An Arthroscopic Humeral Medializing Repair of the Supraspinatus

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Abstract: Posterosuperior repair of the rotator cuff is one of the most frequently performed surgical procedures in the shoulder. Its aim is to fix the tendon back to the bone to restore anatomy, improve shoulder function, and prevent progression of cuff tear arthropathy and attendant muscle degeneration. Despite technical advances in this procedure, in some cases, the tendon cannot be fixed back to the footprint without excessive tension on the repair. In young patients or in patients with low-grade muscle atrophy and fatty degeneration (Goutallier grade 1 or 2), it is mandatory to attempt fixation of the tendon to restore functional anatomy and prevent further muscle degeneration. In such cases, an arthroscopic medialized reinsertion of the supraspinatus may be considered. We describe an arthroscopic humeral medializing repair of the supraspinatus tendon that allows for a tension-free repair of the supraspinatus using common portals and instruments. The goal of this technique is to obtain tendon healing, restore functional anatomy, and prevent atrophy and fatty degeneration of the muscles of the rotator cuff.

Many studies in the literature have reported that an anatomic repair of the ruptured supraspinatus tendon back to its footprint is important to obtain adequate healing and function after cuff tear surgery. In some cases it is not possible to obtain sufficient tendon excursion to allow fixation of the supraspinatus tendon back to its anatomic position on the greater tuberosity. In such cases a number of alternative technical procedures have been previously described in the literature: margin convergence, latissimus dorsi transfer, cuff patch augmentation, or superior capsular reconstruction. The results of these techniques are still under evaluation; however, they all fail to adequately restore the functional anatomy of the muscles of the rotator cuff and so, in the absence of ongoing mechanical stimulation, condemn the supraspinatus muscle to further degeneration and fatty infiltration.

For such patients with a tendon defect, midsubstance tear, or retear after surgery in the presence of fatty infiltration of less than grade 2 (Goutallier classification), we propose a humeral medializing repair of the supraspinatus tendon (HUMEREP) as a viable surgical option. The HUMEREP is a simple technique using common portals and instruments. It allows a tension-free repair of the cuff and prevents cuff tear extension and fatty degeneration of the rotator cuff muscle.

Surgical Technique

Diagnostic Arthroscopy

We perform shoulder arthroscopy with the patient in the beach-chair position. The arm is placed in forward flexion with no traction system. The glenohumeral cartilage, cuff tendons, and biceps are inspected through a posterior portal. The full-thickness supraspinatus tear and its footprint are visualized.

With a grasper, the torn cuff is manipulated to ascertain the extent and direction (medially, anteriorly, or posteriorly) of any retraction. In this manner we may then assess the reducibility of the tendon and the potential for achieving a tension-free repair to the native footprint.

Biceps Management

If the biceps tendon is weak or unstable or if the posterior biceps pulley is torn with the anterior part of
the supraspinatus, a biceps tenotomy or tenodesis is indicated. The tenotomy is performed from a lateral portal through the cuff defect.

In the case of tenodesis, intra-articular fixation is performed. An anchor is placed at the top of the bicipital groove by use of a rotator interval portal. Through the same portal, we use CleverHook devices (Mitek, Raynham, MD) to fix the tendon using the lasso-loop technique. The proximal part of the tendon is then cut with electrocautery.

Generally, in patients younger than 50 years, a tenodesis is performed. In older patients and/or in the presence of a degenerative biceps tendon, a tenotomy is indicated.

**Supraspinatus Tendon Release**

If necessary, we perform a subacromial release (Fig 3) and a peri-glenoid capsulotomy (Fig 4) using electrocautery, through a lateral portal, to release adhesions of the supraspinatus tendon (SST). Occasionally, an anterior release of the tendon from the coracohumeral ligament is performed.

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**Fig 1.** Coronal view of the right shoulder on magnetic resonance imaging showing a midsubstance tear (arrow) of the supraspinatus tendon with severe retraction. (G, glenoid; HH, humeral head.)

**Fig 2.** Sagittal scapular Y-view of the right shoulder on magnetic resonance imaging showing no fatty degeneration (asterisk) of the supraspinatus muscle. (IS, infraspinatus muscle; SSC, subscapularis muscle.)

**Fig 3.** Lateral view of the right shoulder with the patient in the beach-chair position showing superficial release of the supraspinatus tendon (SST) with bursectomy and scapular spine visualization.

**Fig 4.** Lateral view of the right shoulder with the patient in the beach-chair position showing peri-glenoid release of the supraspinatus tendon (SST) with capsulotomy and release of the coracohumeral ligament. (BT, biceps tendon; G, glenoid; HH, humeral head.)
ligament and/or coracoid is also required through the same portal.

