Technical Note

Repair of Massive Rotator Cuff Tear With Medialization and Balloon Spacer Insertion

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Abstract: Retracted massive rotator cuff tears can be challenging to repair. Reduction of the retracted tendon to the native footprint may result in a repair with excessive tension. Repair under excessive tension predisposes to increased tendon retear rates. Footprint medialization involves securing the tendon medial to the anatomic footprint, resulting in decreased tension during repair. Several surgical adjuncts can also be employed to reinforce such tears so as to reduce the risk of retear. The aim of this Technical Note is to describe a surgical technique of rotator cuff repair with medialization of the footprint combined with a balloon spacer insertion.

Large to massive rotator cuff tears with retraction can be challenging to repair.[1,2] In addition, factors such as significant retraction and chronicity increase the technical difficulty for a tension-free repair.[3] In significant retraction to the level of the glenoid (Patte[4] 3), surgeons face difficulty in reducing the tendon to the native footprint on the humeral head (Fig 1). Even if this is achievable, it can often lead to excessive tension on the rotator cuff tendon after repair. This excessive tension can result in increased retear rates.[5] In addition to aggressive scar tissue release, there are several surgical techniques to aid the reduction of a severely retracted tear. These include interval slides, margin convergence, and medialization. Medialization is a technique employed when reattachment of the tendon to the native footprint is not achievable.[6] This technique reduces tension by shifting the native anatomic footprint of the rotator cuff tendon medially. Disadvantages of this technique include concerns regarding reduction of the moment arm of the cuff tendon as well as a loss of range of motion due to the reduction of humeral head articular surface area. Biomechanical studies have demonstrated that medialization should respect an upper limit of 10 mm to avoid these possible complications.[7]

Some authors have also advocated using reinforcement techniques to bolster repair integrity and success rates.[8,9] These include mechanical and biologic adjuncts such as dermal allograft patches and the native bicep tendon. The subacromial balloon spacer (InSpace balloon; Stryker) is a biodegradable device made from poly (l-lactide-co-ε-caprolactone) that has been used for massive irreparable rotator cuff tears. It functions to reduce friction between the humeral head and the acromion, as well as to depress the humeral head inferiorly to restore some degree of normal shoulder kinematics. Its main indication is in irreparable rotator cuff tears, with or without a concomitant partial repair.[10] There is some evidence to suggest that it is effective in improving contact area and protecting the rotator cuff repair.[11] This Technical Note aims to describe our surgical technique for medialization in combination with balloon spacer insertion for retracted large to massive rotator cuff tears.

Surgical Technique

Preoperative Patient Positioning

The surgical procedure is performed with the patient under general anesthesia in either a beach-chair or lateral decubitus position. The authors' preference is for a lateral decubitus position (Video 1). The head is kept in a neutral position while the patient's body is supported with the aid of a beanbag. The operative arm is

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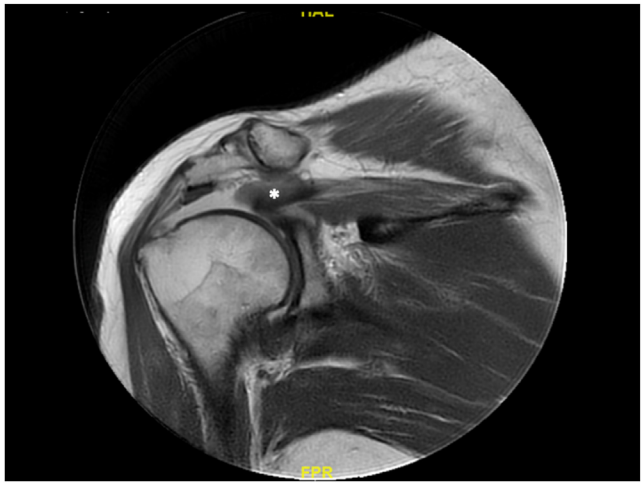

Fig 1. T2-weighted magnetic resonance imaging scan (coronal image) of the right shoulder showing a complete and retracted (Patte 3) supraspinatus tear (white asterisk).

placed in an arm sleeve connected to the shoulder traction tower with 10 lbs of traction.

