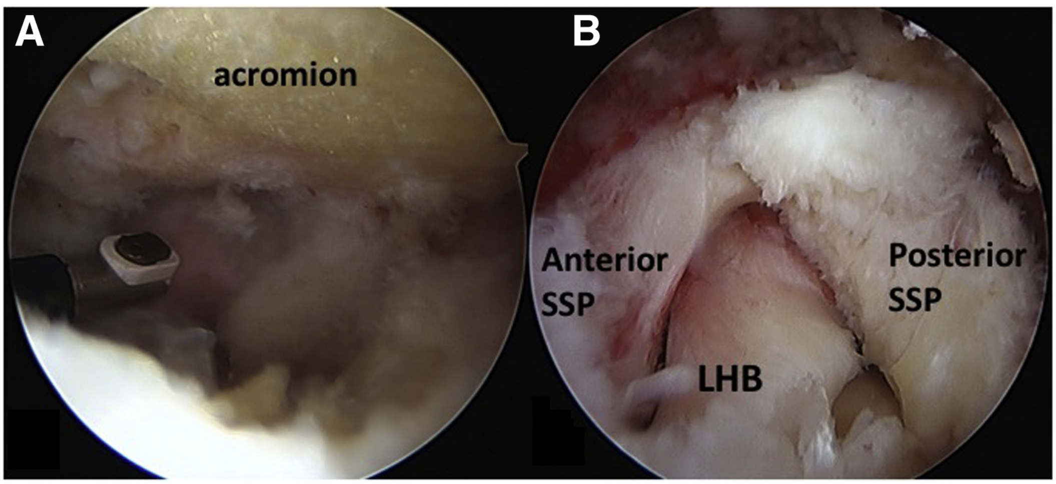

Fig 2. (A) Adequate visualization and working space was obtained after arthroscopic subacromial decompression. (B) Arthroscopic findings through the anterolateral portal on a left shoulder in beach-chair position showing the injured SSP and underlying LHB tendon. (LHB, long head of biceps; SSP, supraspinatus.)

synovectomy permit good visualization and a secure working space for cuff repair (Fig 2A). The longitudinal U-shape supraspinatus (SSP) tear was observed after subacromional decompression and synovectomy (Fig 2B).

Introducing Ultratape to SSP Tendon Using Suture Shuttle Device

The SSP tendon stump was preserved as much as possible using a shoelace suture technique with Ultratape (Smith & Nephew). Using a scope from the anterolateral portal for direct visualization, a suture shuttle device (Accu-Pass; Smith & Nephew) was introduced through the posterior portal and used to pass a suture loop through the posterior side of the SSP tear at the proximal end (Fig 3A). A 35° angled Arthropearce penetrator (Smith & Nephew) was then used to retrieve the lasso through the torn SSP on the anterior side of the SSP tear through the anterior portal (Fig 3 B and C). A bodytape (Ultratape; Smith & Nephew) was then passed through the suture lasso and retrieved with a suture loop through both sides of the SSP tear from the anterior portal to the posterior portal. Then, the Ultratape was passed across from anterior side of the SSP to its posterior side at the proximal end of the tear (Fig 3D).

Proceeding Shoelace Suture With Suture Shuttle Device

Next, a suture shuttle device was used to pass another suture loop through the anterior end of the SSP tear 6 to 7 mm distally from first suture limb at the proximal side of the longitudinal SSP tear. A suture lasso was retrieved at the bursal side of the SSP. The distal limb of the Ultratape was grasped and pulled through the suture lasso. A suture lasso was retrieved with Ultratape and passed through the anterior side of the SSP tear (Fig 4A). Similarly, a suture passer was passed through the posterior side of the SSP tear 6 to 7 mm posterior to the distal limb of the Ultratape (Fig 4B). A suture lasso

