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Diagnostic accuracy of clinical tests directed to the long head of biceps tendon in a surgical population: a combination of old and new tests

Afonso Cardoso, MD*, Pedro Amaro, MD, Luís Barbosa, MD, Ana M. Coelho, MD, Raul Alonso, MD, Luís Pires, MD

Department of Orthopaedics, Hospital Beatriz Ângelo, Loures, Portugal

Background: Our objective was to examine the clinical utility of old and new clinical tests directed to the long head of the biceps tendon (LHBT) and to quantify the importance of proper test interpretation.
Methods: A consecutive 65 patients scheduled to undergo arthroscopic surgery were selected. Before surgery, 5 clinical tests were performed: Speed, Yergason, upper cut, biceps resisted flexion (BRF), and modified BRF (mBRF) using a dumbbell. Pain in an area other than the bicipital groove was noted. The presence of LHBT disease was assessed at arthroscopy, and the clinical utility of the tests was calculated.
Results: The upper cut test was the most sensitive test and the one with the lowest negative likelihood ratio (0.90 and 0.26, respectively); the Yergason test was the most specific and the one with the highest positive likelihood ratio (0.83 and 2.20, respectively). BRF strength did not correlate with an LHBT lesion. The mBRF test has a sensitivity of 0.34 and a specificity of 0.75. Higher age predicted an increased risk of an LHBT lesion (1.2 times). Different interpretations of the tests can result in a difference of up to 29 percentage points in performance (ie, sensitivity).
Conclusion: Our results suggest that the upper cut test should be used as a screening test and that after a positive result, the Speed and the Yergason tests should be used as confirmatory tests.
Level of evidence: Level I; Diagnostic Study

Keywords: Long head of biceps tendon; shoulder tests; clinical utility; test interpretation

Disorders of the long head of the biceps tendon (LHBT) are common and often associated with other diseases of the shoulder.[4,28] As with other shoulder conditions, LHBT disease is complex and difficult to diagnose.[1] The proximal insertion of the LHBT is divided between the superior labrum and the supraglenoid tubercle, with the tendon then running intra-articularly before reaching the bicipital tunnel and its way onto the bicipital muscle mass.[21] As the tendon can be damaged anywhere along its course, this can explain why its pathologic changes can be manifested in different manners. The patient with bicipital disease traditionally presents with complaints of anterior pain, painful palpation of the proximal LHBT in the bicipital groove, pain with activities that require eccentric deceleration of the upper extremity, and pain with loading of the biceps.[8]

Approval for this study was given by Comissão de Ética para a Saúde (CES) of Hospital Beatriz Ângelo (study no. 0338), and all patients gave their consent to the study.

*Reprint requests: Afonso Cardoso, MD, Hospital Beatriz Ângelo, Av. Carlos Teixeira 514, 2674 Loures, Portugal.

E-mail address: afonso.cardoso@hbeatrizangelo.pt (A. Cardoso).

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Since our recognition of the LHBT as a source of pain and disease, which can preclude a satisfactory recovery if it is not treated conjointly with other entities, numerous clinical examination tests have been described. These tests have a sensitivity ranging from 53% to 85% and a specificity ranging from 17% to 87%.[14] As is often the case, the existence of so many tests is symptomatic of the difficulty in testing for LHBT disease. This has much to do with the coexistence of different affected shoulder structures and their close anatomic location. The traditional tests regarded as directed to the LHBT, such as the Speed and Yergason tests, have, however, shown a better performance than the others.[8] Moreover, newly described tests, such as the upper cut and the biceps resisted flexion (BRF) tests, have shown a higher accuracy than these traditional tests.[3,6] However, as these tests' clinical utility remains low, efforts have been made to group tests to improve their accuracy, although with limited results, contrasting with other shoulder conditions.[5,8,24]

From a review of the literature, a source of confusion undermining the usefulness of the clinical examination tests comes from the actual procedure of performing the test and its interpretation. As pointed out by Hanchard et al,[14] the various tests for evaluation of the LHBT have been used by some authors with various modifications and various interpretations. Other authors do not report either the procedure or the interpretation used.[14] Others consider different target conditions and reference standards to be positive results.[14]

Our objective with this study was to investigate the clinical utility of the most accurate traditional tests (Speed and Yergason tests) to diagnose LHBT tendinopathy (excluding superior labrum anterior to posterior [SLAP] lesions) along with newly described tests (the upper cut test; the BRF test as described by the authors and a modification suggested by them to simplify the test), which, to the best of our knowledge, has not been done.[3,6,8] We tested them individually, compared them, and used binary logistic regression analysis to evaluate whether any conjunction of tests resulted in a higher clinical utility. We also aimed to show the importance of the appropriate interpretation of findings. We hypothesized that a combination of tests using old and newly described tests can better predict LHBT disease.

