Clinical and Diagnostic Tests for Shoulder Disorders: A Critical Review

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What is already known on this topic:
The evaluation of shoulder pain can present a diagnostic challenge to clinicians. Multiple tests exist for the physical examination of the shoulder; however, many are nonspecific and do not point to a definite diagnosis. Furthermore, the cause of many shoulder conditions is currently unclear.

What this study adds:
This review of the literature gives the clinician an objective assessment of which physical examination tests are helpful for making the diagnosis of shoulder conditions.

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ABSTRACT

The shoulder is one of the most complex joints in the human body and, as such, presents an evaluation and diagnostic challenge. The first steps in its evaluation are obtaining an accurate history and physical examination and evaluating conventional radiography. The use of other imaging modalities (eg, ultrasound, magnetic resonance imaging, and computed tomography) should be based on the type of additional information needed. Our goals were to review the current limitations of evidence-based medicine with regard to shoulder examination and to assess the rationale for and against the use of diagnostic physical examination tests.

INTRODUCTION

The shoulder, one of the most complex joints in the human body, presents an evaluation and diagnostic challenge because: (1) it involves the simultaneous movement of many individual bones; (2) direct observation of those motions is obscured by muscle; (3) many practitioners have less experience with the shoulder than with other joints; (4) for some shoulder conditions, patient history is vague and undiagnostic; (5) the cause of many shoulder conditions has not been adequately delineated; and (6) diagnostic physical examination tests and imaging studies may not be sufficient for a definitive diagnosis.[1] Therefore, correctly diagnosing shoulder disorders depends on the integration of patient history, physical examination findings, and imaging studies.

Our goals were to evaluate the current limitations of evidence-based medicine with regard to shoulder examination and to assess the rationale for and against the use of diagnostic physical examination tests.

EVIDENCE-BASED MEDICINE FOR SHOULDER EXAMINATION

There are several barriers to evidence-based medicine for physical examinations of the shoulder, including the facts that such tests are often described without sufficient validity evaluation and are rarely compared with a diagnostic gold standard (eg, arthroscopic or open shoulder surgery). In addition, such tests may be described by the inventor, may not have been studied or reproduced by others, and may contain results that cannot be substantiated by independent observers.[2,3] To our knowledge, there are few level-I evidence-based studies that assess the clinical utility of physical examinations of the shoulder.[3]

DISORDER-SPECIFIC EXAMINATIONS

The first step of any shoulder examination is visualization of the front and back of the patient, specifically observing for deformity, swelling, asymmetry, or atrophy.[4,5] The second step of shoulder examination is the use of specific tests to determine the differential/definitive diagnosis.

Scapular malpositioning

To evaluate the scapula, the examiner first views the patient from the back and assesses the resting posture of the scapula on the chest wall by comparing the medial border and inferior edge position with that of the unaffected shoulder.

To diagnose scapular asymmetry, observation alone is sufficient. Scapular asymmetry has been noted in athletes and described as tennis shoulder, drooping of the dominant arm, a protracted scapula, and hypertrophy of the muscles of the dominant arm.[6-8] Other authors[9] have suggested that this protracted shoulder blade position predisposes to “impingement” of the rotator cuff on the acromion when the arm is raised.

The relationship of scapular asymmetry to symptoms remains unclear. Several studies have described the coexistence of altered scapular positioning and shoulder abnormalities.[10-13] Some authors have suggested that these alterations can contribute to symptoms of impingement in overhead athletes.[8,14,15] However, whether the scapular alterations are an adaptation to shoulder abnormalities or contribute to them remains controversial.[16]

Scapular winging (prominence) has two forms: lateral scapular winging (rare in athletes) results from a lesion of the spinal accessory nerve; medial winging (more common) results from a lesion of the long thoracic nerve.[17,18] Some asymmetry may be observed with the patient at rest, but winging is accentuated by the patient forward-flexing both arms 90° or performing a “wall push-up.” In severe cases, the patient cannot stabilize the scapula and may be unable to

fully elevate the arm. For bilateral winging or atrophy, a cervical spine or metabolic cause (eg, fascioscapulothoracic dystrophy) should be considered.

