Arthroscopic Repair of Massive Subscapularis and Supraspinatus Tear by Double-Row Knotless Technique

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Abstract: Subscapularis is the most powerful muscle in the rotator cuff. A steep learning curve and constrained space anteriorly make the repair difficult. In massive tears of the rotator cuff, repair of the subscapularis initially makes the massive supraspinatus tear repairable. We present our technique to repair subscapularis and supraspinatus tear by double-row anchors in a knotless and tension-free manner. This technique can be done in partial or full-thickness tears of the upper subscapularis.

The subscapularis is the largest among the rotator cuff muscles[1] and is more important for arm elevation than the supraspinatus or infraspinatus.[2] Since it is the only anterior rotator cuff muscle, repair must be accomplished to balance the posterior forces of the rotator cuff. The upper portion of the subscapularis is particularly important as this is the part of the insertion that is broadest superiorly, and this site serves as the anterior attachment of the rotator cable.[3,4]

Subscapularis repair has been less described than the supraspinatus and infraspinatus tears in the literature. Repair of a torn subscapularis tendon is critically important to restore anatomy and achieve the best functional outcome possible. Constrained space anteriorly also makes subscapularis repair more difficult. Adequate visualization and understanding of the tear are necessary for repair. A systematic approach can then be used to arthroscopically repair all types of subscapularis tendon tears, from partial tears to full-thickness tears, as well as those that are retracted and have adhesions medially. For massive tears, double-row repair has a larger footprint and better strength compared with single row.[5,6] In a conventional suture bridge technique with medial knot, there may be a possibility of strangulation of the rotator cuff tendon at the medial row. Our technique using knotless suture bridge with double-row anchors has lower retear rates.[7] This Technical Note describes our approach to arthroscopic management of subscapularis and supraspinatus repairs (Video 1).

Surgical Technique

Preoperative assessment done by clinical examination and magnetic resonance imaging. Belly press test and Gerber's liftoff sign were positive, diagnostic of subscapularis weakness. Jobe's test was positive for supraspinatus tear. General anesthesia with regional interscalene block is preferred.

The patient is placed in the beach chair position with an assistant to hold the arm in the desired position. Glenohumeral diagnostic arthroscopy is performed using standard posterior portal using 30° scope, and the arthroscope is shifted to the subacromial region (Fig 1A). Subacromial decompression, acromioplasty, and bursectomy are performed to improve visualization. The accessory-anterior portal is established in the rotator interval region after localization with a spinal needle by an inside-out technique. The needle is then replaced with a 7-mm threaded arthroscopic shoulder cannula (Conmed Linvatec). A 70° arthroscope is used for subscapularis repair. The subscapularis tear is identified, and the edges of the tear are freshened. Biceps

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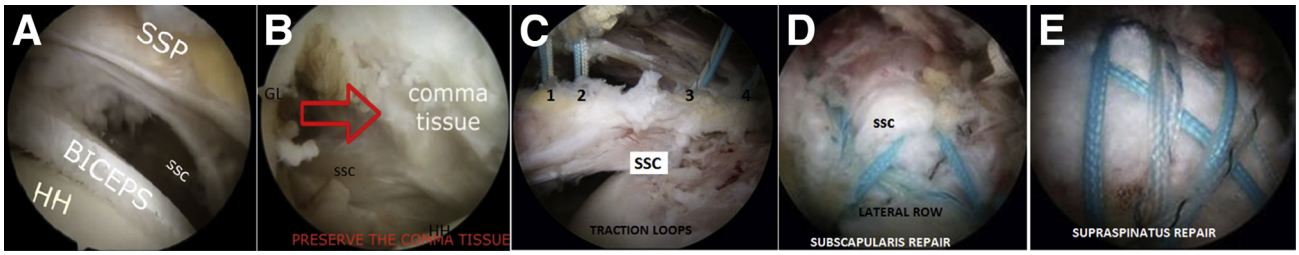

Fig 1. (A) Massive supraspinatus and subscapularis tear (from posterior portal) with 30° scope, patient in beach chair position. (B) Comma sign from posterior portal with 70° scope. (C) Suture loops (total 4) for traction. (D) Final subscapularis repair from posterior portal with 70° scope. (E) Final supraspinatus repair from posterior portal with 30° scope.

tenotomy is done with radiofrequency. Reduction of the tear is checked with a grasper. The rotator interval is cleared. Mobilization of the subscapularis is done by triple release. Clearing of rotator interval, release of medial glenohumeral ligament and capsule, and subcoracoid release are performed. Suture loops are passed through the subscapularis muscle using Truepass (Smith & Nephew) to give traction (Fig 1C). The footprint is identified and prepared by microfracture. One triple-loaded (Y knot, Conmed Linvatec) and one double-loaded (Healicoil PK, Smith & Nephew) anchor suture are inserted to form the medial row. Suture loops are replaced one by one by the anchor sutures, and the suture bridge technique is performed. Arm is rotated externally, and the surface is prepared for lateral row. Knotless anchors (Poplok, Conmed & PEEK, Smith & Nephew) are inserted on the lesser tuberosity to form the lateral row after adequate tensioning (Fig 1D). Supraspinatus tear is examined again. It appears to reduce better after subscapularis repair. Supraspinatus tear is reduced with an apex knot and repaired by a tensionless double-row suture bridge technique in a similar manner (Fig 1E). After repair, the arm is internally and externally rotated to confirm stability of the repair (Video 1). The postoperative protocol consists of abduction sling immobilization with slight internal rotation for 6 weeks.