Portal Placement

A standard posterior viewing portal is placed 2 cm inferior and medial to the posterolateral corner of the acromion. An anterior portal is placed via an inside-out method, lateral to the coracoid process. A subacromial lateral portal and accessory lateral portal are created for the rotator cuff repair as well as for introduction of the balloon spacer.

Evaluation of the Glenohumeral Joint

Via the initial posterior viewing portal, a diagnostic arthroscopy is performed with a 30° arthroscope. The biceps tendon is inspected and the appropriate biceps procedure (tenotomy or tenodesis) can be performed if indicated. The subscapularis tendon is inspected for any existing tears and repair is performed if indicated.

Rotator Cuff Repair

The rotator cuff is inspected via the direct lateral portal (Fig 2). The quality of tendon, tear morphology, and degree of retraction are assessed. Rotator cuff mobility is determined using a grasper via an accessory lateral portal. In severely retracted large to massive supraspinatus tears, an anterior interval slide can be performed by releasing adhesions on both the bursal and articular sides. In this case, there was poor mobility of the supraspinatus. It improved after an anterior interval slide, but there was significant tension on the tendon, and it was unable to reach the native footprint.

Measurement of the Spacer Balloon Size

Prior to performing rotator cuff repair, the distance between the glenoid and the greater tuberosity is measured to determine the appropriate spacer balloon size. Via the posterior viewing portal, a probe is used to measure the medial to lateral distance from the glenoid rim to the greater tuberosity (Fig 3). In this case, a medium-sized spacer balloon was deemed appropriate.

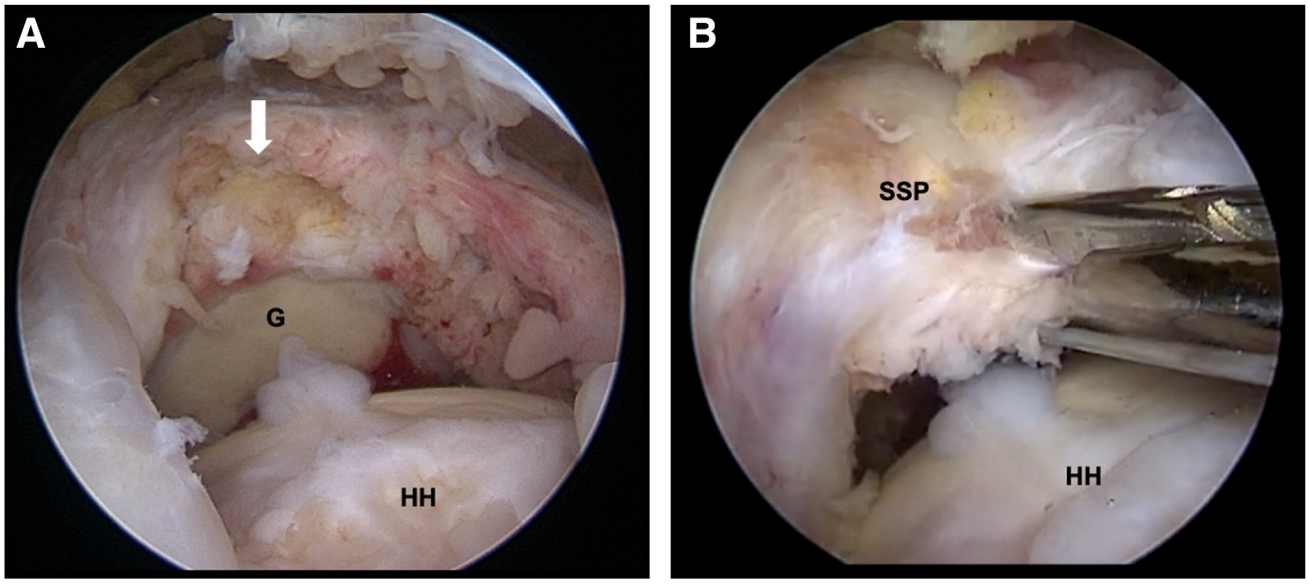

Fig 2. Right shoulder with patient placed in a lateral decubitus position and viewing from the lateral portal. (A) A massive rotator cuff tear is seen with retraction to the level of the glenoid (white arrow). (B) After release of the adhesions, it is noted that the tendon tissue is unable to be reduced to the native footprint without excessive tension. (G, glenoid; HH, humeral head; SSP, supraspinatus tendon.)

