Technical Note

A Comprehensive Review of the Physical Examination for the Biceps-Labrum Complex of the Shoulder

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Abstract: Biceps-labrum complex (BLC) disease is a well-established pain generator in the shoulder. Despite its ubiquity, BLC disease continues to pose a diagnostic challenge for orthopaedic surgeons. The use of magnetic resonance imaging and glenohumeral arthroscopy in the diagnosis of BLC disease has proven to be inadequate when performed independently. As a result, physical examination remains a critical component in the evaluation of BLC disease. The purpose is to provide a comprehensive compendium of physical examination maneuvers in the evaluation of BLC disease.

Understating of the biceps-labrum complex (BLC) has evolved in recent years, as the diagnosis of its related pathologies poses persistent challenges. These challenges include shared symptomatology between BLC disease and other shoulder abnormalities,[1] limited diagnostic value of standard imaging techniques and arthroscopy, and uncertain threshold of when BLC pathology should be addressed with tenodesis or tenotomy.[2] As surgeons move in the direction of treating the superior labrum and long head of the biceps tendon (LHBT) as codependent entities instead of separate independent units, an all-inclusive compendium of physical examination maneuvers becomes paramount. The physical examination is of particular importance in BLC disease, as both magnetic resonance imaging and glenohumeral arthroscopy have been shown to incompletely evaluate the BLC as independent investigative tools.[3,4] Both traditional physical examination maneuvers (Speed's test, Crank test, dynamic labral shear test, Yergason's test, and full can test) and the 3-Pack examination (active compression test [O'Brien sign], palpation of the bicipital tunnel, and resisted throwing test) have diagnostic utility for BLC disease. The purpose of this review is to provide comprehensive descriptions of the various physical examination techniques and insight into their value in the evaluation of BLC disease.

Surgical Technique

Before any specific examination maneuvers, thorough inspection and assessment of the scapulothoracic and glenohumeral joints should be assessed, including cervical spine examination, palpation of bony landmarks, active and passive range of motion, and strength testing. Special attention should be paid to glenohumeral internal rotation deficit in overhead throwers, who commonly experience pathology of the BLC.[5] In addition, anterior and posterior stability of the glenohumeral joint should be evaluated with the patient supine through load and shift testing. If suspicious for scapular pathology, evaluation should be taken further with special attention for SICK (Scapular malposition, Inferior medial border prominence, Coracoid pain and malposition, and dysKinesis of scapular movement) scapula syndrome, which is characterized as scapular malposition, inferior medial border prominence, coracoid pain and malposition, and dyskinetic scapular motion. After a general examination of the shoulder is

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Received April 16, 2024; accepted May 24, 2024.

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2212-6287/24623
https://doi.org/10.1016/j.eats.2024.103136

completed, more specific examination maneuvers can be performed to evaluate for BLC disease (Video 1).

Three-Pack Examination Maneuvers

O'Brien Sign (Active Compression Test) With the Dines and Taylor Modifications

The active compression test[6] with the Dines modification[7] is performed with the patient standing square facing the examiner with both arms forward flexed to 90° with the elbows in full extension (Fig 1). Both arms are then fully internally rotated with the thumbs pointing inferiorly and then adducted toward the midline with the dorsum of both hands touching to create a 10° to 15° adduction angle for both shoulders. In this test, the examiner applies a uniform downward force to the patient's arms as they resist and attempt to maintain 90° of forward flexion. This maneuver is then repeated with the arms at 90° of forward flexion, with the shoulders externally rotated and forearms supinated with palms facing upward. Simultaneous examination of bilateral shoulders with adduction to the midline (i.e., the "Dines" modification) allows for more consistent positioning of the upper extremity, with reliable adduction to the midline. The ulnar surfaces of the patient's hand should remain touching. A positive active compression test (O'Brien sign) occurs when the patient reports pain "inside the shoulder" when their thumb is pointing inferiorly, but the pain is eliminated or reduced when the maneuver is repeated with the palm facing upward. Pain "inside the shoulder" is used to identify the biceps-labrum complex as the source of the pain instead of the acromioclavicular joint, which can also be painful at the top of the shoulder with this maneuver. An alternative modification to this maneuver involves the examiner controlling the contralateral arm at 45° of forward flexion with the shoulder internally rotated to prevent the patient from externally rotating the shoulder of interest during the examination (Taylor modification).

