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National Athletic Trainers' Association Position Statement: Evaluation, Management, and Outcomes of and Return-to-Play Criteria for Overhead Athletes With Superior Labral Anterior-Posterior Injuries

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National Athletic Trainers' Association Position Statement: Evaluation, Management, and Outcomes of and Return-to-Play Criteria for Overhead Athletes With Superior Labral Anterior-Posterior Injuries

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Objective: To present recommendations for the diagnosis, management, outcomes, and return to play of athletes with superior labral anterior-posterior (SLAP) injuries.

Background: In overhead athletes, SLAP tears are common as either acute or chronic injuries. The clinical guidelines presented here were developed based on a systematic review of the current evidence and the consensus of the writing panel. Clinicians can use these guidelines to inform decision making regarding the diagnosis, acute and long-term conservative and surgical treatment, and expected outcomes of and return-to-play guidelines for athletes with SLAP injuries.

Recommendations: Physical examination tests may aid diagnosis; 6 tests are recommended for confirming and 1 test is recommended for ruling out a SLAP lesion. Combinations of tests may be helpful to diagnose SLAP lesions. Clinical trials directly comparing outcomes between surgical and nonoperative management are absent; however, in cohort trials, the reports of function and return-to-sport outcomes are similar for each management approach. Nonoperative management that includes rehabilitation, nonsteroidal anti-inflammatory drugs, and corticosteroid injections is recommended as the first line of treatment. Rehabilitation should address deficits in shoulder internal rotation, total arc of motion, and horizontal-adduction motion, as well as periscapular and glenohumeral muscle strength, endurance, and neuromuscular control. Most researchers have examined the outcomes of surgical management and found high levels of satisfaction and return of shoulder function, but the ability to return to sport varied widely, with 20% to 94% of patients returning to their sport after surgical or nonoperative management. On average, 55% of athletes returned to full participation in prior sports, but overhead athletes had a lower average return of 45%. Additional work is needed to define the criteria for diagnosing and guiding clinical decision making to optimize outcomes and return to play.

Key Words: shoulder, glenohumeral internal-rotation deficit, strengthening

A superior labral anterior-posterior (SLAP) lesion is an injury in proximity to the origin of the long head of the biceps tendon. The glenoid rim is often described as the face of a clock, with the superior rim at 12:00 and the inferior rim at 6:00. Typically, SLAP lesions extend from the 10:00 to the 2:00 position. Via attachment to the labrum, the long head of the biceps tendon forms the biceps-labral complex. Although newer classification schemes for SLAP lesions have been introduced,[1] Snyder et al[2] proposed the most widely used system. Under this system, *type I* describes degenerative fraying of the superior labrum without detachment from the glenoid rim, whereas *types II to IV* describe tears of the labrum with or without involvement of the long head of the biceps tendon. A SLAP lesion can be acute or chronic, and debate exists over the exact mechanism of injury. In overhead athletes, the mechanisms of a SLAP lesion have been associated with repetitive overhead sport activities.[3–5] Tensile forces on the labrum via the biceps during the deceleration phase of the overhead motion,[3] torsional forces on the biceps during the late cocking phase,[4,5] and the high level of repetitive eccentric forces of the biceps imparted to the labrum may result in labral lesions.[3]

Based on the history and physical examination, the differential diagnosis is limited because few clinical tests can diagnose SLAP lesions with a high degree of accuracy.[6] Type I lesions are not considered by most to be a source of symptoms,[7] whereas types II to IV may require treatment for resolution of symptoms. Although SLAP lesions are commonly found during imaging and surgery, the degree to which the presence of these lesions is related to shoulder pain and what treatment options will yield optimal outcomes are unclear. Nonoperative and operative treatments are used to return an injured athlete to sport activity. Many patients achieve satisfactory outcomes and are able to return to sport without surgery, so the first line of recommended management is a 3- to 6-month program of nonoperative treatment.[8,9] Studies[10,11] suggested a high level of shoulder function and satisfaction after treatment, but the ability to return to sport varied widely from 20% to 94%. The outcomes and ability to return to sport after treatment for a SLAP lesion, with or without surgical repair, are less than optimal.[10–12]

The purpose of this position statement is to present recommendations for the diagnosis, management, and outcomes of and return-to-play guidelines for athletes with SLAP lesions based on the systematic analysis of peer-reviewed publications and graded according to the Strength of Recommendation (SOR) Taxonomy evidence-based scale.[13] The alphabet letter indicates the consistency and evidence-based strength of the recommendation (*A* has the strongest evidence base). For the practicing clinician, any grade *A* recommendation warrants attention and should be inherent to clinical practice. Grade *B* recommendations are based on inconsistent or limited controlled research outcomes. Grade *C* recommendations should be considered as expert guidance despite limited research support. Less research supports recommendations with grades B and C; these should be discussed by the sports medicine staff.

RECOMMENDATIONS

Diagnosis

1. Mechanisms of injury that may be responsible for a SLAP lesion can include repetitive overhead activities, especially those requiring shoulder abduction and end-range external rotation (ER), that impart tensile, eccentric, or torsional forces on the biceps-labral complex.[1–3,14–17] *SOR: B*
2. A pain pattern described as posterior-superior or deep within the anterior-superior glenohumeral joint may reflect a SLAP lesion.[18,19] *SOR: C*
3. Throwing athletes who present with posterior shoulder tightness (loss of >15° horizontal adduction or a glenohumeral internal-rotation deficit [GIRD] of >13° to 15° without a concurrent increase in ER of >15° as compared with the nonthrowing shoulder) should be considered to have an increased risk of shoulder injury, including a SLAP lesion.[4,20–23] *SOR: B*
4. Shoulder pain should not be considered a sign of a type I SLAP lesion.[7,24,25] *SOR: B*
5. A stand-alone finding of a history of popping, clicking, or catching is *not* diagnostic of (ruling in or out) a SLAP lesion.[7,16,26] *SOR: A*
6. Bicipital groove or biceps tendon tenderness is *not* diagnostic of a SLAP lesion.[27] *SOR: B*
7. The active compression, or O'Brien, test is *not* diagnostic of a SLAP lesion.[6] *SOR: A*
8. Based on a meta-analysis of pooled diagnostic accuracy values,[6] individual physical examination tests recommended with caution to confirm the diagnosis of type II to type IV SLAP lesions are the anterior slide, Yergason, and compression rotation.[6] However, based on the meta-analysis, no test is recommended for ruling out a SLAP lesion. *SOR: A*
9. Based on evidence from multiple studies, individual physical examination tests recommended with caution to confirm the diagnosis of a SLAP lesion are the pain provocation, anterior apprehension, and biceps load II.[24,27–33] The only test recommended for ruling out a SLAP lesion is pain provocation.[24,32] *SOR: B*
10. Combinations of tests may be helpful to diagnose a SLAP lesion. Recommended with caution to confirm a SLAP lesion are the anterior-slide test with a history of popping, clicking, and catching[7]; the compression-rotation, apprehension, and Yergason tests[27]; and the compression-rotation, apprehension, and biceps load II tests.[27] Caution is warranted because each combination has been investigated in only a single study. No test combination can be recommended for ruling out a SLAP lesion. *SOR: C*
11. If a patient does not respond to conservative care, imaging is advised to aid in the differential diagnosis.[34] A positive magnetic resonance imaging finding of a SLAP lesion should be interpreted with caution if the patient's primary complaint and clinical findings do not correlate with this injury.[18] *SOR: B*
12. Partial- and full-thickness rotator cuff tears, acromioclavicular joint injuries, humeral head fractures, and Bankhart lesions have been associated with SLAP lesions and should be considered in the differential diagnosis.[1,2,17,35] *SOR: B*

Management

13. Patients with SLAP lesions should undergo 3 to 6 months of nonoperative management with the goals of decreasing pain, improving shoulder function, and returning to previous activity levels.[8,9,36] *SOR: B*
14. Nonoperative management may include prescribed nonsteroidal anti-inflammatory drugs and corticosteroid injections to decrease pain and inflammation in the disabled throwing shoulder.[37–40] *SOR: C*
15. Supervised rehabilitation should address deficits in shoulder internal rotation (IR), total arc of motion, and

horizontal-adduction range of motion (ROM), as well as periscapular and glenohumeral muscle strength, endurance, and neuromuscular control.[8,9] *SOR: C*

16. Before being considered for surgical intervention, a patient with a SLAP lesion should fail to improve after 3 to 6 months of nonoperative management. Failure to improve is characterized by the inability to regain pain-free ROM and near-normal rotator cuff strength and to return to the prior or desired level of activity.[8,9] *SOR: B*
17. Surgical considerations for labral repair or debridement are as follows:
    a. Repair of a type II SLAP lesion at the biceps anchor can be considered in those with episodes of biceps anchor instability, shoulder instability, or persistent pain with overhead activity.[41,42] *SOR: B*
    b. Debridement of the labrum is an option for type I and select type III (bucket-handle) lesions.[41] Biceps tenodesis or tenotomy may be considered if the biceps is hypertrophied, frayed, or synovitic. For those with an unstable biceps anchor, repair of the SLAP tear with a biceps tenodesis or tenotomy is a possibility.[43,44] Biceps tenodesis or tenotomy is not typically advocated in baseball players or athletes under 18 years of age. *SOR: C*
    c. Other surgical considerations include release of the posterior glenohumeral capsule ligament (if thickened and contractured) in addition to a SLAP repair[45] and debridement of a ganglion or paralabral cyst, with or without a concurrent SLAP repair.[46] *SOR: C*
    d. Deficits in ER ROM are the most consistent impairments associated with poor outcomes after surgery. Therefore, during repair of a SLAP lesion in an overhead-throwing athlete, anchor placement should preserve the required ER ROM in the abducted and externally rotated position.[36,47] *SOR: B*

Outcomes and Return to Play

18. Patients undergoing surgical or nonsurgical management of SLAP lesions should be educated to expect a patient-rated outcome (PRO) of 85% of normal function at an average of 2 to 3 years.[4,8,36,43,45,48–60] *SOR: C*
19. Patients should be informed to expect 80% satisfaction within 2 to 3 years of surgery.[4,43,50,53,56–59,61–63] However, the level of satisfaction was lower in overhead athletes, with 67% reporting an excellent rating.[4,59,62] *SOR: C*
20. Patients should understand the need to regain 90% of ROM in order to return to full activities.[64] However, at 2-year follow-up, limited evidence suggested that ROM deficits up to 15° may persist.[53,57,58,60] *SOR: C*
21. Patients should be educated to regain at least 70% of strength as compared with the uninvolved side before starting a sport-specific or interval return-to-sport program.[64] *SOR: C*
22. Patients should be informed that the criterion for return to sport activities is primarily time based, with guidelines suggesting return to sport-specific training at around 4 months postsurgery and progression to full activities over the next 2 to 3 months.[55,56,59–61,64] *SOR: C*
23. Patients should understand that after nonoperative management of a SLAP lesion, the rate of return to sport varies from 40% to 95%, but these data are based on only 2 studies.[8,9] *SOR: C*
24. Patients should comprehend that, independent of treatment intervention, 75% (range, 20%–94%) of patients, on average, with a SLAP tear are able to resume some level of sport activity.* Unfortunately, a consistent definition of *return to sport* is lacking across studies.[67] *SOR: C*
25. Patient education after surgical intervention should include the fact that the rate of return to sport for overhead athletes is lower than for nonoverhead athletes or nonathletes.[12] Among all athletes, 55% returned to the same or higher level of sport activity, whereas 31% returned at a lower level of participation or with limitations.[10,11] Among overhead athletes, 45% returned to the same or a higher level of sport participation, whereas 34% returned at a lower level or with continued limitations, and 24% were not able to return.† *SOR: C*
26. Consistency in reporting PROs, the time and level of return to play, and the type of treatment used is recommended to adequately and accurately determine successful management of patients with SLAP lesions.[67]

LITERATURE SEARCH

We performed a systematic search of English-language articles using the MEDLINE, CINAHL, OVID, and SPORTDiscus databases for all sections, as well as the Cochrane Registry of Randomized Controlled Trials for the "Management" section. Search terms were as follows:

Diagnosis: *shoulder* and *pain*, *labral tear* and *shoulder*, *SLAP tear* and *shoulder*, *physical examination*, *sensitiv*$, *diagnos*$, *likelihood ratio*

Management: *shoulder* and *pain*, *labral tear* and *shoulder*, *physical therapy*, *physiotherapy*, *exercise therapy*, *therapeutic exercise*, *mobilizations*, *manipulations*, *manual therapy*, *physical therapy modalities*, *SLAP*, *superior labrum anterior and posterior*, *SLAP lesion* OR *tear*, *SLAP repair*

Outcomes and Return to Play: *shoulder* OR *rotator cuff* OR *SLAP* OR *superior labrum anterior posterior* OR *superior labrum*, *return to play* OR *competition* OR *sport* OR *preinjury* OR *overhead sport*, *athlet*$ OR *overhead* OR *throwing* OR *baseball* OR *tennis* OR *swim*$ OR *football* OR *volleyball* OR *wrestling* OR *softball*.

