Operative Technique: Arthroscopic Repair of Massive Rotator Cuff Tears

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Introduction

Rotator cuff tears are a common cause of pain and disability.[1, 2] With modern advances in arthroscopy and arthroscopic techniques, most rotator cuff tears can now be repaired arthroscopically, with several authors reporting successful results.[3-6] However, the optimal management of massive rotator cuff tears is controversial and evolving.[7] In general, a massive rotator cuff tear (MRCT) is defined as a tear in which the major tear diameter is greater than 5 cm or tears that involve more than one tendon.[8] Despite the imposing retraction, most massive tears can be reduced to their native configuration once the tear configuration is recognized. Burkhart *et al* have classified massive cuff tears into one of three categories: crescent shaped, U-shaped, and L- shaped.[9] Crescent shaped tears are mobile and reduce easily to the anatomic footprint without excessive tension. U-shaped tears extend medially with the apex of the tear at the level of the glenoid. L-shaped tears are massive rotator cuff tears with a longitudinal component along the fibers of the rotator cuff as well as a transverse component along the cuff insertion.

Arthroscopic repair of massive rotator cuff tears presents a challenge to the orthopaedic shoulder surgeon due to tendon retraction, adhesions, and poor tissue quality making tension free repair difficult. Several arthroscopic techniques have been reported with the goal of gaining adequate tendon mobility, including margin convergence, interval slides, as well as release of fibrous bursal tissue and adhesions.[9, 10] Several open options are available to treat this condition, including tendon transfer, the use of allograft and synthetic grafts, arthrodesis, hemiarthroplasty, and reverse total shoulder arthroplasty (RTSA).[11-13] However, there is currently no consensus on the appropriate surgical treatment of massive irreparable tears when non-operative management fails.

There has been a recent broadening of the indications for RTSA for the treatment of patients with massive rotator cuff tears but without arthritis. We urge caution to surgeons performing RTSA for this indication, as the clinical outcome after arthroscopic repair is favorable for most cases with minimal risk, and RTSA may have a high complication rate.[13, 14] Additionally, arthroscopic repair does not preclude or complicate arthroplasty if needed in the future. So the question remains: why are many abandoning arthroscopic repair of massive rotator cuff tears for reverse total shoulder arthroplasty? Here, we review the rationale, preoperative evaluation, and indications for arthroscopic repair, and provide a detailed discussion of our surgical technique and post-operative care.

Preoperative Evaluation and Indications

Massive rotator cuff tears present in different clinical situations: acute traumatic, acute on chronic, and chronic atraumatic. Acute traumatic tears tend to occur in young active individuals, while chronic atraumatic tears occur in elderly patients and by far are most common. Muscle atrophy is typically not seen in acute traumatic tears, whereas atrophy is usually present in patients with chronic atraumatic tears. Patients with acute on chronic tears either present with an acute exacerbation in pain in the presence of a chronic symptomatic tear or with new onset shoulder pain in the presence of a chronic asymptomatic tear.

A detailed physical examination is paramount in determining the status of the rotator cuff and can typically provide insight into the size of the tear. Physical examination of the patient with a suspected MRCT should include thorough visual inspection of the shoulder girdle musculature paying particular attention to the presence of atrophy, any anterior-superior subluxation, and prominence of the humeral head. A MRCT occasionally can be detected as a palpable defect in the supraspinatus tendon at the anterolateral aspect of the shoulder. Loss of external rotation strength in the adducted arm indicates infraspinatus insufficiency. A positive belly press or bear hug test signifies a subscapularis defect, with the "lift off" sign associated with larger retracted tears. A "hornblower sign" denotes the presence of a teres minor lesion.

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Cervical spondylosis and radiculopathy can cause shoulder pain that mimics rotator cuff pathology; therefore, a complete cervical spine examination is warranted. The combination of a detailed history and thorough physical examination often provides sufficient information to establish a diagnosis of MRCT.