Resisted Throwing Test

This test is performed with the elbow flexed to 90°, and the shoulder abducted to 90° with maximal external rotation to mimic the late-cocking position (Fig 2). The examiner stands behind the patient on the side being tested and applies isometric resistance to the arm as the patient steps forward with the contralateral leg moving into the early acceleration throwing phase. A painful throwing test is most specific for junctional disease, but can also indicate bicipital tunnel disease or lesions inside the joint.[8]

Palpation of the Bicipital Tunnel

This test involves manual palpation along the course of the extra-articular LHBT with the arm in a neutral position. To assist palpation of the LHBT, the examiner may passively internally and externally rotate the upper arm (Fig 3). Not surprisingly, this maneuver is most sensitive for lesions in the bicipital tunnel; however, it can also assist in detecting lesions inside the joint and at

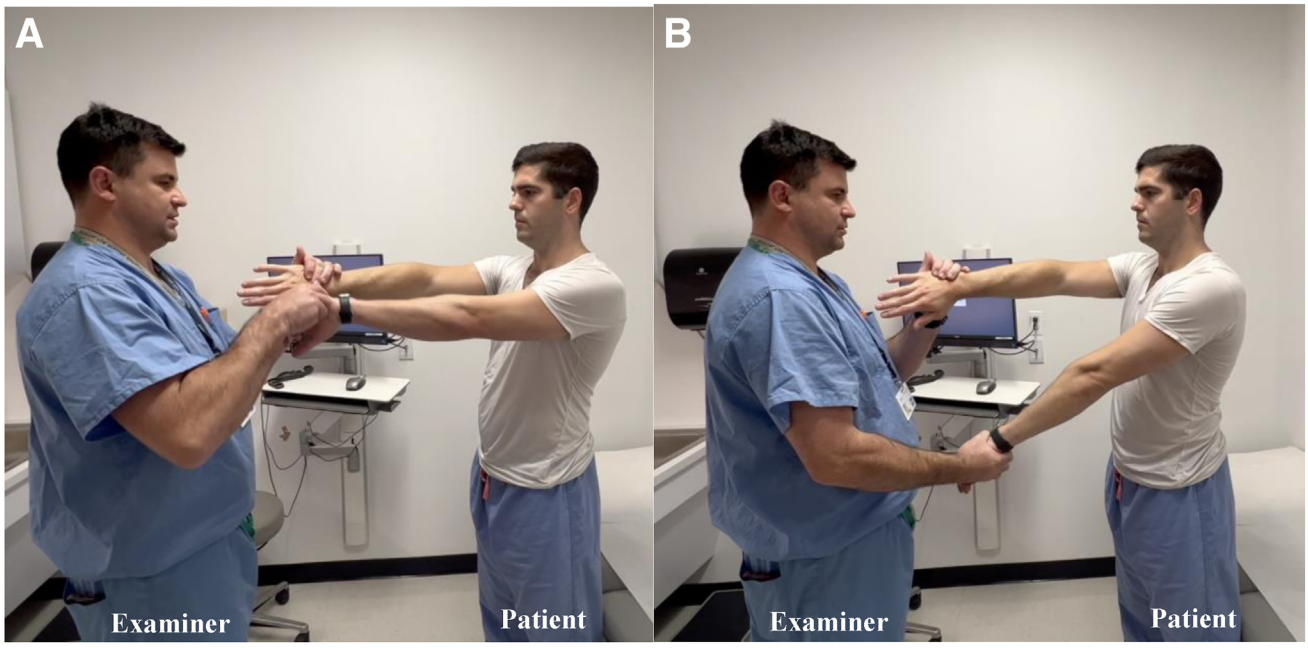

Fig 1. Photograph of the active compression test (O'Brien Sign) with the Dines modification (A) or Taylor modification (B). The examiner applies a uniform downward force to the patient's arms as they resist and attempt to maintain 90° of forward flexion. In the Dines modification, the test is performed bilaterally; in the Taylor modification, the contralateral arm is controlled at the wrist with the arm forward flexed to 45°.

Fig 2. Photograph of the resisted throwing test performed on a patient's right shoulder. The examiner applies isometric resistance to the patient's arm as they step forward with the contralateral leg moving into the early acceleration throwing phase.

