

# Arthroscopic Massive Rotator Cuff Repair and Techniques for Mobilization



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**Abstract:** Massive rotator cuff tears, as classified by size or tendon involvement, are challenging to repair due to scarring, retraction of the tendons, and difficult visualization. Left untreated, these injuries can lead to fatty infiltration and reduced acromiohumeral distance that precludes future repair. The high rate of failure in these patients often impedes an anatomical repair. However, advanced mobilization techniques of the supraspinatus help facilitate a reduction of an otherwise irreparable tear. By performing this repair, more costly procedures may be avoided, such as a superior capsular reconstruction and reverse total shoulder arthroplasty. This Technical Note presents our preferred technique of an all-arthroscopic, medialized repair with double interval slides for the treatment of a massive rotator cuff tear.

**R**otator cuff tears are one of the most prevalent musculoskeletal pathologies in the United States and occur more frequently with age.<sup>1</sup> Tears can be classified as traumatic or nontraumatic from attritional increase in tendon wear over time. Typically, traumatic injury results in larger and more symptomatic tears.<sup>2</sup> Surgical repair is considered in patients with persistent disability and pain despite conservative management. Work-up commonly consists of magnetic resonance imaging to determine size, fatty infiltration, and retraction of muscle tendons to determine whether anatomic rotator cuff repair is viable.<sup>3</sup>

Massive cuff tears may be classified by size (>5 cm) or tendon involvement (full thickness tears of 2 or more tendons). When classified by size, these tears consist of approximately 40% of reported rotator cuff tears.<sup>2</sup>

These tears pose a challenge to manage due to dynamic biomechanical changes in loading of torn and untorn muscle-tendon units, high recurrence rates following repair, and frequent clinical failure despite structural integrity.<sup>3</sup>

Retraction of tendon, scarring, and difficult visualization are challenges that must be addressed in repair. Advances in mobilization techniques allow rotator cuff repair through use of a single- or double-row anchor repair technique and may avoid more expensive and invasive treatment options such as superior capsular reconstruction and reverse total shoulder arthroplasty.<sup>4</sup>

We present an all-arthroscopic surgical technique for the repair of an L-shaped massive rotator cuff tear. Complete visualization of the tear pattern is paramount to creating an optimal repair. Anterior and posterior interval slides were used to allow the free margin of the rotator cuff to converge toward the bony footprint and facilitate repair.<sup>4</sup>

## Surgical Technique

### Preoperative Setup

The complete technique is demonstrated in a supplemental video ([Video 1](#)). Both the beach chair and lateral position may be used; however, the authors prefer the beach chair for rotator cuff repairs. The authors prefer an articulated arm holding device (Spider2 Limb Positioner, Smith & Nephew, Andover, MA) to allow dynamic arm positioning throughout the case. The head is kept in neutral position using a padded head positioner with straps. The patient is brought to

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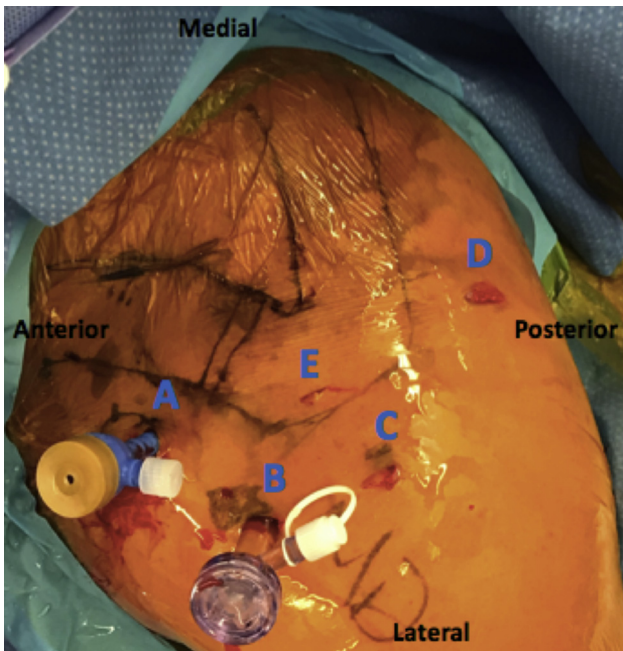
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**Fig 1.** Portal placement of the left shoulder demonstrating (A) standard anterior portal, (B) accessory lateral portal, (C) standard lateral portal, (D) posterior portal, and (E) site for percutaneous anchor placement.