We performed a supplemental hand search by examining the reference lists of retrieved articles for additional relevant publications. Abstracts were independently reviewed by 2 authors; articles that met the inclusion criteria for each section were retained. Criteria for article inclusion were as follows:

Diagnosis: (1) reported diagnostic accuracy of history or physical examination tests in patients with SLAP lesions; (2) level 4 or higher evidence per the Centre for Evidence-

*References 4, 8, 9, 36, 43, 45, 48–60, 62, 65, 66.

†References 4, 9, 36, 45, 49, 51, 62, 65, 66.

Based Medicine (CEBM) criteria; and (3) published in a peer-reviewed journal in English

Management: (1) management of SLAP lesions in overhead athletes or active populations and associated ganglions to the lesions were not excluded; (2) when appropriate, included report of patient satisfaction or return-to-play rates or both; (3) level 4 or higher level of evidence per CEBM; and (4) published in a peer-reviewed journal in English

Outcomes and Return to Play: (1) SLAP lesions repaired with anchors; (2) included athletes or a physically active sample; (3) level 4 or higher evidence per CEBM; and (4) published in a peer-reviewed journal in English.

DIAGNOSIS

History, Observation, and Palpation

Evaluation should begin with a history that includes the mechanism of injury and the degree of trauma sustained during the injury. A history of trauma alone is not diagnostic of a SLAP lesion.[16] An acute mechanism may be a fall on an outstretched hand, which has been reported in 8% to 48%[1,2,17] of patients with a SLAP lesion. A fall on an outstretched hand creates a shear force at the biceps-labral complex and glenoid with the shoulder in abduction and slight flexion.[2] This mechanism could also result in other shoulder injuries, such as a rotator cuff tear or anterior instability.[2,18]

A chronic SLAP lesion more commonly affects athletes in repetitive overhead sports such as baseball, softball, volleyball, and tennis.[3] Hypothesized mechanisms of injury include tension, torsion, and eccentric loads to the biceps during sport activities that injure the biceps-labral complex. Andrews et al[3] hypothesized that tensile forces produced during the deceleration phase of the throwing motion cause the attachment site of the biceps at the labrum to pull the anterosuperior portion of the labrum off the glenoid. The increased biceps activity and subsequent tensile forces were due to an eccentric contraction of the biceps as the elbow extended in the deceleration phase. Conversely, cadaveric studies that simulated the throwing motion showed that late cocking was the only phase that produced greater strain on the posterior labrum[3] and failure of the superior labrum in 90% of cadavers, as compared with 20% during the deceleration phase.[14] Burkhart and Morgan[5] proposed that when the shoulder is abducted and externally rotated, similar to the late cocked-arm position during the throwing motion, torsional force is placed on the biceps at the labral junction that causes the biceps to pull away from the labrum: the "peel-back mechanism." Unfortunately, this concept has not been investigated experimentally.

Patients with SLAP lesions often complain of vague shoulder pain during overhead motions and may have a sensation of popping, clicking, or catching.[1,3,16] However, a history of popping, clicking, or catching as a stand-alone finding is not diagnostic of a SLAP lesion.[7,16,26] Moreover, reports of night pain, pain during overhead activities, and a sense of instability have not been associated with isolated SLAP lesions.[25] The patient should be queried regarding the location, quality, and duration of the pain or symptoms.[18] Pain may be generalized to the shoulder, or more likely, be described as a deep shoulder pain located between the acromioclavicular and coracoid processes of the scapula[19] or at the posterior or anterior glenohumeral joint.[18] Pain levels and their effects on activities can vary greatly. Maffet et al[1] noted that among 84 patients diagnosed with a SLAP lesion, 6% reported complete disability, 1% had slight pain, 42% had moderate pain, 10% had marked pain, and 10% had pain only after unusual activities. A SLAP lesion may result in the "dead arm syndrome."[68] The specific phase of throwing or sport activity that causes pain; the recent activity level, including any changes in volume or intensity of activity (eg, throwing, ball spikes); and decreases in velocity, control, and muscular endurance should be investigated.[69,70] Any history of injury and prior treatments should be considered along with patient-specific goals to develop an individualized treatment plan.

Observation does not generally aid in the diagnosis of a SLAP lesion, but the shoulder should still be inspected for deformity, swelling, and atrophy to assist in the differential diagnosis. Inspection and physical examination should include the glenohumeral, sternoclavicular, and acromioclavicular joints. Similar to observation, palpation should include the entire shoulder girdle and the surrounding bony and soft tissue structures. Diagnostically, bicipital groove and biceps tenderness has limited ability to confirm a SLAP lesion.[27–29]

Glenohumeral elevation, horizontal abduction, and IR and ER ROM should be assessed, as loss of motion can suggest shoulder or elbow injury. No evidence has indicated that altered glenohumeral ROM was specifically related to a SLAP lesion. Overhead athletes, especially throwing athletes, may present with excessive glenohumeral ER ROM and a concomitant loss in IR ROM.[71] The loss of IR, known as *glenohumeral IR deficit* (GIRD), may be due to increased humeral retroversion (bony) or posterior shoulder tightness or both.[72] Based on current evidence,[4,20–23] *GIRD* is defined as an asymmetric IR deficit $>13°–15°$ without a concurrent increase in ER $>15°$ (compared with the nonthrowing shoulder) at the start of a season and has been related to the prevalence of shoulder or upper extremity pain over a season in high school softball and baseball players. Although GIRD and shoulder injuries have been linked in baseball and softball players, a cause-and-effect relationship has not been proven. Burkhart and Morgan[5] postulated that the peel-back mechanism is a direct result of posterior shoulder tightness caused by soft tissue adaptations. The increased tightness results in a posterior-superior shift of the humeral head's contact on the glenoid, allowing for a greater degree of glenohumeral ER ROM[20] but also a theoretical increase in shear force at the biceps-labral complex.[4,5]

Scapular motion abnormalities have been postulated to relate to the development of SLAP lesions. The scapula lags behind the humerus with respect to motion during arm acceleration toward the intended target, which may lead to an increase in both tensile forces to the anterior shoulder and compressive forces to the posterior shoulder.[69] Evidence to support the diagnostic ability of or the cause-and-effect relationship between scapular motion deficits and the development of SLAP lesions is lacking.[73] In overhead athletes, researchers found that the preseason presence of observable scapular dyskinesis (ie, dysrhythmia or winging) during repetitive arm elevation predicted shoulder injuries during the season in handball players[74] but not in baseball players.[75,76] Given the lack of clear evidence for an association between observable scapular dyskinesis and shoulder pain, other impairments detected during the physical examination should provide guidance for conservative management.[77] The scapular examination and other associated impairments are discussed in the "Management" section.

Special Tests for Labral and SLAP Lesions

Clinical tests used to examine the integrity of the labrum and biceps-labral complex attempt to reproduce pain or symptoms. However, most diagnostic studies have been conducted on heterogeneous populations rather than on overhead athletes. Therefore, the clinical utility of these tests may not be specific to overhead athletes. Pain or clicking, popping, or catching can presumably be reproduced by compressing the labrum with the humeral head or imposing a shear force by moving the humeral head on the labrum or a tensile force at the biceps-labral complex.[18] Unfortunately, few special tests used to diagnose SLAP lesions have displayed consistent diagnostic accuracy across studies. Our recommendations were based on diagnostic accuracy statistics of sensitivity, specificity, positive likelihood ratio (+LR), and negative likelihood ratio (–LR). The criteria for recommendations were as follows: (1) a test or finding with a specificity of $\geq$80% or a +LR $\geq$2.0 would confirm (rule in) a SLAP lesion and (2) a test or finding with a sensitivity of $\geq$80% or a –LR $\leq$0.50 would rule out the diagnosis.[78] When available, meta-analyses were preferred as the basis for recommendations.

The active compression, or O'Brien, test is commonly used and has been the most frequently studied for diagnostic accuracy. However, reports of sensitivity (47%–100%) and specificity (10%–99%) varied widely.[16,24,26,28,30,79–82] In the original study[81] of the active compression test, a positive finding of pain alone did not indicate a SLAP lesion. Rather, the patient should specifically describe pain or clicking deep in the joint as opposed to in the anterior-superior shoulder, which reflects acromioclavicular joint injury. In 2012, Hegedus et al[6] pooled the diagnostic accuracy of 6 studies (n = 782 patients) assessing the active compression test and reported 67% sensitivity and 37% specificity, a +LR of 1.06, and a –LR of 0.89 when the original study, which was an outlier, was removed. The active compression test is therefore *not* recommended to confirm or rule out a SLAP lesion.

Hegedus et al[6] also reported pooled diagnostic values for 7 other tests used to diagnose SLAP lesions. The pooled values indicated that the 3 clinical tests useful for confirming a SLAP tear were the anterior slide, Yergason, and compression rotation (summarized in Table 1). No tests could be recommended for ruling out SLAP lesions based on the pooled diagnostic values from the meta-analysis results using a priori established thresholds. The pooled diagnostic values of the Speed, crank, and relocation tests and palpation of the long head of the biceps indicated that these results were inadequate to diagnose (rule in or out) SLAP lesions.

Subsequent investigators have assessed several other physical examination tests. Investigated in multiple studies (Table 1) and recommended with caution to confirm a SLAP lesion are the anterior apprehension,[27–29] biceps load II,[27,30,31] and pain-provocation[24,32] tests. To rule out a SLAP lesion, only the pain-provocation test[24,32] is recommended. These tests are recommended with caution due to inconsistent findings or limited diagnostic ability demonstrated in multiple studies. Three tests examined in single studies that showed promise with high ability (+LR > 6.0) to rule in SLAP lesions were the dynamic labral shear (+LR = 36.0), passive-distraction (+LR = 8.8), and passive-compression (+LR = 5.9) tests.[6]

Because many special tests for SLAP lesions have widely varying diagnostic accuracy values, several authors found that combining specific tests increased the likelihood of correctly diagnosing a SLAP lesion. Table 2 details investigated test combinations that are recommended for confirming a SLAP lesion, but these recommendations are offered with caution as they have been examined in only a single study. Oh et al[27] reported that combining 2 relatively sensitive tests (compression rotation and anterior apprehension) with 1 relatively specific test (Yergason or biceps load II) demonstrated diagnostic values adequate for confirming a type II SLAP lesion but not for ruling out this lesion. McFarland et al[26] observed that compared with each test alone, combining the active-compression, anterior-slide, and compression-rotation tests did not increase the diagnostic accuracy for type II to IV SLAP lesions. Michener et al[7] assessed the ability to diagnose type II to IV SLAP lesions and found that a positive anterior-slide test combined with a history of popping or catching had diagnostic utility for confirming a SLAP lesion but was of limited value for ruling out a SLAP lesion. No tests or test combinations were diagnostic for a type I SLAP lesion. Of note, a history of popping, clicking, or catching was also investigated[15] in patients with a variety of labral lesions, including SLAP lesions. When the history was combined with a positive crank or anterior-slide test, high specificities and positive LRs indicated an ability to confirm a labral lesion; however, the ability to rule out labral lesions was limited. Table 2 summarizes the test combinations recommended for confirming a SLAP lesion but these suggestions should be interpreted with caution as the tests have been assessed in only a single study.

Because SLAP lesions are often accompanied by an associated injury, a definitive diagnosis can be difficult. In patients with SLAP lesions, 72% to 77% had associated injuries.[7,16,17,26] Concurrent conditions may include partial- (26%–32%) and full-thickness (4%–15%) rotator cuff lesions, Bankhart lesions (22%), acromioclavicular joint injuries (11%), and humeral head chondromalacia or indentation fractures (15%).[1,2,17,35] Given the high incidence of associated conditions, the clinical evaluation should include a thorough examination for possible intra-articular damage. Impingement special tests are frequently positive in those with SLAP lesions: 47% to 68% of patients have a positive Neer or Hawkins-Kennedy test,[1,17] which may represent a false-positive finding of a SLAP lesion. To confirm the presence of a SLAP lesion, tests recommended for ruling in a SLAP lesion (Table 1) should be used.