Fig 3. Photograph of the palpation of the bicipital tunnel examination on a patient's right shoulder. The examiner palpates the long head of the biceps tendon while passively internally and externally rotating the upper arm.

the articular junction.[8] It should be noted that excessive pressure in the anterior shoulder can be painful even in uninjured extremities; thus careful titration of force should be used. Comparison of examination findings to the contralateral extremity is of particular value for this maneuver.

Other Examination Maneuvers

Crank Test

The crank test can be performed in either the upright or supine position. The patient's arm is elevated to 160° and the examiner applies axial load through the shoulder joint while also rotating the humerus internally and externally. Pain with this test is typically elicited during external rotation, and a positive finding has historically indicated labral pathology.

Speed's Test

This test is performed with the patient standing upright with their shoulder in 60° to 90° of forward flexion with their forearm fully supinated and elbow extended (Fig 4). The examiner applies a downward force to the patient's forearm as they resist. A positive test is indicated by pain in the anterior shoulder or within the shoulder joint. Studies are somewhat variable; however, most have indicated Speed's test to be poorly sensitive but somewhat specific for BLC lesions.[9,10]

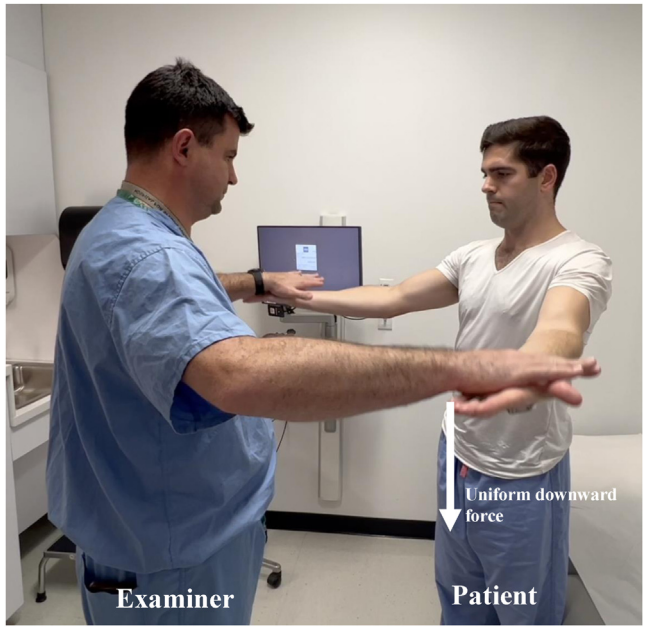

Fig 4. Photograph of examiner preforming a bilateral Speed's test. The examiner applies a uniform downward force to the patient's forearms as they resist with the arms in 60° to 90° of forward flexion and with their forearms fully supinated and elbows extended.

