Tears of the Subscapularis Tendon in Athletes—Diagnosis and Repair Techniques

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KEYWORDS

• Subscapularis • Repair • Tendon • Tears • Diagnosis

Isolated injury to the subscapularis tendon is an uncommon—but potentially debilitating—injury among athletes. The most frequent injury pattern seen in younger athletes is an acute, traumatic tendon avulsion. In the older athletic population, chronic degenerative tearing of the tendon may precede sports-related rupture, particularly after shoulder dislocation. This article reviews how to diagnose this injury in athletes and describes both conservative and operative treatment options and their outcomes.

Although a growing body of literature has come to recognize isolated subscapularis tendon tears in a typically nonathletic population, little has been written on the analogous pathology in active, athletic patients. Injury to this portion of the rotator cuff, however, does occur, with clinical implications ranging from diminished athletic performance to serious disability. Familiarity with the potential injury patterns in an athletic population as well as an understanding of the diagnostic workup and appropriate treatment considerations are important to the practicing orthopedist.

ANATOMY

The subscapularis muscle–tendon unit comprises the anterior rotator cuff, providing active internal rotation of the humerus and contributing to the dynamic anterior stability of the glenohumeral joint. Nervous innervation is provided via the upper and lower subscapular nerves and their variable branches that enter the muscle belly medial to the conjoint tendon.[1] The muscle belly originates on the medial two thirds of the scapular body, developing a tendinous character at the more lateral joint line and inserting at the lesser tuberosity in coalescence with the anterior shoulder capsule.[2] At the joint

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Clin Sports Med 27 (2008) 731–745
doi:10.1016/j.csm.2008.06.005 **sportsmed.theclinics.com**
0278-5919/08/$ – see front matter

line, subscapular and subcoracoid bursae lubricate the muscle–tendon's articulation with the more posterior joint capsule and anterior coracoid process, respectively.[3] The tendon has its greatest bulk superiorly, tapering off to a thinner, more muscular layer inferiorly.[2] The dimensions of the bony insertion follow this theme, with a wider superior aspect (1.8–2.0 cm from medial to lateral) that thins toward the bottom of the lesser tuberosity (mean, 0.3 cm medial to lateral width), creating a trapezoidal insertion whose greatest dimension is its vertical lateral edge (2.5–4 cm from proximal to distal).[4–6] The tendon's insertional fibers also extend posteriorly and laterally over the top of the bicipital groove, coalescing with insertional fibers of the supraspinatus—as well as the coracohumeral (CHL) and superior glenohumeral (SGHL) ligaments—to form the biceps pulley complex, performing an important stabilizing role for the biceps tendon.[7,8] Biomechanically, the superior and midportions of the tendon have substantially greater stiffness and ultimate load to failure than the tendon's inferior portion, providing a measure of protection against propagation of cuff tears superiorly but theoretically posing a region of vulnerability to anterior shoulder dislocation inferiorly.[9]

PATHOPHYSIOLOGY

Acute, high-energy sports-related events are the most commonly reported mechanism of subscapularis tears in athletes. Among sports as varied as waterskiing, baseball, and arm wrestling, several investigators have reported either partial or complete tendon rupture after a typically violent hyperextension or combined adduction and external rotation maneuver.[10–12] In skeletally immature athletes, in whom the physes are generally weaker than musculotendinous or tendinous tissues, similar mechanisms may instead cause frank lesser tuberosity bony avulsions.[13–17] In older athletes, the tendon usually ruptures first and with generally lower energy events. Particularly among athletes older than 40 years, the prevalence of pre-existing degenerative, partial-thickness articular-sided fraying[18–20] may weaken the tendon at its insertion, increasing the likelihood of full-thickness rupture during less-violent sporting activities.[21–23] Similar age-related differences are seen after shoulder dislocations, in which younger patients typically present with a Bankart lesion, whereas older athletes are much more likely to suffer full-thickness rotator cuff tears—particularly of the subscapularis.[24]