Materials and methods

We performed a prospective clinical examination of consecutive patients scheduled to undergo arthroscopic shoulder surgery in our institution from April 2017 to August 2018. Patients were excluded from the study if they had previous shoulder surgery or previous upper extremity fractures; if they were not able to comply with the physical examination; or if there was evidence, during or before surgery, of current shoulder infection or chronic inflammatory arthritis. We identified 75 patients; 4 patients were excluded because of previous ipsilateral shoulder surgery, 4 because of previous ipsilateral shoulder fracture, and 2 for not being able to complete the physical examination. There were 65 patients included in the study (46 women and 19 men), with a mean age at surgery of 55.1 $\pm$ 1.7 years.

Of the 65 patients included in the study, 37 (56.9%) patients had surgery on the right shoulder. The dominant shoulder was affected in 37 (56.9%) patients. No patient had bilateral surgery. Ten (15.4%) patients reported that they smoked. Fifteen patients (23.1%) had diabetes mellitus. Clinical symptoms were present for a mean of 29.3 $\pm$ 2.5 months, with 57 (87.7%) patients reporting actual pain.

Patients were submitted to surgery for rotator cuff tear (52 [80%]), labral lesion (8 [12.3%]), or subacromial impingement (5 [7.7%]). Preoperative diagnoses, based on clinical and imaging data collected from the patients' clinical files, are detailed in Table I.

Preoperatively, every patient was evaluated by a single examiner (A.C.) who was unaware of the preoperative clinical and imaging data; this examiner registered the evaluation results before surgery and did not take part in it afterward. During the evaluation, 5 tests were performed: Speed test, Yergason test, upper cut test, BRF test, and modified BRF (mBRF) test. A modification of the BRF test as suggested by Arrigoni et al[3] was introduced because this modification was, to our knowledge, never tested and we believed that it would greatly simplify the clinical examination of patients while maintaining its usefulness.

The Speed test was performed by having the patient forward flex the shoulder to 90° with the elbow extended and the forearm supinated. Resistance was applied to the forearm, and a positive result was recorded if pain was localized to the bicipital groove.[10] Pain in another area was noted as inconclusive.

The Yergason test was performed with the patient's elbow flexed to 90° and stabilized against the thorax; with the forearm pronated, the examiner resisted supination. A positive test result was indicated by pain localized to the bicipital groove.[29] Pain in another area was noted as inconclusive.

The upper cut test was performed with the involved shoulder in a neutral position, the elbow flexed to 90°, the forearm supinated, and the patient making a fist. The patient was asked to rapidly bring the hand up and toward the chin. The examiner placed a hand over the patient's fist and resisted the motion as the hand came up to the chin. A positive test result was pain or a painful pop over the anterior portion of the involved shoulder during the resisted movement.[6] Pain in another area was noted as inconclusive.

The BRF test was performed with the patient seated with the arm at the side, the elbow at 90° of flexion, and the forearm in neutral pronation-supination. The patient was asked to flex the affected limb against the resistance of a dynamometer and to maintain the maximal resistance for 5 seconds. A digital dynamometer (Dr. Meter, ES-PS01) linked to the ground was used to record BRF strength as originally described.[3] Considering the BRF measure a dichotomic variable, the test result was considered positive if the patient was unable to maintain a force of 1.1 kg for 5 seconds.[3]

The mBRF test was performed with the patient seated with the arm stabilized against the thorax and the forearm in neutral pronation-supination. The patient was asked to lift a 1.1-kg weight (dumbbell) to 90° of elbow flexion and to hold it for 5 seconds. The test result was considered positive if the patient felt pain

Table I Description of preoperative diagnosis

Diagnosis	No. of patients
Rotator cuff lesion*	58
LHBT lesion*	34
Pulley lesion	6
SLAP lesion	3
Subacromial impingement	48
Labral injury	11
AC arthritis	33

LHBT, long head of biceps tendon; *SLAP*, superior labrum anterior to posterior; *AC*, acromioclavicular.
* Tendinopathy included.

