Clinical and Imaging Assessment for Superior Labrum Anterior and Posterior Lesions

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MCFARLAND, E.G., M.J. TANAKA, J. GARZON-MUVDI, X. JIA, and S.A. PETERSEN. Clinical and imaging assessment for superior labrum anterior and posterior lesions. *Curr. Sports Med. Rep.*, Vol. 8, No. 5, pp. 234–239, 2009. *In the evaluation of the painful shoulder, especially in the overhead athlete, diagnosing superior labrum anterior and posterior (SLAP) lesions continues to challenge the clinician because of 1) the lack of specificity of examination tests for SLAP; 2) a paucity of well-controlled studies of those tests; and 3) the presence of coexisting confounding abnormalities. Some evidence indicates that multiple positive tests increase the likelihood that a SLAP lesion is present, but no one physical examination finding conclusively makes that diagnosis. The goals of this article were to review the physical examination techniques for making the diagnosis of SLAP lesions, to evaluate the clinical usefulness of those examinations, and to review the role of magnetic resonance imaging in making the diagnosis.*

INTRODUCTION

Shoulder pain in the athletically active individual, especially in those involved in overhead sports, continues to be a diagnostic challenge for the clinician because many lesions can cause shoulder pain (1,5,16,17,26,41,47), no lesion has one specific pain pattern (27), and multiple abnormalities can coexist (27). In the overhead athlete, one of the common causes of shoulder pain is a superior labrum anterior and posterior (SLAP) lesion, but reviewing the literature on this lesion is problematic for several reasons, all of which have been shown to substantially influence the results reported in each particular study.

First, there is no consensus as to the specific types of SLAP lesions. In 1985, Andrews *et al.* (1) were the first to describe superior labrum abnormalities as a possible cause of shoulder pain, and in 1990, Snyder *et al.* (44) were the first to propose a four-type classification system, but the clinical significance of each variety never has been determined. Since that time, several investigators have contributed additional variants and subtypes (25,31,34).

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Second, the exact pathophysiology of these lesions has not been determined. In the overhead athlete, it has been speculated that possible causes of the tearing of the labrum are anterior instability resulting from stretching of the anterior band of the inferior glenohumeral ligament (18), a form of occult superior instability (5), tension on the biceps with inferior laxity (4), internal impingement of the greater tuberosity on the posterior and superior labrum (47), and repetitive stress on the biceps anchor, similar to a "pulling weeds" motion (1).

Third, there are no definitive maneuvers for diagnosing a SLAP lesion. Reports in the literature describe at least 26 maneuvers as useful in helping to make the diagnosis of a SLAP lesion (1,3,6,10,20–22,24,27,30,32,33,35,44). However, many current studies on SLAP lesions report coexisting abnormalities (10,23,28,31,39,43), and few studies evaluate isolated SLAP lesions (20,36). Therefore, it is not possible to ascribe all of the patient findings reported in the literature to the SLAP lesion alone.

Fourth, there is no gold standard for determining the accuracy of the examination: some investigators advocate magnetic resonance imaging (MRI) (2,11,37), and others are proponents of diagnostic arthroscopy (12,45). However, because the MRI settings and imaging techniques are highly variable, the results of such studies also differ, making comparative metaanalysis difficult (50). In addition, some results indicate a wide variability among surgeons in terms of the grade of labrum lesions seen at the time of arthroscopy (12,42).

Fifth, reported studies are not necessarily free of bias. For example, examiners often are not blinded to the diagnosis of

the patient, and some studies include only patients with the target lesion rather than patients who might have other diagnoses. In addition, interobserver and intraobserver reliability is not reported commonly for the diagnostic tests, and a recent metaanalysis of the literature has indicated that studies reported by the individual who created the test in question tend to have better results than studies of that test performed by other investigators (9,19). It may be that the individual who described the test had a better "feel" for the subtleties of the examination, but unless the test has been performed by independent examiners, the initial reported results always should be interpreted with caution.