the edge of the affected side. The patient is positioned in approximately 30° of hip flexion using a cushion underneath the buttocks. Range of motion and capsular contractures are evaluated by examination under anesthesia.

### Portal Placement

The posterior portal is created 2 cm inferior and medial to the posterolateral corner of the acromion. Stanford diagnostic arthroscopy is performed through this portal using a 30° arthroscope. Following spinal needle localization, the anterior portal is placed in the rotator interval lateral to the coracoid process. In the subacromial space, the lateral portal is placed 2 cm lateral to the distal acromion in the same anteroposterior plane as the distal clavicle. An accessory lateral portal is created off the anterolateral edge of the acromion and may be used to facilitate instrumentation and suture management (Fig 1).

### Preparation and Evaluation of the Glenohumeral Joint

Through the posterior portal, the relevant anatomy is identified. The biceps tendon is examined for signs of inflammation that may be a source of pain. If there are significant signs of tearing or inflammation and the clinical exam is consistent with biceps tenosynovitis, a tenotomy or tenodesis is often performed in addition to the primary repair to address the biceps as a potential pain generator. Concomitant intra-articular pathology

should be identified and repaired at this point such as labral debridement and/or chondroplasty, capsular release, or subscapularis repair. The space between the glenoid labrum and undersurface of the rotator cuff is recreated to facilitate tendon mobilization. The massive cuff tear in this case involved both the supraspinatus and infraspinatus with poor mobility of the supraspinatus and adequate mobility of the infraspinatus (Fig 2).

### Establishing Visualization

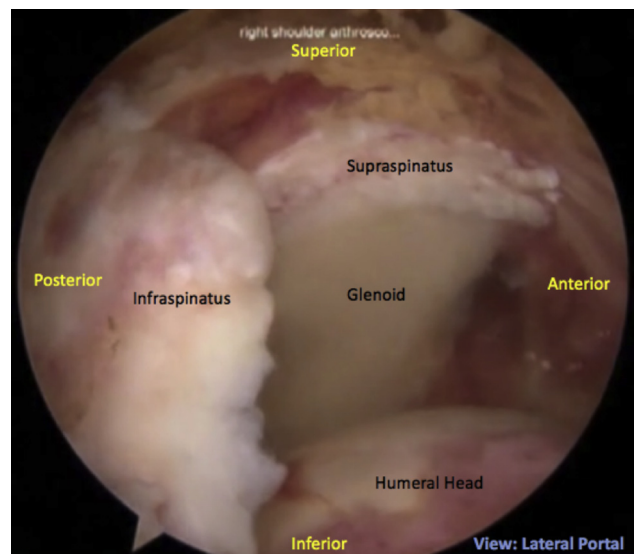
A standard lateral portal is created under direct visualization. Appropriate visualization is established by regulating blood pressure, setting appropriate irrigation pump pressure, frequent use of the radiofrequency probe to create hemostasis, and a thorough bursectomy to expose the anterior, lateral, and posterior gutters. Anesthesia assistance is required to set blood pressure to approximately 100 mmHg systolic.

### Rotator Cuff Repair

Viewing from the direct lateral portal, the rotator cuff mobility is assessed with a grasper placed through the accessory anterolateral portal with a 6.25-mm cannula (Fig 3). Careful inspection of the tendon mobility may allow identification of the tear pattern, which is essential in performing an anatomic repair (Fig 4).

