Technical Note

Arthroscopic Subscapularis Repair With Preserved Biceps Anatomy

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Abstract: Arthroscopic subscapularis repair continues to improve with the advancement of surgical technique and critical focus on careful intraoperative evaluation. As identification of these tears increases, there is an expected increase in repair rates as well. Anatomically, the upper border of the subscapularis and the long head of the biceps (LHB) tendon are in close relation. Many surgeons have advocated concomitant LHB tenotomy versus tenodesis in conjunction with operative subscapularis tears. We hypothesized that in the setting of a preserved anatomic biceps pulley and no LHB pathology, isolated subscapularis repair would result in excellent clinical outcomes when compared with subscapularis repair and biceps tenotomy or tenodesis.

Historically, rates of subscapularis tendon tears in patients presenting with rotator cuff dysfunction have ranged between 2% and 10%.[1,2] However, recent literature has suggested a higher rate of concomitant subscapularis pathology with rotator cuff dysfunction (27%).[3] In addition, with the advancement of arthroscopic capabilities, close evaluation of the superior biceps complex and its relation to the upper border of the subscapularis has come under focus.[4-11] Arai et al.[3] carefully described the close association between the long head of the biceps (LHB) and the upper border of subscapularis both anatomically and with advanced imaging. In their series of 435 patients, an unstable LHB predicted a subscapularis tear 100% of the time; however, the presence of a subscapularis tear did not specifically denote biceps instability.[3] This study coincides with prior work on the biceps pulley system (composed of the superior glenohumeral ligament and coracohumeral ligament in addition to contributions from the subscapularis) that has recognized this discrete anatomic structure as an important stabilizer of the LHB.[9,12-17] Treatment of subscapularis tears has often included biceps tenotomy or tenodesis to improve visualization during the subscapularis repair, as well as to prevent recurrent medial subluxation that would stress the subscapularis repair.[17,18] We hypothesized that in the setting of a preserved biceps sling, no intraoperative LHB instability, and an upper-border subscapularis tear, isolated subscapularis repair would result in improved function with a low complication and reoperation rate.

Surgical Technique

Step 1: Preoperative Workup

All patients undergoing arthroscopic shoulder surgery for rotator cuff repair undergo a complete preoperative physical and imaging examination. A combination of passive external rotation asymmetry, internal rotation weakness as judged by the lift-off, belly-press, and bear-hug tests, and advanced magnetic resonance imaging (MRI) is used to confirm subscapularis pathology as the source of clinically limiting pain and dysfunction.[19-21] In the setting of failed conservative management, some patients elect to undergo arthroscopic subscapularis repair with possible biceps tenodesis.

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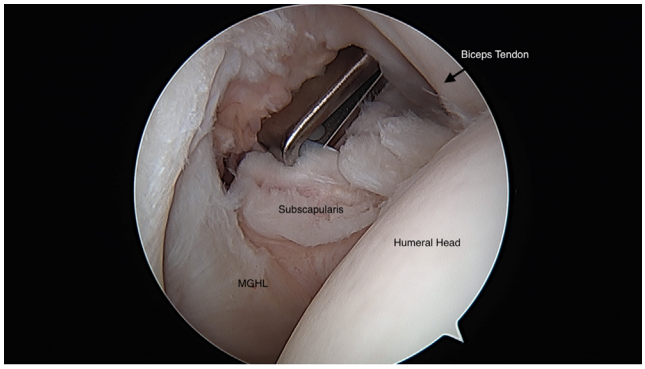

Fig 1. Right shoulder view from posterior portal, with patient in beach-chair position, identifying subscapularis tear. An arthroscopic cuff grasper is visualized coming through the anterior working portal. (MGHL, middle glenohumeral ligament.)

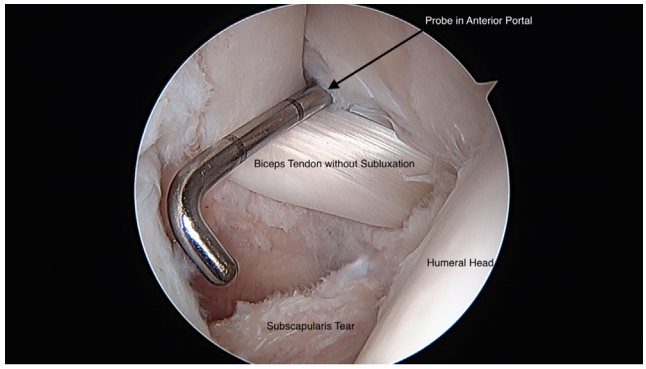

Fig 3. Right shoulder view from posterior portal, with patient in beach-chair position, showing probe through anterior working portal attempting to subluxate long head of biceps medially.