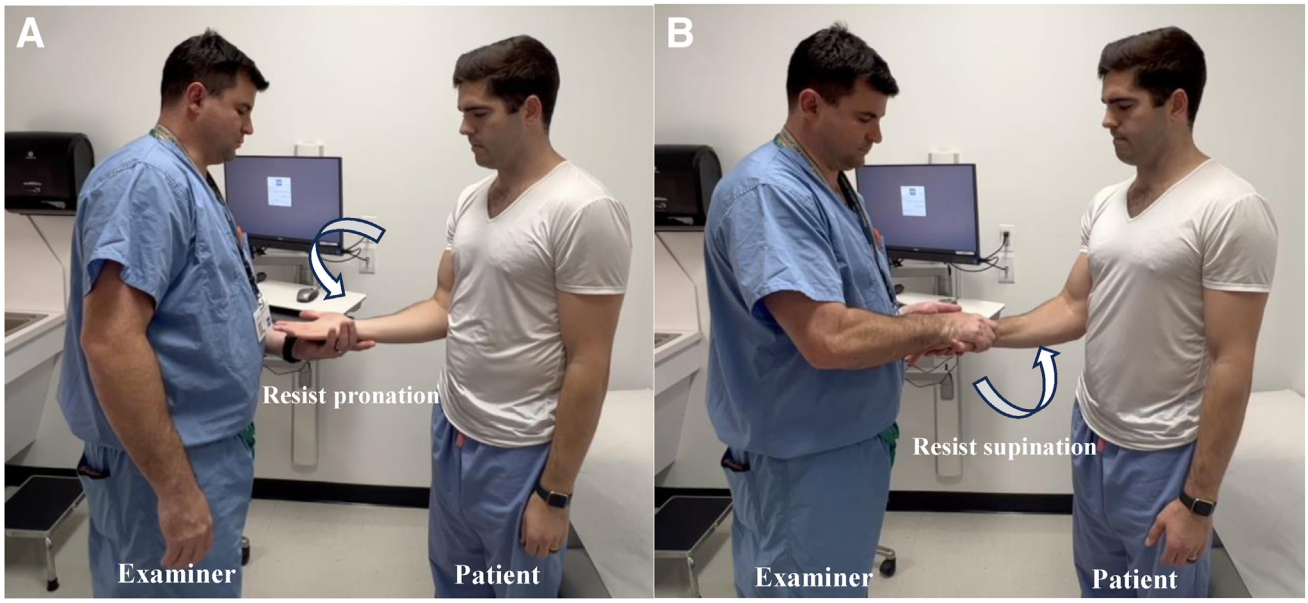

Fig 5. Photograph of Yergason's test performed on a patient's right arm. (A) The patient attempts to pronate the arm against examiner resistance. (B) The patient attempts to supinate the arm against examiner resistance.

Dynamic Labral Shear Test

The dynamic labral shear test is performed with the patient standing upright with the examiner positioned behind them. The examiner holds the wrist of the patient with one hand and uses the other hand to apply an anteriorly directed force on the proximal humerus near the joint line. This is performed with the patient not resisting any of the maneuvers and with the arm externally rotated and elevated in the plane of the body up to maximal abduction. This test is considered positive if the patient reports pain in their shoulder or the examiner feels a click in the posterior shoulder between 90° and 120° of abduction. In assessing SLAP tears, this test has demonstrated moderate sensitivity with somewhat good specificity.[11]

Yergason's Test

Yergason's test is performed with the patient standing upright with their arm at their side and the elbow flexed to 90° (Fig 5). With the forearm in full pronation, the patient is directed to supinate their forearm against the examiner's resistance. Alternatively, the patient may begin with the forearm in full supination and resist the examiner's force to pronate the forearm. A positive test is indicated by pain in the area of the bicipital tunnel or glenohumeral joint. Research has shown this test to be poorly sensitive but highly specific for BLC lesions.[10]

Empty-Can (Jobe's) Test

The empty-can test is performed with the patient standing upright and the arm forward flexed to 90° in the plane of the scapula (Fig 6). The arm, however, is internally rotated with the thumb pointing downward. The examiner applies a downward force as the patient resists. Traditionally, a positive test in the form of shoulder pain indicates supraspinatus pathology.

Full-Can Test

Similar to the empty-can, the full-can test is performed with the patient standing upright and the arm

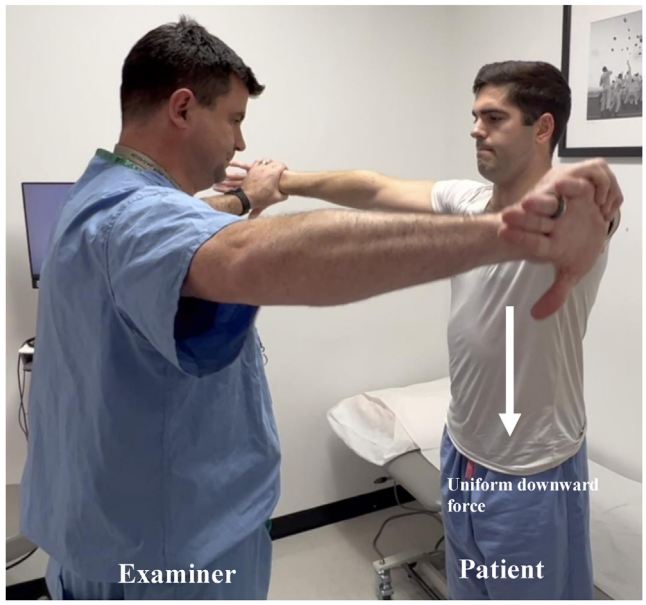

Fig 6. Photograph of examiner preforming the empty-can (Jobe's) test. The examiner applies a downward force as the patient resists with their arms forward flexed to 90° in the plane of the scapula and internally rotated with the thumbs pointing downward.