To screen for synchronistic shoulder movement, the clinician views the patient from behind and observes the scapular motion as the patient elevates the arm from full adduction to full elevation. This "scapulothoracic rhythm" should be smooth and without a "hitch". Side-to-side asymmetry of this movement is called "scapular dyskinesis." The three types of dyskinesis described in the literature[19,20] have only subtle differences; there is no correlation between type and shoulder abnormality or diagnosis. To our knowledge, there are no published level-I studies regarding scapular dyskinesis; therefore, its importance in terms of shoulder conditions remains unknown.

The "shrug sign" is a valuable screening tool for assessing shoulder synchronicity and altered glenohumeral or scapulothoracic positioning.[21-23] The patient elevates the affected arm to 90°; if it cannot be done without shrugging, the test is positive and can indicate rotator cuff tears or stiffness/weakness from other causes.[21]

Rotator cuff disorders

The concept that tears of the rotator cuff are caused by the tendons rubbing against a structure ("impingement") has recently been questioned because of studies showing lack of contact between the superior glenoid and the acromion.[24-28] The current theory is that rotator cuff disease is a degenerative condition that increases linearly with age and is characterized by tenocyte apoptosis and collagen fiber disorganization.[29-32] Although rotator cuff disease is frequently asymptomatic and does not require treatment, signs and symptoms may be highly variable depending on the degree of tendon abnormality, patient activity level, whether the dominant or non-dominant arm is affected, and presence of coexisting abnormalities (eg, a stiff shoulder). On physical examination, some patients with massive rotator cuff tears are profoundly weak and unable to lift their arms; others are asymptomatic with full range of motion.

An evidence-based review of physical examination of the shoulder for rotator cuff disease shows that the tests are more helpful when the abnormality is more severe.[33,34] For example, Murrell and Walton[33] found that if the patient was more than 60 years old, was weak in external rotation, and had a positive impingement sign, the chance of a full-thickness rotator cuff tear was 95%. Similarly, Park *et al*[34] found that if a patient was weak in abduction or external rotation and was more than 65 years old, there was a greater than 90% chance of a rotator cuff tear and a 28% likelihood of a full-thickness rotator cuff tear.

Detection of less severe rotator cuff abnormality by physical examination is much more difficult. The Neer and Kennedy-Hawkins impingement signs have only modest sensitivity and low specificity[34-37] for partial tears of the rotator cuff because "positive" signs can result from a wide variety of shoulder conditions and because patients with partial tears often are asymptomatic. Therefore, positive tests should be interpreted in light of the history and radiographic studies.

Anterior instability

Anterior shoulder instability (humeral head subluxation or dislocation anterior to the glenoid) can be traumatic or atraumatic and is one of the few shoulder conditions for which the history, physical examination, and radiographic studies are extremely accurate and diagnostically helpful. The history alone can almost determine the diagnosis in a patient with a traumatic dislocation that was reduced by the patient or in the emergency room.

Several studies have documented the accuracy of the physical examination for making the diagnosis of traumatic anterior instability.[38-40] These tests are positive if a sense of shoulder instability (apprehension) is reproduced; it is not positive if only pain is produced. For example, the anterior apprehension test[39] and the "surprise test"[38] both have moderate sensitivity and high specificity with apprehension, but not pain, as the diagnostic criterion.

Testing shoulder laxity (amount of translation of the humeral head on the glenoid) has a role in making the diagnosis of shoulder instability, but there is a wide range of normal laxity. Instability is now recognized as abnormal laxity, ie, that which causes symptoms of subluxation or dislocation of the joint. With the patient sitting ("load and shift" test)[41] or supine ("anterior and posterior drawer" test),[42] the examiner attempts to translate the humeral head over the glenoid rim. Although the translation can be estimated in millimeters or percentage of humeral head diameters, the easiest method is to determine if the humeral head does not subluxate over the glenoid rim (grade 1), subluxates and spontaneously reduces (grade 2), or stays dislocated (grade 3).[43,44] If the examiner can subluxate the humeral head over the glenoid rim and it reproduces patient symptoms of instability, then the test has a sensitivity of 53% and a specificity of 85% for anterior instability.[43,44]