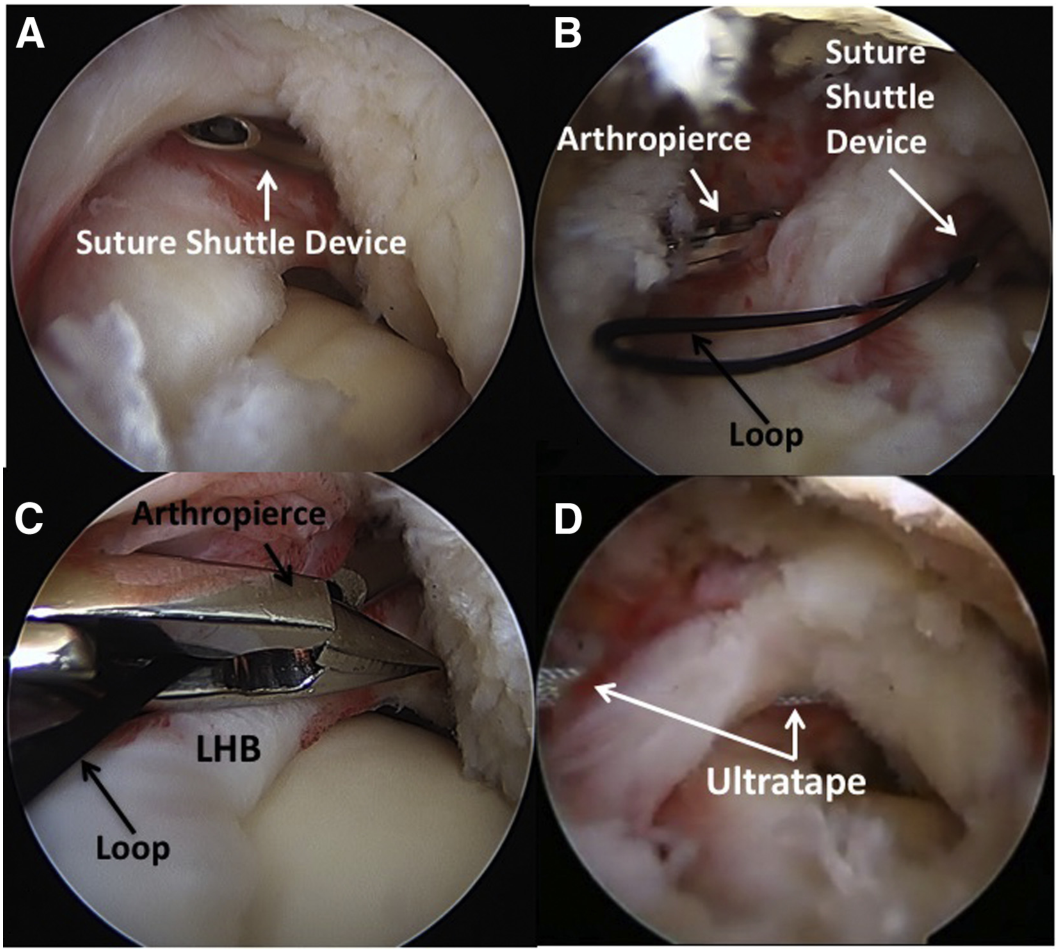

Fig 3. (A) A suture shuttling device is seen passing a suture loop from superficial to deep through the SSP on the posterior side into the glenohumeral joint. (B) A 35° angled Arthropierce penetrator is shown penetrating the anterior side of the SSP and (C) retrieving the lasso through the anterior side of the SSP. (D) A bodytape (Ultratape; Smith & Nephew) was passed through the SSP at the proximal end of tear. (SSP, supraspinatus.)