Patients are limited to early pendulum shoulder exercises. Passive range of motion is performed only under the supervision of a physical therapist for the first 6 weeks, with no external rotation past 45°. At 6 weeks postoperatively, active assisted range of motion is initiated with a gradual progression to full range of motion. Strengthening exercises begin 12 weeks after the surgery. Other activities and return to sports are permitted after 6 months.

Discussion

Subscapularis tears have been treated conservatively for 2 reasons. First, it is difficult to visualize and treat other than the upper third of the subscapularis muscle by 30° arthroscope. Second, the small space in the anterior region makes it difficult to maneuver the instruments. Studies have shown that balance between the anterior and posterior rotator components is a must for efficient functioning of the cuff.[4]

The long head of the biceps is found to be commonly involved in subscapularis tears. It could be frayed or completely torn and retracted distally with the empty bicipital groove on magnetic resonance imaging. Decision regarding tenotomy or tenodesis of the biceps tendon depends on the age and activities of the patients. Most young patients or those involved in active sports need tenodesis. Elderly patients do well with tenotomy alone. Popeye sign could be seen as a sign of prolonged retraction of the torn biceps tendon.

In addition, in cases in which debridement of surrounding tissue and footprint preparation are inadequate or visualization is limited, there is a risk of medialization of the footprint of the subscapularis tendon. Previous studies have showed that medialization of 4 to 7 mm does not alter the biomechanics.

The comma sign[8] is the marker for arthroscopic repair of anterosuperior rotator cuff tear. It is an arc formed by a portion of the superior glenohumeral ligament/coracohumeral ligament complex. It is a useful marker of the superolateral corner of the torn

Table 1. Key Points and Tips and Pearls

Key Points
1. Adequate release of subscapularis is needed.
2. Microfracture of the bed is a must for healing of the tendon.
3. A 70° arthroscope makes it more convenient to see the anterior space.
4. Subacromial decompression and acromioplasty at the start of the procedure give more working space.
5. Externally rotate the arm before placing lateral anchor.
Tips and Pearls
1. Multiple suture loops from upper middle and inferior part of the tendon help pull the tendon and reduce it.
2. Same loops can be used to pass the anchor sutures from the medial side of the tendon.
3. There are only 5 holes in the subscapularis muscle, but 10 sutures minimize the damage to the muscle.
4. It is important to take bites in the full thickness of the tendon, so using a grasper to pull the tendon laterally is helpful to take proper bites.

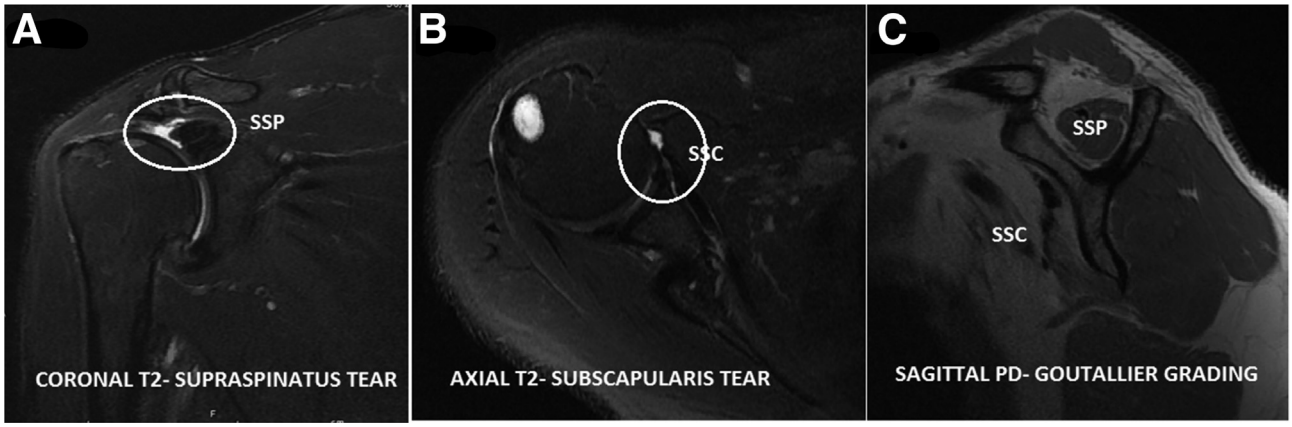

Fig 2. Magnetic resonance imaging preoperative. (A) Coronal T2, supraspinatus tear. (B) Axial T2, subscapularis tear. (C) Sagittal Proton Density (PD) image, Goutallier grade, supraspinatus gr 2, subscapularis gr 4.

subscapularis tendon. During repair of the retracted subscapularis tears that are adherent to the deltoid fascia, it is difficult to identify the subscapularis stump without recognizing the comma sign. Adequate clearing of the rotator interval and the triple release of the subscapularis allow the retracted tendon to be pulled back for repair.