The goals of this article were to review the physical examination techniques for making the diagnosis of SLAP lesions, to evaluate the clinical usefulness of those examinations, and to review the role of MRI in making the diagnosis.

CLINICAL FACTORS

History

No one event in a patient's history conclusively will make the diagnosis of a SLAP lesion, but clinicians always should obtain a thorough history. Although overhead athletes typically experience an insidious, nontraumatic onset of pain, a SLAP lesion can be associated with a history of a traumatic injury, such as a fall on an outstretched arm, a fall directly on the shoulder, or a sudden distraction force or a dislocation of the shoulder with the arm in abduction and external rotation (25).

The pain associated with SLAP lesions is not distinctive in its duration or character. Overhead athletes may experience pain only during their sport activity (*i.e.*, the pain stops when the activity ends) or soreness that lasts for hours or days afterwards. It is difficult to ascribe such pain to the SLAP lesion alone because of the prevalence of coexisting partial rotator cuff tears (23,28,43). Typically, the overhead athlete will locate the pain to the posterior and superior shoulder joint, but it has been recognized that there can be pain in the deltoid region as well. The relationship to arm position with the sport (*e.g.*, the late cocking or the follow-through portion of the stroke or throw) also is not diagnostic for SLAP lesions (27).

There also are no history factors that can be used to make the diagnosis of SLAP lesions in athletes or nonathletes. In a study of 139 SLAP lesions, Kim *et al.* (23) were unable to find any statistically significant correlation between SLAP lesions and symptoms such as night pain, overhead pain, or instability. There is no one symptom with activities of daily living that are diagnostic of SLAP lesions (23).

Several studies have suggested that the presence of a click by history or physical examination may be supportive of a diagnosis of a SLAP lesion (23,28,36,43,45). Walsworth *et al.* (49) studied labrum lesions of all types and found that with a history of a click, the positive likelihood ratio of a labrum lesion was 2.0. Unfortunately, this study included labrum tears in any quadrant of the glenoid, not only SLAP lesions (49). McFarland *et al.* (28) found that the incidence of a click was 5% in a control population and 0% in patients with a SLAP lesion. Therefore, based on the literature, a click might make the examiner suspect a SLAP lesion, but it is not sufficient for making the diagnosis.

Physical Examination

The physical examination techniques used as tests for SLAP lesions have been described extensively in the literature (7,13,27,46,51). The rationale for most of those tests is to reproduce the symptoms by 1) capturing the labrum and producing a click, catch, or pain, 2) causing pain as the humeral head is translated over the glenoid by creating shear at the labrum-glenoid interface, or 3) increasing tension in the biceps and the superior labrum complex, resulting in pain (Table 1).

These physical examination tests are based on the premise that, in all SLAP tears, a fragment of a labrum tear is caught in the joint, analogous to meniscal tears in the knee.

TABLE 1. The diagnostic values of SLAP tests.

Test	Study	S (%)	Sp (%)	PPV (%)	NPV (%)
Active compression (O'Brien)	(10,13,28,31–33,35,36,38,39,45)	32.0–100.0	11.1–98.5	10.0–100.0	14.3–100.0
Anterior slide (Kibler)	(20,28,33,36,39)	5.0–78.4	70.0–93.0	5.0–38.0	50.0–90.0
Biceps load I	(22)	90.9	96.9	83.0	98.0
Biceps load II	(21,36)	30.0–89.7	78.0–96.9	36.0–92.1	52.0–95.5
Compression rotation	(28,33,36)	24.0–73.0	54.0–100.0	9.0–100.0	58.0–90.0
Crank	(13,24,30,32,33,39,45)	8.7–91.0	56.0–100.0	9.5–94.0	29.2–90.0
Forced abduction and elbow flexion	(33)	67.0	67.0	62.0	71.0
Jobe relocation	(13,31,33,36,38,39)	4.0–85.0	27.0–68.0	15.9–55.0	45.0–81.2
Mayo shear	(38)	80.0	NA	NA	NA
Pain provocation	(30,39)	15.0–100.0	89.9–90.2	26.7–40.0	70.9–83.8
SLAPrehension	(3)	87.5	NA	NA	NA

NA = not available; NPV = negative predictive value; PPV = positive predictive value; S = sensitivity; SLAP = superior labrum anterior and posterior; Sp = specificity.

