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REVIEW ARTICLES

Partial-thickness rotator cuff tears

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Introduction

Our understanding of the spectrum of rotator cuff disease continues to improve as imaging modalities and treatment techniques become more refined. The original ideas and contributions provided by Codman[10] and Neer[47,48] continue to inform our understanding. Unfortunately, high-quality data on the management of partial-thickness rotator cuff tears are relatively lacking in the literature when compared with those available on full-thickness tears. This is particularly important because the estimated prevalence of partial-thickness rotator cuff tears is significant and can be expected to increase in light of our aging population and the association between increasing age and rotator cuff pathology.[10,22,39,43,56] There remains a lack of long-term outcome studies; however, short-term follow-up studies provide us with important information regarding the difference between bursal- and articular-sided partial-thickness tears. Our overall understanding of the anatomy, biomechanics, and potential etiologies of partial-thickness tears continues to improve.

Anatomy

The rotator cuff includes the subscapularis, supraspinatus, infraspinatus, and teres minor muscle tendons. Anatomic studies have shown the cuff insertion to be a coalescence of these tendons with the glenohumeral capsule and glenohumeral and coracohumeral ligaments.[9] The supraspinatus and infraspinatus muscles join 15 mm medial to the cuff insertion.

In 1992 Clark and Harryman[9] showed that the rotator cuff insertion contains 5 distinct histologic layers (Figure 1). The second and third layers contain the tendinous fibers, whereas the remaining layers contain arterioles and loose connective tissue. The tendinous fibers of layer 2 are oriented parallel to the axes of the supraspinatus and infraspinatus, whereas the fibers in layer 3 are more obliquely arranged.

Partial-thickness rotator cuff tears can be articular sided, bursal sided, intratendinous, or a combination of these patterns. An understanding of the rotator cuff footprint anatomy is essential for assessing partial-thickness tear depth. The anatomy of the cuff insertion footprint has been studied intently.[15,44,57] Dugas et al[15] and Ruotolo et al[54] showed that the medial-lateral insertion width of the supraspinatus tendon averages 12.7 mm and 12.1 mm, respectively. Thus an articular-sided partial-thickness tear of the supraspinatus tendon with a medial cuff insertion—to—articular margin distance greater than 7 mm is consistent with partial-thickness tearing of greater than 50% of the tendon thickness.

More recently, Mochizuki et al[44] showed slightly different anatomic dimensions in their cadaveric study. They found the maximum medial-lateral and anterior-posterior supraspinatus insertion widths to be only 6.9 mm and 12.6 mm, respectively. In addition, they found the supraspinatus footprint to be much smaller, with the infraspinatus insertion covering the majority of the greater tuberosity. Nevertheless, most authors consider a tear with a depth of 6 mm or greater to represent at least 50% of the tendon thickness.

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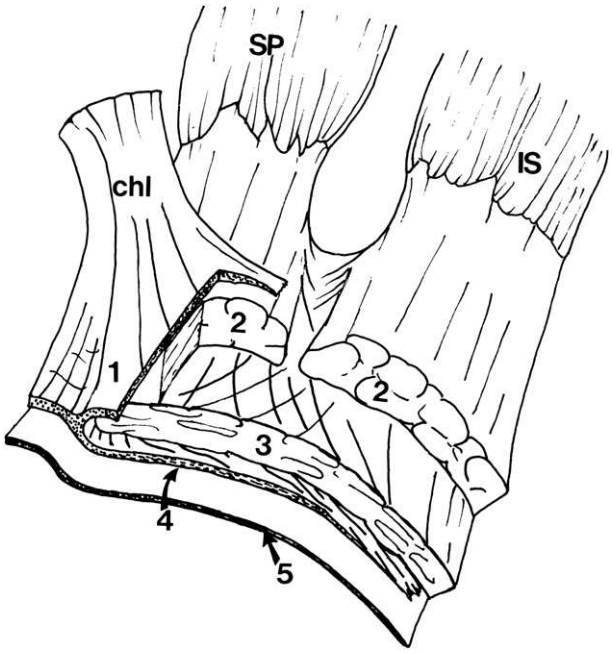