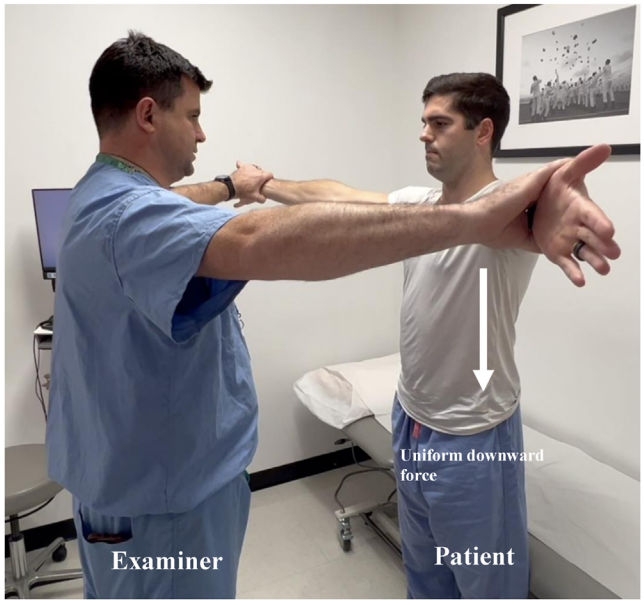

Fig 7. Photograph of examiner preforming the full-can test. With the patient's arms forward flexed to 90° in the plane of the scapula and with thumbs pointing upward, the examiner applied a uniform downward force as the patient resists.

forward flexed to 90° in the plane of the scapula (Fig 7). With the patient's fist closed and thumb pointing up, the patient resists a downward-directed force from the examiner applied through the forearm. A positive test is indicated by pain or weakness in the shoulder joint. Given the arm position, a positive full can implicates pathology along the leading edge of the supraspinatus, LHBT, and upper border of the subscapularis.

Discussion

The BLC represents the shared anatomic and clinical features of the biceps and labrum, and it has 3 anatomical zones: inside, junction, and bicipital tunnel. In their cadaveric study of glenohumeral and subdeltoid arthroscopy, Taylor et al.[3,4] defined the various BLC pathologies unique to these zones. Inside lesions include SLAP tears, anterior labrum tears, posterior labrum tears, and dynamic incarceration of the LHBT between the humeral head and glenoid. Junctional lesions include partial tears of the LHBT, biceps chondromalacia, and proximal LHBT instability from subscapularis insufficiency. Bicipital tunnel lesions include partial tears of the LHBT, painful vincula, instability, stenosis, and loose bodies (Table 1).[3] BLC disease is an important source of shoulder pain, particularly in overhead athletes who present with anterior shoulder pain, shoulder instability, and often mechanical symptoms, such as clicking and popping during the late cocking phase of the throwing motion.[12] Concomitant shoulder injuries are common in the setting of BLC pathology.

Table 1. Common Pathologies of the Three Zones of the Biceps Labrum Complex

Inside Lesions	Junctional Lesions	Bicipital Tunnel Lesions
SLAP tears	Partial LHBT tears	Partial tears of the LHBT
Anterior labrum tears	Biceps chondromalacia	Painful biceps vincula
Posterior labrum tears	Proximal LHBT instability (subscapularis insufficiency)	LHBT instability and stenosis
Incarceration of the LHBT		Loose bodies

LHBT, long head of the biceps tendon.

The reported sensitivity and specificity of the Speed's and Yergason's tests are quite variable throughout the literature. In a study of 152 patients with shoulder pain, the sensitivity and specificity for Speed's test was 32% and 75%, respectively, and the sensitivity and specificity for Yergason's was 43% and 79%, respectively.[10] In a separate study, Bennett reported Speed's test to be 90% sensitive and 13.8% specific for biceps tendinitis, SLAP lesions, and biceps avulsions when compared against arthroscopy.[9] Thus, as concluded by Holtby and Razmjou,[10] these traditional biceps examination maneuvers have variable predictive values in different populations and settings, do not change post-test probability, and are unlikely to change the pretest diagnosis. Another important examination maneuver, the dynamic labral shear test, is useful for evaluating BLC disease and specifically ruling out isolated SLAP tears. In a cohort study evaluating the labral shear test against diagnostic arthroscopy it was found to be 78% sensitive and 51% specific, with a positive predictive value and negative predictive value (NPV) of 2% and 100%, respectively. The high relative sensitivity and NPV with low specificity would suggest that a negative dynamic labral shear test can reliably rule out a SLAP lesion but a positive test cannot effectively distinguish SLAP lesions from concomitant shoulder pathologies.[11] The crank test is an additional test for labral pathology that demonstrated a 41% positive predictive value and 61% NPV, with just 56% specificity and 46% sensitivity.[13] These findings bring into question the utility of the labral shear test for diagnosing labral tears in the shoulder.[13]