Chronic overuse-related microtrauma and tendon degeneration may play an important role in predisposing athletes to traumatic rupture, particularly in older age groups. Several investigators have hypothesized that the tendon may be chronically injured by a mechanical compression between the lesser tuberosity and coracoid process[25–27]—the so-called "roller wringer effect"—of particular significance in high-demand overhead athletes.[28] Another contributory mechanism of injury is anterosuperior impingement, in which articular-sided abrasion may occur at the lesser tuberosity and glenoid rim interface, especially in the resisted flexed and internally rotated positions (eg, the tennis follow-through).[29,30] Such chronic, repetitive stress applied to the subscapularis musculotendinous junction could lead to microtrauma and eventually macroscopic tendon compromise.[23,28,31] Whether sport-specific activities predispose to such chronic overuse is not yet clear, although several studies have demonstrated tremendous subscapularis demands during certain sports. EMG analysis of golfers, for instance, suggests that the subscapularis dominates all other muscle activity during the golf swing, making it vulnerable to injury.[32] Similar investigation has shown tremendous subscapularis demands during the tennis serve and forehand stroke,[33] with a high frequency of ultrasound-confirmed subscapularis tendon calcifications in the dominant shoulder of veteran (age, 35–77 years) tennis players.[34] MRI of amateur baseball pitchers' throwing shoulders has demonstrated significant increases in subscapularis T2-weighted signal 48 hours after pitching,[35] and an isolated subscapularis muscle strain has been reported in an outfielder.[36] EMG study of swimmers has also suggested that the butterfly stroke places particularly high demands on the subscapularis muscle, with greater subscapularis activity associated with pain.[37,38] Although these mechanisms would not appear to be the common primary mechanism of athletic subscapularis tendon tears—and have yet to be linked to increased rates of subscapularis pathology—they may well contribute to traumatic rupture when a suitably abnormal strain is applied.

EPIDEMIOLOGY

Isolated subscapularis tears in athletes are probably quite rare—particularly among young athletes—although the true incidence of these lesions is not currently known. The only published reports of these injuries in active patients younger than 40 years are small case series or case reports. Although the literature on older age groups is largely limited to degenerative tears, several studies suggest that sports-related tears are likely to be more common in older athletes. Although activity level was not specified, Flury and colleagues[39] reported isolated subscapularis tendon tears in 3% of their series of 1345 symptomatic rotator cuff repairs (mean age, 56 years) and Sakurai and colleagues[18] noted a 13% rate of presumptively asymptomatic partial-thickness degenerative tears in their cadaveric study, suggesting that degenerative tears may occur with some frequency in these patients. Where reported, sports-related tears in older athletes tend to occur with less violence than in younger patients, and in association with degenerative tendons.[21–23] Likewise, the association of these tears with shoulder dislocations[24]—as not infrequently occurs during contact sports—suggests that older patients may be expected to suffer sports-related subscapularis tears more frequently than their younger counterparts.

DIAGNOSIS

History

A careful history should be obtained in all athletes presenting with shoulder pain and/or weakness. Specific to subscapularis injury, the time-course and mechanism of injury should be sought. Particularly in younger patients, subscapularis injury will typically follow a significant acute trauma in which the arm is forcibly hyperextended and/or externally rotated, although the diagnosis may be delayed.[12,40] Older patients may report pre-existing mild pain in the anterior aspect of the shoulder (ie, from symptomatic partial-thickness degenerative tears) with a dramatic worsening of pain and internal rotation weakness after a sports-related dislocation or maneuver in which the subscapularis is overstressed (eg, tennis serve follow-through or high-speed pitching).[22,23] Symptoms at the time of presentation typically involve anterior shoulder pain—occasionally with radiation to the forearm—during use of the arm both above and below shoulder level and at night.[12,40] Most of the patients will also note subjective upper extremity weakness.[12] Given the stabilizing role of the subscapularis, patients should also be questioned about subluxation or dislocation events and any subsequent sense of instability.[40] In older patients, the high association of subscapularis tears with tears of other rotator cuff tendons and/or the biceps pulley complex warrants focused questioning in these areas as well. These findings are summarized in **Table 1**.