Figure 1 Transverse schematic representation of rotator cuff showing 5 distinct histologic layers. The second and third layers contain the actual tendinous fibers of the rotator cuff, whereas the remaining layers contain arterioles and loose connective tissue. chl = coracohumeral ligament; SP = supraspinatus; IS = infraspinatus. (Adapted and reprinted with permission).[9]

The vascular supply to the rotator cuff is vital to potential healing of rotator cuff pathology. The arterial supply comes from the anastomotic network formed by the suprascapular and subscapular arteries with retrograde contribution from the osseous circumflex arteries.[53] Clark and Harryman[9] showed that vessel size and density decrease from medial to lateral and that arterioles are larger and more prevalent on the bursal surface of the rotator cuff. Though theoretically implying increased healing capacity for bursal-sided tears, this has not been shown to be true in clinical studies.[13,20,62]

Incidence

Despite numerous cadaveric and imaging studies, the incidence of partial-thickness tears is unknown. Codman[10] reported a 32% incidence of supraspinatus rupture. Some epidemiologic data are from cadaveric studies, which produce different results compared with clinical population reports.[17] However, cadaveric studies remain instructive. Lohr and Uhthoff[39] examined the supraspinatus tendons of 306 cadaveric shoulders and found an incidence of 19% for full-thickness tears and 32% for partial-thickness tears. Fukuda et al[17] referenced their own previous examination of 249 cadaveric shoulders and found partial-thickness supraspinatus tears in 13%, with bursal-sided tears in 18%, intratendinous tears in 55%, and articular-sided tears in 27%.

Clinical studies have found a higher percentage of articular-sided tears when compared with cadaveric studies, and the incidence of partial-thickness tears increases with age. Sher et al[56] reported a 20% prevalence of partial-thickness tears after magnetic resonance imaging (MRI) in 96 asymptomatic shoulders. Those subjects aged between 19 and 39 years had no full-thickness tears and 4% had partial-thickness tears, as compared with 28% and 26%, respectively, in subjects aged older than 60 years. Milgrom et al[43] reported similar results using ultrasound in asymptomatic shoulders. They found a prevalence of full- or partial-thickness tears of 5% to 11% in subjects aged 40 to 60 years, increasing to 80% in subjects aged older than 70 years.

Connor et al[11] evaluated 20 asymptomatic, elite overhead athletes with MRI. They reported a 40% prevalence of full- or partial-thickness tears in the dominant shoulder. Interestingly, 5 years later, 16 of the 20 subjects reported no subjective shoulder symptoms and had not required any treatment.

Pathogenesis

The pathogenesis of partial-thickness rotator cuff tears is likely the end result of a common pathway involving both intrinsic and extrinsic causes. Intrinsic causes include age-related metabolic and vascular changes leading to degenerative tearing and differential shear stress within the tendon leading to intratendinous tears.[3,36,40,49] Extrinsic causes include subacromial impingement, glenohumeral instability, internal impingement, acute traumatic events, and repetitive microtrauma.[14,23,32,48,61]

Age-related degenerative changes have been shown in the rotator cuff and are likely irreversible. Decreased cellularity, fascicular thinning and disruption, accumulation of granulation tissue, and dystrophic calcification were shown by Lohr and Uhthoff[39] in degenerative rotator cuff tears. A zone of relative hypovascularity is found on the articular surface of the rotator cuff lateral to the rotator cable, extending to within 5 mm of the cuff insertion.[6,38,53]

The 5-layer histologic structure of the rotator cuff also lends itself to differential shear stresses within the tendons.[3,9,46,51,64] Nakajima et al[46] found the articular side of the rotator cuff to be composed of an array of tendon, ligament, and capsular tissue. This less uniformly arranged composition is less tolerant of deformation and shows approximately half the ultimate stress to failure as that of the bursal side. Bey et al[3] showed in a cadaveric model that partial-thickness articular surface tears increased intratendinous strain at angles of abduction greater than 15°. Reilly et al[51] and Yang et al[64] have both shown similar findings of increased strain and tear propagation resulting from partial-thickness tearing.