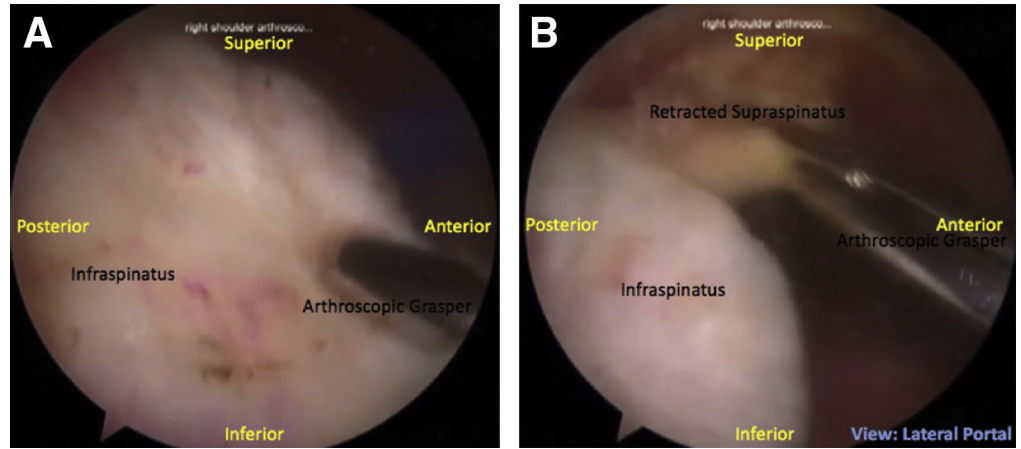
### Anterior Interval Slide

In cases with a retracted supraspinatus tendon, the anterior interval slide can be used to improve tendon mobility. This technique is performed by releasing adhesions on the bursal and articular side down to the base of the coracoid process while leaving the lateral



**Fig 2.** View from right shoulder direct lateral portal following debridement demonstrating torn but mobile infraspinatus and torn but retracted supraspinatus.

**Fig 3.** View from identical right shoulder direct lateral portal and grasper in accessory lateral portal to demonstrate mobility of torn rotator cuff tendons: (A) greater mobility of infraspinatus in comparison with (B) restricted mobility of supraspinatus.



soft tissues linking the supraspinatus and infraspinatus intact. Exposure of the base of the coracoid confirms the extent of the medial release.

**Posterior Interval Slide**

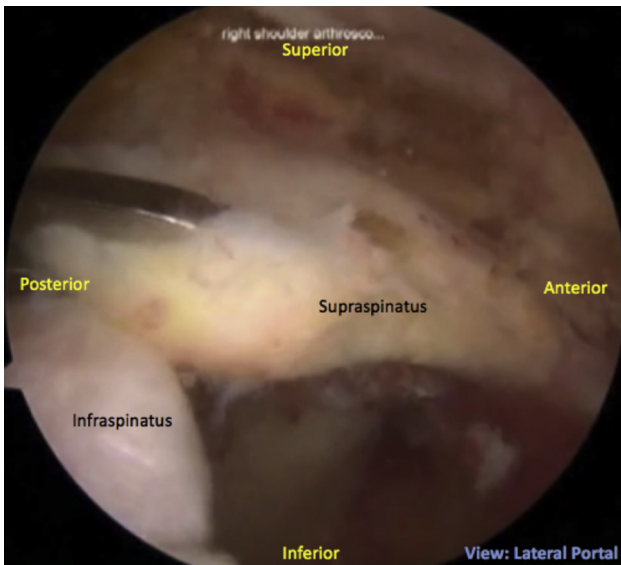
If the supraspinatus is still restricted in mobility, a posterior interval slide may be performed. Traction stitches are placed in the supraspinatus and infraspinatus to facilitate this technique. The scapular spine is used as a guide to identify the interval between the supraspinatus and infraspinatus. Arthroscopic Metzenbaum scissors may be used to cut in this interval, although care must be taken to avoid the suprascapular nerve upon reaching the adipose tissue when dissecting medially (Fig 5).