Step 2: Surgical Positioning

After general anesthesia has been induced, the patient is positioned approximately 70° to 80° upright with a standard beach-chair positioner, with close attention paid to neutral spinal alignment and padded nonoperative extremities. Wide surgical preparation is used as part of standard arthroscopic beach-chair shoulder case preparation. The anatomic landmarks of the Neviaser portal,[22] clavicular border, coracoid prominence, and acromion are denoted on the skin. A standard posterolateral viewing portal is placed in line with the soft spot of the posterior glenohumeral joint approximately 1 cm medial and 1 cm inferior to the posterolateral border of the acromion. The anterior working portal is placed through the superolateral aspect of the rotator interval with aid from a spinal needle, with care taken to avoid the superior glenohumeral ligament–coracohumeral ligament–biceps pulley complex. This trajectory is scrutinized for the ability to access the lesser tuberosity for debridement and anchor placement. Additionally, 1 lateral portal just off the anterolateral edge of the acromion is established as an additional working portal to aid in accessing the subcoracoid space as described by Burkhart and Brady.[17] This accessory portal allows parallel access to the superior edge of the subscapularis in line with the muscle fibers for both debridement and suture management. Of note, cannulas are not routinely used in this technique because suture passing and management are performed within the joint itself, eliminating the potential for soft-tissue bridging.

Step 3: Diagnostic Arthroscopy

With the aforementioned portals established, diagnostic arthroscopy of the joint is performed to thoroughly evaluate the glenohumeral joint surfaces, rotator cuff attachment, and interval comma tissue. After confirmation of a subscapularis tear, assessment of the LHB and biceps pulley tissue is critical (Figs 1 and 2). We recommend attempting medial subluxation of the biceps through the anterior portal using a probe (Fig 3). If instability is noted, then biceps tenodesis is performed in conjunction with subscapularis repair.

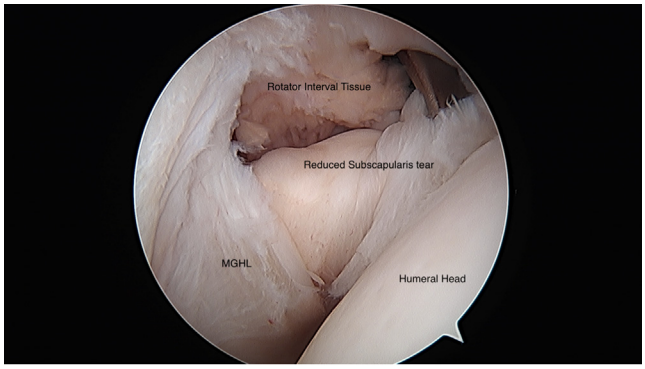

Fig 2. Right shoulder view from posterior portal, with patient in beach-chair position, showing subscapularis tear with interval reduction by cuff grasper through anterior working portal. (MGHL, middle glenohumeral ligament.)

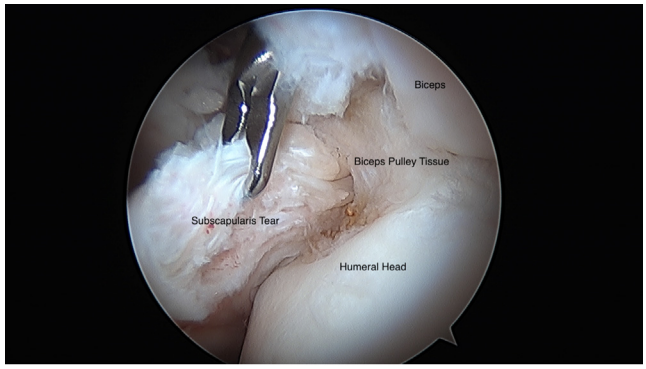

Fig 4. Right shoulder view from posterior portal, with patient in beach-chair position, with loop grasper through anterior working portal, showing full-thickness tear of upper border of subscapularis with retained intact biceps pulley tissue.