Physical Examination

The involved upper extremity should be inspected for signs of trauma, and a thorough physical examination performed with special attention directed toward range of

Table 1
History findings in supscapularis tendon tear

Mechanism
Younger (<40 y) athletes: forced hyperextension or external rotation
Older (>40 y) athletes: preceding symptoms, often lower energy acute event (eg, throwing or dislocation)
Symptoms
Anterior shoulder pain
With activity above and below shoulder level
At night
Subjective weakness in internal rotation, overhead activities
Subjective instability

motion, rotator cuff strength, instability, neurovascular status, and potentially coexistent biceps pathology. Most of the patients with isolated subscapularis rupture will present with tenderness over the lesser tuberosity,[40] increased passive external rotation, slightly diminished internal rotation strength, and a positive bear-hug,[41] belly-press,[42] or lift-off[12] test. Partial tears of the upper subscapularis may first present with only a positive bear-hug test because of this maneuver's greater sensitivity in detecting smaller tears.[41,43] Likewise, because the lift-off test preferentially evaluates the lower portion of the muscle–tendon complex[44] and tears tend to propagate from superiorly to inferiorly this test is not typically positive unless tears exceed roughly 75% of the insertion.[41] Some investigators have also reported a frequently positive Jobe supraspinatus test[21] in isolated subscapularis tears, probably because of a relative force couple imbalance about the anterosuperior aspect of the humeral head. A significant number of patients may also have a positive apprehension sign[12,20] during instability testing, and provocative biceps findings (Speed and Yergason's tests) are also commonly reported.[22,40] In older patients, coincident tears of the other rotator cuff tendons may present with positive impingement signs or weakness in forward elevation.[20] Common physical examination findings are shown in **Table 2**.

Imaging

Routine plain films (anterior/posterior [AP] and axillary views) \should be obtained in all patients suspected of having subscapularis tendon ruptures. Although these images

Table 2
Physical examination findings in subscapularis tendon tear

Inspection
Signs of trauma and possible cuff atrophy (older patients)
Palpation
Tenderness over lesser tuberosity and bicipital groove
Range of motion
Increased passive external rotation with arm at side
Strength
Weakness in resisted internal rotation
Provocative testing
Positive lift-off
Positive belly-press
Positive bear-hug
Positive Jobe supraspinatus test

will usually be normal,[12,40] an associated greater[45] or lesser tuberosity avulsion fracture[14,46] may be evident on a radiograph, particularly in skeletally immature athletes. Although lesser tuberosity fractures are often best visualized on the axillary view, an internally and/or externally rotated AP view often adds to the visualization of the tuberosity portion of the humeral head, and these views are also frequently obtained. A narrowed acromiohumeral interval in older patients may indicate an associated massive rotator cuff tear.[47] In all patients, plain films should be used to identify any joint space narrowing and to confirm that the glenohumeral joint is located.

Several other imaging methods are available to assess subscapularis tendon integrity. Ultrasound may be useful in patients suspected of having large subscapularis tears, although this modality is highly operator-dependent and less likely to visualize and/or quantify smaller, partial-thickness tears.[48] CT arthrograms may also be used for detection of subscapularis tendon tears—isolated tears typically associated with contrast extravasation from the glenohumeral joint onto the lesser tuberosity[21]—but are limited in visualizing associated biceps and rotator cuff pathology.

MRI is the imaging modality of choice in patients suspected of subscapularis tendon injury.[40] Isolated subscapularis muscle strain can be appreciated as increased muscle belly signal on T2-weighted images.[36] Partial-thickness[11,18] tears are also visualized as loss of T1 signal and increased T2 signal on axial images at the tendon's lesser tuberosity insertion, typically on the articular side. Full-thickness tears are readily visualized as tendon discontinuity at or near the tuberosity insertion,[40] with a high frequency of focal periarticular fluid in the superior subscapularis recess[49] and associated biceps tendon subluxation or dislocation (**Fig. 1**).[50] Sagittal oblique images may be particularly helpful for appreciating both tendon discontinuity and retraction (**Fig. 2**).[49,50] The examiner should also carefully evaluate the status of the subscapularis muscle belly. Chronic tears may show significant fatty degeneration,[51,52] which is also easily quantified on MRI. Despite the usefulness of MRI for imaging these tears, the above findings may be frequently overlooked by radiologists,[49] and may be further complicated in overhead athletes—who may have pre-existing asymptomatic rotator cuff lesions.[53] A summary of pertinent imaging findings is given in **Table 3**.