The clinical examination is fundamentally limited in the ability to differentially diagnose a SLAP lesion.[6] Imaging is an important tool for diagnosing SLAP lesions and is warranted for the differential diagnosis. The American College of Radiology[33] recommended radiographs as the initial imaging study, followed by magnetic resonance arthrography if a SLAP tear is suspected. Furthermore, if a

Table 1. Summary Statistics for Recommended Diagnostic Tests

Type of Study	Authors (year)	Test	Studies (Participants)	% (95% CI) Sensitivity	% (95% CI) Specificity	Likelihood Ratio (95% CI) +	Likelihood Ratio (95% CI) −	Diagnostic Odds Ratio (95% CI)	Level of Evidence[83]
Meta-analysis									
	Hegedus et al (2012)[6]								1
		Active compression	6 (n = 782)	67 (51, 80)	37 (22, 54)	1.06 (0.90, 1.25)	0.89 (0.67, 1.20)	1.19 (0.76, 1.86)	
		Speed	4 (n = 327)	20 (5, 53)	78 (58, 90)	0.90 (0.43, 1.90)	1.03 (0.86, 1.23)	0.87 (0.35, 2.55)	
		Anterior slide	4 (n = 831)	17 (3, 55)	86 (81, 89)	1.20 (0.22, 6.51)	0.97 (0.96, 1.36)	1.24 (0.16, 9.47)	
		Crank	4 (n = 282)	34 (19, 53)	75 (65, 83)	1.36 (0.84, 2.21)	0.88 (0.69, 1.12)	1.54 (0.75, 3.18)	
		Yergason	3 (n = 246)	12 (6.6, 21)	95 (91, 98)	2.49 (0.97, 6.40)	0.91 (0.84, 0.99)	2.67 (0.99, 7.73)	
		Relocation	3 (n = 246)	52 (41, 62)	52 (44, 61)	1.13 (0.88, 1.45)	0.93 (0.72, 1.20)	1.23 (0.72, 2.11)	
		Biceps palpation	2 (n = 114)	39 (26, 52)	67 (53, 79)	1.06 (0.66, 1.68)	0.95 (0.74, 1.22)	1.13 (0.51, 2.50)	
		Compression rotation	2 (n = 355)	25 (14, 38)	78 (73, 83)	2.81 (0.20, 39.70)	0.87 (0.66, 1.16)	3.39 (0.15, 74.78)	
				%		Likelihood Ratio			
Multiple studies			Participants	Sensitivity	Specificity	+	−		
	Mimori et al (1999)[32]	Pain provocation	n = 32	100	90	7.17	0.025		2
	Parentis et al (2006)[24]	Pain provocation	n = 132	17	90	1.72	0.92		2
	Oh et al (2008)[27]	Anterior apprehension	n = 146	62	42	1.07	0.91		2
	Nakagawa et al (2005)[29]	Anterior apprehension	n = 54	58	72	2.07	0.58		2
	Guanche and Jones (2003)[28,a]	Anterior apprehension	n = 62	30	63	0.81	1.11		2
	Guanche and Jones (2003)[28,b]	Anterior apprehension	n = 62	40	87	3.08	0.69		2
	Fowler et al (2010)[33]	Anterior apprehension	n = 101	29	69	0.92	1.03		2
	Oh et al (2008)[27]	Biceps load II	n = 146	30	78	1.36	0.90		2
	Cook et al (2012)[30,a]	Biceps load II	n = 87	67	51	1.4	0.66		2
	Cook et al (2012)[30,c]		n = 87	55	53	1.2	0.85		2
	Kim et al (2001)[31]		n = 127	89.7	96.6	26.3	0.11		2

Abbreviation: CI, confidence interval.

[a] Superior labral anterior-posterior (SLAP) lesions only.
[b] SLAP lesions with other labral lesions.
[c] SLAP with other concomitant diagnosis of the shoulder.

Table 2. Combinations of Tests Recommended With Caution for Confirming a Superior Labral Anterior-Posterior Lesion[a]

			%		Likelihood Ratio		
Combination of Tests	Authors (year)	Participants	Sensitivity	Specificity	+	−	Level of Evidence[83]
History of popping, clicking, or catching + anterior slide	Michener et al (2011)[7]	n = 55	40	93	6.00	0.64	2
Compression rotation + apprehension + Yergason	Oh et al (2008)[27]	n = 146	12	96	3.00	0.92	2
Compression rotation + apprehension + biceps load II	Oh et al (2008)[27]	n = 146	26	90	2.60	0.82	2

[a] Caution advised because each combination has been investigated in only a single study.

SLAP lesion is suspected and the athlete does not respond to conservative management in a relatively short period of time, he or she should be referred for imaging to aid in the differential diagnosis.

MANAGEMENT

This section reviews the nonoperative and operative management of overhead athletes with SLAP lesions, including recommendations and clinical considerations for successful management. The SLAP lesions addressed in these recommendations are due to overhead throwing. The outcomes of interest were those directly related to returning the overhead-throwing athlete to preinjury status. Outcomes were assessed via PRO scales for disability or satisfaction with shoulder function. Because many patients achieve satisfactory outcomes and are able to return to sport without surgery, a 3- to 6-month program of nonoperative treatment is recommended as the first line of management.[8,9]

Nonoperative Management

A course of nonoperative management is often the initial approach when symptoms related to a SLAP tear develop. A staged, multimodal approach to nonoperative treatment is advised, aimed at resolving modifiable impairments including posterior shoulder flexibility, shoulder IR deficit and horizontal-adduction loss, strength, endurance, and neuromuscular control of the glenohumeral and periscapular musculature to restore shoulder function.[77] This process most often includes nonsteroidal anti-inflammatory medication or intra-articular corticosteroid injections (or both) in conjunction with physical therapy, followed by progressive therapeutic interventions.[59,83–86] Of note, no researchers have evaluated the effects of ROM and muscle-performance exercises in a homogeneous population of patients with isolated SLAP tears. Thus, the reported improvement in symptoms and function and the ability to return to full activity were attributed to a multimodal rehabilitation approach.[8,9] However, many patients, particularly overhead athletes with type II to IV SLAP lesions and instability, fail to improve with nonoperative management, leaving surgical intervention as the remaining option.[8,36,41,57,60]

Studies of nonoperative care for patients with SLAP tears are limited. This may be due to the evolution of the diagnosis and surgical repair over the last 15 years: management of shoulder pain typically included a nonoperative trial, but this likely occurred before a SLAP lesion was confirmed. Long-term follow-up (3.1 ± 1.5 years) showed that almost half (49%) of patients with SLAP lesions did not require surgery, suggesting some level of success with nonoperative management.[8] The nonoperative management included nonsteroidal anti-inflammatory drugs, intra-articular corticosteroid injections, and an average of 18 (range, 4–40) supervised physical therapy sessions. Although nonsteroidal anti-inflammatory drugs are helpful for reducing general shoulder pain and improving function in the short term, no researchers have specifically examined their effects in patients with SLAP lesions. Rehabilitation should focus on core and periscapular stabilization, rotator cuff strengthening and neuromuscular control, and posterior shoulder stretching for 3 to 6 months.[8,9] Overhead athletes undergoing nonoperative care showed significant improvements of greater than 50% in function, pain, and quality of life for 18 of 19 patients. Specifically, 67% of overhead athletes (10 of 15) in the nonoperative group returned to their preinjury activity level. Because the evidence for nonoperative management is SOR C, the recommendation is to consider pain and associated impairments in overhead athletes as the basis for the rehabilitation program.

Range-of-Motion Deficits. Measured at 90° of abduction, deficits in shoulder ROM including total arc of motion, IR, and horizontal adduction have been shown to increase the injury risk in overhead athletes and have been reported in overhead athletes, including those diagnosed with SLAP lesions.[4,21–23,87–89] Authors of prospective injury risk studies have indicated that deficits in the total arc of motion (ER + IR) of as little as 5°, passive IR $\geq$25°, or horizontal adduction $\geq$15° increased the injury risk in skeletally mature baseball players. Specifically for pitchers, a deficit $\geq$15° in horizontal adduction but a deficit $\geq$13° only in IR predicted upper extremity injuries, which included SLAP lesions.[21,23] These motion deficits have been reported in overhead athletes diagnosed with SLAP lesions.[87,88,90,91] Thus, based on these studies, a rehabilitation program focused on glenohumeral mobilizations and stretching to improve posterior shoulder flexibility and rotator cuff and scapular stabilization strengthening and a home exercise program consisting of sleeper and cross-body adduction stretches were recommended. All athletes experienced resolution of symptoms and returned to full activity after 21 ± 5 visits over 7 ± 2 weeks. Concurrently, improvements in ROM of IR and ER and horizontal adduction of 7° to 10° occurred.[91] It is important to note that these overhead athletes presented with posterior or superior shoulder pain but were not pitchers, nor were they definitely diagnosed with SLAP lesions. In collegiate and professional players, stretching of the posterior structures of the shoulder has been effective in increasing shoulder ROM (IR or horizontal adduction or both) within a single session[92] and over multiple seasons.[93,94] Therefore, the evidence suggests that restoring the symmetry in IR, horizontal adduction, and the total arc of motion should be 1 goal of nonoperative management of overhead athletes with shoulder pain, among them those with SLAP lesions.

Muscle Performance. Over the course of a professional season, deficits in posterior shoulder strength are associated with the development of arm injuries that include SLAP lesions.[95] Additionally, the preseason ratio of ER : IR strength was more highly correlated with shoulder injury than baseline ER strength alone, suggesting that the relative imbalance was just as important as absolute ER strength.[95] Ratio deficits in posterior rotator cuff endurance and strength compared with the anterior rotator cuff have been theorized as risk factors for the development of arm injuries in pitchers.[95–97] In professional pitchers, decreased ER muscle performance relative to IR strength was associated with subsequent injury during the season, indicating they were more likely to experience arm injuries, including SLAP tears.[95] Additionally, preseason deficits in shoulder-elevation strength have also been linked to injury in high school pitchers.[98] These findings support the concept that similar to ROM deficits, such strength and endurance deficits are thought to be the result of repetitive overhead use.[99–101] Therefore, theoretically, the restoration and balance of ER : IR strength ratios are critical in prevention and rehabilitation protocols.[64] Preseason strengthening programs have been shown to increase ER and IR strength as well as to normalize strength ratios[102–106]; however, no evidence indicates that these strengthening programs prevent shoulder injuries in overhead athletes.

Scapular Motion and the Kinetic Chain. Alterations in scapular movement have been reported in overhead athletes with shoulder pain[74,107–109] and found to predict the development of shoulder pain in handball players.[74] It is not clear if these alterations are a causal or a compensatory impairment. Assessment for scapular dyskinesis of dysrhythmia and winging can be performed visually[109,110] but should be combined with symptom-alteration tests to determine if deficits of scapular motion and control contribute to shoulder pain. Specifically, the scapular retraction or reposition test[111,112] and the scapular assist test[113] can be conducted; if symptoms are altered, then muscle-performance and -length tests should be carried out to determine their contribution to shoulder symptoms. Motor control and performance along with stretching focused on related impairments to the scapula may be warranted. Assessments of lower extremity strength and core stability during lower extremity balance tasks such as the single-legged squat, single-legged balance, and Y-balance test suggested that alterations in the kinetic chain were associated with shoulder and elbow injuries in the throwing athlete.[114–116] These assessments may help to direct treatment at deficits in core stability and lower extremity strength and flexibility to improve shoulder performance.

In summary, based on the available evidence, components of a structured rehabilitation program should consist of normalization of shoulder ROM (equal total arc of motion, IR, and horizontal adduction), scapular and rotator cuff strengthening and motor control performance, and core and lower extremity kinetic chain exercises. In our opinion, resolving these impairments provides the best opportunity to restore pain-free shoulder function and allow full overhead athletic activities without surgical repair of the SLAP lesion. Failure of nonoperative treatment after 3 to 6 months suggests that further workup and imaging[34] are indicated before planning surgery.

Operative Management

Operative management should begin with arthroscopic confirmation and classification of the SLAP tear describing biceps anchor disruption and superior labral avulsion.[42,117,118] Surgical treatment is then dictated based on classification and can include debridement, posterior capsulotomy, anterior capsule plication, superior labral repair, biceps tenotomy, biceps tenodesis, or a combination of these procedures. Each surgical option is briefly described as it has been reported in the literature in relationship to SLAP tears in overhead athletes.

Debridement. Arthroscopic evaluation is completed through anterior and posterior portals. The unstable portion of the labrum is sharply excised, and adjacent synovitis may be resected.[41]

Capsulotomy. A preoperative examination under anesthesia is performed, and the reduction in humeral IR is compared with the contralateral extremity. After the SLAP lesion is confirmed and classified, the posterior space is reduced posteriorly when viewed from an anterior articular portal. Articular scissors or an "arthroscopic punch" is used to divide the soft tissue, and a capsulotomy is performed from the posterosuperior to inferior aspect along the posterior-inferior band of the glenohumeral ligament (from approximately 8:00 to 6:00). This is followed by gentle ROM for additional stretch and to confirm the improved IR.[41,71,90]

Capsular Plication. In select patients determined to have symptomatic increased anterior glenohumeral translation, an anteroinferior capsular plication may be accomplished.[119,120] Small plications with both absorbable and permanent sutures are performed. These may include the inferior glenohumeral ligament and potentially the anterior capsular middle and superior glenohumeral ligaments. Alternatively, thermal techniques may be used to reduce the length of select tissues.[121]

Repair of the SLAP Lesion. Two techniques were included in the literature review: tacks and suture anchors.[11,41,57,59,86,122] In both techniques, the glenoid neck is debrided, and the labrum and biceps anchor are reduced and then fixated. Knots or knotless fixation is used to grasp and repair the tissue.

Biceps Tenotomy and Tenodesis. The biceps can be separated from the damaged labrum by sharp division. Options are releasing the biceps alone or proceeding to a form of tenodesis to the proximal humerus.[44,122] The soft tissue or bone can be affixed above or below the bicipital groove. This procedure is often combined with debridement of adjacent damaged soft tissue.