However, this theory is not supported by morphologic studies, which indicate that bucket handle tears of the labrum or labrum tears with flaps are rare and constitute a minority of all SLAP tears (14,25,43,44). Therefore, the idea that the clicking and catching similar to that reproduced by a McMurray test (29) indicates a SLAP lesion has not proved valid in most cases (23,28). For example, in the compression-rotation test, performed with the patient supine, the clinician applies an axial load to the shoulder while rotating the shoulder to catch a labrum fragment (44); however, this test has been reported to have a sensitivity of 24% and a specificity of 76% (28). Therefore, a catch or click during physical examination for SLAP lesions is not a proven criterion for making the diagnosis of superior labrum abnormalities.

Other tests, such as the anterior slide test (20), the Mayo shear test (O'Driscoll, S., personal communication, 2000), and the relocation test (6), are designed to create shear (movement) of the labrum across the superior glenoid to produce pain. Studies of these tests (Table 1) have shown that their usefulness is limited in the diagnosis of SLAP tears. The specificity of the anterior slide test is high, but its sensitivity is low (28,36,39). The Mayo shear test has been the subject of only one study, to our knowledge, with a reported sensitivity of 80% (38).

Examination tests that create tension in the biceps tendon or superior labrum complex include the active compression test (35), the Kim-I (22) and Kim-II (21) tests, the forced shoulder abduction and elbow flexion test (33), and several others (Table 1). The most commonly reported test is the active compression test, which has been used for making the diagnosis of SLAP lesions or acromioclavicular disorders (35). This test depends on a patient reporting that the pain is deep in the shoulder for a SLAP lesion or that the pain is in the acromioclavicular area for symptoms at that joint. This reliance on the patient to localize the pain is one of the limitations of this test. This test is a popular one, but although Myers *et al.* (32) found that this test had a sensitivity of 78% and specificity of 11%, and Morgan *et al.* (31) found it to have a sensitivity of 85% and specificity of 41%, multiple other studies have shown that its sensitivity and specificity are less than 65% (28,33,39). Other tests that place tensile stresses on the biceps anchor do not perform much better when studied by independent observers (Table 1). Unfortunately, most of these tests have not been studied by independent observers.

Finally, some shoulder examination tests have been studied for their possible use as physical examination tests for SLAP lesions (Table 2). These tests indirectly may result in symptoms consistent with SLAP lesions through some unknown mechanism, but they offer little direct clinical usefulness for making the diagnosis of SLAP lesions.

Three studies have reaffirmed the complexity of the physical examination of the shoulder for SLAP lesions (23,36,39) (Table 3). Tests that are purported to diagnose other shoulder conditions frequently are positive in patients with SLAP lesions. Morgan *et al.* (31) suggested that tests for three different variations of SLAP lesions can vary, depending on a constellation of physical examination findings. For example, they found that the Speed test had 100% sensitivity for anterior type-II SLAP lesions, but only 29% and 78% sensitivity for posterior and combined type-II SLAP lesions, respectively. Although these findings have not been reproduced by independent studies, they do reinforce the concept that a consideration of a constellation of findings may be needed to make the diagnosis of a SLAP lesion.

Two studies have evaluated the clinical value of using multiple tests to assess for the presence of a SLAP lesion

TABLE 2. The diagnostic values of miscellaneous shoulder examinations used as tests for SLAP lesions.