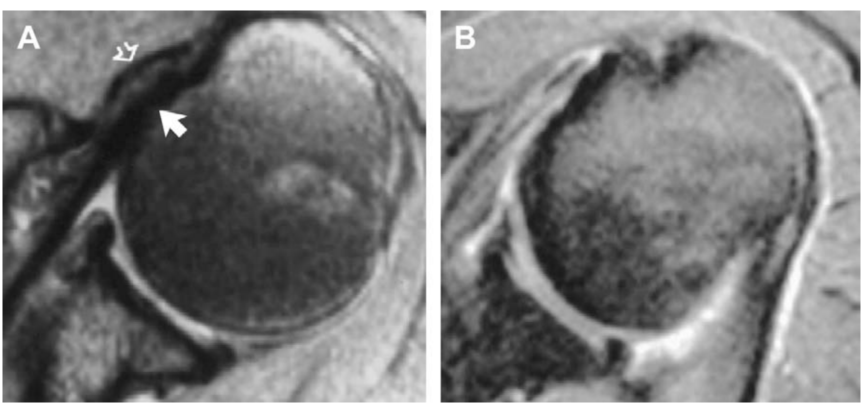

Fig. 1. MR image (axial cut) demonstrating (*A*) normal subscapularis tendon appearance, compared with (*B*) increased T2, decreased T1 signal at the subscapularis insertion, and a medially dislocated biceps tendon which accompanies a tear. (*From* Tung GA, Yoo DC, Levine SM, Brody JM, Green A. Subscapularis tendon tear: primary and associated signs on MRI. J Comput Assist Tomogr 2001;25(3):417–24; with permission.)

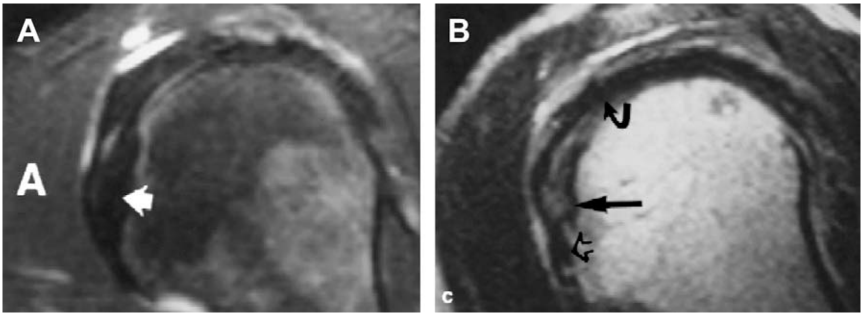

Fig. 2. Sagittal oblique MRI cuts may also be useful in visualizing the subscapularis insertion. (*A*) Normal insertion compared with (*B*) the increased signal (*straight solid arrow*) on this T2-weighted image involving a partial tear of the cranial portion of the insertion (*curved arrow*, intact supraspinatus; *unfilled straight arrow*, intact caudal subscapularis insertion.) (*From* Tung GA, Yoo DC, Levine SM, Brody JM, Green A. Subscapularis tendon tear: primary and associated signs on MRI. J Comput Assist Tomogr 2001;25(3):417–24; with permission).

Arthroscopy

In cases where the history, physical examination, and imaging studies are inconclusive, a diagnostic arthroscopy may be necessary to confirm subscapularis tendon injury. During a standard diagnostic arthroscopy, the upper rolled edge of subscapularis tendon and its insertion into the lesser tuberosity can be viewed with the scope in the posterior portal and the arm forward flexed and internally rotated (**Fig. 3**). Further increasing forward elevation from 60° to 90° enhances visualization of the undersurface of the tendon adjacent to the lesser tuberosity, and allows it to be probed through the anterior portal.[54] Given the frequent association of subscapularis tears with cuff and biceps pulley complex pathology, particular attention should also be paid to these structures during arthroscopy. Although only the upper 25% of the subscapularis tendon and its insertion can be viewed from within the joint,[55] this region is the most structurally significant[9] and most frequently injured.[18] Should additional visualization be necessary, viewing the footprint with a 70° lens from the posterior portal is