**Reducibility Testing of Cuff**

After supraspinatus release, if the tendon cannot be reduced to allow tension-free fixation to at least the medial one-third of the native footprint, then a medialized repair of the cuff tear is indicated (Fig 5). In our experience we consider it vital to insert the arthroscope through the posterolateral portal to allow a global overview of the tendon tear from the subacromial space. The cuff may then, once again, be mobilized in all directions to further ascertain the direction of any remaining retraction. The subscapularis and infraspinatus tendons must also be exposed and examined to confirm the absence of concomitant pathology. In the presence of fatty infiltration of less than grade 2, if it is not possible to achieve tendon contact with at least the medial one-third of the native footprint, then we opt to perform an HUMEREP.

**Bone Bed Preparation and Anchor Positioning**

The humeral head cartilage is debrided by use of a full-radius blade with a Tornado Handpiece (Mitek). It is vital to remove only the cartilage to expose the subchondral bone. The subscapularis and infraspinatus tendons must also be exposed and examined to confirm the absence of concomitant pathology. In the presence of fatty infiltration of less than grade 2, if it is not possible to achieve tendon contact with at least the medial one-third of the native footprint, then we opt to perform an HUMEREP.

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subchondral bone (Fig 6). In our experience this bone is strong enough to allow very stable anchor placement. Two or three Healix Advance 4.5-mm anchors (Mitek) are placed in the humeral head, at approximately 1-cm intervals, depending on the size of the cuff tear and the native footprint being replicated (Fig 7).

**Supraspinatus Repair**

A single-row repair of the supraspinatus to this medialized footprint is performed with CleverHook devices, by use of anterior and posterior portals. Because of muscle retraction and/or a tendon defect, in most cases we use a Mason-Allen suture technique for the tendon repair. It is vital to repair all tendon layers, particularly in the presence of tendon delamination (Fig 8). With this technique, it is not possible to perform a double-row repair (Fig 9).

**Acromioplasty**

The arthroscope is inserted through the lateral portal. The coracoacromial ligament is detached from the posterior portal with electrocautery. A burr is then introduced into the subacromial space through the same portal. The anterolateral edge of the acromion is removed with the burr to reduce any subacromial impingement in a Bigliani type 2 or 3 acromion. If an HUMEREP cannot be performed and the acromio-humeral interval is narrowed (<6 mm), as previously recommended, we do not perform an acromioplasty or release of the coracoacromial ligament to prevent superior migration of the humeral head.

**Table 1. Pearls and Pitfalls of HUMEREP Technique**

| Pearls                                                                 | Pitfalls                                                                 |
|------------------------------------------------------------------------|-------------------------------------------------------------------------|
| Subacromial release of the supraspinatus and a peri-glenoid capsulotomy should be performed to improve tendon excursion. | HUMEREP should be avoided in the case of cuff tear arthropathy and/or significant fatty infiltration of the rotator cuff (Goutallier grade ≥3). |
| Coracoacromial ligament release and acromioplasty should be performed in a Bigliani type 2 or 3 acromion. | Patients should be required to use an abduction sling for shoulder immobilization. |
| The subchondral bone should be retained for stable anchor placement. | HUMEREP, humeral medializing repair of supraspinatus tendon. |
| All layers of the torn tendon end should be included in the suture repair, starting with the posterior anchor. |

**Table 2. Advantages and Disadvantages of HUMEREP Technique**

| Advantages                                                                 | Disadvantages                                                                 |
|---------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Simple technique using common portals and instruments                     | Not possible in presence of significant supraspinatus muscle atrophy (Goutallier grade ≥3). |
| Tension-free repair of rotator cuff                                         | Limitation of range of motion                                                |
| Prevention of atrophy and fatty degeneration of rotator cuff muscles       | Single-row repair                                                            |
| Ability to consider other techniques (LD transfer, patch, and so on) is retained in case of failure | HUMEREP, humeral medializing repair of supraspinatus tendon; LD, latissimus dorsi. |

Fig 9. Lateral view of the right shoulder with the patient in the beach-chair position showing the final aspect of the supraspinatus tendon (SST) after humeral medializing repair with Mason-Allen sutures. (HH, humeral head.)

Fig 10. Postoperative coronal view of the right shoulder on magnetic resonance imaging after humeral medializing repair of the supraspinatus tendon, showing good healing of the tendon (arrow).
Postoperative Protocol

Postoperatively, the shoulder is immobilized in a sling with an abduction pillow for 1 month. Pendular exercises with passive and active rehabilitation can then be gradually introduced.

We routinely perform magnetic resonance imaging 3 months after surgery to visualize tendon healing (Fig 10). Pearls and pitfalls of the HUMEREP technique are shown in Table 1, and advantages and disadvantages are listed in Table 2.

Discussion

The principal advantages of the HUMEREP are as follows: It is a simple procedure that allows a tension-free repair of the rotator cuff using common portals and instruments. It prevents cuff tear extension and fatty degeneration of the rotator cuff muscle.