Test	Study	S (%)	Sp (%)	PPV (%)	NPV (%)
Abduction inferior stability (Feagin)	(33)	29.0	90.0	70.0	61.0
Anterior apprehension	(13,36)	30.0–62.0	42.0–63.0	32.0–56.0	43.0–71.0
Bicipital groove pain	(13,31,33,36)	25.0–100.0	13.0–80.0	21.0–55.0	45.0–73.0
Ellman	(33)	42.0	63.0	48.0	58.0
Fulcrum	(33)	83.0	40.0	53.0	75.0
Hawkins impingement	(33,38,39)	31.0–67.5	30.3–67.0	16.5–55.0	63.0–80.5
Neer impingement	(33,38,39)	33.0–50.0	51.4–60.0	17.2–40.0	53.0–82.4
Painful arc sign	(33)	21.0	73.0	39.0	54.0
Posterior jerk	(33)	25.0	80.0	50.0	57.0
Resisted supination external rotation	(32)	82.8	81.8	92.3	64.3
Speed	(10,13,27,31,33,36,39)	4.0–100.0	11.0–100.0	12.0–100.0	40.0–91.0
Sulcus	(33)	17.0	93.0	67.0	58.0
Supine flexion resistance	(10)	80.0–92.0	69.0	36.0–100.0	94.0
Whipple	(36)	65.0–68.0	42.0	28.0–50.0	57.0–79.0
Yergason	(13,33,36,39)	12.0–15.0	87.0–100.0	27.3–100.0	47.0–88.5

NPV = negative predictive value; PPV = positive predictive value; S = sensitivity; SLAP = superior labrum anterior and posterior; Sp = specificity.

TABLE 3. Physical examination of SLAP lesions.

	Kim *et al.* (2003) (23) (Sensitivity of Diagnostic Tests [%])		Parentis *et al.* (2006) (39) (Sensitivity of Diagnostic Tests [%])							Oh *et al.* (2008) (36)							
										SLAP Only (%)				SLAP and Other Shoulder Pathology (%)			
Test	No SLAP (N = 405)	Type I SLAP (N = 103)	Type II SLAP (N = 29)	Type II SLAP	Type I, II SLAP	Complete Rotator Cuff Tear	Partial Rotator Cuff Tear	Impingement	Instability	S	Sp	PPV	NPV	S	Sp	PPV	NPV
Active compression (O'Brien)	47.0	57.0	52.0	65.2	62.5	55.0	48.0	61.0	45.0	65.0	53.0	33.0	81.0	63.0	53.0	55.0	61.0
Anterior slide (Kibler)	17.0	15.0	13.0	13.0	10.0	NA	NA	NA	NA	12.0	70.0	12.0	70.0	21.0	70.0	38.0	50.0
Apprehension	23.0	15.0	27.0	NA	NA	NA	NA	NA	NA	61.0	42.0	32.0	71.0	62.0	42.0	56.0	49.0
Biceps load II	NA	NA	NA	NA	NA	NA	NA	NA	NA	32.0	78.0	36.0	75.0	30.0	78.0	59.0	52.0
Compression rotation	23.0	23.0	25.0	NA	NA	NA	NA	NA	NA	73.0	54.0	35.0	85.0	61.0	54.0	55.0	61.0
Crank	NA	NA	NA	8.7	12.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Hawkins impingement	62.0	72.0	69.0	65.2	67.5	75.0	76.0	83.0	48.0	NA	NA	NA	NA	NA	NA	NA	NA
Neer impingement	60.0	63.0	59.0	47.8	50.0	50.0	52.0	57.0	19.0	NA	NA	NA	NA	NA	NA	NA	NA
Painful arc	47.0	57.0	58.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Pain provocation	NA	NA	NA	17.4	15.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Relocation (Jobe)	22.0	20.0	40.0	43.5	50.0	50.0	38.0	26.0	86.0	35.0	54.0	24.0	67.0	44.0	54.0	52.0	47.0
Speed	28.0	43.0	31.0	47.8	47.8	50.0	19.0	39.0	42.0	27.0	66.0	21.0	73.0	32.0	66.0	46.0	53.0
Tenderness on biceps groove	NA	NA	NA	NA	NA	NA	NA	NA	NA	27.0	66.0	21.0	73.0	27.0	66.0	41.0	51.0
Whipple	NA	NA	NA	NA	NA	NA	NA	NA	NA	68.0	42.0	28.0	79.0	65.0	42.0	50.0	57.0
Yergason	NA	NA	NA	13.0	12.5	NA	NA	NA	NA	15.0	87.0	29.0	75.0	12.0	87.0	44.0	53.0

NA = not available; NPV = negative predictive value; PPV = positive predictive value; S = sensitivity; SLAP = superior labrum anterior and posterior; Sp = specificity.