Table 3
Imaging Findings for SubscapularisTendonTear

Radiograph (AP, axillary)	
	Usually normal (to rule out fracture, dislocation, arthrosis)
	Evaluate acromiohumeral, CHL intervals
Ultrasound	
	Tendon discontinuity (including intrasubstance tears)
CT arthrogram	
	Dye on the lesser tuberosity
MRI	
	Decreased T1 and increased T2 signal at insertion
	Focal periarticular fluid in subscapularis recess
	Evaluate tendon retraction and degree of fatty infiltration
	Evaluate biceps tendon subluxation/dislocation
	Evaluate remaining rotator cuff

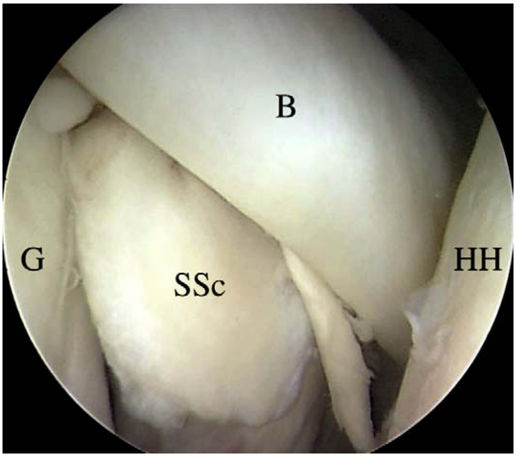

Fig. 3. Arthroscopy. With the scope in the posterior portal of the right shoulder, the retracted stump of a full-thickness subscapularis tendon tear (SSc) and dislocated biceps tendon (B) are immediately evident. HH, humeral head; G, glenoid.

effective. Some investigators have described visualizing the entirety of the extra-articular portion of the tendon via the subacromial space (with the scope in the lateral portal).[56]

CLASSIFICATION

The most common classification scheme for subscapularis tendon tears is descriptive,[20] noting whether the tear is of partial or full thickness and whether it involves only a portion or the entirety of the insertion. Full-thickness, complete tears are also described in relation to the degree of retraction. Associated tears of the SGHL and CHL as well as the remaining rotator cuff tendons should also be noted.[57] Pfirrmann and colleagues[58] have also proposed an MR classification scheme, denoting grade 1 tears as those involving less than 25% of the craniocaudal tendon, grade 2 tears as those involving more than 25% but without complete detachment, and grade 3 tears as those with complete detachment.

TREATMENT

Nonoperative Treatment

Given the functional disability and long-term clinical implications of delayed surgical management of full-thickness tears,[39] conservative management of athletic subscapularis tears should be reserved for isolated, partial-thickness lesions. Particularly in older athletes with tendonopathy and/or partial tears—which may be incidental to other nonsurgical causes of shoulder pain—a trial of rest, activity restrictions, physical therapy, and anti-inflammatory medications may be considered for up to 3 months. A similar nonoperative approach has also been used successfully in treating nondisplaced lesser tuberosity fractures.[15] An initial nonsurgical approach may additionally be considered in patients presenting with select chronic, full-thickness tears that are either minimally symptomatic or impaired and/or have a high likelihood of failure after primary repair. For complete, retracted tears older than 1 year and/or with stage 3 or greater fatty degeneration[51] and/or associated rotator cuff arthropathy, the substantial risk for failure[39] may warrant a course of nonoperative treatment in lieu of pectoralis tendon transfer or other salvage procedures; this is especially relevant in older, less demanding patients. Continued pain and/or functional limitation after nonoperative treatment in any patient warrants consideration for operative intervention.

Operative Treatment

Patients with partial-thickness tears failing nonoperative treatment—and those with full-thickness tears— require surgery to relieve pain and restore shoulder function. In the case of full-thickness tears, surgery to repair the tendon at its insertion should not be delayed given the evidence of compromised outcomes in patients subjected to delayed repair.[39,42] Most surgeons recommend repair within 1 to 2 weeks of presentation to avoid tendon retraction and scarring. The indications for debridement versus repair of partial-thickness tears in an athletic population are not yet clear in the literature. In the case of isolated partial subscapularis tears in athletes, the authors' preferred approach is to attempt debridement in the majority of tears involving less than 50% of the tendon's insertion, especially when pain, and not functional loss, is the primary complaint.[59] After failure of nonoperative management, the authors prefer to fix partial tears involving more than 50% of the upper subscapularis insertion—particularly among athletes with any functional impairment and/or whose sports place considerable demands on the tendon given the theoretic risk this represents for later full-thickness tearing. Associated biceps tendon subluxation in the case of partial-thickness subscapularis tears poses a challenge; there is no consensus regarding whether the biceps should be preserved or tenodesed. The authors' preference in this situation depends on the appearance of the biceps tendon. If the tendon is not frayed and degenerative, the authors have a lower threshold for fixing partial subscapularis tears and preserving the biceps tendon long head, recognizing that not all repairs will protect against subluxation. Although a case-by-case approach is used for biceps instability after such fixation, the authors find this problem is most reliably managed by the authors with biceps tenodesis. Displaced lesser tuberosity avulsion fractures are treated as full-thickness tendon tears.