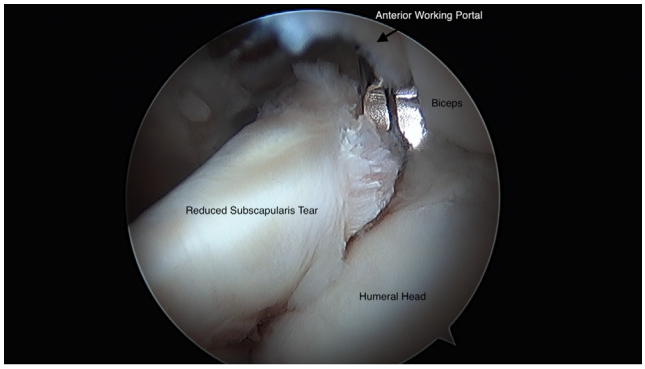

Fig 5. Right shoulder view from posterior portal, with patient in beach-chair position, with loop grasper working through anterior portal, showing interval reduction of upper-border subscapularis tear. The reconstituted and appropriately tensioned upper rolled border of the subscapularis can be seen.

However, if the biceps pulley tissue is intact (Figs 4 and 5) and the long head is stable, then isolated subscapularis repair is performed.

Step 4: Lesser Tuberosity Preparation

While viewing posteriorly, the surgeon uses the anterior portal to clear out the rotator interval tissue, paying close attention to preservation of biceps pulley tissue. It is also critical to decompress the subcoracoid interval to allow space to work on the subscapularis, as well as to pass sutures through the tendon. Debridement through both the anterior portal and the accessory anterolateral portal will allow for decortication of the lesser tuberosity, mobilization of the subscapularis tendon for repair, and decompression of the subcoracoid space.

Step 5: Anchor and Suture Placement

The arm is placed in slight external rotation and flexion to facilitate anchor placement, and the anterior portal is used to place suture anchors (Healicoil Regenesorb, 4.75 mm; Smith & Nephew, Watford, England) into the lesser tuberosity (Fig 6). The preference of the senior author (JB) is to work from inferior to superior when placing multiple anchors. Sutures can be shuttled out through the accessory anterolateral portal for management. Next, a suture-passing/-capturing device (ACCU-Pass Direct; Smith & Nephew) can be used to pierce the subscapularis tendon from the anterior portal and shuttle sutures out. When passing sutures, the senior author prefers to pass a single limb through as a post and to pass the second limb through in a luggage-tag configuration (Fig 7).[6] This process is repeated with the second suture from the initial double-loaded anchor placed (Video 1).

Step 6: Subscapularis Reduction and Closure

A 4.75-mm anchor is placed into the anterior portal, and sutures are retrieved 1 pair at a time. The post limb can be tensioned, and the subscapularis will reduce into place. Four reverse half-hitches on alternating posts are then used to tie down the subscapularis repair. This is repeated with the second suture, and the knots are then cut. At this point, the repair can be assessed for reduction quality, as well as preservation of the anterior biceps pulley construct (Fig 7, Table 1).

Step 7: Rehabilitation

The rehabilitation protocol incorporates 3 phases as generally outlined by the Multicenter Orthopaedic Outcomes Network (MOON) group. A sling is worn full time for the first 6 weeks after surgery except for removal daily for showers, pendulum exercises, and passive range of motion with the therapist limiting external rotation to 0° with the patient's arm at the patient's side. Gradual active-assisted range of motion

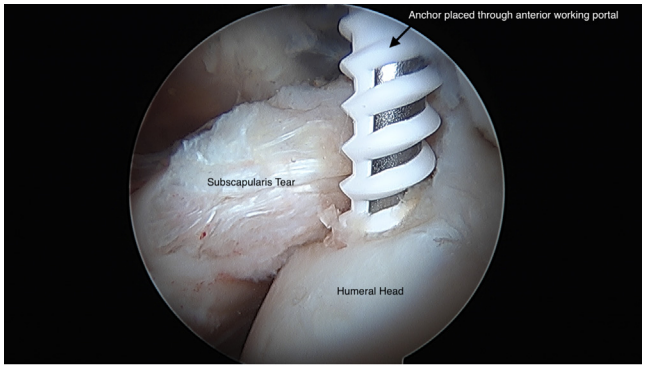

Fig 6. Right shoulder view from posterior portal, with patient in beach-chair position, showing placement of double-loaded anchor through anterior working portal into debrided footprint of lesser tuberosity.