The available literature primarily earned an SOR grade of C for describing the authors' techniques for patients with a type II lesion. Most of the articles had subsections on atraumatic or overuse versus traumatic injuries, other athletes versus overhead-throwing athletes, and a variety of outcome measures. Many researchers measured and reported the chances of successful anatomical repair but did not document return-to-sport results. In early studies, investigators[90,107] described good or excellent results but not a return to preinjury status. Authors of more recent studies indicated lower levels of return to full activity after a SLAP repair in overhead athletes; outcomes and return-to-sport rates are presented in detail in the "Outcomes and Return to Play" section. Patients who underwent debridement had early improvement but often regressed to their preoperative status by 2 years after surgery. Although no single study has directly compared debridement versus nonoperative care,[11] the latter was not associated with a higher percentage of patients demonstrating a 50% improvement in PRO. Debridement alone is commonly performed, but long-term success appears limited.[41,123,124]

Capsulotomy was an isolated surgical option in patients with SLAP lesions. This was often combined with another procedure addressing type II SLAP lesions. Posterior capsular stiffness was addressed with preoperative therapeutic stretching, though capsulotomy can be considered if improvement is limited.[41,71,90]

Anterior capsular plication was performed in patients with symptomatic excessive anterior translation. Early successful reports of thermal capsulorrhaphy combined with debridement offered reason for some enthusiasm. Concerns about loss of ER limited this approach in the overhead thrower, yet in select patients with internal impingement, this treatment has been successful.[119,125] An important factor is determining the significance of increased humeral translation. In an experimental model, type II SLAP lesions increased anterior and posterior translation. Therefore, the significance of humeral translation in producing symptoms should be considered in selecting the preferred treatment. An additional question is whether the increased translation caused or was the result of the SLAP lesion.

Repairs of type II SLAP lesions had variable outcomes, as detailed in the next section. Anatomically, most studies suggested a stabilizing effect, but unfortunately, stiffness and loss of desired ER in the abducted position is a potential complication associated with an inability to return to throwing.[36,44,126] Earlier studies of absorbable tacks showed good return-to-play rates, yet reactions to the implants shifted the consensus to suture anchor repairs. Complications including stiffness, knot impingement, and biceps subluxation have been reported, indicating that appropriate patient selection and technique may be critical in the overhead athlete. The distinctive biomechanics and the significant demands of rotation make the overhead athlete unique.

Early procedures using absorbable tacks had success (87% good to excellent outcomes) in allowing patients to return to sport; however, there were concerns about complications related to the degradation of the implant. Suture anchor techniques had good or excellent results (70%–94%), although return to the previous level of sport was limited.[36,41,57,60,123] The return to overhead throwing or the preinjury level was 53% to 57%, including adolescent and young adult throwers. Athletes younger than age 20 were at greatest risk for additional surgery due to continued symptoms after surgical repair.[36]

Biceps tenodesis or tenotomy has been reported to be an effective method for patients with biceps groove pain or pathologic changes within the biceps (ie, type IV SLAP lesion, subluxation, tendon thickening).[43,127] In younger overhead athletes, these procedures have been considered an alternative to a SLAP repair; yet to date, outcomes have been reported only in case studies. The biceps complex is thought to play a supportive role in protecting the stabilizing effect of the anterior-inferior capsule. However, biceps tenotomy or tenodesis has not been shown to improve or compromise this structure. Biceps tenodesis is an option in patients with an associated rotator cuff tear[43] and failed SLAP lesion repair,[44] suggesting its role in the presence of the combined injury. The biceps tenotomy or tenodesis has been helpful in more complex cases, including revision surgery, but it is unclear if biceps tenodesis in the younger athlete is a viable primary option. Biceps detachment may be helpful in reducing shoulder pain but does not address the potential effect of reducing glenohumeral translation anteriorly and inferiorly. In patients with symptomatic biceps anchor changes who require labral repair for stabilization, tenodesis may have a role.

The significance of increased anterior translation in the throwing shoulder and whether this needs to be reduced in symptomatic athletes remain questions. Patients considering surgical repair should be counseled on its potential limits and the ability to return to their prior level of function after operative intervention. Multiple techniques have been recommended, which would suggest that complex conditions often coexist with the SLAP lesion in the symptomatic athletic shoulder.

OUTCOMES AND RETURN TO PLAY

After an injury, the goal is to return the athlete to his or her prior level of function given the individual demands of the sport. The multifactorial assessment of the ability to return to sport is based on the patient's perception of readiness to return to sport, satisfaction with functional use and outcome, resolution of impairments, and physical performance of sport activity.

Patient Self-Report Outcomes

Information regarding the patient's perception of symptoms and use of the shoulder is provided by PROs. One limitation is that not all PRO instruments have a section or focus on shoulder injuries related to sport or return to sport. Commonly used PRO instruments for patients with SLAP lesions are as follows:

(1) American Shoulder and Elbow Surgeons (ASES) self-report form, which has 11 items to assess pain and function (0–100, 100 = *full function*)[128]
(2) University of California at Los Angeles (UCLA) Shoulder Rating scale, which has 5 items to assess pain, function, strength, ROM, and satisfaction and incorporates both subjective and objective components (0–35, 35 = *full function*)[129]
(3) Shoulder Rating Questionnaire, also known as the L'Insalata Questionnaire, which uses 21 items that assess pain, daily activities, global assessment, recreational and athletic activities, work, and satisfaction to identify what is most important to the patient for improvement (17–100, 100 = *full function*)[130]

(4) Western Ontario Shoulder Instability Index, which was developed for patients with shoulder instability and uses 21 questions to assess physical symptoms; sport, recreation, and work; lifestyle; and emotions (0–2100 or converted to 0–100, 100 = *full function*)[131]
(5) Kerlan-Jobe Orthopedic Clinic questionnaire (KJOC), which uses 10 physical function questions to assess function during sport participation (0–100, 100 = *full function*)[132]
(6) Constant-Murley Shoulder Score, which incorporates both subjective and objective assessments with 4 subscales of pain, function, ROM, and strength (0–100, 100 = *full function*)[133]
(7) Single Assessment Numeric Evaluation score, also known as the global rating of function, which asks the patient to rate the shoulder as a percentage of normal function (0–100, 100 = *normal, full use of the shoulder*)[134]

Patient satisfaction with the outcome after an intervention is commonly evaluated, yet no standard format is used to measure satisfaction. Many authors selected a question from the UCLA scale, which asks whether the patient is satisfied, whereas others used a variation of a general question regarding satisfaction with the surgery.

Outcomes Scores With Surgical or Nonoperative Management

The inconsistent use of PROs across studies did not allow outcomes to be collapsed on a single PRO. The reviewed studies combined for operative and nonoperative management indicated that shoulder function via PRO assessment was high, with reports of 70% to 97% of full function at long-term follow-up (Table 3). With nonoperative management, 1 study[8] indicated very high PRO shoulder scores (85%–92%, 100% = *full function*), and only 5% did not return to sport. However, a second study[9] of professional baseball players showed that most players (60.3%) were unable to return to professional baseball after nonoperative management. Both studies were retrospective.

At 2 to 4 years after SLAP repair, the majority of athletes were able to return to their sport and demonstrated average PRO scores of 85% for normal function, regardless of the scale used. However, it is important to note that only the KJOC scale was specifically designed to assess shoulder function in overhead athletes. In the 3 studies[36,45,59] that used the KJOC as their PRO to assess the outcomes of throwing athletes after SLAP repair, average function was 70% (range, 59%–77%). The level of function assessed with non–athlete-specific scales may not adequately reflect what is needed for return to sport. Another limitation of most studies is the lack of information on when the PROs were measured in these retrospective case series. Prospective studies are needed to enroll consecutive athletes undergoing nonoperative or operative treatment for SLAP lesions so that we can adequately understand the outcomes of care.

A summary of specific PROs after SLAP repairs follows:

(1) The most common PRO used to assess function was the ASES. At 2 to 4 years, the average score was 85/100 points (85%).
(2) The UCLA scale was the second most commonly used, and the average was 31/35 (89%).
(3) The Shoulder Rating Questionnaire average score at 2 to 4 years postoperatively was 88 points (85.5%).
(4) The ASES, Western Ontario Shoulder Instability Index, and Single Assessment Numeric Evaluation scores were used in a single study[9] and demonstrated similar overall functional scores of 80% to 90% for 179 active-duty military patients.
(5) The Constant-Murley shoulder score was 83/100 (83%) at 3 years postsurgery in a single study.[43]
(6) The KJOC score was used in 3 studies[36,45,59] and ranged from 59 to 77 out of 100 points at 2 to 4 years postoperatively. The KJOC scores describe a lower level of function because the instrument focuses on the demands of an overhead athlete. This scale has demonstrated the capability to discriminate between overhead athletes performing without pain, those performing with pain, and those unable to perform.[132,135] This makes the KJOC a good scale to use in determining readiness to return in overhead athletes.

Satisfaction levels were not reported with nonoperative care. Satisfaction with outcomes reported in 13 of the 22 studies of operative management of SLAP lesions was high, with 78% ± 18% of patients reporting an excellent level of satisfaction at an average follow-up of 34 ± 8 months. This finding is quite similar to the 83% satisfaction score in a systematic review of type II SLAP repairs by Sayde et al,[11] who evaluated surgical outcomes published from 1950 to 2010. Their results and those of the prior systematic review indicate that it is reasonable to expect the large majority of athletes to be satisfied with their outcomes after SLAP repair. However, overall satisfaction appeared to be lower in overhead athletes. In 8 studies,[4,36,45,49,51,59,62,65] only 68% ± 17% of overhead athletes reported an excellent level of satisfaction at follow-up. The athlete's demands need to be taken into consideration regarding the level of satisfaction after a SLAP repair. The athlete's assessment should include a PRO; although several instruments have been used to date, the only one specifically evaluating short-term and long-term outcomes in overhead athletes is the KJOC.[67]

Resolution of Impairments

Postoperative ROM was compared with preoperative values or the opposite-shoulder values in only 4 studies.[53,56,58,60] In a mix of 48 laborers and athletes at 41 months, flexion (20°), abduction (23°), IR (1 spinal level), and ER (6°) improved significantly.[58] These results are contrary to the findings of 2 studies that showed significant reductions postoperatively for shoulder flexion (5°) and abduction (15°)[60] and a loss of IR (≥1 vertebral level)[53] in 20/33 (61%) patients at long-term follow-up. Yung et al[56] reported that by 6 months, 14/16 (88%) patients had full shoulder motion as measured on the UCLA scale. In the overhead athlete, total arc of motion is a key measurement. Values of approximately 125° to 130° of ER and approximately 50° of IR are typically reported in high school[21,23] and professional baseball players.[64] Provencher et al,[60] who evaluated active military patients, observed postoperative values of approximately 85° of ER and 60° of IR, which may be adequate for this population but not for a throwing athlete. Limited and inconsistent evidence suggested that ROM recovers after a SLAP repair, but it is important to note that ROM measures were not taken sequentially over the course of recovery to determine when normal motion was restored. Future authors should track ROM values over the course of recovery to provide milestones and a prognosis to the patient regarding the expected amount of and time frame for return of ROM.

Strength was reported in only 2 studies[43,58] after SLAP repair. No differences were found in shoulder-flexion or elbow-flexion strength between those treated with a biceps tenodesis versus a SLAP repair.[43] Compared with the opposite arm, small losses were seen in both shoulder-flexion and ER strength postsurgery.[58] The recommended strength criterion to start functional exercises and an interval return-to-sport program is $\geq$70% of the contralateral arm.[64] Values greater than or equal to 80% of the preinjury number of push-ups or pull-ups have been suggested before a return to full military duty.[61] However, the current literature does not provide evidence-based strength values for clinical progression and return to sport. Additional testing (ie, isokinetics, Functional Movement Screen, or upper extremity Y-balance test) may inform clinical decision making, but evidence to determine the usefulness of additional functional testing for return to sport is not yet available.

Criteria to Return to Sport

Time-based criteria are commonly used to progress athletes to sport-specific training. At approximately 4 months postoperatively, an interval throwing program and sport-specific activities can be started. From months 4 to 6, progressive demands on the shoulder continue with the goal of resuming full sport activity at about 6 months. One study[61] of active military patients identified 4 specific criteria for a return to military duty: (1) greater than 80% of preoperative motion regained, (2) greater than 80% of preoperative strength regained (measured by the self-reported number of push-ups or pull-ups), (3) ability to perform the physical requirements of the patient's military occupational specialty (which varied widely depending on the job), and (4) full participation in overhead sport after 6 months. On average, patients returned to military duty in 4.4 months (range, 2–7 months) after SLAP repair. In a retrospective review,[59] 30 overhead athletes participating in baseball, softball, tennis, or javelin required a mean of 11.7 months (range, 6–18 months) for 24/30 (80%) to return to some level of sport participation; unfortunately, the level was not clearly reported. Among 13 overhead athletes, 2 nonoverhead athletes, and 1 nonathlete with isolated type II SLAP tears, 11/16 returned to their preinjury level within an average of 7 months; however, 4 patients described as being involved in intense and frequent overhead activities required an average of 11 months to return to their preinjury level and 1 elite handball player never returned to the preinjury level.[56] The time to return can be quite variable. Although protocols suggest that sport activities can resume in 6 months, a longer time period is likely required for a full return to sport after a SLAP repair.

An interval return-to-sport protocol should be used for progression. Multiple programs have been described for throwers.[64,136–138] Volume and distance need to be considered in the throwing program. The total volume varies depending on the athlete's sport and his or her role on the team. The type of sport and position played in the sport should also be taken into account when developing an interval return-to-sport program, but no current evidence has demonstrated the effectiveness of 1 progression compared with another. The program depends on the individual athlete and the clinician's ability to blend the science and art of rehabilitation. Programs for returning a throwing athlete with a SLAP tear to competition vary widely. Research is needed to compare the efficacy of different throwing programs and progressions to establish a standard of care relating to return-to-play criteria for the overhead athlete.