Goutallier et al. reported the importance of a tension-free repair of the cuff. They described a technique lateralizing the muscle—a technical procedure that is still the subject of some debate; however, the concept of decreasing tension in the repaired rotator cuff was introduced. As we describe in this report, arthroscopically, it is much simpler to achieve a similar goal on the tendon side by medializing the tendon footprint and so allowing a tension-free repair of the retracted or deficient supraspinatus tendon.

Over-tensioning is associated with ongoing shoulder pain and poor functional outcomes. If the tendon cannot be reduced to the footprint in a tension-free manner, 3 main arthroscopic procedures have been described: latissimus dorsi tendon transfer, margin convergence, and patch augmentation.

Latissimus dorsi tendon transfer is technically challenging, has a high rate of complications, and requires a long postoperative rehabilitation. Margin convergence does not adequately restore muscle function and is associated with poor functional outcomes.

Patch augmentation techniques have a number of drawbacks: lack of availability of the patch, high costs, and potential for graft rejection. The patch is not fixed to the tendon, and therefore muscle function is not restored.

The main potential drawback of medialization of the supraspinatus insertion is limitation of range of motion after healing. In 2003 Kessler et al. reported on a partially medialized repair of the cuff, fixing the tendon at the bone-cartilage junction in massive retracted tears. They reported good healing and clinical outcomes. Medialization of more than 10 mm of the supraspinatus tendon attachment site has been shown to significantly decrease glenohumeral joint motion in cadaveric studies.

Midsubstance tears are often seen after needling of calcific tendinitis. Retear is the main complication after traditional arthroscopic rotator cuff tear repair. In these cases, if fatty infiltration of the muscle belly is less than grade 2 (Goutallier classification), we present the HUMEREP as a viable alternative to the previously discussed salvage options. The HUMEREP is the only technique for such cases that restores rotator cuff functional anatomy.

References

1. Bennett WF. Arthroscopic repair of full-thickness supraspinatus tears (small-to-medium). A prospective study with 2- to 4-year follow-up. Arthroscopy 2003;19:249-256.
2. Porcellini G, Castagna A, Cesari A, Merolla G, Pellegrini A, Paladini P. Partial repair of irreparable supraspinatus tendon tears: Clinical and radiographic evaluations at long-term follow-up. J Shoulder Elbow Surg 2011;20:1170-1177.
3. Nové-Josserand L, Costa P, Liotard J-P, Safar J-F, Walch G, Zilber S. Results of latissimus dorsi tendon transfer for irreparable cuff tears. Orthop Traumatol 2009;95:108-113.
4. Steinhaus M, Mahni E, Cole B, Romeo A, Verma N. Outcomes after patch use in rotator cuff repair. Arthroscopy 2016;32:1676-1690.
5. Petri A, Greenspoon J, Millett P. Arthroscopic superior capsule reconstruction for irreparable rotator cuff tears. Arthrosc Tech 2015;4:751-755.
6. Kempf JF, Gleyze P, Bonnomet F, et al. A multicenter study of 210 rotator cuff tears treated by arthroscopic acromioplasty. Arthroscopy 1999;15:56-66.
7. Goutallier D, Postel J-M, Van Driessche S, Godefroy D, Radier C. Tension free cuff repairs with excision of macroscopic tendon lesions and muscular advancement: Result in a prospective series with limited fatty muscular degeneration. J Shoulder Elbow Surg 2006;15:164-172.
8. Grimberg J, Kany J. Latissimus dorsi tendon transfer for irreparable postero-superior cuff tears: Current concepts, indications, and recent advances. Curr Rev Musculoskelet Med 2014;7:22-32.
9. Nové-Josserand L, Maia R, Maurcot-Boulch D, Ogassawara R. Open side-to-side repair for non-reparable tendon-to-bone rotator cuff tear. Clinical and anatomic outcome at a mean 5 years’ follow-up. Orthop Traumatol Surg Res 2013;101:819-822.
10. Kessler MA, Lichtenberg S, Habermeyer P. Reconstruction of big rotator cuff ruptures. A new technique of tendon refixation with the corkscrew suture anchor system. Unfallchirurg 2003;106:826-833 [in German].
11. Yamamoto N, Itoi E, Tuoheti Y, et al. Glenohumeral joint motion after medial shift of the attachment site of the supraspinatus tendon: A cadaveric study. J Shoulder Elbow Surg 2007;16:373-378.
12. Liu J, Hughes R, O’Driscoll S, An K-N. Biomechanical effect of medial advancement of the supraspinatus tendon. A study in cadaver. J Bone Joint Surg Am 1998;80:853-859.
13. Randelli P, Spennachio P, Ragone V, Arrigoni P, Casella A, Cabiizza P. Complications associated with arthroscopic rotator cuff repair: A literature review. Musculoskelet Surg 2012;96:9-16.