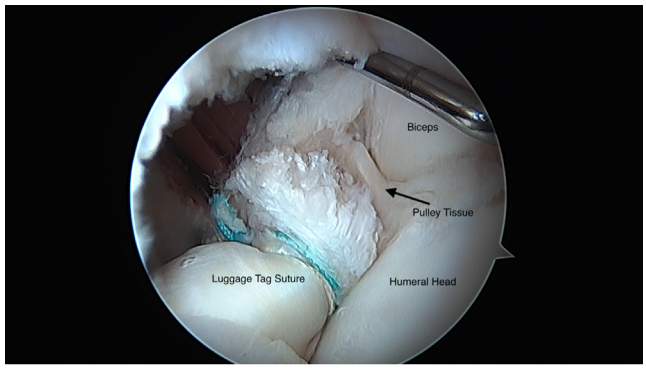

Fig 7. Right shoulder view from posterior portal, with patient in beach-chair position, showing restored subscapularis tear with 2 luggage-tag sutures tied through anterior working portal restoring upper rolled border of subscapularis tendon. A probe through the anterior working portal is retracting the long head of the biceps to allow visualization of the preserved biceps pulley tissue.

Table 1. Pearls and Pitfalls of Arthroscopic Subscapularis Repair With Biceps Preservation

Pearls	Pitfalls
A sufficiently wide exposure should be obtained.	Inadequate subcoracoid space exposure should be avoided because this will prevent facile suture management.
Suture should be passed through the anterior portal under direct visualization to avoid suture entanglement.	Failure to bring out both limbs simultaneously prior to tying may result in a soft-tissue bridge if using a technique with no cannula.
The accessory lateral portal should be used to reduce the subscapularis while tensioning the anterior luggage-tag sutures.	Debridement of the distinct biceps pulley structure should be avoided because preservation is crucial to ensure adequate LHB restraint.
A 70° arthroscope should be available to free up a retracted subscapularis tear if needed. Alternatively, one can view through the accessory anterolateral portal.	

LHB, long head of biceps.

can be initiated at week 4 and continue through week 8, with sling use discontinued at week 6. From week 8 to 12, active motion is emphasized, with gradual strengthening beginning at 12 weeks. Patients are advised that a return to full unrestricted activity should be expected between 5 and 6 months postoperatively.

Discussion

Since the description of rotator cuff tear pathology was originally outlined by Codman[23] in 1934, which included a description of subscapularis tears, the identification and treatment of these anterior cuff tear pathologies have increased. Ticker and Burkhart[5] described 2 crucial reasons for restoration of subscapularis tears, and Burkhart and Brady[17] described an arthroscopic technique to accomplish this[19]: The primary reason is to restore the anterior rotator cable footprint to allow overall rotator cuff function, as well as to facilitate appropriate tension-free repair of any concomitant posterosuperior cuff tear variants.[5,24] The second reason is to decrease pain from these tears and increase function primarily with internal humeral rotation and endurance.[5]

As our anatomic understanding of the anterior confluence of the subscapularis, LHB tendon, and surrounding pulley tissue has increased, multiple descriptions of the biomechanical importance of these structures have been reported.[9,10,13,15,16] Notably, arthroscopic imaging and MRI of LHB subluxation are significantly associated with upper-border subscapularis pathology; however, the inverse is not necessarily true.[9,13] Shi et al.[13] showed that the value of LHB subluxation as seen on axial cuts on MRI was primarily in its negative predictive value. If the LHB was located within the groove, there was a low likelihood of a full-thickness subscapularis tear. However, the positive predictive value was less clear in their study.[13] In our arthroscopic technique, we highlight the unique entity of a full-thickness upper subscapularis tear with a stable and intact biceps tendon without pathology treated with an isolated upper subscapularis repair.

The limitations of this technique description are largely confined to the nature of the study in that long term reoperation rates and failures are not reported. Future follow-up, outcome measurements, and comparison with a similar pathologic cohort undergoing concomitant biceps tenodesis or tenotomy are needed, and this research is ongoing.

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