Return to Sport or Work

The level of return to sport participation is not uniformly reported or defined in the literature. Some authors[36,132] have categorized the level of return to sport based on the ability to participate with or without pain or the inability to participate. Another approach devised for baseball athletes was to describe whether the athlete was able to return to a higher, the same, or a lower level of participation or had retired.[65] We used a 3-level categorization to more clearly represent the level of recovery when adequate information is provided: (1) able to return to the preinjury level of sport or better (indicating forward movement in the career, such as from minor to major league baseball), (2) able to return to sport but at a lower level or with occasional pain in the shoulder (indicating a return to sport with limitations), or (3) not able to return to sport activity at all.

Two retrospective case series[8,9] of nonoperative treatment of patients with SLAP lesions have been published. In a mixed group of athletes (n = 107), 89% returned to functional activities within 6 months, and overall, 95% had returned to their sport by 3 years. Among the sample, 67% were overhead athletes and were able to return to the same level of sport participation.[8] However, the return to sport for professional baseball players undergoing nonoperative care was not impressive. In a retrospective study of professional baseball players,[9] the majority of players (60.3%) were not able to return to professional baseball after 2 trials of nonoperative management for a SLAP tear. Among pitchers, 18/45 (40%) returned to sport, but only 10/45 (22%) were able to return to their prior performance level; 60% of pitchers eventually sought surgical intervention. Of the 23 position players, 9 (39%) returned to sport, 6 (26%) returned to their prior performance level, and 1 (4%) retired; 56% eventually underwent surgical intervention for their SLAP lesion.[9]

Return-to-sport rates vary widely after operative treatment for SLAP lesions. Gorantla et al[10] reported that 20% to 94% of athletes were able to return to their preinjury level of sport. Recovery was most challenging for overhead athletes, as only 64% were able to return to sport. In a subsequent systematic review[11] of 506 patients (including 198 overhead athletes, 81 of whom were baseball players), return to the preinjury level averaged 73% (range, 20%–94%) for overhead athletes and 63% (range, 22%–92%) for baseball players. We evaluated many of the same articles plus 6 articles that were not included in the most recent systematic review. Collapsing the results of return to play across 13/22 studies for mixed groups of athletes at all

Table 3. Studies for the Management, Outcomes, and Return to Play of Physically Active Individuals With Superior Labral Anterior-Posterior (SLAP) Lesions Extended on Next Page

Authors (year)	Study Design	Level of Evidence	Population: N	Population: Age (Range)	Population: Mechanism of Injury	Population: Position or Level of Sport	Treatment
Edwards et al (2010)[8]	Retrospective case series	3	N = 19 SLAP lesions	34 y (13–47 y)	14 traumatic 5 nontraumatic	9 competitive 9 recreation 1 NR	Nonoperative
Fedoriw et al (2014)[9]	Retrospective case series	3	N = 68 professional baseball players with type II SLAP lesions	24 y (17–42 y)		45 pitchers 23 position players	Nonoperative
Fedoriw et al (2014)[9]	Retrospective case series	3	N = 68 professional baseball players with type II SLAP lesions	24 y (17–42 y)		45 pitchers 23 position players	Surgical treatment: suture anchors after nonoperative treatment failed
Yoneda et al (1991)[62]	Retrospective case series	3	N = 10 superior labrum involving biceps labral complex	18 y (14–23 y)	4 traumatic 6 nontraumatic	7 baseball players 2 volleyball players 1 badminton player	Surgical repair with staple fixation; staple removed at 3–6 mo in 2nd surgery
Morgan et al (1998)[4]	Retrospective case series	3	N = 102	33 y (15–72 y)	49 traumatic 53 repetitive motion	53 overhead athletes (10 partial-thickness rotator cuff tears, 1 complete tear) 49 nonoverhead throwers (10 partial-thickness rotator cuff tears, 11 complete tears)	Surgical repair with metal suture anchors
Samani et al (2001)[48]	Retrospective case series	3	N = 25	36 y (17–58 y)		24 recreational athletes 3 overhead throwers	Surgical repair with bioabsorbable tacks
Kim et al (2002)[49]	Retrospective case series	3	N = 34 isolated SLAP lesions	26 y (16–35 y)	27 traumatic 7 nontraumatic	18 overhead athletes 12 contact-sport athletes 4 no sport participation	Surgical repair with metal anchor nonabsorbable sutures
O'Brien et al (2002)[50]	Retrospective case series	3	N = 31 with SLAP lesions	39 y (16–71 y)	2 traumatic 11 unknown 18 sport related		Surgical repair with bioabsorbable tacks
Ide et al (2005)[51]	Retrospective case series	3	N = 40 isolated SLAP repairs in overhead athletes	24 y (15–38 y)	18 traumatic 22 overuse		Surgical repair with bioabsorbable anchor and nonabsorbable suture anchor
Rhee et al (2005)[52]	Retrospective case series	3	N = 41, 44 SLAP repairs	24 y (17–43 y)		13 throwing athletes 17 nonthrowing athletes 11 nonathletes	Surgical repair with bioabsorbable tacks (n = 14) Surgical repair with metal suture anchors (n = 30)
Cohen et al (2006)[53]	Retrospective case series	3	N = 39 isolated SLAP repairs	34 y (16–56 y)	19 traumatic 20 nontraumatic	8 throwing athletes 21 nonthrowing athletes 10 nonathletes	Surgical repair with bioabsorbable tacks

Table 3. Extended From Previous Page

Average Follow-Up (Range), mo	Patient-Rated Outcome	Return to Sport, No. (%)			Patient-Rated Satisfaction
		Preinjury Level or Better	Lower Level	Unable to Return	
36 (12−74)	ASES: Pre = 58.5% ± 21% Post = 84.7% ± 12% Simple shoulder test: Pre = 8.3/12 ± 3.5/12 Post = 11/12 ± 1/12	12/19 (63)	6/19 (32)	1/19 (5)	NR
NR	NR	10/45 (22) 6/23 (26)	8/45 (18) 3 unsatisfied with function, had surgery 3/23 (13)	27/45 (60) 3/27 failed to return to play 24/27 opted for surgery 14/23 (61), 1/14 (1) failed to return to play, 13/14 (93) opted for surgery	NR
NR	NR	2/27 (7) 7/13 (54)	11/27 (41) 4/13 (31)	14/27 (52) 2/13 (15)	
37 (24−47)	NR	5/10 (50)	3/10 (30) with occasional pain	2/10 (20)	Excellent = 5 (50), good = 3 (30), fair =1 (10), poor =1 (10)
12	Overhead athletes: UCLA: 46/53 (87) rated excellent (≥34), 13% rated good (28−33)	Baseball pitchers: 37/44 (84)	Baseball pitchers: 7/44 (16); all had associated partial-thickness rotator cuff tears		Excellent = 85/102 (83), good = 14/102 (14), fair = 3/102 (3)
35 (24−51)	ASES: Pre = 42 (13−27) Post = 92 (47−100) UCLA: Pre = 18 (13−27) Post = 32 (18−35)	20/24 (83) included the 3 throwers	2/24 (8) not related to shoulder per authors	2/24 (8) due to shoulder limitations per authors	NR
33 (24−49)	UCLA: Pre (n = 34) = 21 (14−26) Post = 33 (22−35) for overhead athletes, 34 (30–35) for nonoverhead athletes	4/18 (22) 10/16 (63)	Returned to lower level of function: 14/18 (78) 6/16 (37)		NR
45 (24–84)	SRQ: Post = 87 ± 14 ASES: Post = 87 ± 16	16/31 (51)	11/31 (35)	2/31 (6) did not return to sport 2/31 (6) NR	Satisfaction with procedure = 3.8/5-point scale, good–excellent = 23/31 (74), fair = 6/31 (19), unsatisfied = 2/31 (6)
41 (24−58)	Modified Rowe score[a]: Pre = 27.5 (10−55) Post = 92.1 (45−100)	All participants: 30/40 (75) Mechanism of injury: 16/18 (89) traumatic 14/22 (63) overuse	8/40 (20) Mechanism of injury: 2/18 (11) traumatic 6/22 (27) overuse	2/40 (5) all overuse	NR
33 (25–67)	UCLA Pre = 23 (16−26) Post = 32 (20−35) No difference between surgical interventions (*P* = .84)	17/30 (57)	6/30 (20)	7/30 (23) not attributed to surgery per authors	Satisfied = 38/41 (93)
44 (25−97)	SRQ: Post = 87 (46–100) Throwing athletes = 75.9 Nonthrowing athletes = 91 ASES: Post = 87 (47−100)	Athletes: 14/29 (48)	13/29 (45)	Athletes: 2/29 (7)	Good to excellent = 27/39 (69), fair = 7/39 (18), poor = 5/39 (5)

Table 3. Continued From Previous Page

Authors (year)	Study Design	Level of Evidence	Population: N	Age (Range)	Mechanism of Injury	Position or Level of Sport	Treatment
Coleman et al (2007)[54]	Retrospective case series	3	N = 50 SLAP repairs 34 isolated type II tears without acromioplasties	34 y (16–56 y)		9 competitive athletes 24 recreational athletes 1 nonathlete	Surgical repair with bioabsorbable tacks
			16 SLAP repairs with concomitant arthroscopic acromioplasties	42 y (33–71 y)	1 recreational athlete 4 nonathletes		
Enad and Kurtz (2007)[55]	Retrospective case series	3	N = 30 SLAP repairs	32 y (22–41 y)	15 traumatic 15 nontraumatic	30 active military 26 participated in recreational sports	Surgical repair with biodegradable suture anchors
Enad and Kurtz (2007)[55]	Retrospective case series	3	N = 32 active military N = 18 isolated type II SLAP tears	31 y (22–41 y)	6 traumatic 9 repetitive microtrauma 3 nontraumatic		Surgical repairs with biodegradable suture anchors
			N = 18 type II SLAP tears + 6 subacromial impingement 3 acromioclavicular arthrosis 4 combined acromioclavicular arthrosis and impingement 4 spinoglenoid cysts 1 loose body		11 traumatic 4 repetitive microtrauma 3 nontraumatic		
Yung et al (2008)[56]	Prospective cohort	2	N = 16 isolated SLAP repairs	24 y (15–38 y)	8 traumatic 4 repetitive microtrauma 2 non-sport related 2 unknown	13 overhead athletes 2 nonoverhead athletes 1 nonathlete	Surgical repair with bioabsorbable suture anchors
Boileau et al (2009)[43]	Prospective cohort	2	N = 25 patients 15 biceps tenodesis	53 y (28–64 y)	14 traumatic 11 nontraumatic	8 overhead athletes 2 contact-sport athletes 5 nonathletes	15 arthroscopic biceps tenodesis with bioabsorbable interference screw
			N = 10 isolated type II SLAP repairs	37 y (19–57 y)		7 overhead athletes 2 contact-sport athletes 1 nonathlete	10 SLAP repairs with bioabsorbable suture anchors
Brockmeier et al (2009)[57]	Prospective cohort	2	N = 47 SLAP II lesions	36 y (14–49 y)	25 traumatic 22 nontraumatic 34 athletes 28 overhead athletes 13 nonathletes		Surgical repair with metal anchor or bioabsorbable anchors with nonabsorbable suture
Friel et al (2010)[58]	Prospective cohort	2	N = 48 SLAP lesions	33 y (16–60 y)	24 traumatic 24 nontraumatic	13 overhead athletes 14 nonoverhead athletes 17 nonathletes or laborers 4 overhead laborers	Surgical repair with bio-suture anchors 2 athletes: revision SLAP repairs, 1 due to traumatic event 2 nonathletes: subsequent procedures
Cohen et al (2011)[65]	Prospective cohort	2	N = 27 23 SLAP lesions 2 rotator cuff injuries 1 capsular contracture 1 outlet impingement	25 y ± 4 y	3 traumatic 20 nontraumatic	Professional baseball players	Surgical repair with suture anchors 1 athlete required reoperation