The relocation test also assesses for anterior instability.[45] With the patient supine, the arm is placed in abduction and external rotation until the patient becomes apprehensive that the shoulder will become unstable. The examiner then stabilizes the humeral head with a posteriorly directed force, which should relieve the patient's sense of instability. This test has been found to have a moderate sensitivity and a high specificity.[3]

Using pain as a diagnostic criterion can be a confounding factor when evaluating any test for shoulder instability. Jobe and Kvitne[45] observed that overhead athletes who had pain with abduction and external rotation, and hypothesized that this pain might indicate a subtle form of anterior instability. To our knowledge, these tests have not been studied in relationship to this particular clinical presentation in athletes who have only pain in the shoulder. Because the exact mechanisms of pain of the overhead athlete have not been totally resolved, these tests should be interpreted with caution when they are performed on athletes without overt instability.[43]

Inferior instability

The concept of inferior shoulder instability continues to evolve with recognition of the wide range of normal inferior laxity that is unrelated to instability.[46,47] Inferior laxity can be evaluated with the sulcus sign[48] or the "hyperangulation sign".[49] For the sulcus sign, the patient can sit, stand, or be supine as the examiner pulls down on the arm and grades the laxity: 1 (<1.5 cm), 2 (1.5 to 2.0 cm), or 3 (>2 cm).[41] Although this classification is widely accepted, to our knowledge it has never been validated nor has its reliability been adequately studied. One study found that using a positive sulcus sign as an indication of multidirectional shoulder instability would result in a substantial over-diagnosis.[50] Another test for inferior laxity is the hyperangulation sign test as described by Gagey and Gagey.[49] To our knowledge, there are no level-I studies that define the clinically appropriate use of these two signs for making the diagnosis of inferior instability.

Posterior instability

The physical examination tests for posterior instability (e.g., posterior apprehension sign,[51] "jerk" test,[52] and posterior drawer test,[43]) have not been adequately studied to determine accuracy or clinical utility. When patients can show posterior subluxation, there is a high chance

that subluxation is causing the symptoms.[53] However, many patients with a demonstrable instability pattern have no subluxation-related pain or activity limitation, so "demonstrability" is not a sufficient criterion for surgical intervention.

Acromioclavicular joint disorders

Diagnoses of injuries and conditions affecting the acromioclavicular (AC) joint can be made fairly reliably. Often patients with such disorders have swelling locally at the AC joint or point directly to the AC joint when asked the location of their pain (the "one-finger test"). Most patients with AC joint abnormality are locally tender at the AC joint, and their pain resolves with an injection of local anesthetic. There are few level-I studies of the clinical usefulness of examination tests for the AC joint, although clinicians have found the active compression test,[54,55] the crossed-arm adduction stress test[56] (which is not as specific or sensitive the active compression test[57]), the "arm extension test,"[54,58] and the Paxinos test (reported by Walton *et al*[57]) helpful; to our knowledge, the last has not been independently verified.

Lesions of the long head of the biceps tendon

Abnormalities of the long head of the biceps tendon include full tears, partial tears, tenosynovitis, and subluxation. Patients with full-thickness tears typically present with a "popeye" arm after feeling a pop or snap in the shoulder. To our knowledge, the diagnostic accuracy of the observation of a sudden appearance of a lump in the arm of a patient with a history of prodromal pain has not been studied. However, typically these swellings are at least somewhat painful initially. Several of our patients have had malignant soft-tissue masses in their arms near the area where the deformity of a long head of the biceps tendon rupture would appear, so it is important to thoroughly evaluate any mass that appears without a history of trauma.