**Footprint Preparation and Anchor Placement**

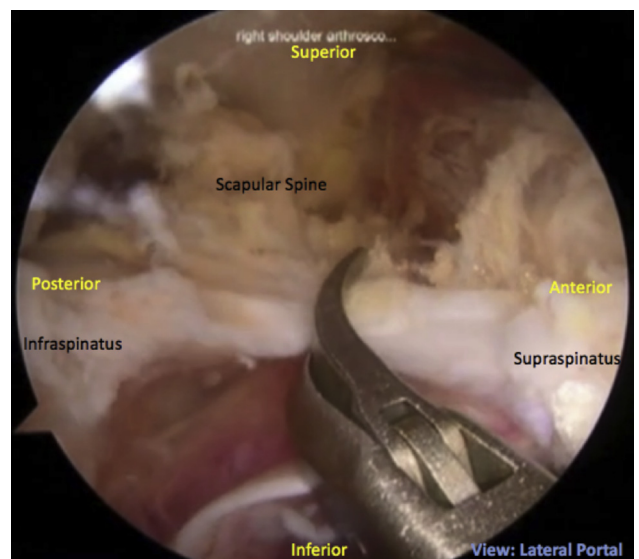
The tendon footprint is prepared using an arthroscopic bone shaver to expose the cortical bone on the greater tuberosity sized at a 15- to 20-mm segment up until the articular surface. The footprint can be medialized 5 to 7 mm without changing the biomechanics of the repair. To improve tendon healing and local biology, microfracture is performed on the lateral aspect of the greater tuberosity using an arthroscopic awl.

**Infraspinatus Repair**

The infraspinatus is repaired first to the lateral margin of the greater tuberosity to mobilize and relieve tension on the subsequent supraspinatus repair. An accessory portal off the edge of the acromion can be created to obtain the appropriate trajectory for suture anchor

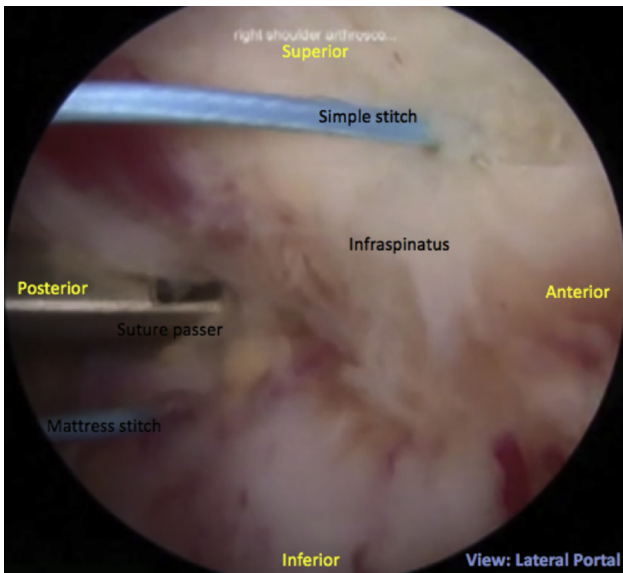


**Fig 4.** View from right shoulder direct lateral portal with arthroscopic grasper in the posterior portal demonstrating a reverse L-component tear of the supraspinatus and infraspinatus.



**Fig 5.** View from right shoulder direct lateral portal and arthroscopic Metzenbaum through the accessory lateral portal to perform the posterior interval slide.