Table 3. Extended From Previous Page

Average Follow-Up (Range), mo	Patient-Rated Outcome	Return to Sport, No. (%) Preinjury Level or Better	Lower Level	Unable to Return	Patient-Rated Satisfaction
Isolated SLAP group = 45 (31–72) Combined group = 40 (24–84)	SRQ: Post = 87 ± 14 (isolated), 85 ± 17 (combined) ASES: Isolated = 86 ± 15 Combined = 87 ± 16	Athletes: 42/45 (93)		Athletes: 3/45 (7)	Isolated: excellent–good = 22/34 (65), fair = 7/34 (20), poor = 5/34 (15) Combined: good–excellent = 13/16 (81), fair = 2/16 (13), poor = 1/16 (6)
30 (22–41)	Only 27 patients available for follow-up UCLA: Post = 30 (22–35) ASES: Post = 87 (53–100)	20/26 (77) returned to sport participation 29/30 (97) returned to full military duty	6/26 (23) returned to lower level of sport participation		Satisfied with procedure and result = 26/27 (96)
Isolated: average follow-up = 29 ± 6 Combined (SLAP repair with concomitant diagnoses): average follow-up = 30 ± 7	UCLA: Isolated = 30 (95% CI = 29, 32) Combined = 31 (95% CI = 30, 32) ASES: Isolated = 84 (95% CI = 78, 90) Combined = 92 (95% CI = 89, 94)	Isolated SLAP: 17/18 (94) returned to full military duty Combined SLAP repair with concomitant diagnoses: 17/18 (94) returned to full military duty		Isolated SLAP: 1/18 (6) did not return to military duty Combined SLAP repair with concomitant diagnoses: 1/18 (6) did not return to military duty	NR
28 (24–31)	UCLA: Pre = 18.1 ± 3.3 Post = 31.3 ± 3.7	15/16 (94)		1/16 (6)	Satisfied = 16/16 (100) via UCLA scale
Biceps tenodesis 35 (24–69) SLAP repairs 34 (24–68)	Constant: Biceps tenodesis Pre = 59 (no SD given) Post = 89 ± 5 SLAP repairs Pre = 65 (no SD given) Post = 83 ± 5 4/10 required revision surgery (biceps tenodesis) due to pain at 12–26 mo	Biceps tenodesis: 13/15 (87) returned to preinjury level of activity SLAP repairs: 2/10 (20) returned to preinjury level of activity		Biceps tenodesis: 3/15 (13) did not return to preinjury level of activity SLAP repairs: 8/10 (80) did not return to preinjury level of activity	Bicep tenodesis Satisfied = 14/15 (93; 4-point Likert scale of *very satisfied* to *dissatisfied*) SLAP repairs Satisfied or above = 4/10 (40)
32 (24–48)	ASES: Pre = median 62 (18–95) Post = median 97 (62–100) SRQ: Pre = median 65 (38–88) Post = median 93 (71–100)	All athletes: 25/34 (75) Overhead athletes: 20/28 (71) Traumatic mechanism: 11/12 (92) Nontraumatic mechanism: 14/22 (64)		All athletes: 9/34 (25) Overhead athletes: 8/28 (29)	Median satisfaction: 9/10 (2–10) Fully satisfied = 10
41 (24–69)	All patients SST: Pre = 7 Post = 10 ASES: Pre = 59 Post = 83 No measure of distribution reported	7/13 (54) athletes returned to preinjury level of activity		6/13 (46) athletes did not return to preinjury level of sport, 5/6 due to their shoulders	41/48 (85) would have surgery again
Minimum = 24	NR	SLAP lesions: 8/23 (34) returned to preinjury level of sport Other procedures: 3/4 (75) returned to preinjury level of sport or higher		SLAP lesions: 5/23 (22) returned to lower level of sport activity 10/23 (43) did not return to sport activity Other procedures: 1/4 (25) did not return to sport activity	NR

Table 3. Continued From Previous Page

Authors (year)	Study Design	Level of Evidence	Population				Treatment
			N	Age (Range)	Mechanism of Injury	Position or Level of Sport	
Neri et al (2011)[36]	Retrospective case series	3	N = 23 SLAP repairs	25 y (18–45 y)	5 traumatic 18 nontraumatic	Overhead athletes 17 professional athletes 6 collegiate athletes	Surgical repair with nonabsorbable sutures
Neuman et al (2011)[59]	Retrospective case series	3	N = 30 SLAP repairs	24 y (16–48)		Overhead athletes 21 baseball or softball (14 pitchers) 9 other (tennis, javelin)	Surgical repair with bioabsorbable suture anchors
Van Kleunen et al (2012)[45]	Retrospective case series	3	N = 17 SLAP lesions + infraspinatus tear	19 y (16–23 y)	11 posterior inferior releases 6 not released rotator cuff tear 11 partial thickness 6 full thickness	Baseball players	SLAP lesions repaired with bioabsorbable suture anchors
Provencher et al (2013)[60]	Prospective cohort	2	N = 179 type II SLAP lesions	32 y (18–45 y)	85 traumatic 94 nontraumatic	179 active military	Surgical repaired with metal suture anchor 50/66 failed to improve and had revision shoulder surgery
Ricchetti et al (2010)[66]	Case-control	3	N = 51 isolated labral repairs N = 110 controls: professional baseball pitchers randomly chosen without labral or rotator cuff surgery	28 y 29 y		Professional baseball pitchers	NR

Abbreviations: ASES, American Shoulder and Elbow Surgeons score (0–100, 100 = *best function*); Constant, Constant-Murley scale (0–100, 100 = *best function*); CI = confidence interval; KJOC, Kerlan-Jobe Orthopedic Clinic score (0–100, 100 = *best function*); NR, not reported; SANE, Single Assessment Numeric Evaluation score (0–100, 100 = *best function*); SRQ, Shoulder Rating Questionnaire (17–100, 100 = *best function*), score (0–35, 35 = *best function*); UCLA, University of California at Los Angeles Shoulder Rating score (0–35, 35 = *best function*); WOSI, Western Ontario Shoulder Instability score (raw score 0–2100, 0 = *best function*, converted score 0–100, 100 = *best function*).

[a] Modified Rowe score (0–100, 100 = *best function*).

levels and nonathletes showed that 55% ± 17% returned to the preinjury level or better, 31% ± 17% returned to sport but at a lower level or with pain, and 18% ± 13% were not able to return to sport. For the 6/13 studies of overhead athletes, 45% ± 19% returned to the preinjury level or better, 34% ± 22% returned to sport but at a lower level or with pain, and 24% ± 15% were not able to return to sport. A recent systematic review[12] indicated that the odds of a full return to overhead sport after an isolated SLAP lesion repair were 0.2 to 3.0. Specifically, overhead athletes and throwers had a 2.3 to 6 times greater chance of returning to full activity than nonoverhead, nonthrowing athletes. The wide variations in reported return rates are most likely related to the lack of standardized return-to-play criteria in the literature.

In summary, the literature poorly documents outcomes and return-to-play criteria for athletes with type II SLAP lesions. No level 1 or 2 studies have provided data regarding return to play in the literature, and most studies were level 4 (case series). Patient-reported outcomes for function and satisfaction were at relatively high levels: whether patients were managed nonoperatively or operatively, they regained approximately 80% of normal function, and 78% were satisfied 2 to 4 years after SLAP repair. However, these results were not correlated with the ability to return to sport, as rates for return to full sport participation ranged from 45% to 55%. Those with higher levels of sport demand and overhead athletes in general appeared to have worse outcomes and lower rates of return to sport. Most patients require about 6 months to return to play, and throwers may require 9 to 12 months. To adequately and systematically assess outcomes, we need consistent reporting of the type of treatment used, patient outcomes, and the time to and level of return to play.[67]

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Table 3. Extended From Previous Page

Average Follow-Up (Range), mo	Patient-Rated Outcome	Return to Sport, No. (%)			Patient-Rated Satisfaction
		Preinjury Level or Better	Lower Level	Unable to Return	
38 (12–70)	ASES: Post = 94 (90–100) KJOC: Post = 77 (63–93)	13/23 (57) returned to preinjury level of sport	6/23 (26) returned to lower level of preinjury sport	4/23 (17) did not return to sport activity	NR
42 (18–84)	ASES: All post = 88 (53–100) KJOC: 24/30 post = 74 (39–100)		24/30 (80) returned to unspecified level of sport	6/30 (20) did not return to preinjury level of sport, 2/6 due to their shoulder injuries	Very satisfied = 21/30 (70), satisfied = 7/30 (23), unsatisfied = 2/30 (7)
37 (24–55)	KJOC: Post = 59 (21–91) Tear size = no difference in scores (P = .16) Full-thickness tear = 66 (42–81) Partial-thickness tear = 55 (21–78) Capsular release: no difference in scores (P = .08) Release = 63 (33–81) No release = 48 (21–73)	6/17 (35) tear size and release condition did not affect ability to return to full activity	5/17 (29)	6/17 (35)	NR
40 (26–62)	ASES: Pre = 64 ± 4 Post = 88 ± 5 SANE: Pre = 50 ± 5 Post = 85 ± 6 WOSI score: Pre = 54% ± 32% Post = 82% ± 26%	113/179 (63) returned to preinjury level of activity and full military duty		66/179 (37) did not return to preinjury activity level 16/66 medically separated from military	NR
31 (3–45)		37/51 (73) cases 77/110 (70) controls		14/51 (27) cases 33/110 (30) controls	NR

FINANCIAL DISCLOSURE

Lori A. Michener, PhD, PT, ATC, is on the Board of the Orthopaedic Section of the American Physical Therapy Association (Alexandria, VA). Jeffrey S. Abrams, MD, is a consultant for Cayenne Medical Inc (Scottsdale, AZ), ConMed Corporation (Utica, NY), Mitek Sports Medicine (Raynham, MA), Rotation Medical (Plymouth, MN), and Smith & Nephew (London, UK). Sue Falsone, PT, MS, SCS, ATC, is the owner of Structure & Function Education, Phoenix, AZ. Edward G. McFarland, MD, is a consultant for Styker Inc (New York, NY) and received research grants from Depuy Synthes (Raynham, MA) and Stryker Inc (Kalamazoo, MI). James Tibone, MD, is a consultant for Arthrex (Naples, FL). Timothy L. Uhl, PhD, PT, ATC, FNATA, is a consultant for BTE Technologies (Greenwood Village, CO) and the recipient of a research grant from Patterson Medical (Warrenville, IL). Kellie C. Huxel Bliven, PhD, ATC; Kevin G. Laudner, PhD, ATC; and Charles A. Thigpen, PhD, PT, ATC, have no disclosures to report.

DISCLAIMER

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REFERENCES

1. Maffet MW, Gartsman GM, Moseley B. Superior labrum-biceps tendon complex lesions of the shoulder. *Am J Sports Med*. 1995;23(1):93–98.
2. Snyder SJ, Karzel RP, Del Pizzo W, Ferkel RD, Friedman MJ. SLAP lesions of the shoulder. *Arthroscopy*. 1990;6(4):274–279.
3. Andrews JR, Carson WG Jr, McLeod WD. Glenoid labrum tears related to the long head of the biceps. *Am J Sports Med*. 1985;13(5):337–341.
4. Morgan CD, Burkhart SS, Palmeri M, Gillespie M. Type II SLAP lesions: three subtypes and their relationships to superior instability and rotator cuff tears. *Arthroscopy*. 1998;14(6):553–565.
5. Burkhart SS, Morgan CD. The peel-back mechanism: its role in producing and extending posterior type II SLAP lesions and its effect on SLAP repair rehabilitation. *Arthroscopy*. 1998;14(6):637–640.
6. Hegedus EJ, Goode AP, Cook CE, et al. Which physical examination tests provide clinicians with the most value when