Neer[48] proposed the extrinsic theory of subacromial impingement as a progressive spectrum of cuff tendinopathy resulting from impingement of the rotator cuff against

subacromial osteophytes or the coracoacromial ligament. Although this theory is biologically plausible, conclusive support in the literature is not to be found. Ozaki et al[49] examined 200 cadaveric shoulders and found that a lesion in the anterior one-third of the undersurface of the acromion was always associated with a bursal-sided tear. However, the undersurface of the acromion was almost always intact in articular-sided tears. Schneeberger et al[55] created iatrogenic impingement in rats and found exclusively bursal-sided tears.

Extrinsic causes of partial-thickness rotator cuff tears are not limited to subacromial impingement but include microinstability, repetitive microtrauma, acute events, and internal impingement. Internal impingement is described most commonly in the overhead athlete and implies contact between the posterosuperior glenoid and the articular surface of the rotator cuff at the supraspinatus-infraspinatus interval.[14,29,61] Internal impingement is influenced by anterior instability, posterior capsular tightness, decreased humeral retroversion, poor throwing mechanics, and scapular dyskinesis.

Classification

Codman[10] first described partial-thickness tearing as ''rim rents.'' Neer[47] later described a continuum of rotator cuff pathology resulting from subacromial impingement ranging from inflammation, hemorrhage, edema, and pain to tendon fibrosis leading to progressive tearing. Building on these early descriptive attempts, contemporary classification systems have proven to be more useful and have greater interobserver reliability.

Ellman[16] presented a classification system based on arthroscopic findings in 120 arthroscopic subacromial decompressions. The classification is based on the location of the tear (A, articular; B, bursal; or C, intratendinous) and the depth of the tear (grade 1, <3 mm; grade 2, 3-6 mm; and grade 3, >6 mm). In addition, the area of the tear (in square millimeters) is included. Subsequently, Snyder et al[57] described the PASTA (partial articular supraspinatus tendon avulsion) lesion in combination with a new classification system based on tear location and severity (0-4, normal to tear >3 cm). Conway[12] addressed the intratendinous extension of partial-thickness tears with his description of the PAINT (partial articular tears with intratendinous extension) lesion. Habermeyer et al[26] have recently proposed a new classification system that incorporates both coronal and sagittal tear extensions to quantify articular-sided supraspinatus tendon tears.

Recently, Kuhn et al[33] evaluated the interobserver reliability of 6 different rotator cuff tear classification systems, including that described by Ellman, using arthroscopic video evaluations. With the exception of distinguishing partial- and full-thickness tears and the side of tear involvement, there was poor agreement among fellowship-trained orthopaedic surgeons in determining tear depth.

Clinical presentation

History and clinical examination

The approach to the patient with a suspected partial-thickness rotator cuff tear should not differ from that in any patient presenting with complaints of shoulder pain or dysfunction. Patients will often report pain and stiffness of the affected shoulder. Nocturnal pain and pain exacerbated by overhead activity are common but not specific for partial-thickness tearing. The physical examination will often elicit a painful arc, positive impingement signs, and real or apparent weakness with rotator cuff strength testing. Signs of unidirectional or multidirectional instability should not be overlooked and should be pursued when one is evaluating the overhead athlete with complaints of shoulder pain.

There have been several interesting reports regarding pain associated with partial-thickness tears. Fukuda[17] reported a difference in preoperative pain perception between patients with subacromial bursitis and/or partial-thickness tears compared with those with full-thickness tears. Nearly three-quarters of patients (73.3%) with the former diagnosis reported ''more than moderate pain'' (score on visual analog scale >5) preoperatively compared with 50% of patients with full-thickness tears, and bursal-sided tears were more painful than articular-sided tears. Gotoh et al[25] found levels of substance P and immunoreactive nerve fibers to be higher in the subacromial bursae of those patients with partial-thickness tears compared with patients with full-thickness tears. These findings correlated with preoperative pain scores, leading to the conclusion that pain correlates with the degree of subacromial bursitis, not the degree or size of the rotator cuff tear.

Diagnostic imaging

The initial evaluation of the patient with shoulder pain and dysfunction should always include a complete series of plain radiographs of the shoulder. Although these are rarely helpful in making the specific diagnosis of a partial-thickness rotator cuff tear, they are necessary to evaluate other causes of shoulder pain and to assess acromial morphology. Nakagawa et al[45] described the presence of a greater tuberosity ''notch'' in 38 of 40 baseball players with articular-sided partial-thickness tears at the supraspinatus-infraspinatus interval.