Table II Description of surgical findings of long head of biceps tendon (*LHBT*) and pulley

Finding	No. of patients (%)
Normal LHBT	24 (36.9)
Abnormal LHBT	41 (63.1)
Complete tear	5 (12.2)
Intra-articular lesion	36 (87.8)
Tendinopathy	14 (38.9)
Disruption < 50%	8 (22.2)
Disruption ≥ 50%	14 (38.9)
Pulley	
Normal	52 (80.0)
Lesion	13 (20.0)
Medial sling	9 (69.2)
Complete	4 (30.8)

Percentages are according to group.

localized to the bicipital groove region.[3] Pain in another area was noted as inconclusive.

The main location of pain and pain in the bicipital groove to palpation were also noted. The bicipital groove was palpated with the shoulder in external rotation (hand supinated) as the examiner tried to feel and to palpate the humeral tuberosities and, subsequently, the bicipital groove in an area that is 1 fingerbreadth medial and distal to the midway point between the coracoid and the lateral limit of the arm (2-4 cm lateral to the coracoid). The clinical examination was conducted a mean of 2.1 ± 0.3 (0-7) days before surgery.

Surgery was conducted by 1 of 2 senior surgeons who were blinded to the test results. At the end of the operation, as it is general practice, the surgeon described every lesion found during the operation and the procedures performed, per protocol. Surgery was performed in a lateral decubitus or a beach chair position, according to the surgeon's preference.

During the diagnostic phase of arthroscopy, LHBT disease was assessed through the posterior portal. LHBT disease was classified as complete tear or intra-articular lesions (from 0.5 cm distal to the biceps anchor to the most distal portion of tendon visualized after the pull test, thus excluding SLAP lesions), subclassified as tendinopathy, disruption of <50% of tendon thickness, or disruption of >50% of tendon thickness. Tendinopathy was diagnosed by an inflamed or frayed appearance of the LHTB.[25] Pulley lesions were diagnosed when they resulted in LHBT instability, subclassified as lesions involving the medial sling, the lateral sling, or complete lesions. Other diagnoses of interest were supraspinatus and infraspinatus partial and complete tears (classified as described by Cofield as small, <1 cm; medium, 1-3 cm; large, 3-5 cm; and massive, >5 cm), subscapularis tears (complete or partial), SLAP lesions (Snyder types I-IV), and subacromial impingement.[11,26]

Regarding the statistical analysis, we considered inconclusive test results negative as well as positive on separate analysis. Thus, we present test results with a "strict" interpretation, whereby inconclusive test results were considered negative, and a "loose" interpretation, whereby inconclusive responses were considered positive. The target condition was a lesion of the LHBT, either a complete tear or an intra-articular lesion, as described. For all clinical tests, we calculated the number of true positives, true negatives, false positives, and false negatives to determine sensitivity, specificity, accuracy, positive predictive value, negative predictive value, positive likelihood ratio (LR+), and negative likelihood ratio (LR–) using 2 × 2 tables. We calculated likelihood ratios as these are not affected by disease prevalence and reflect the probability of a disease being present. Data normality was tested using the Kolmogorov-Smirnov test. Continuous variables were presented as the mean (± standard deviation). To analyze them, the Student *t*-test or Mann-Whitney test was used, according to the data distribution. The proportions were expressed for nominal variables. To compare them, we used the Pearson χ^2 test or the Fisher exact test, according to the data distribution. The Monte Carlo correction was applied where needed. The cutoff for the BRF test was retested with a receiver operating characteristic curve analysis. A binary logistic regression model was used to predict an arthroscopically confirmed LHBT lesion (including tendinopathy) from physical examination tests and the collected clinical data. A P value < .05 was considered significant. The statistical analysis was done with SPSS version 20 (IBM, Armonk, NY, USA).

Results

During arthroscopy, we found 41 (63.1%) patients with an LHBT lesion, mainly consisting of a partial rupture (Table II). Pulley lesions were not related to LHB lesions (P = .139). Other lesions are detailed in Table III. There were no cases of arthritis or adhesive capsulitis.

The mean age of patients without an LHBT lesion was 46.7 ± 3.5 years; in those with a lesion, it was 60.1 ± 1.2 years (P = .001). Regarding sex (P = .262), surgical laterality (P = .225), arm dominance (P = .527), dominant arm surgery (P = .225), smoking status (P = .479), diabetes mellitus (P = .348), duration of symptoms (P = .610), and presence of pain and whether it was anterior (P = .134 and P = .487, respectively), there was no relation to the presence of an LHBT lesion.