examining the shoulder? Update of a systematic review with meta-analysis of individual tests. *Br J Sports Med*. 2012;46(14):964–978.
7. Michener LA, Doukas WC, Murphy KP, Walsworth MK. Diagnostic accuracy of history and physical examination of superior labrum anterior-posterior lesions. *J Athl Train*. 2011;46(4):343–348.
8. Edwards SL, Lee JA, Bell JE, et al. Nonoperative treatment of superior labrum anterior posterior tears: improvements in pain, function, and quality of life. *Am J Sports Med*. 2010;38(7):1456–1461.
9. Fedoriw WW, Ramkumar P, McCulloch PC, Lintner DM. Return to play after treatment of superior labral tears in professional baseball players. *Am J Sports Med*. 2014;42(5):1155–1160.
10. Gorantla K, Gill C, Wright RW. The outcome of type II SLAP repair: a systematic review. *Arthroscopy*. 2010;26(4):537–545.
11. Sayde WM, Cohen SB, Ciccotti MG, Dodson CC. Return to play after Type II superior labral anterior-posterior lesion repairs in athletes: a systematic review. *Clin Orthop Relat Res*. 2012;470(6):1595–1600.
12. Sciascia A, Myers N, Kibler WB, Uhl TL. Return to preinjury levels of participation after superior labral repair in overhead athletes: a systematic review. *J Athl Train*. 2015;50(7):767–777.
13. Ebell MH, Siwek J, Weiss BD, Woolf SH, et al. Strength of recommendation taxonomy (SORT): a patient-centered approach to grading evidence in the medical literature. *J Am Board Fam Pract*. 2004;17(1):59–67.
14. Kuhn JE, Lindholm SR, Huston LJ, Soslowsky LJ, Blasier RB. Failure of the biceps superior labral complex: a cadaveric biomechanical investigation comparing the late cocking and early deceleration positions of throwing. *Arthroscopy*. 2003;19(4):373–379.
15. Pradhan RL, Itoi E, Hatakeyama Y, Urayama M, Sato K. Superior labral strain during the throwing motion. A cadaveric study. *Am J Sports Med*. 2001;29(4):488–492.
16. Walsworth MK, Doukas WC, Murphy KP, Mielcarek BJ, Michener LA. Reliability and diagnostic accuracy of history and physical examination for diagnosing glenoid labral tears. *Am J Sports Med*. 2008;36(1):162–168.
17. Snyder SJ, Banas MP, Karzel RP. An analysis of 140 injuries to the superior glenoid labrum. *J Shoulder Elbow Surg*. 1995;4(4):243–248.
18. McFarland EG, Tanaka MJ, Garzon-Muvdi J, Jia X, Petersen SA. Clinical and imaging assessment for superior labrum anterior and posterior lesions. *Curr Sports Med Rep*. 2009;8(5):234–239.
19. D'Alessandro DF, Fleischli JE, Connor PM. Superior labral lesions: diagnosis and management. *J Athl Train*. 2000;35(3):286–292.
20. Burkhart SS, Morgan CD, Kibler WB. The disabled throwing shoulder: spectrum of pathology Part I: pathoanatomy and biomechanics. *Arthroscopy*. 2003;19(4):404–420.
21. Shanley E, Rauh MJ, Michener LA, Ellenbecker TS, Garrison JC, Thigpen CA. Shoulder range of motion measures as risk factors for shoulder and elbow injuries in high school softball and baseball players. *Am J Sports Med*. 2011;39(9):1997–2006.
22. Wilk KE, Macrina LC, Fleisig GS, et al. Correlation of glenohumeral internal rotation deficit and total rotational motion to shoulder injuries in professional baseball pitchers. *Am J Sports Med*. 2011;39(2):329–335.
23. Shanley E, Kissenberth MJ, Thigpen CA, et al. Preseason shoulder range of motion screening as a predictor of injury among youth and adolescent baseball pitchers. *J Shoulder Elbow Surg*. 2015;24(7):1005–1013.
24. Parentis MA, Glousman RE, Mohr KS, Yocum LA. An evaluation of the provocative tests for superior labral anterior posterior lesions. *Am J Sports Med*. 2006;34(2):265–268.
25. Kim TK, Queale WS, Cosgarea AJ, McFarland EG. Clinical features of the different types of SLAP lesions: an analysis of one hundred and thirty-nine cases. *J Bone Joint Surg Am*. 2003;85-A(1):66–71.
26. McFarland EG, Kim TK, Savino RM. Clinical assessment of three common tests for superior labral anterior-posterior lesions. *Am J Sports Med*. 2002;30(6):810–815.
27. Oh JH, Kim JY, Kim WS, Gong HS, Lee JH. The evaluation of various physical examinations for the diagnosis of type II superior labrum anterior and posterior lesion. *Am J Sports Med*. 2008;36(2):353–359.
28. Guanche CA, Jones DC. Clinical testing for tears of the glenoid labrum. *Arthroscopy*. 2003;19(5):517–523.
29. Nakagawa S, Yoneda M, Hayashida K, Obata M, Fukushima S, Miyazaki Y. Forced shoulder abduction and elbow flexion test: a new simple clinical test to detect superior labral injury in the throwing shoulder. *Arthroscopy*. 2005;21(11):1290–1295.
30. Cook C, Beaty S, Kissenberth MJ, Siffri P, Pill SG, Hawkins RJ. Diagnostic accuracy of five orthopedic clinical tests for diagnosis of superior labrum anterior posterior (SLAP) lesions. *J Shoulder Elbow Surg*. 2012;21(1):13–22.
31. Kim SH, Ha KI, Ahn JH, Kim SH, Choi HJ. Biceps load test II: a clinical test for SLAP lesions of the shoulder. *Arthroscopy*. 2001;17(2):160–164.
32. Mimori K, Muneta T, Nakagawa T, Shinomiya K. A new pain provocation test for superior labral tears of the shoulder. *Am J Sports Med*. 1999;27(2):137–142.
33. Fowler EM, Horsley IG, Rolf CG. Clinical and arthroscopic findings in recreationally active patients. *Sports Med Arthrosc Rehabil Ther Technol*. 2010;2:2.
34. Wise JN, Daffner RH, Weissman BN, et al. ACR Appropriateness Criteria on acute shoulder pain. *J Am Coll Radiol*. 2011;8(9):602–609.
35. Handelberg F, Willems S, Shahabpour M, Huskin JP, Kuta J. SLAP lesions: a retrospective multicenter study. *Arthroscopy*. 1998;14(8):856–862.
36. Neri BR, Elattrache NS, Owsley KC, Mohr K, Yocum LA. Outcome of type II superior labral anterior posterior repairs in elite overhead athletes: effect of concomitant partial-thickness rotator cuff tears. *Am J Sports Med*. 2011;39(1):114–120.
37. Tobola A, Cook C, Cassas KJ, et al. Accuracy of glenohumeral joint injections: comparing approach and experience of provider. *J Shoulder Elbow Surg*. 2011;20(7):1147–1154.
38. Contreras F, Brown HC, Marx RG. Predictors of success of corticosteroid injection for the management of rotator cuff disease. *HSS J*. 2013;9(1):2–5.
39. Min KS, St. Pierre P, Ryan PM, Marchant BG, Wilson CJ, Arrington ED. A double-blind randomized controlled trial comparing the effects of subacromial injection with corticosteroid versus NSAID in patients with shoulder impingement syndrome. *J Shoulder Elbow Surg*. 2013;22(5):595–601.
40. Bateman M, McClymont S, Hinchliffe SR. The effectiveness and cost of corticosteroid injection and physiotherapy in the treatment of frozen shoulder–a single-centre service evaluation. *Clin Rheumatol*. 2014;33(7):1005–1008.
41. Abbot AE, Li X, Busconi BD. Arthroscopic treatment of concomitant superior labral anterior posterior (SLAP) lesions and rotator cuff tears in patients over the age of 45 years. *Am J Sports Med*. 2009;37(7):1358–1362.
42. Burns JP, Bahk M, Snyder SJ. Superior labral tears: repair versus biceps tenodesis. *J Shoulder Elbow Surg*. 2011;20(suppl 2):S2–S8.
43. Boileau P, Parratte S, Chuinard C, Roussanne Y, Shia D, Bicknell R. Arthroscopic treatment of isolated type II SLAP lesions: biceps tenodesis as an alternative to reinsertion. *Am J Sports Med*. 2009;37(5):929–936.
44. Gupta AK, Bruce B, Klosterman EL, McCormick F, Harris J, Romeo AA. Subpectoral biceps tenodesis for failed type II SLAP repair. *Orthopedics*. 2013;36(6):E723–E728.

45. Van Kleunen JP, Tucker SA, Field LD, Savoie FH. Return to high-level throwing after combination infraspinatus repair, SLAP repair, and release of glenohumeral internal rotation deficit. *Am J Sports Med*. 2012;40(11):2536–2541.
46. Chen AL, Ong BC, Rose DJ. Arthroscopic management of spinoglenoid cysts associated with SLAP lesions and suprascapular neuropathy. *Arthroscopy*. 2003;19(6):E15–E21.
47. McCulloch PC, Andrews WJ, Alexander J, Brekke A, Duwani S, Noble P. The effect on external rotation of an anchor placed anterior to the biceps in type 2 SLAP repairs in a cadaveric throwing model. *Arthroscopy*. 2013;29(1):18–24.
48. Samani JE, Marston SB, Buss DD. Arthroscopic stabilization of type II SLAP lesions using an absorbable tack. *Arthroscopy*. 2001;17(1):19–24.
49. Kim SH, Ha KI, Kim SH, Choi HJ. Results of arthroscopic treatment of superior labral lesions. *J Bone Joint Surg Am*. 2002;84-A(6):981–985.
50. O'Brien SJ, Allen AA, Coleman SH, Drakos MC. The trans-rotator cuff approach to SLAP lesions: technical aspects for repair and a clinical follow-up of 31 patients at a minimum of 2 years. *Arthroscopy*. 2002;18(4):372–377.
51. Ide J, Maeda S, Takagi K. Sports activity after arthroscopic superior labral repair using suture anchors in overhead-throwing athletes. *Am J Sports Med*. 2005;33(4):507–514.
52. Rhee YG, Lee DH, Lim CT. Unstable isolated SLAP lesion: clinical presentation and outcome of arthroscopic fixation. *Arthroscopy*. 2005;21(9):1099.
53. Cohen DB, Coleman S, Drakos MC, et al. Outcomes of isolated type II SLAP lesions treated with arthroscopic fixation using a bioabsorbable tack. *Arthroscopy*. 2006;22(2):136–142.
54. Coleman SH, Cohen DB, Drakos MC, et al. Arthroscopic repair of type II superior labral anterior posterior lesions with and without acromioplasty: a clinical analysis of 50 patients. *Am J Sports Med*. 2007;35(5):749–753.
55. Enad JG, Kurtz CA. Isolated and combined Type II SLAP repairs in a military population. *Knee Surg Sports Traumatol Arthrosc*. 2007;15(11):1382–1389.
56. Yung PS, Fong DT, Kong MF, et al. Arthroscopic repair of isolated type II superior labrum anterior-posterior lesion. *Knee Surg Sports Traumatol Arthrosc*. 2008;16(12):1151–1157.
57. Brockmeier SF, Voos JE, Williams RJ, et al. Outcomes after arthroscopic repair of type-II SLAP lesions. *J Bone Joint Surg Am*. 2009;91(7):1595–1603.
58. Friel NA, Karas V, Slabaugh MA, Cole BJ. Outcomes of type II superior labrum, anterior to posterior (SLAP) repair: prospective evaluation at a minimum two-year follow-up. *J Shoulder Elbow Surg*. 2010;19(6):859–867.
59. Neuman BJ, Boisvert CB, Reiter B, Lawson K, Ciccotti MG, Cohen SB. Results of arthroscopic repair of type II superior labral anterior posterior lesions in overhead athletes: assessment of return to preinjury playing level and satisfaction. *Am J Sports Med*. 2011;39(9):1883–1888.
60. Provencher MT, McCormick F, Dewing C, McIntire S, Solomon D. A prospective analysis of 179 type 2 superior labrum anterior and posterior repairs: outcomes and factors associated with success and failure. *Am J Sports Med*. 2013;41(4):880–886.
61. Enad JG, Gaines RJ, White SM, Kurtz CA. Arthroscopic superior labrum anterior-posterior repair in military patients. *J Shoulder Elbow Surg*. 2007;16(3):300–305.
62. Yoneda M, Hirooka A, Saito S, Yamamoto T, Ochi T, Shino K. Arthroscopic stapling for detached superior glenoid labrum. *J Bone Joint Surg Br*. 1991;73(5):746–750.
63. Anderson K, Warren RF, Altchek DW, Craig EV, O'Brien SJ. Risk factors for early failure after thermal capsulorrhaphy. *Am J Sports Med*. 2002;30(1):103–107.
64. Wilk KE, Macrina LC, Cain EL, Dugas JR, Andrews JR. The recognition and treatment of superior labral (slap) lesions in the overhead athlete. *Int J Sports Phys Ther*. 2013;8(5):579–600.
65. Cohen SB, Sheridan S, Ciccotti MG. Return to sports for professional baseball players after surgery of the shoulder or elbow. *Sports Health*. 2011;3(1):105–111.
66. Ricchetti ET, Weidner Z, Lawrence JT, Sennett BJ, Huffman GR. Glenoid labral repair in Major League Baseball pitchers. *Int J Sports Med*. 2010;31(4):265–270.
67. Makhni EC, Saltzman BM, Meyer MA, et al. Outcomes after shoulder and elbow injury in baseball players: are we reporting what matters? *Am J Sports Med*. 2017;45(2):495–500.
68. Rowe CR, Zarins B. Recurrent transient subluxation of the shoulder. *J Bone Joint Surg Am*. 1981;63(6):863–872.
69. Burkhart SS, Morgan CD, Kibler WB. The disabled throwing shoulder: spectrum of pathology Part III: the SICK scapula, scapular dyskinesis, the kinetic chain, and rehabilitation. *Arthroscopy*. 2003;19(6):641–661.
70. Abrams GD, Safran MR. Diagnosis and management of superior labrum anterior posterior lesions in overhead athletes. *Br J Sports Med*. 2010;44(5):311–318.
71. Dodson CC, Altchek DW. SLAP lesions: an update on recognition and treatment. *J Orthop Sports Phys Ther*. 2009;39(2):71–80.
72. Reagan KM, Meister K, Horodyski MB, Werner DW, Carruthers C, Wilk K. Humeral retroversion and its relationship to glenohumeral rotation in the shoulder of college baseball players. *Am J Sports Med*. 2002;30(3):354–360.
73. Wright AA, Wassinger CA, Frank M, Michener LA, Hegedus EJ. Diagnostic accuracy of scapular physical examination tests for shoulder disorders: a systematic review. *Br J Sports Med*. 2013;47(14):886–892.
74. Clarsen B, Bahr R, Andersson SH, Munk R, Myklebust G. Reduced glenohumeral rotation, external rotation weakness and scapular dyskinesis are risk factors for shoulder injuries among elite male handball players: a prospective cohort study. *Br J Sports Med*. 2014;48(1):1327–1333.
75. Myers JB, Oyama S, Hibberd EE. Scapular dysfunction in high school baseball players sustaining throwing-related upper extremity injury: a prospective study. *J Shoulder Elbow Surg*. 2013;22(9):1154–1159.
76. Shitara H, Kobayashi T, Yamamoto A, et al. Prospective multifactorial analysis of preseason risk factors for shoulder and elbow injuries in high school baseball pitchers. *Knee Surg Sports Traumatol Arthrosc*. 2017;25(10):3303–3310.
77. McClure PW, Michener LA. Staged approach for rehabilitation classification: shoulder disorders (STAR-shoulder). *Phys Ther*. 2015;95(5):791–800.
78. Jaeschke R, Guyatt G, Sackett DL. Users' guides to the medical literature. III. How to use an article about a diagnostic test. A. Are the results of the study valid? Evidence-Based Medicine Working Group. *JAMA*. 1994;271(5):389–391.
79. Schlechter JA, Summa S, Rubin BD. The passive distraction test: a new diagnostic aid for clinically significant superior labral pathology. *Arthroscopy*. 2009;25(12):1374–1379.
80. Ebinger N, Magosch P, Lichtenberg S, Habermeyer P. A new SLAP test: the supine flexion resistance test. *Arthroscopy*. 2008;24(5):500–505.
81. O'Brien SJ, Pagnani MJ, Fealy S, McGlynn SR, Wilson JB. The active compression test: a new and effective test for diagnosing labral tears and acromioclavicular joint abnormality. *Am J Sports Med*. 1998;26(5):610–613.
82. Stetson WB, Templin K. The crank test, the O'Brien test, and routine magnetic resonance imaging scans in the diagnosis of labral tears. *Am J Sports Med*. 2002;30(6):806–809.
83. Levels of evidence. Oxford Centre for Evidence-based Medicine Web site. http://www.cebm.net/oxford-centre-evidence-based-