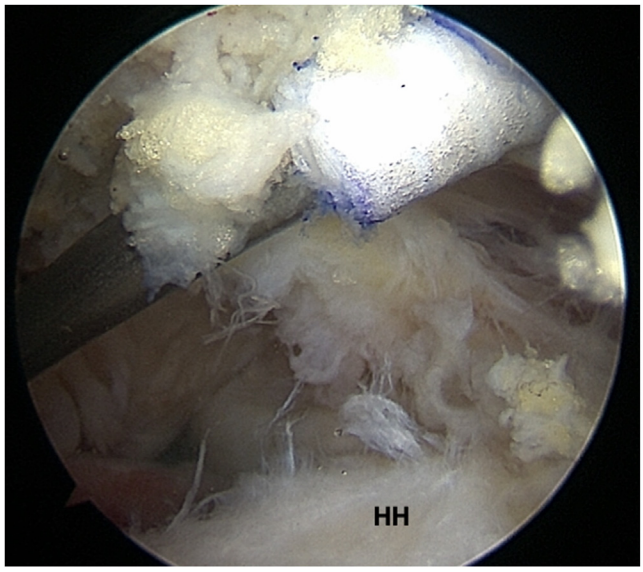

Fig 3. Right shoulder with patient placed in a lateral decubitus position and viewing from the posterior portal. Sizing of the balloon is performed prior to the rotator cuff repair. A probe is used to measure the distance from 1 cm medial to the glenoid edge, to the lateral edge of the greater tuberosity. A tape corresponding to a medium-sized balloon is placed onto the probe prior to introduction. This allows for appropriate sizing of the balloon. (HH, humeral head.)

Greater Tuberosity Footprint Preparation

The greater tuberosity footprint is prepared by removing the soft tissue off the rotator cuff footprint.

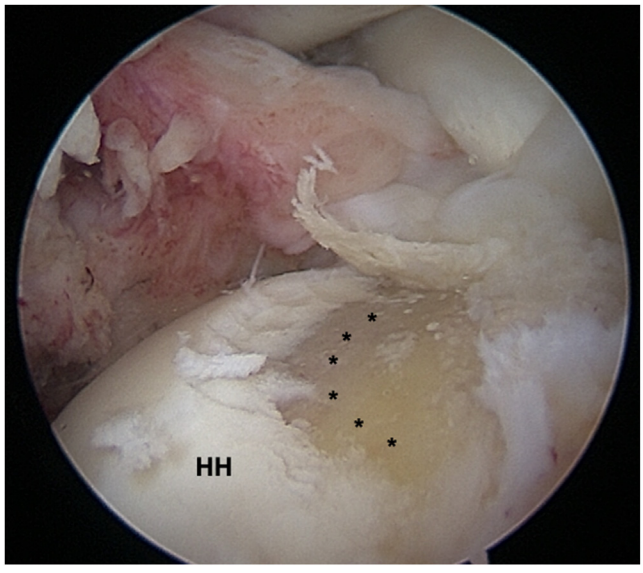

Fig 4. Right shoulder with patient placed in a lateral decubitus position and viewing from the posterior portal. Removal of cartilage over the lateral aspect of the humeral articular surface is performed, using a combination of a radiofrequency ablator, curette, and burr. Asterisks indicate medialized footprint with native cartilage removed. (HH, humeral head.)