Pain localized in the bicipital groove region was present in 37 (56.9%) patients. Painful palpation of the bicipital groove demonstrated sensitivity of 0.73, specificity of 0.42, accuracy of 61.5%, positive predictive value of 0.68,

Table III Description of other surgical findings

Finding	No. of patients (%)
Supraspinatus and infraspinatus lesions	52 (80.0)
Tendinopathy	2 (3.8)
Partial tear	8 (15.4)
Small tear	11 (21.2)
Medium tear	17 (32.7)
Large tear	6 (11.5)
Massive tear	8 (15.4)
Subscapularis lesion	23 (35.4)
Tendinopathy	8 (34.8)
Partial tear	13 (56.5)
Complete tear	2 (8.7)
SLAP lesion	22 (35.4)
Type I	10 (45.45)
Type II	10 (45.45)
Type III	2 (9.1)
Labral lesion	13 (20.0)
Subacromial impingement	47 (72.3)

SLAP, superior labrum anterior to posterior.
Percentages are according to group.

negative predictive value of 0.48, LR+ of 1.254, and LR– of 0.644.

Although test properties such as sensitivity and specificity are widely published, these do not have a straightforward application in a clinical setting. For the clinician conducting clinical tests, LR+ and LR– give a better understanding of how likely the disease is to be present in patients with different pretest probabilities of the disease. Whereas LR+ higher than 10 and LR– lower than 0.1 are the most useful in changing the probability of a disease's being present, tests with intermediate values up to 1 reflect progressively less capability of the test to do so.[17]

A detailed description of clinical utility of each test is presented in Table IV. As detailed before, we present a strict and a loose interpretation of each test according to the location of pain. No test was able to differentiate between the various subtypes or grades of lesions.

For the detection of an LHBT injury, considering strict interpretation of the tests, the tests that demonstrated better sensitivity were the Speed and the upper cut tests (0.61), whereas the Yergason test was the most specific (0.83). A loose interpretation of the tests gave higher sensitivity (upper cut test, 0.90) but lower specificity (mBRF, 0.71). The tests with higher LR+ were the Speed and the Yergason tests (2.09 and 2.20, respectively; strict interpretation). Conversely, loose interpretation gave the lowest LR– of 0.26 for the upper cut test.

BRF strength was 7.8 (2-16) kg in patients without an LHBT lesion and 7.1 (1-27) kg in patients with a lesion, a nonsignificant difference ($P = .763$). In our sample, only 1 patient was unable to sustain a force of >1.1 kg for 5 seconds. A receiver operating characteristic curve analysis resulted in an area under the curve of 0.478, which did not allow determination of a cutoff point for the test.

Interestingly, of the 5 patients with complete ruptures of the LHBT, none had completely negative results of the examination tests. All of them had a non-negative (positive or inconclusive) upper cut test result, 3 had non-negative Speed and mBRF test results, and 2 had non-negative Yergason test results.

A logistic regression was performed to ascertain the utility of the clinical tests (Speed, Yergason, upper cut, and mBRF tests and their different interpretations) in the prediction of an LHBT lesion (Table IV). In the model, strict interpretations were more helpful for the Speed and Yergason tests, whether the opposite happened to the upper cut and the mBRF tests, and so the other interpretations were dropped. The logistic regression model was statistically significant (χ^2 [4] = 10.724; $P = .030$). The model explained 20.8% (Nagelkerke R^2) of the variance in having an LHBT lesion and correctly classified 72.3% of cases. Regarding other parameters, age was also shown to positively predict an LHBT lesion (χ^2 [1] = 16.481; $P < .001$) so that for each year increase in age, the risk of an LHBT lesion increased by 1.2 times ($P = .002$; 95% confidence interval, 1.036-1.174).

Discussion

Shoulder complaints continue to be common in primary and secondary care settings.[2,20] The myriad different clinical conditions affecting the shoulder girdle and its close anatomic relationships make the evaluation of a painful shoulder a traditionally challenging one. The patient's history and clinical examination are of paramount importance in the diagnostic process, but concerning the shoulder, accuracy is often lacking because most complaints are manifested with similar signs and symptoms.[4] The interplay between impingement syndromes, rotator cuff tears, instability, labroligamentous lesions, and biceps tendon disease is such that a diagnosis often cannot be made without requiring imaging modalities, and even so, there is often uncertainty.[4,23] Nonetheless, it does not mean that clinical examination should be ignored altogether, as it can preclude other investigations and lead to a better outcome by ensuring that patients receive appropriate and timely treatment and correct information about their prognosis.