medicine-levels-evidence-march-2009. Accessed September 29, 2017.
84. Braun S, Kokmeyer D, Millett PJ. Shoulder injuries in the throwing athlete. *J Bone Joint Surg Am*. 2009;91(4):966–978.
85. Sciascia A, Thigpen C, Namdari S, Baldwin K. Kinetic chain abnormalities in the athletic shoulder. *Sports Med Arthrosc*. 2012;20(1):16–21.
86. Frank RM, Nho SJ, McGill KC, et al. Retrospective analysis of arthroscopic superior labrum anterior to posterior repair: prognostic factors associated with failure. *Adv Orthop*. 2013;2013:125960.
87. Kibler WB, Kuhn JE, Wilk K, et al. The disabled throwing shoulder: spectrum of pathology–10-year update. *Arthroscopy*. 2013;29(1):141–161.
88. Myers JB, Laudner KG, Pasquale MR, Bradley JP, Lephart SM. Glenohumeral range of motion deficits and posterior shoulder tightness in throwers with pathologic internal impingement. *Am J Sports Med*. 2006;34(3):385–391.
89. Lintner DM. Superior labrum anterior to posterior tears in throwing athletes. *Instr Course Lect*. 2013;62:491–500.
90. Burkhart SS, Morgan C. SLAP lesions in the overhead athlete. *Orthop Clin North Am*. 2001;32(3):431–441, viii.
91. Sweitzer BA, Thigpen CA, Shanley E, et al. A comparison of glenoid morphology and glenohumeral range of motion between professional baseball pitchers with and without a history of SLAP repair. *Arthroscopy*. 2012;28(9):1206–1213.
92. Tyler TF, Nicholas SJ, Lee SJ, Mullaney M, McHugh MP. Correction of posterior shoulder tightness is associated with symptom resolution in patients with internal impingement. *Am J Sports Med*. 2010;38(1):114–119.
93. Laudner KG, Sipes RC, Wilson JT. The acute effects of sleeper stretches on shoulder range of motion. *J Athl Train*. 2008;43(4):359–363.
94. Lintner D, Mayol M, Uzodinma O, Jones R, Labossiere D. Glenohumeral internal rotation deficits in professional pitchers enrolled in an internal rotation stretching program. *Am J Sports Med*. 2007;35(4):617–621.
95. Byram IR, Bushnell BD, Dugger K, Charron K, Harrell FE Jr, Noonan TJ. Preseason shoulder strength measurements in professional baseball pitchers: identifying players at risk for injury. *Am J Sports Med*. 2010;38(7):1375–1382.
96. Ellenbecker TS, Davies GJ, Rowinski MJ. Concentric versus eccentric isokinetic strengthening of the rotator cuff. Objective data versus functional test. *Am J Sports Med*. 1988;16(1):64–69.
97. Mullaney MJ, McHugh MP. Concentric and eccentric muscle fatigue of the shoulder rotators. *Int J Sports Med*. 2006;27(9):725–729.
98. Tyler TF, Mullaney MJ, Mirabella MR, Nicholas SJ, McHugh MP. Risk factors for shoulder and elbow injuries in high school baseball pitchers: the role of preseason strength and range of motion. *Am J Sports Med*. 2014;42(8):1993–1999.
99. Borsa PA, Laudner KG, Sauers EL. Mobility and stability adaptations in the shoulder of the overhead athlete: a theoretical and evidence-based perspective. *Sports Med*. 2008;38(1):17–36.
100. Wilk KE, Obma P, Simpson CD, Cain EL, Dugas JR, Andrews JR. Shoulder injuries in the overhead athlete. *J Orthop Sports Phys Ther*. 2009;39(2):38–54.
101. Hurd WJ, Kaplan KM, Elattrache NS, Jobe FW, Morrey BF, Kaufman KR. A profile of glenohumeral internal and external rotation motion in the uninjured high school baseball pitcher, part II: strength. *J Athl Train*. 2011;46(3):289–295.
102. Wooden MJ, Greenfield B, Johanson M, Litzelman L, Mundrane M, Donatelli RA. Effects of strength training on throwing velocity and shoulder muscle performance in teenage baseball players. *J Orthop Sports Phys Ther*. 1992;15(5):223–228.
103. Szymanski DJ, Szymanski JM, Molloy JM, Pascoe DD. Effect of 12 weeks of wrist and forearm training on high school baseball players. *J Strength Cond Res*. 2004;18(3):432–440.
104. Szymanski DJ, Szymanski JM, Bradford TJ, Schade RL, Pascoe DD. Effect of twelve weeks of medicine ball training on high school baseball players. *J Strength Cond Res*. 2007;21(3):894–901.
105. Niederbracht Y, Shim AL, Sloniger MA, Paternostro-Bayles M, Short TH. Effects of a shoulder injury prevention strength training program on eccentric external rotator muscle strength and glenohumeral joint imbalance in female overhead activity athletes. *J Strength Cond Res*. 2008;22(1):140–145.
106. Moore SD, Uhl TL, Kibler WB. Improvements in shoulder endurance following a baseball-specific strengthening program in high school baseball players. *Sports Health*. 2013;5(3):233–238.
107. Musgrave DS, Rodosky MW. SLAP lesions: current concepts. *Am J Orthop (Belle Mead NJ)*. 2001;30(1):29–38.
108. Laudner KG, Myers JB, Pasquale MR, Bradley JP, Lephart SM. Scapular dysfunction in throwers with pathologic internal impingement. *J Orthop Sports Phys Ther*. 2006;36(7):485–494.
109. McClure P, Tate AR, Kareha S, Irwin D, Zlupko E. A clinical method for identifying scapular dyskinesis, part 1: reliability. *J Athl Train*. 2009;44(2):160–164.
110. Uhl TL, Kibler WB, Gecewich B, Tripp BL. Evaluation of clinical assessment methods for scapular dyskinesis. *Arthroscopy*. 2009;25(11):1240–1248.
111. Kibler WB, Sciascia A, Dome D. Evaluation of apparent and absolute supraspinatus strength in patients with shoulder injury using the scapular retraction test. *Am J Sports Med*. 2006;34(10):1643–1647.
112. Tate AR, McClure PW, Kareha S, Irwin D. Effect of the Scapula Reposition Test on shoulder impingement symptoms and elevation strength in overhead athletes. *J Orthop Sports Phys Ther*. 2008;38(1):4–11.
113. Seitz AL, McClure PW, Finucane S, et al. The scapular assistance test results in changes in scapular position and subacromial space but not rotator cuff strength in subacromial impingement. *J Orthop Sports Phys Ther*. 2012;42(5):400–412.
114. Laudner KG, Moore SD, Sipes RC, Meister K. Functional hip characteristics of baseball pitchers and position players. *Am J Sports Med*. 2010;38(2):383–387.
115. Scher S, Anderson K, Weber N, Bajorek J, Rand K, Bey MJ. Associations among hip and shoulder range of motion and shoulder injury in professional baseball players. *J Athl Train*. 2010;45(2):191–197.
116. Garrison JC, Arnold A, Macko MJ, Conway JE. Baseball players diagnosed with ulnar collateral ligament tears demonstrate decreased balance compared to healthy controls. *J Orthop Sports Phys Ther*. 2013;43(10):752–758.
117. Radwan A, Francis J, Green A, et al. Is there a relation between shoulder dysfunction and core instability? *Int J Sports Phys Ther*. 2014;9(1):8–13.
118. Snyder SJ, Karzel RP, Del Pizzo W, Ferkel RD, Friedman MJ. Arthroscopy classics. SLAP lesions of the shoulder. *Arthroscopy*. 2010;26(8):1117.
119. Jobe FW, Giangarra CE, Kvitne RS, Glousman RE. Anterior capsulolabral reconstruction of the shoulder in athletes in overhand sports. *Am J Sports Med*. 1991;19(5):428–434.
120. Paley KJ, Jobe FW, Pink MM, Kvitne RS, Elattrache NS. Arthroscopic findings in the overhand throwing athlete: evidence for posterior internal impingement of the rotator cuff. *Arthroscopy*. 2000;16(1):35–40.
121. Reynolds SB, Dugas JR, Cain EL, McMichael CS, Andrews JR. Debridement of small partial-thickness rotator cuff tears in elite overhead throwers. *Clin Orthop Relat Res*. 2008;466(3):614–621.
122. Paxinos A, Walton J, Rutten S, Muller M, Murrell GA. Arthroscopic stabilization of superior labral (SLAP) tears with biodegradable tack: outcomes to 2 years. *Arthroscopy*. 2006;22(6):627–634.

123. Knesek M, Skendzel JG, Dines JS, Altchek DW, Allen AA, Bedi A. Diagnosis and management of superior labral anterior posterior tears in throwing athletes. *Am J Sports Med*. 2013;41(2):444–460.
124. Funk L, Snow M. SLAP tears of the glenoid labrum in contact athletes. *Clin J Sport Med*. 2007;17(1):1–4.
125. Rubenstein DL, Jobe FW, Glousman RE, Kvitne RS, Pink M, Giangarra CE. Anterior capsulolabral reconstruction of the shoulder in athletes. *J Shoulder Elbow Surg*. 1992;1(5):229–237.
126. Katz LM, Hsu S, Miller SL, et al. Poor outcomes after SLAP repair: descriptive analysis and prognosis. *Arthroscopy*. 2009;25(8):849–855.
127. McCormick F, Bhatia S, Chalmers P, Gupta A, Verma N, Romeo AA. The management of type II superior labral anterior to posterior injuries. *Orthop Clin North Am*. 2014;45(1):121–128.
128. Michener LA, McClure PW, Sennett BJ. American Shoulder and Elbow Surgeons Standardized Shoulder Assessment Form, patient self-report section: reliability, validity, and responsiveness. *J Shoulder Elbow Surg*. 2002;11(6):587–594.
129. Kirkley A, Griffin S, Dainty K. Scoring systems for the functional assessment of the shoulder. *Arthroscopy*. 2003;19(10):1109–1120.
130. L'Insalata JC, Warren RF, Cohen SB, Altchek DW, Peterson MG. A self-administered questionnaire for assessment of symptoms and function of the shoulder. *J Bone Joint Surg Am*. 1997;79(5):738–748.
131. Kirkley A, Griffin S, McLintock H, Ng L. The development and evaluation of a disease-specific quality of life measurement tool for shoulder instability. The Western Ontario Shoulder Instability Index (WOSI). *Am J Sports Med*. 1998;26(6):764–772.
132. Alberta FG, Elattrache NS, Bissell S, et al. The development and validation of a functional assessment tool for the upper extremity in the overhead athlete. *Am J Sports Med*. 2010;38(5):903–911.
133. Roy JS, Macdermid JC, Woodhouse LJ. A systematic review of the psychometric properties of the Constant-Murley score. *J Shoulder Elbow Surg*. 2010;19(1):157–164.
134. Williams GN, Gangel TJ, Arciero RA, Uhorchak JM, Taylor DC. Comparison of the Single Assessment Numeric Evaluation method and two shoulder rating scales. Outcomes measures after shoulder surgery. *Am J Sports Med*. 1999;27(2):214–221.
135. Franz JO, McCulloch PC, Kneip CJ, Noble PC, Lintner DM. The utility of the KJOC score in professional baseball in the United States. *Am J Sports Med*. 2013;41(9):2167–2173.
136. Axe MJ, Windley TC, Snyder-Mackler L. Data-based interval throwing programs for collegiate softball players. *J Athl Train*. 2002;37(2):194–203.
137. Axe MJ, Snyder-Mackler L, Konin JG, Strube MJ. Development of a distance-based interval throwing program for Little League-aged athletes. *Am J Sports Med*. 1996;24(5):594–602.
138. Axe M, Wickham R, Snyder-Mackler L. Data-based interval throwing programs for little league, high school, college, and professional baseball pitchers. *Sports Med Arthrosc Rev*. 2001;9(1):24–34.

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