**Fig 6.** View from right shoulder direct lateral portal with the suture passer in the posterior portal. Already passed is the simple stitch and mattress stitch that will be tied down to create a Mason-Allen equivalent. To be passed is a lateral stitch to hold down the infraspinatus during tying.

placement. A single-row repair using a resorbable triple-loaded PEEK (polyether ether ketone) suture anchor (Healicoil suture anchor, Smith & Nephew) is used to obtain adequate fixation of the repair. A penetrating type suture-passing device is used to facilitate the suture configurations by passing the suture through the infraspinatus, lateral to the musculotendinous junction. The first stitch is passed in a mattress fashion. A separate simple stitch is placed on the medial edge of the mattress stitch to collectively create a Mason-Allen stitch equivalent (Fig 6). The third suture is another simple suture at the lateral margin to hold the tendon in reduced fashion. Following suture passing, the infraspinatus is tied down in order to take tension off upcoming supraspinatus repair (Fig 7).

### Supraspinatus Repair

Although double-row repair is preferred with appropriate tendon mobility, a low-tension single-row medialized repair is preferred to a high-tension double-row repair. The medial row typically requires 2 to 3 anchors; these can be placed from the same accessory portal off the edge of the acromion by internally or externally rotating the arm to achieve the appropriate trajectory. The first anchor site is placed at the lateral junction between the infraspinatus and supraspinatus, with the remainder placed more anteriorly along the footprint of the tendon (Fig 8). In cases of single-row medialized repair, the use of resorbable triple-loaded PEEK suture anchors (Healicoil suture anchor) is preferred. Sutures from the posterior anchor are passed

between the infraspinatus and supraspinatus in a mattress fashion to help close the defect (Fig 9). Reduction of the tendon with an arthroscopic instrument by an assistant can take tension off the repair during knot tying (Fig 10). Complete pearls, pitfalls, and associated complications are discussed in Table 1.

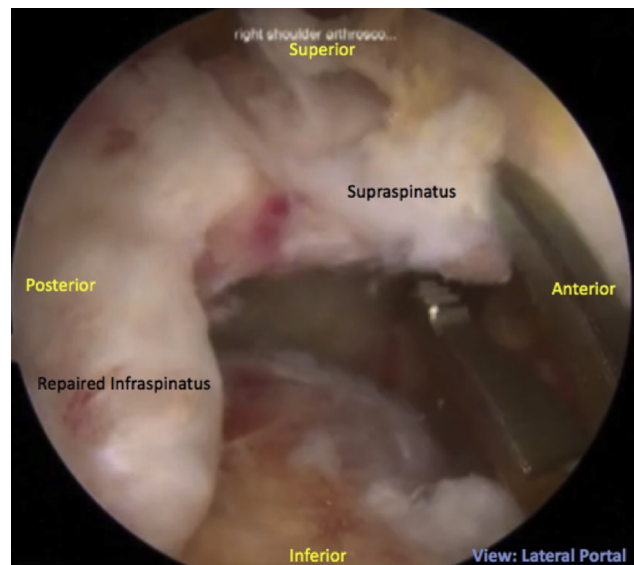
### Rehabilitation

The patient must be in a sling for 6 weeks with no motion of the shoulder. Active assist and passive motion can begin at 6 weeks, while active motion is delayed until 8 weeks postoperatively. Strengthening is initiated at 14 to 16 weeks.

