Clinical assessment of the glenoid labrum

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Abstract

Background: The glenoid labrum is integral to shoulder stability and can be difficult to assess clinically. Whilst it is a single anatomical structure, damage to different regions results in very different clinical manifestations. A large number of provocative tests have been described, all of which initially purport to have excellent diagnostic accuracy. Clinical experience suggests that this is not the case and decision making can be difficult for the non-expert. The purpose of this study is to review the current evidence for the most commonly used tests and to provide suggestions for tests which have the most evidence for efficacy.

Methods: The glenoid labrum was divided into anterior, superior and posterior regions. The English language literature describing labral tests was reviewed. The evidence provided by the authors and any subsequent studies was analysed.

Results: Whilst a large number of tests have been described with the primary authors reporting excellent results the evidence for most is poor when later tested critically.

Discussion: No single test will accurately diagnose labral pathology. The clinician must use evidence from the clinical history combined with selective use and interpretation of tests with which they are familiar.

Keywords

Clinical assessment, labral tear, labrum; test

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Introduction

From a purely osseous point of view, the shoulder is a most unstable joint; it relies on dynamic and static soft tissue structures to achieve adequate stability to perform its function of placing the hand in space.

The glenoid labrum plays a role in deepening the relatively flat glenoid. The superior half is relatively loose and mobile in contrast to the inferior half which is more tightly attached to the glenoid rim.¹ The long head of biceps tendon is partly anchored to the labrum and partly to the superior glenoid tubercle. Injuries to this biceps anchor were described as recently as 1985 by Andrews et al., and Snyder et al. coined the acronym SLAP (superior labrum anterior and posterior) and classified these injuries into four types.^{2,3}

By contrast to the superior labrum (equivalent to the 10.30 through to the 02.30 position on a clock face), the anteroinferior labrum plays a role in the stability of the glenohumeral joint. Damage caused by the anteriorly dislocating humeral head can lead to the detachment of the labrum, which can include bone or periosteal elements. This can in turn lead to frank or subtle ongoing instability.^{4,5}

Much less common and trickier to diagnose are the posteriorinferior labral injuries, in which a similar injury is sustained in the posterior aspect of the glenoid.

To assist in the diagnosis of a labral injury, a history and clinical evaluation of the labrum is required. Radiological investigations are very important because these clinical tests have not been demonstrated to have high degrees of accuracy.

There are a bewildering array of shoulder tests that supposedly interrogate specific structures. The tests can carry the name of the originating author, and often appear to be very similar; in reality, there is a great deal of overlap between tests, with multiple pathologies often coexisting.⁶

We review some of the more commonly used and investigated tests and recommend those that are most

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appropriate, based on the available evidence and experience.

In terms of the literature, there are three broad categories of studies. The 'first generation' studies comprise original studies that introduce a novel test, which usually demonstrate outstanding results in terms of test sensitivity and specificity. Following these, a 'second generation' of studies are reported by independent investigators; these generally are not able to reproduce the good initial results from the original papers.

The 'third generation' of studies are the systematic reviews and meta-analyses, applying complex and stringent criteria to the other two categories of published studies. These studies are few but resounding in their assessment of the other two generations of studies, leaving the reader with doubt as to the utility of any of the tests.

Rather than mechanically apply parrot-fashion a battery of tests, the shoulder surgeon must gather an impression from the history and use a crafted selection of tests to achieve a working diagnosis. Typically, a trainee might attempt to use all of the described examinations, resulting in hours of effort followed by frustration and confusion when the tests and the results do not match up. This review introduces some of the commoner tests and attempts to synthesize a pragmatic list of the most reliable examinations. It is not intended to be a prescriptive list, and experienced clinicians will

have tests or combinations of tests which they prefer to use.

For the purposes of simplicity, the labrum has been divided into three areas: superior (i.e. SLAP tests), anterior and posterior, of which the latter two are tested by provoking instability. This split into three zones is an artificial subdivision of what is actually a continuous circumferential structure, although it is a convenient way of systematically diagnosing the pathological labral entities that affect the shoulder.

Superior labral tests (slap)

Broadly speaking, these tests try and mimic the forces that acted on the labrum to cause the injury: the forces are compression, trapping, distracting the biceps or peeling back as in the repetitive injuries found in the overhead athlete.^{7,8}

The active compression (O'Brien's) test (Fig. 1)⁹

In this test, the standing patient forward flexes the arm to 90° (i.e. horizontal and parallel to the floor) with the elbow straight and the arm in 10° of adduction, with the thumb down (therefore the shoulder should be internally rotated). The examiner pushes down on the arm as the patient resists this. The test is then repeated

Figure 1. O'Brien's test. The patient can be standing or seated. The straight arm is lifted into a horizontal position with 15° of adduction (best seen in D). The patient is asked to resist the downward pressure (arrow in C), both in maximal internal rotation (A) and full external rotation/supination (B). Pain or painful clicking felt within the joint that improves with supination is a positive result. This manoeuvre also stresses the ACJ, and so pain felt on top of the shoulder is indicative of ACJ pathology and is unaffected by arm rotation.

but with the forearm fully supinated (i.e. the shoulder in external rotation). The test is considered positive for a SLAP if pain felt 'inside' the joint is felt to improve with the supination. The test is also diagnostic for acromioclavicular joint (ACJ) problems, wherein the pain is felt 'on top' in the ACJ itself in both manoeuvres.