Historically, arthrography and bursography have been used as the primary imaging modalities for the rotator cuff. However, their accuracy rates have been challenged in the

literature, with values ranging from 15% to 83% and 25% to 67%, respectively.[21,22,28]

More recently, ultrasonography (US) and MRI have become the imaging modalities of choice for most clinicians and investigators. Proponents of US have shown accuracy rates equivalent to those of MRI. Using arthroscopic findings as the gold standard, van Holsbeeck et al[59] found preoperative US findings of a mixed hyperechoic/hypoechoic focus in the supraspinatus tendon to have a sensitivity of 93%, specificity of 94%, positive predictive value of 82%, and negative predictive value of 98%. Yen et al[65] found US to be 94% accurate in the detection of partial-thickness tears and reported ''focal heterogeneous hypoechogenicity'' to favor partial-thickness tears. With its high accuracy rates, relatively low cost, and high degree of patient tolerance, US is an attractive option for clinicians. However, its widespread adoption in clinical practice may be limited by its high dependence on operator skill and experience.

Advances in MRI, specifically sequence alteration, contrast arthrography, and differential arm positioning, have greatly improved its accuracy in identifying rotator cuff pathology. The abduction–external rotation view has been shown to improve visualization of intratendinous tears when combined with magnetic resonance (MR) arthrography.[34] With arthroscopic findings as the gold standard, Meister et al[42] found preoperative, gadopentetate contrast MR arthrography to have a sensitivity of 84%, specificity of 96%, positive predictive value of 93%, and overall accuracy of 91%, with coronal oblique T1 fat-suppressed images being most valuable. The MRI diagnosis of partial-thickness rotator cuff tears is based on the presence of increased signal and abnormal morphology without discontinuity on T1 images corresponding to increased signal on T2 images with a focal defect. The primary advantage of MRI for the evaluation of rotator cuff pathology is the ability to evaluate the remainder of the shoulder anatomy. Recently, the use of short volumetric interpolated breath-hold examination sequences has been shown to have satisfactory concordance with traditionally used T1-weighted, fat-saturated images for articular-sided partial-thickness tears.[60] The shorter time needed for volumetric interpolated breath-hold examination sequence acquisition (15 seconds) could improve patient compliance and acceptance when compared with traditional MR time requirements.

Teefey et al[58] compared US and MRI with arthroscopic findings as the gold standard in 71 consecutive patients. They found both modalities to have an accuracy of 87% and to not differ statistically in distinguishing full-thickness from partial-thickness tears or in predicting tear size and tendon retraction.

Diagnostic arthroscopy

The gold standard for the diagnosis and assessment of partial-thickness rotator cuff tears is arthroscopic inspection. Arthroscopy allows the surgeon direct visualization and probing of the bursal and articular surfaces and the footprint of the rotator cuff. The size of a tear can be determined intraoperatively by comparing the known size of an arthroscopic instrument with the depth of the tear or the size of the exposed footprint. Several arthroscopic techniques have been described for intraoperative assessment and diagnosis of surface tears including tissue staining with methylene blue and suture marking.[18,57] Lo et al[37] described the ''bubble sign'' to facilitate the diagnosis of intratendinous tears, which can be difficult to assess even under direct visualization. Regardless of the technique used, arthroscopy provides the surgeon an opportunity to directly assess the quality of the rotator cuff tissue, as well as perform a comprehensive, systematic diagnostic arthroscopy and bursoscopy.

Treatment

Unfortunately, there is not a consensus on a single algorithmic treatment approach for the patient with a symptomatic, partial-thickness rotator cuff tear. The treating clinician must remain cognizant of concomitant shoulder pathology in the painful, dysfunctional shoulder, which may be responsible for the patient's symptoms.

As with most conditions in orthopaedics, general treatment options can be divided into nonoperative and surgical arms.