In our technique, we use a 70° arthroscope for subscapularis repair and a 30° one for the rest. This saves the time needed to manipulate a 30° scope in the narrow space. The push lever arm is done by flexing the shoulder and pushing it back to create more space for repairing the subscapularis. Suture loops are used effectively to give traction. Later the same suture loops are replaced by the anchor sutures in the medial part of muscle. Massive cuff tears can be treated by this technique and repaired by the tension-free suture bridge (Table 1). Improvement in Goutallier grading has been observed in our experience as we consider the muscle fibers seen before and after surgery. Some authors who consider fatty streaks only for grading did not observe any change after surgery (Figs 2 and 3).

Very large and retracted tears benefit from a double-row repair, which can create a larger footprint. Biomechanical evaluation has suggested superior strength and stiffness in double-row repairs.[5,6] A quick and effective technique for repair is ideal because it allows time for treatment of associated pathology before fluid distension limits visibility, particularly if the surgeon is working in the subacromial space. Knotless arthroscopic repair of the subscapularis tendon tears using a looped suture can be done quickly. This technique combines the advantages of earlier techniques and has lower retear rates compared with conventional suture bridge with medial knot tying.[7]

There is no knot on medial row; if the bone quality is not good, all constructs will fail. Knotless repair needs good bone to hold. Therefore, bone quality must be known before performing this technique. Six

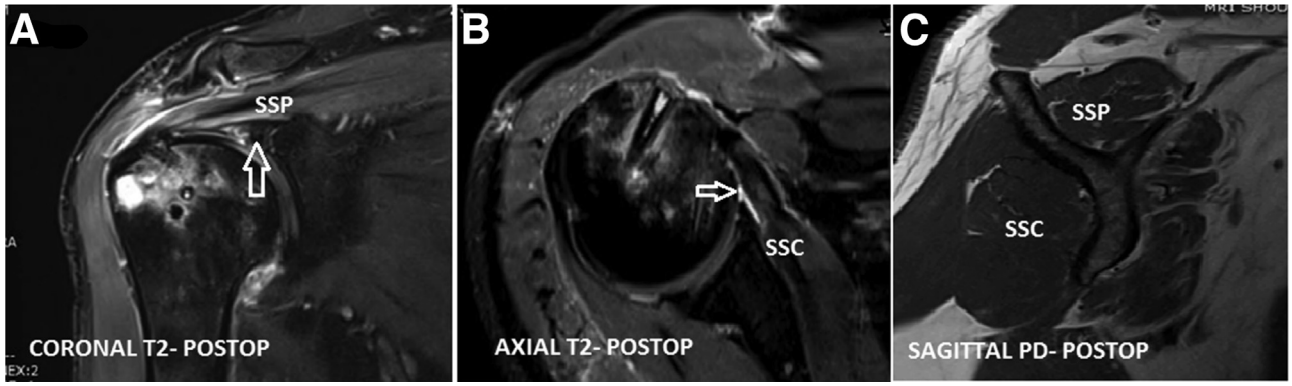

Fig 3. Magnetic resonance imaging postoperative (6 weeks). (A) Coronal T2, repaired supraspinatus with double-row suture bridge. (B) Axial T2, repaired subscapularis with double-row suture bridge. (C) Sagittal Proton Density (PD) image, Goutallier grade, supraspinatus gr 1, subscapularis gr 1.

Table 2. Advantages, Limitations, and Disadvantages

Advantages
1. Suture loops are good for giving the traction and to pass anchor sutures medially.
2. Triple release frees the retracted tendon to close the gap.
3. After the repair of the subscapularis, massive supraspinatus tear becomes repairable.
4. Using a knotless technique prevents strangulation and reduces medial tear.
5. Knotless anchors can save time to treat associated pathologies before the fluid distension can limit visibility.
Limitations and Disadvantages
1. A 70° scope is needed for proper visualization.
2. The strength of the healed tendon is not known; no studies related to it could be found.
3. There is no knot on the medial row; if the bone quality is not good, all construct will fail. Knotless repair needs good bone to hold.
4. Failure to externally rotate the arm to neutral before anchor placement leads to overtensioning of the repair.
5. Poor visualization can lead to inadvertent medialization of the footprint.

weeks postoperative magnetic resonance imaging shows a repaired cuff with improved Goutallier grading (Table 2).

Research is needed for further studies on the biomechanical properties of this technique.

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