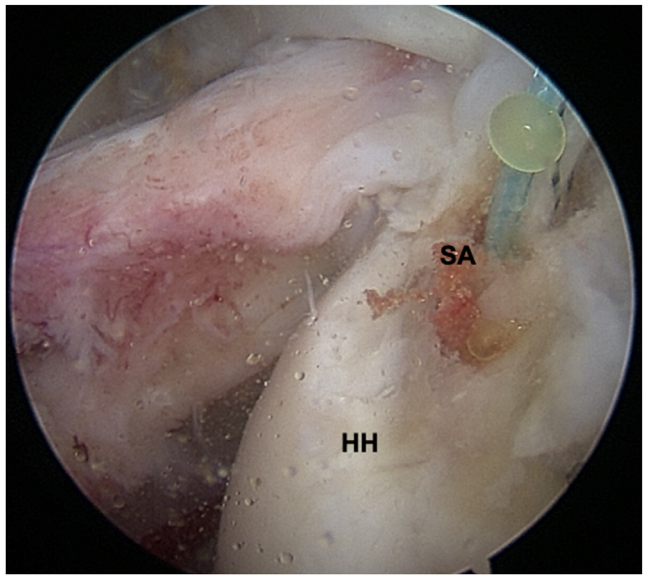

Fig 5. Right shoulder with patient placed in a lateral decubitus position and viewing from the posterior portal. The suture anchor is placed just lateral to the cartilage margin, within the newly medialized footprint. (HH, humeral head; SA, suture anchor.)

The greater tuberosity is gently decorticated to improve healing of the tendon. In this case, as a tension-free repair was not possible, the decision for medialization was taken. A 5-mm rim of cartilage was removed using a combination of the radiofrequency ablator, burr, and

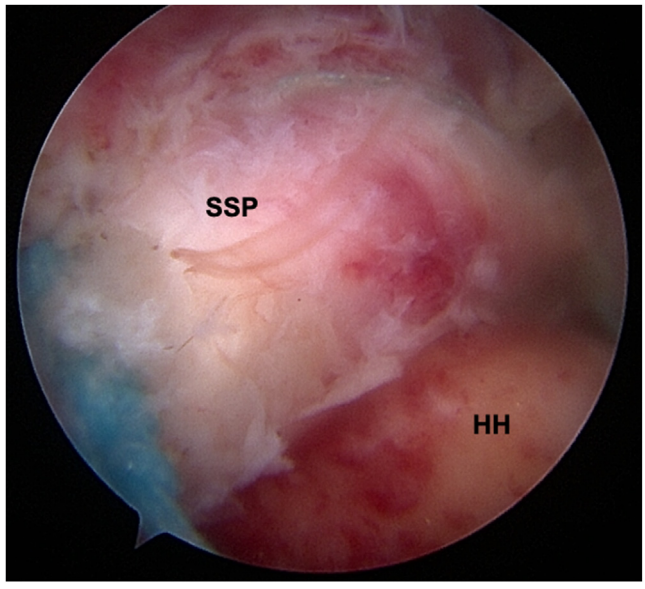

Fig 6. Right shoulder with patient placed in a lateral decubitus position and viewing from the lateral portal. Final repair is seen with a tension-appropriate repair of the supraspinatus onto the humeral head. (HH, humeral head; SSP, supraspinatus tendon.)

curette (Fig 4). Care is taken not to medialize the footprint by more than 10 mm.

Anchor Placement and Supraspinatus Repair

The medial row suture anchors are placed in a position medial to the anatomic footprint (Fig 5). This may require 2 to 3 anchors, depending on the size of the tear. The sutures are then passed through the tendon via either an antegrade or a retrograde passer. In cases of higher tension, a single-row medialized repair may be preferable (Fig 6).

Balloon Spacer Insertion

The appropriately size spacer balloon is prepared. The cannula is introduced from the lateral portal, and the tip of the cannula is placed 1 cm medial to the glenoid face. The black mark on the cannula should align with the lateral border of the acromion. Once the cannula is in the appropriate position, the sheath is withdrawn and the balloon is then inflated with saline solution via a Luer lock syringe attached to the cannula. Depending on the size of the balloon inserted, the appropriate volume of saline is pushed in, before allowing some backflow of the saline solution to achieve the final volume. The shoulder is then ranged to determine appropriate siting and stability of the spacer balloon.