### Discussion

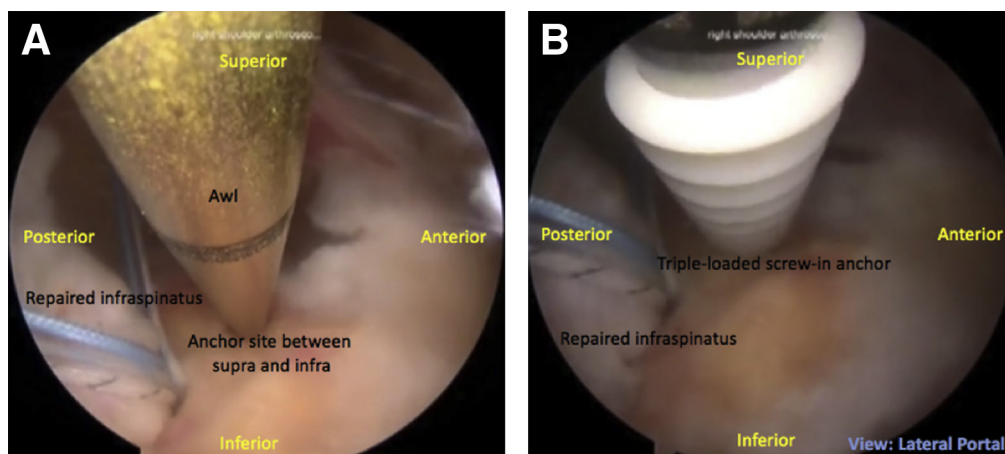
The disease burden of rotator cuff tears continues to increase in an aging population. Nonoperative management of these injuries can result in progression of fatty infiltration and decrease in acromiohumeral distance that can progress to irreparable structural deficits, particularly in younger, more active patients.<sup>5</sup> While multiple studies have demonstrated improvements in patient-reported outcome measures, range of motion, and strength following repair of massive rotator cuff tears,<sup>2,6-8</sup> an optimal surgical technique has not been established. This manuscript presents the repair of a massive rotator cuff tear that required both anterior and posterior interval slides and a medialized footprint to achieve an optimal low-tension repair.

Few studies have provided data on homogeneous populations treated with either single or double interval slides for tendon mobility. Berdusco et al. and Lädermann et al. demonstrated improved clinical and



**Fig 7.** View from right shoulder direct lateral portal and arthroscopic grasper in the accessory lateral portal demonstrating repaired infraspinatus and supraspinatus following double interval slide.

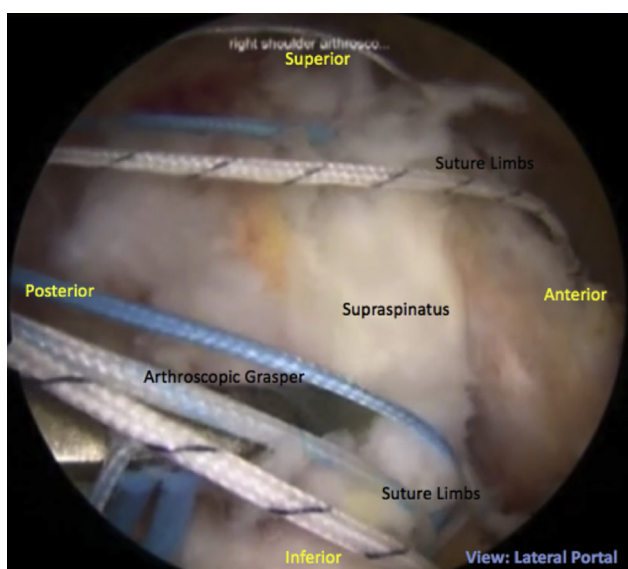
**Fig 8.** View from right shoulder direct lateral portal to create an anchor site between the infraspinatus and supraspinatus using an awl followed by placement of screw-in triple-loaded suture anchor.