Debridement of partial-thickness tears can readily be accomplished through an arthroscopic approach, which preserves the bursal side of the tendon.[60] With the arthroscope in the posterior portal and the arm elevated (to 45° or more) and internally rotated, the most common articular-sided tear pattern can be visualized. In this position, a probe can be introduced through the anterior interval portal and used to explore and quantify the degree of insertional compromise. A shaver introduced through the same portal can then be used to debride the frayed articular side of the tendon. The surgeon should simultaneously perform a careful evaluation of the SGHL and medial CHL portions of the biceps pulley complex, which are frequently injured in association with tears of the upper subscapularis tendon. Damage to these structures is often associated with a subluxating or dislocating biceps tendon and may influence treatment decision making, necessitating a biceps tenodesis.[43]

Repair of partial-thickness tears can also be accomplished using a similar setup. With the scope in the posterior portal, the articular side of the tendon and its upper rolled border can be gently debrided with a shaver introduced through a standard portal. A more medially based portal, however, permits direct access to the tuberosity, as well as easier targeting with suture passers when considering subscapularis repair.[43] Debridement of the frayed tendon and overlying rotator interval tissue at the insertion facilitates accurate quantification of the degree of tendon compromise, although the surgeon should take care to preserve the SGHL and CHL contributions to the medial biceps pulley complex, if still intact. Medially, exposure of the coracoid process both increases the field of view and allows subsequent coracoplasty should this be indicated (**Fig. 4**).[43] Coracoplasty is performed rarely in younger athletes with acute, traumatic presentations but may be a helpful adjunct in older athletes with prior subcoracoid impingement symptoms and an inferolaterally prominent coracoid process, prominent lesser tuberosity, and narrowed CHL interval.[61,62] If a biceps tenodesis is planned, tenotomy at this stage of the operation will further facilitate exposure of the subscapularis insertion, although the authors generally make decisions about tenotomy after the subscapularis is fixed, particularly in overhead athletes in whom preservation of the biceps tendon is preferred. Bony preparation of the lesser tuberosity is performed in the region of tendon compromise with a burr from the anterior portal. An accessory anterosuperolateral rotator interval portal[43] is then established using an 8.25-mm cannula as the principal working portal. Suture anchors can be introduced through the anterior portal and sutures then passed through the tendon using various tendon penetrating devices from the anterosuperolateral portal. To avoid obstructing one's field of view, anchors and suture passage is generally performed from inferior to superior, with typically a double-loaded anchor per centimeter of repair.[43] Knots are usually tied most easily through the anterosuperolateral portal with the arm in internal rotation.

Full-thickness tears have traditionally been fixed through an open approach, although several arthroscopic repair techniques have been described. Arthroscopically, the technique is similar to that used for repair of partial-thickness tears (discussed earlier). However, full-thickness tears present a greater technical challenge given the frequent retraction of the tendon medially. Typically the upper corner of the tendon can be located by persistent attachment of the SGHL and CHL, which has he appearance of a "comma" (**Fig. 5**).[43,63] Once the tendon is located in this manner, a traction stitch may be placed at the junction of the comma sign and the upper corner of the tendon; passed outside the anterosuperolateral cannula, these stitches may be used to apply traction to the tendon in a nonobstructive way.[43] The tendon is then released of any adhesions, anteriorly and superiorly between the tendon and the coracoid, and, if necessary, posteriorly through the capsule to the anterior glenoid neck.[43] Care must be taken to avoid any dissection medial to the coracoid process during the anterior and superior releases. Bony preparation and anchor insertion are then performed as for partial-thickness tears, with the traction stitch providing tendon reduction during suture passage.