(28,36). McFarland *et al.* (28) found that a combination of three tests did not increase the ability to diagnose a SLAP lesion successfully. However, Oh *et al.* (36) found that combining three tests increased the chance of making the diagnosis of a SLAP lesion. When they divided the examination tests into "major" tests (active compression, compression rotation, and anterior apprehension) and "minor" tests (Speed, Yergason, and biceps load-II), they found that if there were two positive major tests and one positive minor test, the sensitivity and specificity went up to 75% and 90%, respectively (36).

Making the diagnosis of a SLAP lesion based on history and examination continues to be a challenge. The only patient population in whom one might think that there is superior labral pathology based on history alone would be an overhead-throwing athlete who reports posterior superior shoulder pain with throwing. Unfortunately, in this group, it is not safe to assume that the pain is coming from a SLAP lesion because many of these patients have coexisting partial rotator cuff tears. Similarly, no one physical examination test for SLAP lesions is accurate enough to make the diagnosis reliably (9,50). Although combinations of tests may be of some benefit in terms of sensitivity and specificity, the odds ratio does not seem to increase enough to help the clinician. In the senior author's experience, the decision for surgery in a patient with a possible SLAP lesion depends on the failure of nonoperative treatment, and the examination supplements the subjective findings of the patient and the degree of patient disability. Unfortunately, MRI also does not provide a concrete and reliable conclusion about SLAP lesions in most cases.

Magnetic Resonance Imaging

There is a consensus that magnetic resonance arthrography is better for evaluating labrum abnormalities than magnetic resonance imaging (MRI) without arthrography (11,37,38,40). However, it should be noted that the reported values for sensitivity and specificity range from 50%–92% and 69%–98%, respectively, for MRI with arthrography (2,15,38,48), and 27%–98% and 92%–99%, respectively, for MRI without arthrography (8,38,40,45). One study has shown that the experience of the radiologist is a critical factor in the interpretation of the MRI scans (40). Reuss *et al.* (40) found that the interpretations of MRI scans by two musculoskeletal-fellowship-trained radiologists were 67.5% and 60.2% sensitive and 76.5% and 70.6% specific for making the diagnosis of SLAP lesions and that those by 28 community radiologists without this training were 50.6% sensitive. That study suggests that clinicians should not rely entirely on radiographic evaluation for the decision for surgery because of the variability in interpretation and the low sensitivity and specificity.

It has been the authors' experience that labrum pathology is overdiagnosed by radiologists, particularly labrum abnormalities in the superior half of the glenoid, where it essentially is normal for the labrum to have a more "meniscoid" appearance. Another area in which the anatomy is confusing is the anterior and superior glenoid, where a labrum totally detached or absent from the glenoid rim can be a normal variant. The radiologist is obligated to note this variation and also is obligated to state that it could or could not be a labrum lesion.

As with any diagnostic tool, MRI of the shoulder should be interpreted in light of the clinical presentation and the examination findings. The inability to make the diagnosis of a SLAP lesion reliably with radiologic evaluation alone is one factor contributing to the difficulty of making the diagnosis.