In a study of 116 subjects with chronic BLC symptoms and 29 asymptomatic comparison subjects, Taylor et al.[8] evaluated 4 of the traditional examination maneuvers (Speed's test, Yergason's test, empty-can test, and full-can test) for their diagnostic utility in the identification of BLC disease. Similar to previous studies, the traditional tests were specific (75.6-100.0), but much less sensitive (15.2-67.4). In addition, these

Table 2. Pearls and Pitfalls

Pearls	Pitfalls
The active compression test (O'Brien sign) should be performed with the Dines or Taylor modification to prevent the patient from externally rotating their shoulder during the examination	Failure to control the patient's contralateral arm during the active compression test (O'Brien sign) can lead to false-negative or false-positive findings as the patient rotates the extremity of interest into the plane of the scapula
The empty- and full-can tests can help the examiner to differentiate BLC pathology (full can) from rotator cuff pathology (empty can)	Pain during the active compression test must be identified as either "inside the shoulder" or "on top of the shoulder" to distinguish between pain at the BLC versus pain at the acromioclavicular joint
During palpation of the bicipital tunnel, internal and external rotation at the shoulder can help the examiner reliably palpate the LHBT	Excessive force when palpating the bicipital tunnel may result in a false-positive examination.
Given its high NPV, a negative 3-Pack examination can effectively rule out extra-articular BLC disease	Imaging (MRI) and arthroscopy incompletely evaluates all 3 zones of the BLC; reliance on these modalities without a comprehensive examination will lead to missed pathology

BLC, biceps-labrum complex; LHBT, long head of the biceps tendon; MRI, magnetic resonance imaging; NPV, negative predictive value.

tests had widely variable inter-rater reliability with kappa coefficients from 25.4 to 56.2, indicating weak-to-moderate inter-rater reliability. In the same study, the 3-Pack examination maneuvers were found to be more sensitive (72.6-97.8) but less specific (45.7-78.8) than the traditional physical examination maneuvers.[8,12] Palpation of the bicipital tunnel and the O'Brien sign demonstrated NPVs of 96.4% and 92.6%, respectively, for lesions in the bicipital tunnel, demonstrating that these 2 components of the 3-Pack examination can very effectively rule out extra-articular bicipital tunnel disease when negative.[8,12] Given that extra-articular bicipital tunnel lesions are frequently concealed during arthroscopy,[3] examination maneuvers that can effectively identify or rule out these lesions are valuable. The 3-Pack examination also demonstrates excellent inter-rater reliability with a kappa coefficient of 71.0, 70.0, and 85.0 for the active compression test, throwing test, and bicipital tunnel palpation, respectively.[8] The 3-Pack examination has greater sensitivity, NPV, and inter-rater reliability than traditional tests, making it critical in the assessment and diagnosis of BLC disease. Pearls and pitfalls of the described physical examination maneuvers are presented in Table 2.

Orthopaedic surgeons face challenges in the diagnosis of BLC disease and its related pathologies. In general, there is no single presentation unique to BLC disease, and there is a somewhat broad differential in the assessment of anterior shoulder pain. In addition, magnetic resonance imaging and arthroscopy are limited in their diagnostic value. For these reasons, developing a reliable compendium of physical examination maneuvers is critical in the evaluation of BLC disease. Although Speed's, Yergason's, empty-can, and full-can tests have diagnostic value, the 3-Pack examination maneuvers have greater sensitivity, NPV, and inter-rater reliability. The combination of these examination maneuvers is critical in the comprehensive evaluation of anterior shoulder pathology and in the diagnosis of BLC disease.

Disclosures

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: S.A.T. reports a relationship with DJ Orthopedics that includes: consulting or advisory. All other authors (M.R.B., A.E.W., P.M.I., S.J.O.) declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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