LHBT lesions could have an incidence as high as 66% in patients with shoulder pain and can be present in up to 90% of rotator cuff tears.[12,22] Pulley lesions also add complexity in this setting, and although we did not find a correlation between LHBT lesions and pulley lesions, other authors have.[9,19] In this context, there have been different proposed classifications for pulley lesions and associations have been found, such as between pulley lesions and a greater width of the LHBT, LHBT tears, subluxation or dislocation of the

Table IV Diagnostic reliability of clinical tests to detect long head of biceps tendon lesions

	Speed test*		Yergason test*		Upper cut test*		mBRF test*	
	Strict	Loose	Strict	Loose	Strict	Loose	Strict	Loose
Sensitivity	0.61	0.83	0.37	0.46	0.61	0.90	0.34	0.49
Specificity	0.71	0.33	0.83	0.54	0.63	0.38	0.75	0.71
Accuracy	0.65	0.65	0.54	0.49	0.62	0.70	0.49	0.57
PPV	0.78	0.68	0.79	0.63	0.74	0.71	0.70	0.74
NPV	0.52	0.53	0.43	0.37	0.48	0.69	0.40	0.45
LR+	2.09	1.24	2.20	1.01	1.63	1.44	1.36	1.67
LR–	0.55	0.51	0.76	0.99	0.62	0.26	0.88	0.72
BLR *P* value	.013	.133	.088	.968	.067	.007	.441	.121

mBRF, modified biceps resisted flexion; *PPV*, positive predictive value; *NPV*, negative predictive value; *LR+*, positive likelihood ratio; *LR–*, negative likelihood ratio; *BLR*, binary logistic regression.

* Pain in an area other than the bicipital groove region was considered inconclusive; a strict interpretation of the test considers this a negative result, in contrast to a loose interpretation, which considers this a positive result.

tendon, SLAP tears, and rotator cuff tears, including subscapularis tears.[9,13,19]

Various authors have investigated the role of different tests in identifying LHBT tendon disease, such as the active compression test of O'Brien, anterior slide test, bear-hug test, belly-press test, BRF test, modified dynamic labral shear test, palm-up test, Speed test, upper cut test, and Yergason test.[3,6,14] If we also consider SLAP lesions, the list grows even more. Among these tests, the ones with a higher clinical utility for LHBT tendon disease are the Speed and Yergason tests, whereas others have been proven to better predict other entities.[3,6,8,14]

As stated, an important problem of research on the utility of clinical tests comes from the studies' heterogeneity regarding target conditions, the actual procedure of performing the tests, and its interpretation. In this study, we tried to clearly define our target condition as an LHBT lesion. We did not differentiate between tendinopathy and an actual rupture of the tendon as we think both will lead to the same clinical manifestation, even though the treatment can be different. The tests were performed by the same observer to make sure they were executed in the same manner, with the inherent drawback of preventing a between-tester agreement analysis.

Regarding the test results, we are aware of the clinical difficulty in interpreting patients' complaints and of correctly classifying test results as positive or negative when the response is ambiguous. As such, we differentiated between clearly positive, clearly negative, and ambiguous responses (pain in an area other than the bicipital groove region). Although it can be intuitive that such responses and the conclusions taken after them can have an impact on the tests' accuracy, the actual extent of such an impact has not been demonstrated to our knowledge.

Regarding the Speed test, Bennet[7] initially reported a sensitivity of 0.90 and a specificity of 0.13, whereas Iagnocco et al[16] found a sensitivity of 0.87 and a specificity of 0.80 and Kibler et al[6] found a sensitivity of 0.55 and a specificity of 0.81. A contrast between the studies available in the literature is evident, with our study showing intermediate values of 0.61 and 0.71 for sensitivity and specificity, respectively. In our study, being strict in what concerns the interpretation of this test resulted in a higher clinical utility. It is worth noting a drop of 38 percentage points in the test's specificity or a drop of 0.85 in the LR+ if we had considered pain in an area other than the bicipital groove. The LR+ of the test (2.09) was second only to the Yergason test.