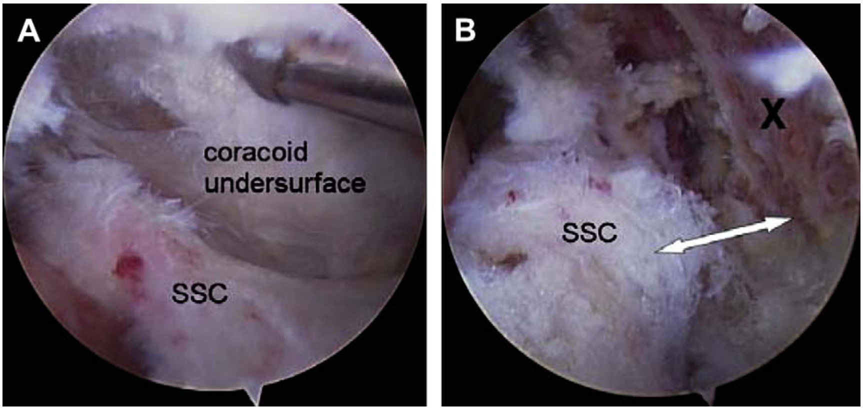

Fig. 4. Coracoplasty. The coracoid is first exposed and then burred posteriorly to increase the space available for the subscapularis tendon.

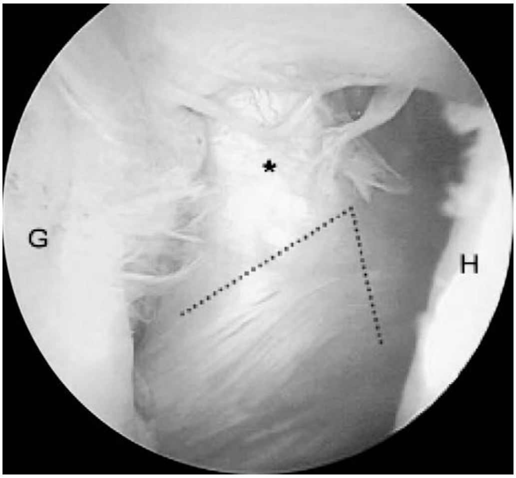

Fig. 5. The "comma sign" is formed by residual attachments of the retracted tendon edge to the SGHL and CHL. In the figure (right shoulder), an asterisk marks this tissue and dotted lines mark the corner of the subscapularis tendon. G, glenoid; H, humerus. (*From* Lo IK, Burkhart SS. The comma sign: An arthroscopic guide to the torn subscapularis tendon. Arthroscopy 2003;19(3):334–7; with permission).

Open repair of isolated subscapularis tendon tears is typically performed through a standard deltopectoral approach (**Fig. 6**).[64] A combined subscapularis and supraspinatus tear may be managed through a superior deltoid splitting exposure[64,65] or a "hybrid" technique (arthroscopic supraspinatus repair followed by open subscapularis repair) so long as fluid extravasation is minimal before the open exposure. Even in cases where an open approach is planned, it may be beneficial to perform an initial diagnostic arthroscopy before open repair to assist in quantifying the degree of rotator

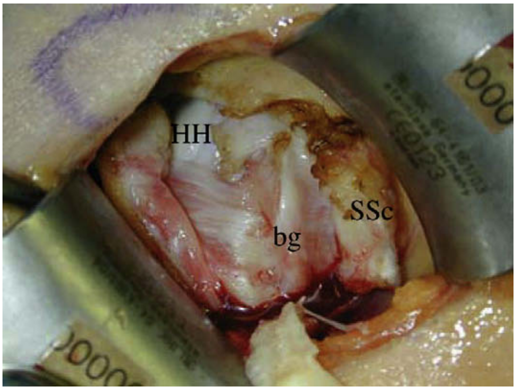

Fig. 6. Open repair. Exposure and repair of an isolated subscapularis repair is usually performed through a standard deltopectoral approach. After the development of the deltopectoral interval, satisfactory exposure is provided of the subscapularis insertion. A full-thickness subscapularis tear is seen through this approach (right shoulder). Repair may subsequently be performed using either suture anchors or transosseous sutures. SSc, subscapularis; HH, humeral head; bg, bicipital groove.