All patients should be evaluated with preoperative imaging including Xray and MRI. A complete radiographic evaluation of the shoulder includes anteroposterior, anteroposterior in both internal and external rotation, axillary lateral, and outlet views. Radiographs are particularly helpful in demonstrating the osseous changes associated with massive rotator cuff tears. Elevation of the humeral head relative to the glenoid and narrowing of the acromiohumeral space are findings consistent with long-standing rotator cuff pathology. Studies have reported that an acromiohumeral space <7 mm is consistent with a rotator cuff tear, and that a space <5 mm indicates a massive tear. MRI is highly accurate and demonstrates detailed anatomic information of the rotator cuff.[15] The size, presence of fatty infiltration, and retraction of the rotator cuff muscles can be easily identified, thus allowing determination of the chronicity of the tear, guiding surgical decision-making, and providing prognostic insight which can be relayed to the patient. The Goutallier classification is the standard means of assessing cuff integrity.[16] Many investigators advise against cuff repair with Goutallier grade greater than two. However, Burkhart has reported excellent results in patients presenting with Goutallier grade four (more fat than cuff).[17]

Patients with a history and physical examination findings of pain and/or weakness with the presence of a massive rotator cuff tear on MRI are excellent candidates for arthroscopic rotator cuff repair provided there is some remaining "force couple," or ability to initiate abduction. Pseudoparalysis, once considered a contraindication for cuff repair, has been found to be amenable to repair, provided the abduction deficit has not been present for longer than six months.[18]

Surgical Technique

Pre-operatively, a scalene block is placed to aid with post-operative pain. Examination under anesthesia is performed to assess shoulder range of motion and stability. The patient is placed in the lateral decubitus position. The extremity is placed in ten pounds of traction with the shoulder held at 45° of abduction and 15° of forward flexion. A posterior portal is made in the standard fashion with the portal established slightly lateral to the convexity of the humeral head. Massive cuff tears are evident once the joint in entered. Gentle mobilization of the cuff off the labrum is commenced at this point. Subscapularis tears, complete with the attached "comma sign" (Figure 1) are repaired at this time. Subscapularis repair is critical as restoration of the comma tissue (coracohumeral and superior glenohumeral ligaments) will enhance the superior cuff repair. Retracted infraspinatus tears can be sewn to comma tissue once the subacromial space is entered (Figure 2). If superior migration of the humeral head is appreciable, an inferior capsular release is performed to minimize strain on the repair.

The camera is then placed in the subacromial space through the posterior portal and a thorough bursectomy is performed via a lateral working portal. The portals should be placed low enough such that the cannulas are parallel with the rotator cuff tendons. A second lateral portal can be established for large tears in order to obtain a "50-yard line view" of the tear. Thermal ablation is used to excavate the rotator cuff to the scapular spine while viewing laterally. An acromioplasty is performed, making sure to remove the anterior-inferior hook

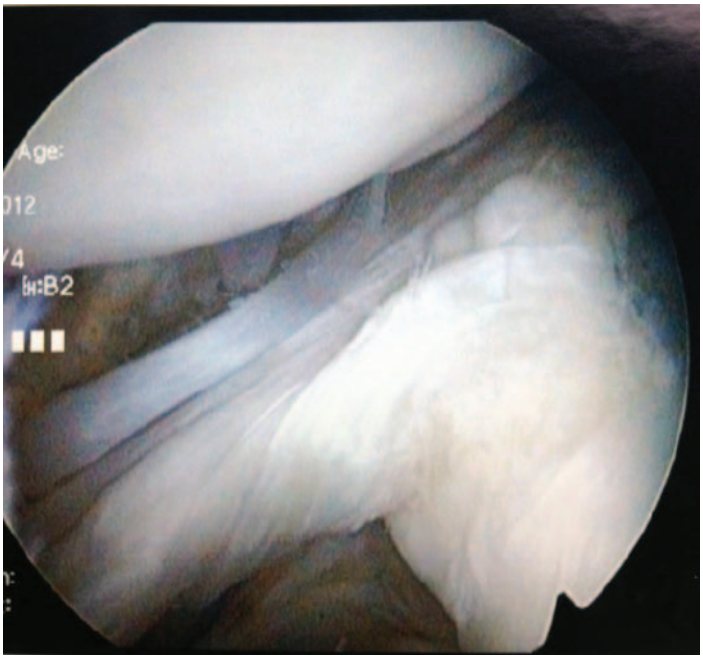

Figure 1. The comma sign, an indication of a subscapularis tear.