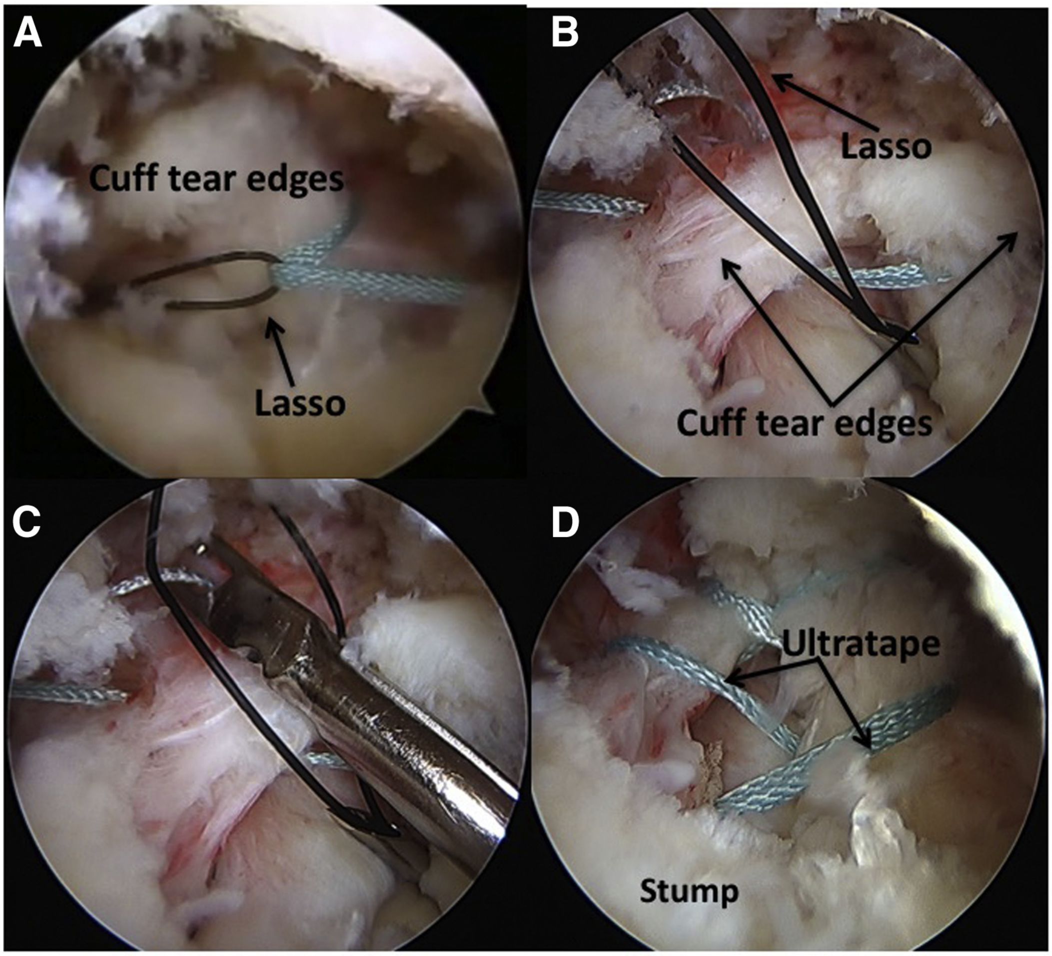

Fig 4. (A) A suture loop is passed through the SSP 6-7 mm distally from the first suture of the SSP tear. After retrieving the lasso, an Ultratape was passed through the suture lasso. (B, C) Similarly, another suture loop was retrieved through the other end of the SSP tear. (D) Repeated suture loop retrieval forms a shoelace suture. (SSP, supraspinatus.)

was retrieved on the bursal side of the SSP. The proximal limb of the first Ultratape was grabbed and passed through the suture lasso (Fig 4C). A suture lasso was retrieved with Ultratape and passed through the posterior side of the SSP tear. This procedure was repeated at least twice depending on the severity and extent of the SSP tear (Fig 4D).

Finalizing Shoelace Suture With Knot Tying

Finally, a suture passer was passed through the tendon stump of the SSP at the greater tubercle. The free end of the Ultratape was grabbed and passed through the suture lasso (Fig 5 A and B). A suture lasso was retrieved with Ultratape and passed through the tendon stump of the SSP at the greater tubercle of the humerus. Both limbs of the Ultratape are retrieved through a Clear Trac Cannula (DePuy Mitek) and gradually pulled and tightened through the cannula to achieve adequate tension (Fig 5C). Finally, knot tying was performed and the skin was closed in a standard fashion to complete the procedure (Fig 5D). Indications and contraindications as well as the advantages and disadvantages of this surgical technique are summarized in Tables 1 and 2, respectively (Video 1).

Discussion

This Technical Note describes an arthroscopic shoelace rotator cuff repair technique using Ultratape for the treatment of a longitudinal L-shape rotator cuff tear. Rotator cuff tear patterns and methods of repair have been described by several studies, but none of the existing systems have been widely adopted because these tears are often associated with several comorbidities such as subscapularis tears, biceps tendon tears, or cuff fatty degeneration. No one treatment method is superior to the others as these comorbidities are patient dependent, and each cuff repair should be individually considered. Davidson geometrically classified the rotator cuff tears into 4 types according to magnetic resonance imaging findings and recommended 3 repair techniques: single-row, double-row, to suture bridge.[3,6]