Postoperative Protocol

The operated upper extremity is placed in a sling for a total of 6 weeks postoperatively. Range-of-motion exercises commence after 6 weeks, and a progressive strengthening program is then implemented.

Discussion

Arthroscopic rotator cuff repair is a common orthopaedic procedure. Tendon quality, tear morphology, degree of fatty infiltration, and degree of tendon retraction are established prognostic factors for successful repair.[4] In particular, the degree of tendon retraction can make it challenging to achieve a tension-free repair to the native tendon footprint. In such cases, surgeons may opt for partial repair or use adjunct surgical techniques to augment the repair so as to reduce retear rates. Bozkurt et al.[12] previously published a technique using a balloon spacer after repair of a massive rotator cuff tear. It should be noted that in this case, repair was achievable without any adjunct techniques. Yokoya et al.[13] described their technique using muscle advancement to increase cuff excursion. This was combined with a biodegradable sheet reinforcement. Medialization of the rotator cuff tendon can achieve a similar effect but should be limited to 10 mm to prevent possible limitation of range of motion. Recently, Mizuki et al.[14] described extreme medialization repair exceeding 10 mm and stated that there was no loss of range of motion in their patients. Further long-term clinical data should be obtained to determine outcomes of such extreme medialization.

Several authors have described the use of balloon spacers for massive irreparable rotator cuff tears.[10,15,16] There is less established data on the use of the balloon spacers in reparable rotator cuff tears. The aim of using a balloon spacer in the same setting as a rotator cuff repair is to mechanically improve the contact area for healing. The balloon spacer is favorable in that degradation occurs in vivo. It is important to note that while the manufacturer states that balloon degradation occurs after 12 months, the literature reports a variable timing of degradation ranging as early as 3 to 6 months.[17] Despite degradation, the effects of using a balloon spacer have been reported to last beyond its degradation.[17]

By combining medialization with a balloon spacer reinforcement, the authors believe that a low-tension repair can be achieved, coupled with an improved contact area for tendon healing (Table 1). In addition, it is technically straightforward to perform both these maneuvers in tandem (Table 2). In this case, combining these 2 procedures resulted in good healing of the rotator cuff tendon as visualized on magnetic resonance imaging at 1 year postsurgery (Fig 7). In the setting of a retracted, large to massive rotator cuff tear, a

Table 1. Pearls and Pitfalls

Pearls	- Cartilage can be removed using the radiofrequency ablator and curette first prior to using a burr to achieve a flat subchondral surface. - Measurement of the cartilage to be removed can be performed using an arthroscopic probe. This allows the surgeon to determine the extent of medialization so as to avoid removing excessive cartilage. - Measurement of the spacer balloon should be done prior to rotator cuff repair for better visualization and accuracy. - After insertion and inflation of the spacer balloon, the shoulder should be ranged to ensure stability of the spacer balloon with no migration. - If there is any concern regarding the spacer balloon, it can be simply decompressed with a spinal needle, either intraoperatively or in the outpatient clinic setting under ultrasound guidance.
Pitfalls	- The rotator cuff footprint should not be medialized more than 10 mm to avoid possible complications such as reduction in range of motion. - The spacer balloon should be appropriately sized. Too small a balloon will result in inadequate contact with the rotator cuff repair while too large a balloon may adversely affect the postoperative range of motion.

Table 2. Advantages and Disadvantages of Our Technique

Advantages	- This technique will achieve a reduced-tension repair of a retracted rotator cuff tendon tear. - Both procedures of medialization and insertion of the spacer balloon are technically simple to perform. - In the event of complications related to the spacer balloon, it can be easily decompressed in the outpatient clinic setting.
Disadvantages	- Medialization may be insufficient to restore the rotator cuff tendon completely to the native footprint in some cases. In these cases, partial repair may have to be performed. - This technique should not be used in patients with existing glenohumeral arthritis.

Fig 7. Repeat magnetic resonance imaging of the right shoulder at 1 year postsurgery. There is healing of the supraspinatus tendon (white arrow). The balloon spacer is no longer visible within the subacromial space.

combination of medialization of the footprint and balloon spacer reinforcement can allow for a tension-free repair of the rotator cuff tendon.

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