The Yergason test was found to have a sensitivity between 0.43 and 0.74 and a specificity between 0.58 and 0.79.[6,8,15] In our study, the strict interpretation of the test, deemed more useful, resulted in a slightly lower sensitivity (0.37) but with a higher specificity (0.83, the highest in this analysis). More important, this test also showed the highest LR+ (2.20).

Of the new tests, the upper cut test, described by Kibler et al,[6] has shown a better clinical utility than the traditional tests. In their original description, the investigators reported a sensitivity of 0.77 and a specificity of 0.80 and argued that both the position of the humerus during testing and the overall testing procedure are responsible for the superior results. In their view, the fact that the test requires a concentric activation of the biceps combined with a forward motion, leading to movement of the tendon in the bicipital groove, leads to a better performance of the test. In our study, the upper cut test seemed more helpful if a loose interpretation of complaints was made, meaning that pain in an area other than the bicipital groove should also be considered a positive test result. This, with the inherent drawback of lowering its specificity (0.38), made the test highly sensitive (0.90), with an LR– of 0.26.

The BFR test, described by Arrigoni et al,[3] initially showed a sensitivity of 0.60 and a specificity of 0.88, and they reported a significant difference in strength between patients with and patients without an LHBT lesion. In their study, they stressed the advantage of the ability of the test to provide an objective measure and that the position of the arm reduces any confounding pain from rotator cuff disease. In contrast, we did not find such a difference and could not set a cutoff point to differentiate between such patients. We conclude that further studies are needed to determine the usefulness of this test.

On the other hand, Arrigoni et al[3] also suggested that the dichotomic version could be applied without the need of a dynamometer. In our study, we investigated whether lifting a weight of 1.1 kg would result in a useful clinical test and found a sensitivity of 0.34 and a specificity of 0.75. Although it can appear to have some utility, it does not seem superior to traditional and extensively studied tests like the Speed and Yergason tests, and so, in our opinion, no recommendation can be made until further studies are conducted.

In the literature, no combination of tests has been convincingly shown to be able to predict LHBT disease.[6,8] As mentioned, in our binary logistic regression model, only the Yergason and the upper cut tests significantly contributed to it. With the diagnostic characteristics of the tests found in this study, it seems that the best use of these tests is for the upper cut test to be a rule-out test when the result is negative (high sensitivity, 0.90; low LR–, 0.26) and for the Speed and Yergason tests to be confirmatory (high specificity, 0.71 and 0.83; high LR+ of 2.09 and 2.20, respectively).

Finally, regarding the effect of the interpretation of the tests, this study shows how much more specific tests become by strictly classifying them (as stated about the Speed test), with the inherent loss of sensitivity (ie, 29 percentage points in the upper cut test). A loose interpretation has the opposite effect of increasing the sensitivity and lowering the specificity.

Regarding other evaluations, simple palpation of the bicipital groove, which yields a higher test accuracy than the Yergason test, for example (61.5% vs 54%), should not be disregarded altogether. Of other clinical parameters, age was the only one associated with a higher prevalence of an LHBT lesion, in accordance with other studies.[3,12]

To further compound the issue, a systematic review concluded that arthroscopy visualizes only a small part of the extra-articular LHBT tendon, with a considerable rate of missed disease.[18] Taylor et al[27] found that 18% of LHBT lesions were confined to the bicipital tunnel and hidden from arthroscopic visualization, even after the pull test. As the majority of published statistics for sensitivities and specificities of physical examination and imaging tests for LHBT disease are based on arthroscopy as the "gold standard," such as is the case with our study, these numbers are possibly under-rated.[18]

As a limitation of our work, the fact that the study was conducted in a hospital, in a preoperative setting, can hamper the applicability of the results to the primary care setting, where they would be, perhaps, most helpful. A gold standard to evaluate nonsurgical patients is still missing, which puts a great limitation on the selection of patients, and therefore it has to be taken into account that the patients included in the study might not be representative of the general population of patients with shoulder pain and possible LHBT disease. This population of patients had a degree of disease that warranted surgery, and most of them did not have isolated bicipital disease. Another limitation is that all the tests were performed by a single examiner, one single time, which precludes intraobserver and interobserver analysis. We excluded SLAP lesions because we believe that they have a different pathophysiologic mechanism and express themselves differently clinically.

Conclusion

Our results suggest that the upper cut test should be used as a screening test (loose interpretation) and that after a positive result, the Speed and Yergason tests should be used as confirmatory tests (strict interpretation).

Disclaimer

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