Arthroscopy

Although many studies suggest that arthroscopic evaluation is the only accurate way to evaluate the superior labrum for SLAP lesions (39,44,45), some have suggested that surgeons may not agree on the type of lesion present, even when viewed arthroscopically (12,42). Gobezie *et al.* (12) showed videotapes of shoulder arthroscopic procedures to 73 surgeons with experience in shoulder arthroscopy and found that there was little unanimity on the diagnosis of SLAP lesions ($\kappa = 0.75$). In another study, six experienced orthopedic surgeons were asked to view videotaped arthroscopic procedures and decide whether there was a SLAP lesion; agreement averaged only 60% (42). This lack of agreement about what constitutes a SLAP lesion may be a contributing factor to reported accuracy rates of the clinical examination in which the diagnosis was based on arthroscopic evaluation. Such studies show that even the arthroscopic criteria for SLAP lesions are highly variable, which may contribute to the results in clinical studies that use arthroscopic findings as the gold standard for evaluating physical examination tests to make the diagnosis.

CONCLUSION

The diagnosis of a SLAP lesion remains difficult because there is no one history factor, one symptom, or one physical examination test that definitively will make the diagnosis. MRI can provide some assistance, but the experience of the radiologist reading the study is a critical factor in its interpretation. When faced with these uncertainties, the risks and benefits of arthroscopic evaluation must be weighed against the need to make the diagnosis and to treat the lesion. Timing of the arthroscopic evaluation is important because recovery time (typically 6–12 months) from surgical repair can affect the ability to participate in sport. When time allows, nonoperative treatment is recommended unless the symptoms and disability are so severe that delay of surgery might postpone athletic participation. The physical examination tests described to date for making the diagnosis of SLAP lesions should not be used as the sole criteria for determining surgical intervention for the treatment of SLAP lesions.

References

1. Andrews JR, Carson WG, Jr, McLeod WD. Glenoid labrum tears related to the long head of the biceps. *Am. J. Sports Med.* 1985; 13:337–41.
2. Bencardino JT, Beltran J, Rosenberg ZS, *et al.* Superior labrum anterior-posterior lesions: diagnosis with MR arthrography of the shoulder. *Radiology.* 2000; 214:267–71.