There are two main reasons that biceps tendon abnormalities other than full tears are difficult to diagnose on physical examination: the tendon's physical location and the rarity of an isolated abnormality. First, the biceps tendon usually lies deep in the anterior shoulder under the transverse ligament between the lesser and greater tuberosity, making palpation difficult, although externally rotating the arm 20° and flexing and extending the elbow often allow the examiner to feel the tendon excursion in the bicipital groove or just below that location. It is often difficult to differentiate the biceps tendon, supraspinatus tendon attachment to the greater tuberosity, and subscapularis attachment to the lesser tuberosity because these structures are in close proximity. Second, the biceps tendon is rarely affected without coexisting rotator cuff abnormality, so a positive physical examination finding (pain) could indicate that either or both could be the cause.

Therefore, it is easy to understand why there is little level-I evidence regarding the accuracy of physical examination tests for biceps tendon abnormality. The Speed test was found to be only moderately useful for diagnosing biceps tendon tears,[59,60]; biceps tendon palpation was not found to be predictive of abnormality.[61,62]. A recent study by Kibler *et al*[63] found that a newly described examination, the upper cut, had the highest accuracy rate (0.77) and produced the highest positive likelihood ratio of biceps disease. The bear hug was also found to have high sensitivity (0.79), whereas the belly press and Speed's test had the highest specificity (0.85 and 0.81, respectively).[63]

Superior labrum anterior to posterior lesions

Diagnosing superior labrum anterior and posterior **(**SLAP) lesions with physical examination

continues to be marked by controversy for many reasons: (1) many SLAP studies include labrum tears in areas other than the superior labrum[64-66]; (2) patients tested are often those who would be expected to have a positive test; (3) in some studies, the SLAP lesion is verified not arthroscopically, but with other methods (eg, ultrasound or magnetic resonance imaging) known to be unreliable in confirming that diagnosis[67,68]; (4) the development of the physical examination is often based on a perception of how SLAP lesions cause symptoms (eg, some tests "assume" that pain is produced by tension on the biceps tendon, whereas others attribute pain to shear across the superior labrum by the humeral head or greater tuberosity)[69]; and (5) several reviews have shown that physical examination test results have frequently been better for first users than subsequent ones.[3,67,70,71]

For most of these physical examination tests, a positive result is pain or a click in the shoulder during the test, but a click has also been shown to occur in patients without SLAP lesions.[72] This finding reinforces the impression that SLAP lesions rarely behave like meniscal tears, i.e., with an entrapped fragment or bucket handle of the labrum in the joint.[73]

There seems to be some increased accuracy in making the diagnosis of SLAP lesion when multiple tests are positive. A recent study found that for a patient with a history of a click, pop, or catch in the shoulder, the specificity was moderate (73%) for a labral lesion,[66] but that combining a positive history with a positive crank test or a positive active slide test raised the specificity (91% and 100%, respectively).[66] However, that study considered a click a positive finding and included labral tears from any portion of the glenoid. In another study, multiple tests were of no benefit for diagnosing SLAP lesions, but only three tests were evaluated.[72] A study of seven commonly used examination tests for SLAP lesions found that any combination of two or three tests resulted in lower sensitivity but higher specificity than individual tests.[65] A recent study found that the combination of the dynamic labral shear test and the O'Brien test best identified labral lesions on physical examination.[63]

Several meta-analyses of the physical examination tests for SLAP lesions have found that individual tests are not sensitive nor specific enough to be used reliably,[3,67,70,71] that "methodological inadequacies in the reporting" of the publications regarding SLAP lesions were common,[71] and that "caution must be exercised when drawing inferences from the results of these studies".[43]

SUMMARY

Evidenced-based medicine provides a sense of the clinical usefulness of shoulder examination tests. The diagnosis of traumatic anterior instability can be made reliably on physical examination, and most conditions of the AC joint can be accurately diagnosed. Posterior shoulder instability can be diagnosed if the patient can show the instability or if laxity testing reproduces the symptoms. Multidirectional instability is rare, and tests to measure inferior shoulder laxity should not be assumed to represent instability unless they reproduce symptoms of instability. Symptomatic full-thickness rotator cuff tears can be successfully diagnosed in many instances, but lesser forms of rotator cuff disease are difficult to distinguish. Biceps tendon lesions are difficult to diagnose on physical examination, but SLAP lesions might be more accurately diagnosed on physical examination if multiple tests are positive.

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