O'Brien et al. reported exceptional results for labral assessment with his prospective series of 318 patients, demonstrating a sensitivity of 100% and a specificity of 98.5%, with arthroscopy or imaging as the 'gold standard'.⁹ Subsequent studies have fallen short of reproducing these results in the diagnosis of SLAP lesions, demonstrating a sensitivity of the test ranging from 47% to 78% and a specificity from 11% to 55%.^{10,11} A meta-analysis of six pooled studies calculated a sensitivity of 67% and a specificity of 37% with positive likelihood ratio of 1.06.¹² Another study looked at inter-observer reliability and derived a low kappa value of 0.25, which was suggested to possibly explain such poor results in the literature.¹³

Kim's biceps load test i and ii^{14,15}

Kim et al. described two biceps load tests, based on activating the biceps to generate pain by distracting the biceps anchor.^{14,15} The first biceps load test (biceps load test I), reported in 1999, was specifically for the evaluation of the superior glenoid in shoulders with recurrent dislocations. The test involves the examiner sitting next to a supine patient, and supporting the arm at the elbow and hand. The arm is put into a position of apprehension with the forearm supinated. The patient is then asked to flex the elbow against resistance and report on whether the apprehension has improved, ie the shoulder feels more comfortable. If it feels more

secure, the test indicates that there is no SLAP lesion. This test relies on seeing whether tightening the intact biceps and anchor provides extra stability to an otherwise unstable shoulder joint.

Kim et al. reported on 75 patients prospectively with double blinded arthroscopy. He reported a sensitivity of 90.9% and specificity of 96.9%, with a positive predictive value (PPV) of 83% and a negative predictive value (NPV) of 98%. Unlike many other studies, he also included a reproducibility test and reported a Kappa score of 0.846.¹⁵

Kim went on to describe the biceps load test II in 2001 (Fig. 2). Although the biceps load test I assessed concurrent SLAP injury and instability, the biceps load test II assesses isolated SLAP lesions in the absence of instability. The rationale for this test is that it reproduces the peel back mechanism of SLAP lesions described by Burkhart and Morgan.⁷ The patient lies supine, with the examiner holding the elbow and hand and bringing the arm into 120° of abduction, and into maximum endpoint of external rotation. The patient attempts to flex the elbow against the examiner who holds it in 90° of flexion and supination. A positive test result requires that the active elbow flexion manoeuvre increases the patient's pain.

Similar to the biceps load test I, the study included reproducibility data (Kappa 0.815). In total, 127 patients were assessed and subsequently underwent arthroscopy, yielding a sensitivity of 89.7%, a specificity of 96.9%, a PPV of 92.1% and an NPV of 95.5%.¹⁴

Subsequent second generation studies have not produced such good results, with reported sensitivity ranging from 55% to 30% and specificity ranging from 53% to 78%.^{16,17}

Figure 2. Kim's 'biceps load test II'. (A). The patient is supine. The arm is elevated 120° and externally rotated maximally, with the examiner supporting the arm. The elbow is flexed 90° and maximally supinated. This position may or may not be painful in itself. (B). The patient then is asked to try to bend the elbow against resistance of the examiner. If pain occurs or is increased by this elbow flexion, then the test is positive.

Pain provocation test¹⁸

In this test, the sitting patient abducts the shoulder as in an apprehension test. The examiner then compares pain with the forearm in maximum pronation and subsequently maximum supination. A positive test occurs when pain is greater in the pronated position: the rationale being that pronation adds further tension on any SLAP lesion.