Nonoperative treatment

In the patient with a partial-thickness rotator cuff tear, a trial of nonoperative treatment is a reasonable treatment option. This approach includes activity modification with the avoidance of provocative activity and the judicious use of nonsteroidal anti-inflammatory medications. A supervised physical therapy regimen is also indicated to reestablish or maintain normal shoulder dynamics including attention to capsular stretching. As pain is decreased and motion improves, strengthening exercises focusing on the rotator cuff and periscapular musculature should be initiated. In the overhead athlete, particular attention should be paid to the kinetic chain and the institution of an interval throwing program as symptoms dictate.

The use of subacromial corticosteroid injections deserves some mention. Unfortunately, the available literature lacks high-quality evidence evaluating the efficacy of subacromial corticosteroid injections for the treatment of partial-thickness rotator cuff tears. Because of the heterogeneity of the available studies, Koester et al[32] were unable to perform a meta-analysis and instead provided a systematic, evidence-based review of the efficacy of subacromial corticosteroid injections in the treatment of rotator cuff disease. They found no evidence to support the use of subacromial injections. However, subacromial injections

certainly have benefits for some patients, and individual patient response informs the treatment approach. The judicious use of subacromial corticosteroid injections for acute relief of pain can be beneficial to allow a more aggressive initiation of directed physical therapy.

Unfortunately, there are no standardized, long-term follow-up studies evaluating the clinical outcomes of patients with partial-thickness rotator cuff tears treated nonoperatively. Although available basic science indicates that tears progress with time, it is possible that patients may improve symptomatically with appropriate nonoperative treatment measures. However, if the patient is not satisfied with his or her outcome after 6 to 12 months of dedicated nonoperative treatment, operative intervention should be considered, with the clinician bearing in mind the overall constellation of symptoms and their improvement with time, as well as the patient's activity level and concomitant shoulder pathology.

Operative treatment

There is a body of lower-level evidence to support the operative treatment of partial-thickness tears. Fukuda et al[19,21] have shown in histologic studies that partial-thickness tears have essentially no ability to heal themselves over time. Intratendinous and bursal-sided tears biopsied at the time of operative intervention showed granulation tissue with rounded, avascular tissue margins without evidence of healing. Yamanaka and Matsumoto[63] followed 40 articular-sided tears over 2 years with arthrography and showed 80% tear progression (28% to full thickness).

The biomechanical data available regarding differential shear stress and tear propagation provide a mechanical rationale for repair of partial-thickness tears.[3,46,51,64] Recently, Mazzocca et al[41] showed increased tendon strain patterns with progressive tearing, but they also showed strain pattern return to near-intact states with in situ tendon repair.

Surgical intervention is generally limited to tear debridement with or without acromioplasty or tear repair with or without acromioplasty. Most authors recommend repair of tears involving 50% or more of the tendon thickness. Relative indications for tear repair include acute traumatic tears, bursal-sided tears, and tears in the more physically active patient with the general exception of the overhead athlete.

Studies of partial-thickness tear debridement without acromioplasty have shown some success. Budoff et al[5] reported on a series of 79 shoulders treated with arthroscopic debridement and followed for a minimum of 25 months. The partial-thickness tears were not graded. No formal subacromial decompression was performed; however, 25% and 15% of the shoulders had acromial and clavicular osteophytes removed, respectively. Over three-quarters of these shoulders (77%) had associated labral pathology. By use of University of California, Los Angeles (UCLA) scores, 89% of the shoulders had good or excellent outcomes at less than 5 years, with 81% of the shoulders maintaining that score at more than 5 years of follow-up.

Goodmurphy et al[24] proposed that a very limited cuff debridement should be sufficient. On the basis of histologic specimens taken at the time of arthroscopy, adjacent tissue (<2.5 mm) was viable in both microvasculature and cellular synthesis of procollagen I. However, the amount of tissue debrided remains a surgical judgment based on tear pattern and tissue quality.

Andrews and colleagues[1,52] reported on their experience with debridement of partial-thickness tears in the overhead athlete, showing the differences encountered in this patient population. In a series of 34 athletes (64% pitchers), good or excellent results were obtained in 85% during short-term follow-up (mean, 13 months).[1] Similar to the findings of Budoff et al,[5] all patients in this series had associated labral lesions and 25% had abnormalities in the tendon of the long head of the biceps. In a later series, 67 professional pitchers were treated with debridement alone.[52] Of these, 76% were able to return to competitive pitching; however, only 55% returned to the same level of competition or a higher level.