cuff and biceps pulley involvement. However, the authors are careful to limit the duration of the arthroscopy to avoid fluid extravasation into the soft tissues, which makes open repair considerably more difficult. After the initial open approach, the bicipital groove region should be identified, the groove and rotator interval opened, and the degree of subscapularis insertional compromise determined.[64] In the most common scenario of associated biceps instability, a biceps tenotomy and subsequent tenodesis in the bicipital groove is performed to optimize outcome.[66] Traction sutures can be placed in the lateral subscapularis tendon and, as necessary, similar releases can be performed as described for arthroscopic repair. Some investigators have noted an advantage to the deltopectoral approach when a posterior release is necessary.[64] Once appropriately mobilized, the lesser tuberosity bony bed is prepared using a curet or burr, and the tendon is repaired anatomically using either suture anchors or transosseous sutures.[64] In superior deltoid splitting exposures where a portion of the deltoid is released from the acromion, a careful full-thickness repair back to the acromial insertion with nonabsorbable sutures is a critical portion of the closure.

Displaced lesser tuberosity avulsion fractures typically require open surgical fixation. Small bony fragments can be excised, and the tendon then repaired back to the lesser tuberosity using the same technique discussed earlier for full-thickness tears.[16,67] Larger fragments have been reportedly fixed with transosseous sutures and/or suture anchors through a similar approach.[14,17] In the rare case in which the biceps tendon is not subluxed or dislocated, an arthroscopic repair with suture anchors may be considered.[46]

AFTERCARE

Postoperatively, all patients are initially placed in a sling for protection. In cases where isolated partial tears are only debrided, full activities may be allowed once postoperative pain has subsided.[60] In all repairs, the tendon must be protected for a minimum of 6 weeks. Although passive forward elevation and internal rotation are initiated immediately after surgery, passive external rotation is limited to the extent that the repair is not overly stressed, and limits should be determined in the operating room after repair. Active internal rotation and overhead motion is also prevented until after the 6-week period of protection.[43] After 6 weeks, the sling is discontinued and end-range stretching in external rotation is advanced along with isometric strengthening exercises. At 3 months, below shoulder-level Thera-Band strengthening can be initiated and sport-specific activities started around 4.5 months. Return to play is predicated on the return of adequate motion and strength and usually occurs roughly 6 months postoperatively.

RESULTS

No substantial studies have reported outcomes after debridement and/or repair of isolated subscapularis tendon tears in athletes. The available case report data suggest good-to-excellent outcomes for operative repair of athletic partial-[11] and full-thickness[22,40] tears, as well as nonoperative[15] (nondisplaced) and operative[16,17,67] management of lesser tuberosity avulsion fractures, with the vast majority of patients returning to full activities and/or their preinjury level of sport in 3 to 6 months. Deutsch and colleagues[40] have reported excellent outcomes in a series of 13 patients (mean age, 39 years) after open repair of isolated full-thickness tears, with 12 of 13 patients returning to preinjury sports activities at mean 2-year follow-up. Larger series in predominantly older patients (mean age, 60 years) echo these findings, with appropriately indicated arthroscopic debridement of partial tears producing high levels of patient satisfaction and functional improvement.[60] Similar results have been reported after arthroscopic[68,69] and open[42,66] repair of partial- and full-thickness tears. However, the latter outcomes do not include a return to athletic activity and for their older cohorts are difficult to relate to a younger, athletic population.

SUMMARY

Subscapularis tendon tears are uncommon, but typically debilitating, injuries among athletes. Potential injury patterns range from overuse tendinopathy and/or partial tearing to complete bone–tendon avulsion. Diagnosis can usually be made with a careful history, physical examination and imaging studies, although definitive assessment may require arthroscopic evaluation. Tears are typically classified based on the extent of insertional compromise and the potential association with injury to the biceps tendon and/or remaining rotator cuff. Conservative management, consisting of activity restrictions and physical therapy, is generally limited to overuse tendinopathy and/or partial-thickness tears. Complete tendon compromise warrants expedient operative fixation in most cases, through either an arthroscopic or an open approach. Limited outcome data suggest that after surgical intervention, athletes with isolated subscapularis tears do well, with most of them eventually returning to their preinjury level of sport.

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