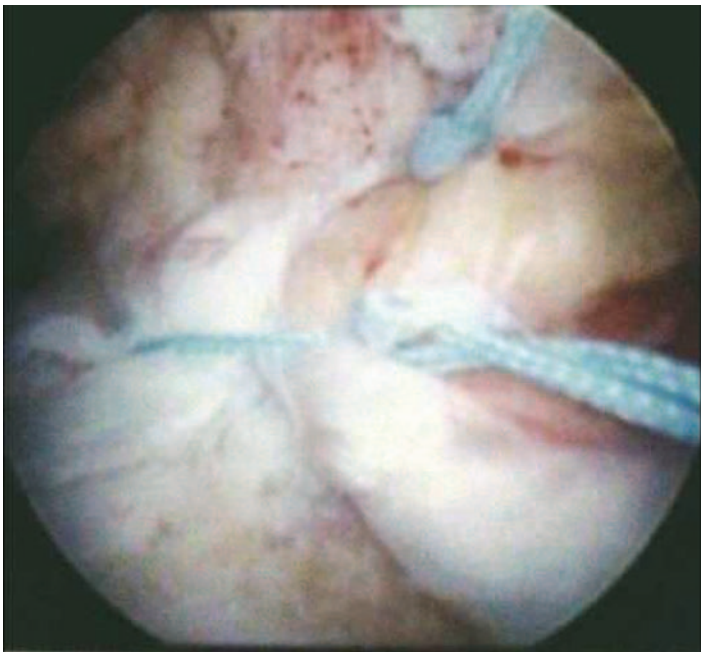

Figure 2. The infraspinatus is sewn to the comma tissue.

while protecting the coracoacromial ligament. The senior author prefers to perform a Mumford procedure in most cases as the procedure is quick, and acromioclavicular joint arthritis is usually present.

The coracohumeral ligament is then released if the subscapularis tendon is not involved. This maneuver increases the lateral mobility of the supraspinatus and infraspinatus tendons. Traction sutures are placed in opposing cuff edges in order to facilitate approximation. The biceps tendon is then visualized and addressed. The biceps tendon is usually frayed or subluxed medially if a tear of the subscapularis tendon is present. Generally, a tenodesis is performed in patients younger than 60. In patients over the age of 60, a biceps tenotomy is usually preferred.

The tear is visualized and a tear pattern is determined. The mobile limb of the tear indicates the pattern of tear extension. Crescent shaped tears have symmetric retraction. U-shaped tears have anterior and posterior limbs that are equally mobile. L-shaped tears and reverse L-shaped tears have a mobile anterior and posterior limb respectively. The cuff tears are repaired using margin convergence. This technique involves placing side-to-side sutures in the tear which shifts the adjacent tissue into the cuff defect. This technique shortens the medial-lateral dimension as the free margin "converges" toward the tuberosity. This results in decreased strain in the rotator cuff margin (Figure 3).