When partial-thickness tear debridement is combined with acromioplasty, the results are similar. Neer[48] reported satisfactory results with open anterior acromioplasty in 15 of 16 patients with bursal-sided cuff fraying at 9 months to 5 years of follow-up. However, the outcomes measured in this original study were limited when compared with more contemporary reports. Snyder et al[57] retrospectively reported on 31 patients at 10 to 43 months' follow-up, 82% of whom had bursal-sided tears. Tear debridement alone was performed in 13 patients, whereas additional subacromial decompression was performed in 18 patients. Tears ranged from synovial inflammation (Snyder A or B1) with superficial fraying to partial-thickness tendon disruptions between 2 and 3 cm in size (Snyder A or B3). At final evaluation, there was no statistically significant difference in UCLA scores with good and excellent results in 84% of patients in both groups.

On the basis of these early studies, it is difficult to draw conclusions about the ideal treatment of the partial-thickness rotator cuff tear. The reports include relatively small retrospective studies with short follow-up, differing surgical techniques, and mixed populations including various pathologies. More recent studies provide the surgeon with more coherent results to guide decision making.

Park et al[50] reported on 37 patients with tears involving less than 50% of the cuff thickness (Ellman grade 1 and 2) who were treated with debridement and subacromial decompression. Of the patients, 24 were treated for articular-sided tears whereas 13 had bursal-sided tears. At 6 months, pain and function were better in the bursal-sided group, but no difference between groups was found at 1 and 2 years. Cordasco et al[13] found slightly different results in a similar group of patients. One hundred five patients with Ellman grade 1 and 2 tears were treated with debridement and subacromial decompression and followed up for 2 to 10

years. The articular-sided tears fared better, with a 3% failure rate over the time of the study compared with a 29% failure rate for bursal-sided tears.

Weber[62] compared results for a minimum follow-up period of 2 years in 65 patients with grade 3A or 3B partial-thickness rotator cuff tears treated with arthroscopic debridement alone or with additional mini-open repair. Using UCLA scores, he reported significantly improved outcomes in patients who underwent mini-open repair. The difference was greatest within the bursal-sided tear subgroup, with a mean UCLA score of 33.0 by use of mini-open repair compared with 13.6 with debridement alone. These findings agree with those from Cordasco et al[13] and lend support to the view that bursal-sided tears fare especially poorly and that grade 3 tears are not adequately treated with debridement alone.

Liem et al[35] stratified 46 patients based on the tear pattern identified intraoperatively. Twenty-six Ellman grade 1 tears were treated with acromioplasty alone, and twenty Ellman grade 2 tears were treated with debridement and acromioplasty. American Shoulder and Elbow Surgeons scores and follow-up US evaluations were performed at a minimum of 36 months (range, 36-86 months). Final outcome scores were similar between the groups, with a mean Constant score of 87.6 and 3 progressions to full-thickness tears. Kartus et al[31] reported further rotator cuff disease progression after debridement and acromioplasty for Ellman grade 2 partial-thickness tears. They followed up 26 of 33 patients (10 bursal-sided tears, 13 articular-sided tears, and 3 combined tears) for a minimum of 5 years after tear debridement and acromioplasty with physical examination and ultrasound evaluation. The final Constant score was significantly lower for the index shoulder (65 vs 84 for contralateral shoulder), and bursal-sided tears fared worse than articular-sided tears, with Constant scores of 61.5 and 72, respectively. In addition, 9 shoulders progressed to full-thickness tears.

On the basis of the literature, grade 1 and 2 articular-sided tears can be successfully treated in the short term with arthroscopic debridement alone whereas grade 3 tears (>6 mm depth) should be repaired. However, the literature suggests that bursal-sided tears should be approached more aggressively with debridement for grade 1 tears only and with repair for grade 2 and 3 (>3 mm) tears. Acromioplasty alone in the setting of a partial-thickness rotator cuff tear has been shown to be inadequate and should be performed in conjunction with tear debridement based on acromial morphology with the goal of creating a flat acromion free of impingement on the underlying rotator cuff.[2]

The technique chosen for surgical repair is a judgment made by the surgeon. Intratendinous repair techniques have been described with good results and biomechanical properties.[4,8,23,27,36] Some surgeons prefer to complete the tear and perform a more traditional repair via arthroscopic or open approaches.[28,62] A proposed advantage of transtendinous repair is the maintenance of the rotator cuff footprint, which allows for a more accurate anatomic repair while minimizing any length-tension mismatch created with repair.