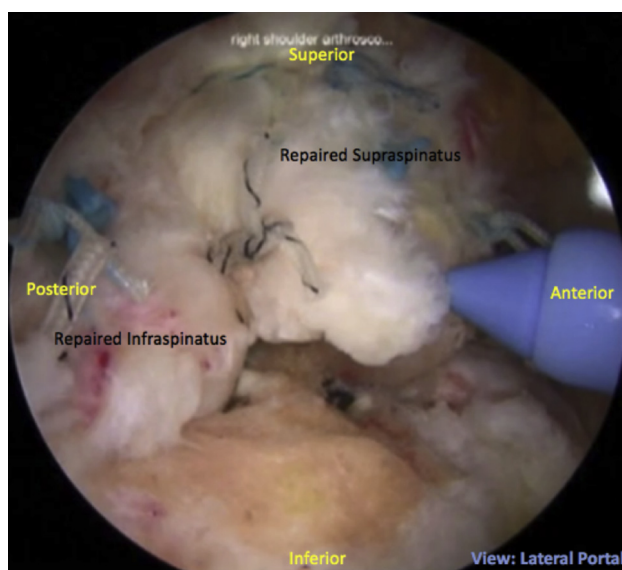
functional outcomes following repairs using interval slides.<sup>4,9</sup> In contrast, Kim et al.<sup>10</sup> has suggested that the posterior interval slide may be associated with a risk of devascularization of the torn tendon with a concomitant anterior interval slide. In their study comparing massive cuff tear cohorts undergoing complete repair with margin convergence and posterior interval slide to those undergoing partial repair with margin convergence, there was no difference in retear rates or clinical outcomes; both groups had significantly improved clinical and functional outcomes when compared with their preoperative level. The dearth of literature, particularly assessing long-term outcomes following repair of massive rotator cuff tears, makes conclusions regarding the efficacy of interval slides difficult. Nevertheless, these mobilization techniques allow for

repair of tendons that would otherwise be irreparable, which may prevent the need for more costly procedures such as superior capsule reconstruction or reverse shoulder replacement in the future.

Despite advanced mobilization techniques, arthroscopic repair of massive rotator cuff tears is associated with a high retear rate.<sup>7</sup> The etiology of these retears is likely multifactorial, including age, tendon quality, and surgical technique. Anatomic repair of massive cuff tears is also technically difficult due to scarring, retracted tissue, and large lesion size. While double-row or transosseous equivalent techniques are ideal in recreating the anatomic footprint of the rotator cuff, a medialized repair may be used when significant retraction precludes a low-tension repair using a double-row technique. Biomechanics literature demonstrates that the footprint may be medialized 5 to



**Fig 9.** View from right shoulder direct lateral portal with arthroscopic grasper in posterior portal to reduce the defect between supraspinatus and infraspinatus.



**Fig 10.** Final right shoulder rotator cuff repair following placement of supraspinatus stitches.

**Table 1.** Surgeon Pearls, Pitfalls, and Complications in Medialized Repair of Massive Rotator Cuff

Pearls	Pitfalls	Complications
Inspection through lateral portal will allow for visualization of the tear pattern.	Improper visualization of rotator cuff tear may lead to nonatomic repair.	Rotator cuff retear or failure of repair.
Tie down infraspinatus before moving on to supraspinatus to allow superior reduction.	Excessive debridement, ablation in the adipose tissue, and posterior interval slide can lead to suprascapular nerve injury.	Hardware-related complications: greater tuberosity fracture, loose body, anchor or suture pullout or dislodgement, hypersensitivity reaction to suture anchors,
Prefer using a penetrating suture passer device as these allow more precise passage of suture through the tendon.	When passing sutures through rotator cuff, stay out of the musculotendinous junction.	Injury to suprascapular or axillary nerves.
Using an awl to create microfractures in humeral head may improve bone healing.	Employ conservative postoperative rehabilitation to minimize retear rate.	Infection.

7 mm without changing the mechanical advantage of the rotator cuff.<sup>11,12</sup> Multiple clinical series have also demonstrated strong clinical outcomes with low failure rates at midterm follow-up.<sup>10,13,14</sup> Given the high retear rate of massive cuffs, a medialized repair that creates minimum tension may improve the long-term integrity of the repaired rotator cuffs.

Early clinical outcomes suggest that creating a low-tension medialized repair with mobilization techniques is a viable option for the treatment of massive cuff tears. The all-arthroscopic technique can be performed in an ambulatory setting with a conservative postoperative protocol. In comparison with more invasive procedures such as tendon transfers, reverse total shoulder arthroplasty, and supracapsular reconstruction, the medialized repair is a promising first option in patients with massive cuff injuries not amenable to double-row repair. Patient selection is critical, and further research is needed to distinguish massive cuff tears and irreparable cuff tears to allow for optimal return to function after surgery.

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