3. Berg EE, Ciullo JV. A clinical test for superior glenoid labral or 'SLAP' lesions. *Clin. J. Sport Med.* 1998; 8:121–3.
4. Bey MJ, Elders GJ, Huston LJ, *et al.* The mechanism of creation of superior labrum, anterior, and posterior lesions in a dynamic biomechanical model of the shoulder: the role of inferior subluxation. *J. Shoulder Elbow Surg.* 1998; 7:397–401.
5. Burkhart SS, Morgan CD, Kibler WB. The disabled throwing shoulder: spectrum of pathology. Part I: pathoanatomy and biomechanics. *Arthroscopy.* 2003; 19:404–20.
6. Burkhart SS, Morgan CD, Kibler WB. Shoulder injuries in overhead athletes. The "dead arm" revisited. *Clin. Sports Med.* 2000; 19:125–58.
7. Codsi M, McCarron J, Brems JJ. Clinical evaluation of shoulder problems. In: Rockwood CA, Jr, Matsen FA III, Wirth MA, *et al.*, editors. *The Shoulder*, Philadelphia: Saunders; 2009, p. 145–76.
8. Connell DA, Potter HG, Wickiewicz TL, *et al.* Noncontrast magnetic resonance imaging of superior labral lesions. 102 cases confirmed at arthroscopic surgery. *Am. J. Sports Med.* 1999; 27:208–13.
9. Dessaur WA, Magarey ME. Diagnostic accuracy of clinical tests for superior labral anterior posterior lesions: a systematic review. *J. Orthop. Sports Phys. Ther.* 2008; 38:341–52.
10. Ebinger N, Magosch P, Lichtenberg S, *et al.* A new SLAP test: the supine flexion resistance test. *Arthroscopy.* 2008; 24:500–5.
11. Flannigan B, Kursunoglu-Brahme S, Snyder S, *et al.* MR arthrography of the shoulder: comparison with conventional MR imaging. *AJR Am. J. Roentgenol.* 1990; 155:829–32.
12. Gobezie R, Zurakowski D, Lavery K, *et al.* Analysis of interobserver and intraobserver variability in the diagnosis and treatment of SLAP tears using the Snyder classification. *Am. J. Sports Med.* 2008; 36: 1373–9.
13. Guanche CA, Jones DC. Clinical testing for tears of the glenoid labrum. *Arthroscopy.* 2003; 19:517–23.
14. Handelberg F, Willems S, Shahabpour M, *et al.* SLAP lesions: a retrospective multicenter study. *Arthroscopy.* 1998; 14:856–62.
15. Jee WH, McCauley TR, Katz LD, *et al.* Superior labral anterior posterior (SLAP) lesions of the glenoid labrum: reliability and accuracy of MR arthrography for diagnosis. *Radiology.* 2001; 218:127–32.
16. Jobe CM. Posterior superior glenoid impingement: expanded spectrum. *Arthroscopy.* 1995; 11:530–6.
17. Jobe CM, Coen MJ, Screnar P. Evaluation of impingement syndromes in the overhead-throwing athlete. *J. Athl. Train.* 2000; 35:293–9.
18. Jobe CM, Pink MM, Jobe FW, *et al.* Anterior shoulder instability, impingement, and rotator cuff tear. Section A: theories and concepts. In: Jobe FW, editor. *Operative Techniques in Upper Extremity Sports Injuries*, St. Louis: Mosby; 1996, p. 164–76.
19. Jones GL, Galluch DB. Clinical assessment of superior glenoid labral lesions: a systematic review. *Clin. Orthop. Relat. Res.* 2007; 455:45–51.
20. Kibler WB. Specificity and sensitivity of the anterior slide test in throwing athletes with superior glenoid labral tears. *Arthroscopy.* 1995; 11:296–300.
21. Kim SH, Ha KI, Ahn JH, *et al.* Biceps load test II: a clinical test for SLAP lesions of the shoulder. *Arthroscopy.* 2001; 17:160–4.
22. Kim SH, Ha KI, Han KY. Biceps load test: a clinical test for superior labrum anterior and posterior lesions in shoulders with recurrent anterior dislocations. *Am. J. Sports Med.* 1999; 27:300–3.
23. Kim TK, Queale WS, Cosgarea AJ, *et al.* Clinical features of the different types of SLAP lesions. An analysis of one hundred and thirty-nine cases. *J. Bone Joint Surg. Am.* 2003; 85:66–71.
24. Liu SH, Henry MH, Nuccion SL. A prospective evaluation of a new physical examination in predicting glenoid labral tears. *Am. J. Sports Med.* 1996; 24:721–5.
25. Maffet MW, Gartsman GM, Moseley B. Superior labrum-biceps tendon complex lesions of the shoulder. *Am. J. Sports Med.* 1995; 23:93–8.
26. McAdams TR, Dillingham MF. Surgical decompression of the quadrilateral space in overhead athletes. *Am. J. Sports Med.* 2008; 36:528–32.
27. McFarland EG. Examination of the biceps tendon and superior labrum anterior and posterior (SLAP) lesions. In: Kim TK, Park HB, El Rassi G, *et al.*, editors. *Examination of the Shoulder: The Complete Guide*, New York: Thieme; 2006, p. 213–43.