Mimori et al. reported results of 100% sensitivity and 90% specificity, although subsequent studies only showed a sensitivity less than 20% but a specificity of approximately 90%.¹⁹

Anterior slide test²⁰

In this test, the patient stands or sits with the hands on the hips but the thumbs pointing backwards. From behind, the examiner stresses the labrum by shunting the humerus forward and superiorly, with the patient trying to resist this vector of push. Anterior pain or a click/pop is considered positive. Kibler reported a sensitivity of 78.4% and a specificity of 91.5%.²⁰ Subsequent studies have not achieved these results, with a meta-analysis of pooled data from four other second generation papers yielding a summary estimate of 17% sensitivity and 86% specificity with a positive likelihood ratio of 1.20.¹²

Crank test²¹

The shoulder is elevated to 160° in the plane of the scapula, and axial force is applied through the elbow compressing into the glenohumeral joint. When this force is applied, the arm is rotated from full internal rotation to full external rotation, with pain representing a positive result. Their results were all above 90%, although further studies yielded poorer results, with a sensitivity range from 13% to 81% and a specificity range from 67% to 88%.^{10,11,18,19,22,23} A meta-analysis showing pooled positive and negative likelihood ratios straddling 1, indicating no clear diagnostic utility.²⁴

A number of other tests have been described but have not been validated independently. These include the resisted supination external rotation test,¹¹ the forced shoulder abduction and elbow flexion test,²³ the passive compression test,²⁵ the 'SLAPprehension' test²⁶ and the passive distraction test.²⁷

Combining tests for labral lesions

Some studies have assessed the diagnostic value of combining tests, claiming improved results compared to single tests. By combining passive distraction and active compression (O'Brien's) in the assessment of a

SLAP lesion, a sensitivity of 70% and specificity of 90% have been reported.²⁷ The combination of anterior slide and crank tests yielded a sensitivity of 34% and specificity of 91% in labral tear diagnosis.¹³

Anterior labral tests

Apprehension, relocation and surprise

In some cases, there is little doubt to the diagnosis as a result of the clear history and corroborating radiographic evidence of dislocation. In cases of subtle instability, clinical tests aim to place the arm into a position of risk of anterior dislocation, namely abduction and external rotation. The anterior draw test also allows the examiner to assess the mobility and laxity of the glenohumeral joint by simply trying to passively drag the humerus anteriorly with respect to the glenoid. This is often performed on an anaesthetized patient prior to surgery.²⁸

The apprehension test (Fig. 3)

The arm is placed in a maximally externally and abducted position, with the patient either sitting or supine. In this position, an anterior force is applied by pushing the humerus or humeral head from behind, with a positive result when the patient becomes apprehensive and/or experiences pain. This position can also cause pain from cuff impingement rather than just instability. The original study reported the test to be positive in all 60 patients operated on, although they the validity of the test was not formally analyzed.²⁹

Second generation studies have assessed this test's role in diagnosis of instability, as well as SLAP lesions and labral tears, reporting a sensitivity of 40% to 62% and a specificity of 42% to 87%.^{17,22} A meta-analysis yielded a sensitivity of 65.6%, a specificity of 95.4% and a positive likelihood ratio of 5.48.¹²

Jobe's relocation test (Fig. 3)

In this test, the pain and/or apprehension previously felt in the apprehension test is subsequently relieved by relieving the painful tension on the anterior labrum. The arm in the same position as the apprehension test, and the examiner's hand is placed on the front of the humeral head and gently pushes the humeral head backwards. This should relieve the pain and apprehension caused by instability, although it will not help any pain caused by impingement.³⁰

A second generation paper assessing this test not only reported a sensitivity of 86% for instability, but also a 89.9% specificity of type II SLAP lesions.¹⁹

Figure 3. Apprehension test and relocation test. Note that this test can be performed either sitting or supine. Here, we demonstrate it in the sitting position, as well as supine for clarity. The arm is placed in a position of 90° of abduction and 90° of external rotation. (A) View from front. (B) View from side. (C) View from above. (D) View in supine position. An anteriorly directed force is applied to the back of the humeral head (red arrow in C). A positive test results if pain or apprehension is experienced by the patient. A star shows the point of labral stress by this manoeuvre. (E) In the relocation test, a posteriorly applied force (blue arrow in E) relieves the pain or apprehension if caused by labral pathology.

A meta-analysis combining three studies showed a sensitivity of 64.6%, a specificity of 90.2% and a very strong positive likelihood ratio of 17.21.¹²

Surprise test

A further modification of the above tests is the surprise test. The arm is placed in the position of risk but with the posteriorly directed force maintained by the

examiner pushing backward. This is then released without warning to cause pain and apprehension. The original study reported a sensitivity of 91.9% and a specificity of 88.9% in 100 patients scheduled for surgery.³¹ Subsequent analysis found this to be the single most accurate test for instability, with a sensitivity of 64% and a specificity of 99% and a good inter-observer reliability of 0.83.³² A meta-analysis yielded good results of two combined studies, yielding a sensitivity

Figure 4. The Kim test for posteriorinferior labral lesions. The patient is sitting. The arm is held in 90° abduction, and the examiner applies an axial combined with posterior and inferior force to the humerus. This force acts on the posteroinferior labrum. The patient should be sitting on a chair with a back (not a stool) to support this force. The examiner then moves the arm in a 45° diagonal direction upwards and across the patient. A sudden onset of posterior pain is a positive result, regardless of any clunk.

of 81.8%, a specificity of 86.1% and a positive likelihood ratio of 5.42.¹²

Bony apprehension test

The 'bony apprehension test' is a further modification for patients with anterior glenoid bony deficiency, in which apprehension is felt at only 45° of abduction and 45° of external rotation, indicating a greater degree of instability indicating a bony defect. They reported on a small series of 29 cases, with a positive test proving to be 100% sensitive and 86% specific for diagnosing bony deficiency, and it was concluded that the test is more useful than plain films.³³ This test has not been assessed in subsequent studies.