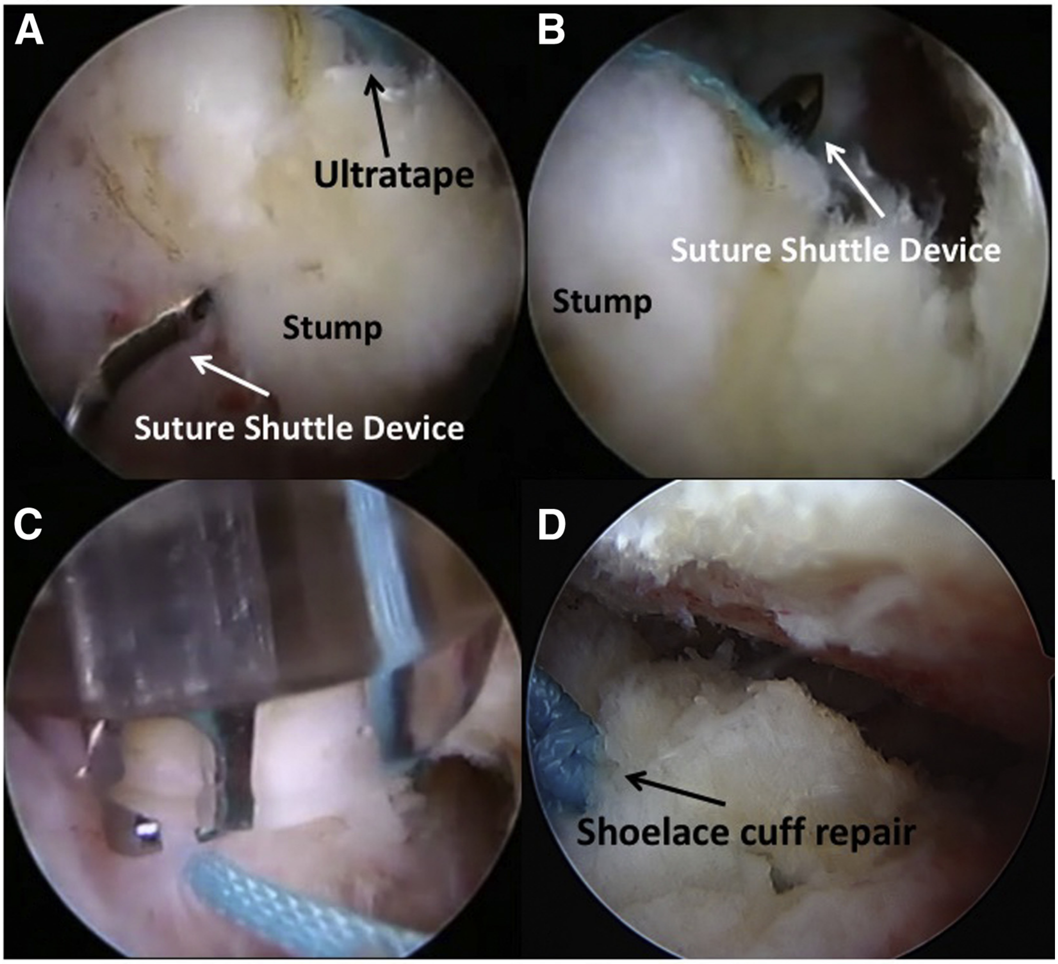

Fig 5. (A, B) A suture shuttle device was passed through the tendon stump of the SSP at the greater tubercle and retrieving Ultratape. (B) Both limbs of the Ultratape are retrieved through a Clear Trac Cannula. (C) Arthroscopic image showing the final construct of the shoelace sutures after tying the Ultratape as viewed from the posterolateral portal. (SSP, supraspinatus.)

Several biomechanical studies examined rotator cuff strain after side-to-side/margin convergence for a retracted rotator cuff tear.[4] Although margin convergence decreases the size of the tear gap and reduces strain during knot tying, the re-tear rate varies from 19% to 47.8%.[7-9] Considering the variable and relatively high retear rate, the shoelace suture technique may potentially provide a solution for the issue. In addition, there are reports of other orthopaedic techniques that suggest a shoelace wound closure was a stronger construct than other types of sutures in cases following leg fasciotomy for compartment syndrome.[10] The shoelace suture technique could enable a more secure and stable rotator cuff repair compared with side-to-side/margin convergence repair method. This technique allows tendon stump preservation, which is advantageous as it promotes good tendon healing for partial-thickness tears of the rotator cuff.[11] The shoelace suture technique allows for not only vertical sutures but also horizontal mattress sutures. Moreover, it reduces the number of suture anchors required to adequately repair an injured rotator cuff. The disadvantage of this technique is that it is technically demanding and therefore can initially increase the operative time. In conclusion, the shoelace technique for the treatment of longitudinal L-shape or

Table 1. Indications and Contraindications of the Technique

Indications	Contraindications
Longitudinal U-shape tear	Short and wide crescent tear
Longitudinal L-shape tear	Massive contracted tear
	Cuff tear arthropathy

Table 2. Advantages and Disadvantages of the Technique

Advantages	Disadvantages
Stronger construct than single-stich margin convergence suture	Poor visualization
Allows preservation of the cuff stump	Technically challenging
Reduces use of suture anchors	

U-shape rotator cuff tear with strong body tape provides a more durable cuff repair.

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