28. McFarland EG, Kim TK, Savino RM. Clinical assessment of three common tests for superior labral anterior-posterior lesions. *Am. J. Sports Med.* 2002; 30:810–5.
29. McMurray TP. The semilunar cartilages. *Br. J. Surg.* 1942; 29:407–14.
30. Mimori K, Muneta T, Nakagawa T, *et al.* A new pain provocation test for superior labral tears of the shoulder. *Am. J. Sports Med.* 1999; 27:137–42.
31. Morgan CD, Burkhart SS, Palmeri M, *et al.* Type II SLAP lesions: three subtypes and their relationships to superior instability and rotator cuff tears. *Arthroscopy.* 1998; 14:553–65.
32. Myers TH, Zemanovic JR, Andrews JR. The resisted supination external rotation test: a new test for the diagnosis of superior labral anterior posterior lesions. *Am. J. Sports Med.* 2005; 33:1315–20.
33. Nakagawa S, Yoneda M, Hayashida K, *et al.* Forced shoulder abduction and elbow flexion test: a new simple clinical test to detect superior labral injury in the throwing shoulder. *Arthroscopy.* 2005; 21:1290–5.
34. Nord KD, Ryu RKN. Further refinement of SLAP classification. Presented at the Annual Meeting of the Arthroscopy Association of North America, Orlando (FL), April 22–25, 2004.
35. O'Brien SJ, Pagnani MJ, Fealy S, *et al.* The active compression test: a new and effective test for diagnosing labral tears and acromioclavicular joint abnormality. *Am. J. Sports Med.* 1998; 26:610–3.
36. Oh JH, Kim JY, Kim WS, *et al.* The evaluation of various physical examinations for the diagnosis of type II superior labrum anterior and posterior lesion. *Am. J. Sports Med.* 2008; 36:353–9.
37. Palmer WE, Brown JH, Rosenthal DI. Labral-ligamentous complex of the shoulder: evaluation with MR arthrography. *Radiology.* 1994; 190:645–51.
38. Pandya NK, Colton A, Webner D, *et al.* Physical examination and magnetic resonance imaging in the diagnosis of superior labrum anterior-posterior lesions of the shoulder: a sensitivity analysis. *Arthroscopy.* 2008; 24:311–7.
39. Parentis MA, Glousman RE, Mohr KS, *et al.* An evaluation of the provocative tests for superior labral anterior posterior lesions. *Am. J. Sports Med.* 2006; 34:265–8.
40. Reuss BL, Schwartzberg R, Zlatkin MB, *et al.* Magnetic resonance imaging accuracy for the diagnosis of superior labrum anterior-posterior lesions in the community setting: eighty-three arthroscopically confirmed cases. *J. Shoulder Elbow Surg.* 2006; 15:580–5.
41. Ryu RKN, Dunbar WH V, Kuhn JE, *et al.* Comprehensive evaluation and treatment of the shoulder in the throwing athlete. *Arthroscopy.* 2002; 18:70–89.
42. Sasyniuk TM, Mohtadi NGH, Hollinshead RM, *et al.* The inter-rater reliability of shoulder arthroscopy. *Arthroscopy.* 2007; 23:971–7.
43. Snyder SJ, Banas MP, Karzel RP. An analysis of 140 injuries to the superior glenoid labrum. *J. Shoulder Elbow Surg.* 1995; 4:243–8.
44. Snyder SJ, Karzel RP, Del Pizzo W, *et al.* SLAP lesions of the shoulder. *Arthroscopy.* 1990; 6:274–9.
45. 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; 30:806–9.
46. Tennent TD, Beach WR, Meyers JF. A review of the special tests associated with shoulder examination. Part II: laxity, instability, and superior labral anterior and posterior (SLAP) lesions. *Am. J. Sports Med.* 2003; 31:301–7.
47. Walch G, Boileau P, Noel E, *et al.* Impingement of the deep surface of the supraspinatus tendon on the posterosuperior glenoid rim: an arthroscopic study. *J. Shoulder Elbow Surg.* 1992; 1:238–45.
48. Waldt S, Burkart A, Lange P, *et al.* Diagnostic performance of MR arthrography in the assessment of superior labral anteroposterior lesions of the shoulder. *AJR Am. J. Roentgenol.* 2004; 182:1271–8.
49. Walsworth MK, Doukas WC, Murphy KP, *et al.* Reliability and diagnostic accuracy of history and physical examination for diagnosing glenoid labral tears. *Am. J. Sports Med.* 2008; 36:162–8.
50. Walton DM, Sadi J. Identifying SLAP lesions: a meta-analysis of clinical tests and exercise in clinical reasoning. *Phys. Ther. Sport.* 2008; 9: 167–76.
51. Wilk KE, Reinold MM, Andrews JR, editors. *The Athlete's Shoulder.* Philadelphia: Churchill Livingstone, 2009.