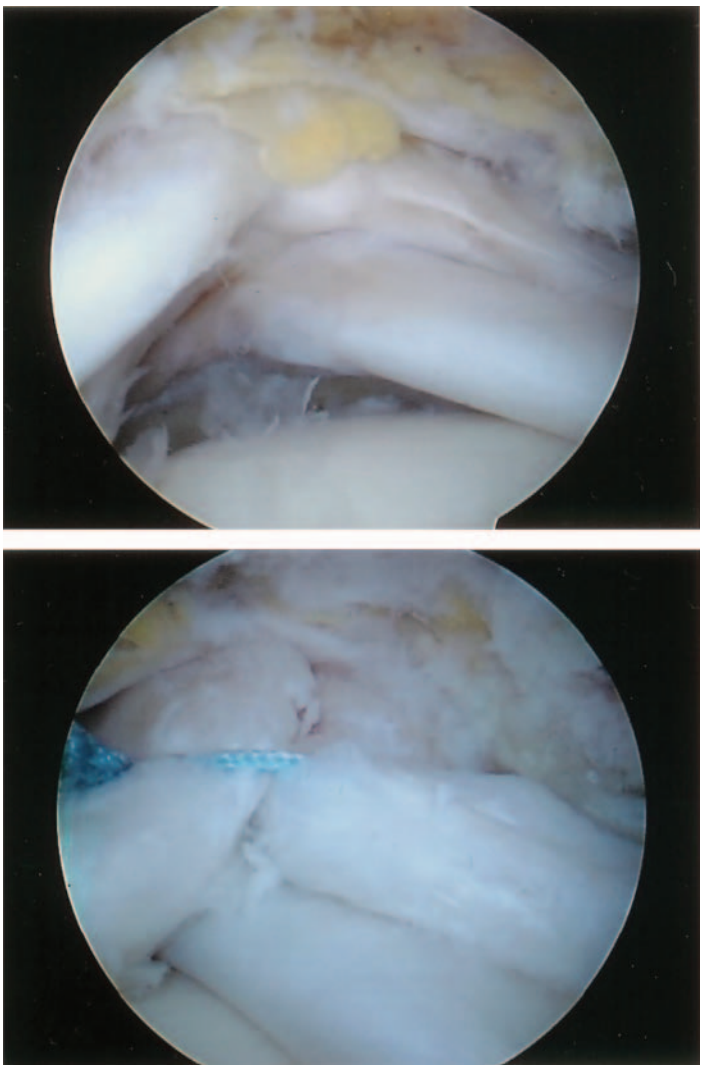

Figure 3. Margin convergence shifts tissue toward the cuff margin.

If the cuff cannot be fully mobilized to its footprint without over-tensioning the repair, then partial repair is performed. "Rip stop" sutures are employed in cases of very weak tissue. The senior author favors "tape" type suture as reinforcement. A single row of anchors is used to reattach the tendons to the footprint. Care is taken to minimize tension across the repair. Double row configurations are not indicated as they do not effect a proper "reduction" of the tear pattern. Secondly, undue tension disturbs biology and is to be avoided. If full coverage is not achieved, an awl is used to punch holes into the tuberosity in order to enhance biology. More recently, the senior author has augmented deficient tissue with dermal allograft secured with 'four corner" arthroscopic fixation.

Postoperative Care

Patients are kept in an abduction pillow for six to eight weeks, depending on the tissue quality. Only elbow and wrist motion is permitted. Active elevation is discouraged for at least six weeks. Physiotherapy commences approximately at week seven, and strengthening is avoided until 12-14 weeks.

Discussion

There are several advantages to performing arthroscopic repair of massive rotator cuff tears. Arthroscopic repair of massive tears can provide pain relief, help the patient regain function, and halt or delay the onset of arthropathy. Additionally, arthroscopic repair is relatively safe with low complication rates when compared to other open surgical options such as RTSAs.[9] Denard *et al* reported that arthroscopic repair of MRCTs with advanced mobilization techniques can lead to reversal of preoperative pseudoparalysis in 90% of patients who have not had previous surgery. These results were achieved with low complication rates.[18] Good to excellent outcomes have been reported even in patients who do not maintain cuff integrity after arthroscopic rotator cuff repair.[19,20]

There has recently been increased interest in the role of RTSA in the treatment of massive rotator cuff tears. There may be a population of patients for whom this is a reasonable option, including patients with rotator cuff arthropathy and a high riding humeral head. However, RTSA is not without risk. Studies have reported as high as a 68% complication rate after RTSA.[21-23] The most common complications include neurologic injury, periprosthetic fracture, hematoma, infection, scapular notching, dislocation, mechanical baseplate failure, and acromial fracture.[14]

Conclusion

Arthroscopic rotator cuff repair is a viable surgical option for management of massive rotator cuff tears. It provides pain relief and improves function with or without the maintenance of structural integrity. It also poses minimal

risk and does not preclude further intervention if necessary. Reverse total shoulder arthroplasty for the management of massive cuff tears is also an option but is associated with significant complication rates and should be reserved for advanced cuff tear arthropathy. Shoulder surgeons should still have arthroscopic repair as a treatment modality in their armamentarium when tackling massive rotator cuff tears.

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