Evidence for combining tests for anterior labral pathology

By combining both apprehension and relocation tests, Guanche and Jones found a sensitivity of 38% and a

specificity of 93% but concluded overall that tests or combinations of tests were not very good at accurately detecting labral injuries.²²

Other studies reported a positive result for all three tests (apprehension, relocation and surprise), yielding a PPV of 93.6% and an NPV of 71.9%.³²

Posterior labral pathology

Compared to the superior labrum and anterior labrum, there are very few described tests for posterior labral lesions, and they are also more difficult to detect on magnetic resonance imaging than anterior lesions.³⁴ Very little validation of these tests has been carried out.

The jerk test

The arm is forward elevated, 90° internally rotated and adducted across the body with the humerus parallel to the floor, with a posterior directed force being applied to the elbow. This manoeuvre subluxates the glenoid

out of joint in cases of posterior instability. Then, the examiner abducts the arm and a clunk or jerk is felt as the humerus reduces into joint. The test is considered positive when pain is elicited.³⁵

Kim test for posterior instability (Fig. 4)

Not satisfied that the jerk test was sufficiently helpful in diagnosing posterior labral injuries requiring repair, Kim et al. described a new test. A seated patient has the arm held in 90° of abduction. The examiner holds the patients elbow and lateral aspect of their arm and simultaneously applies an axial loading force and 45° upward diagonal movement with an inferior and posterior force being applied. A sudden onset of pain, regardless of a clunk, is considered positive. Kim compared his test with the jerk test. He found that his test yielded a 80% sensitivity, a 94% specificity, a PPV of 73% and an NPV of 96% with inter examiner reliability of 0.91, whereas his assessment of the jerk test showed a 73% sensitivity, a 98% specificity, a PPV of 88% and an NPV of 95%. It was concluded the Kim test was more sensitive in predicting inferior labral lesions, whereas the jerk test more sensitive for posterior lesions. Combining the two tests increased sensitivity.³⁶ To our knowledge, no further studies have examined these tests.

Sulcus sign and hyperlaxity

Commonly, much significance is placed on the demonstration of a sulcus sign in association with a diagnosis of instability. This is often used in conjunction with a Beighton score for hypermobility.³⁷

It is important to remember the distinction between laxity and instability. Laxity refers to asymptomatic increased physiological movement in a joint; in the shoulder, this can be demonstrated by the sulcus sign.³⁸ On the other hand, instability refers to abnormal symptomatic movement in a joint, leading to pain, subluxation or dislocation. An appreciation of the general laxity of the individual and their shoulder joint is important in the management of instability because a patient might have both laxity and instability concurrently.

Conclusions

There have been meta-analyses and systematic reviews in the literature of these labral tests. Heterogenicity of study populations in the literature, co-existence of multiple pathologies, lack of rigorous methodology and potential inherent bias mean that there are pitifully few solid conclusions that can be drawn from these tests.

The most comprehensive review and meta-analysis, recently updated in 2012, comes to the conclusion, 'the use of any single test...cannot be unequivocally endorsed'.¹²

Author's recommendations

Anterior labrum

This is relatively simple because only a few tests have been described and there is relatively good evidence to show their usefulness.

We use the anterior apprehension test, supplemented with the relocation and surprise test if there is any doubt. All three tests require the arm to be in a similar position and so are easy to quickly combine.

Posterior labrum

This is more difficult because the condition is less common and fewer tests have been described and there is less evidence as to their utility.

The recommendation is that the examiner should have a high index of suspicion if the jerk test is positive. Again, combining this with the Kim test is easily achieved because the positions are similar and may improve sensitivity.

It must be remembered that a negative result is not indicative of the absence of pathology.

Superior labrum/SLAP

Much has been written concerning the testing of the biceps anchor compared to the rest of the labrum combined. This is indicative of the fact that probably none of the tests are very reliable in isolation. O'Briens test is often useful, although attention has to be paid to performing it properly and correctly identifying the location of the pain.

The senior author has found that Kim's biceps load test II, when used in combination with the O'Brien's test, increases the likelihood of a positive result.

Any of the other tests used in addition may aid diagnosis, although little work has been conducted regarding the best combinations to use.

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