Itoi and Tabata[28] performed a retrospective review of their experience with 38 shoulders (36 patients) having partial-thickness tear completion and open repair. Their series included 12 bursal tears, 3 intratendinous tears, and 23 articular-sided tears. At 5 years, good or excellent results were maintained in 82%, with no differences noted in repair technique or with the addition of acromioplasty. With a focus on both functional outcome and repair integrity using US evaluation at a mean follow-up of 11 months, Kamath[30] et al reported a high rate of patient satisfaction and tendon healing. Forty-two consecutive shoulders with greater than 50% partial-thickness rotator cuff tears were treated with arthroscopic repair after conversion to full-thickness tears. At final follow-up, 37 of 42 shoulders (88%) had an intact rotator cuff seen on ultrasound with improved American Shoulder and Elbow Surgeons scores and a 93% patient satisfaction rate. The authors noted that tendon healing was better in younger patients.

Ide et al[27] used a transtendinous arthroscopic repair technique. Seventeen patients with grade 3A tears underwent arthroscopic transtendinous repairs and showed excellent improvement by use of UCLA and Japanese Orthopaedic Association Shoulder scores at a minimum follow-up of 25 months. Six overhead athletes were included in this series; two were able to return to the same level of competition, whereas three returned at a lower level (the outcome of the sixth patient is unknown).

Partial-thickness tears in overhead athlete

Outcomes vary in the surgical treatment of partial-thickness tears in the overhead athlete.[1,27,52] In this group the etiology and pathogenesis of partial-thickness tearing are likely to be different from the general population. Accordingly, treatment can be different. The overhead athlete will likely present with reports of the insidious onset of shoulder pain, with pain at rest and loss of power or velocity. Generally, overhead athletes tend to display partial-thickness cuff tears on the articular side of the dominant shoulder and the supraspinatus-infraspinatus interval. These partial-thickness tears are often associated with other pathology including labral lesions, posterior capsular contracture, anterior capsular attenuation, and internal rotation deficits.[1,7,14]

The extrapolation of the available data on the repair of partial-thickness rotator cuff tears to the overhead athlete population should be done with great caution. In general, the results of rotator cuff repair in the high-level overhead athlete have been discouraging, with few players able to return to the same level of competition.[40]

The treatment of the overhead athlete with a partial-thickness rotator cuff tear should begin with a focused, directed, and aggressive trial of nonoperative management

including posterior capsular stretching, cuff strengthening, core and lower extremity training, an evaluation of throwing mechanics, and nonsteroidal anti-inflammatory medications. If nonsurgical treatment fails, rotator cuff debridement with the treatment of concurrent symptomatic pathology is indicated.[51]

Conclusions

The approach to the patient with a symptomatic partial-thickness rotator cuff tear should begin with directed, nonsurgical management focused at restoring or maintaining normal shoulder dynamics, avoidance of provocative activities, and strengthening of the intact rotator cuff. If nonsurgical management fails to provide adequate relief, surgical intervention can provide excellent pain relief and return of function. The classification system devised by Ellman[16] remains useful for intraoperative decision making. Degenerative bursal-sided tears less than 3 mm in depth (Ellman grade B1) can be treated with arthroscopic debridement. Bursal-sided tears greater than 3 mm in depth (Ellman grades B2 and B3) should be repaired using the technique with which the treating surgeon is most comfortable. Acromioplasty is indicated in the treatment of bursal-sided tears based on the patient's acromial morphology. Articular-sided tears less than 6 mm (Ellman grades A1 and A2) can be treated successfully in the short term with arthroscopic debridement, whereas tears greater than 6 mm in depth (Ellman grade A3) should be repaired, again, using the technique with which the treating surgeon is most comfortable.

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