

The Crank Test, the O'Brien Test, and Routine Magnetic Resonance Imaging Scans in the Diagnosis of Labral Tears*

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Background: Tears of the superior labrum of the shoulder, anterior to posterior, are difficult to diagnose clinically.

Purpose: We examined whether the crank or O'Brien tests were reliable tools for detecting glenoid labral tears.

Study Design: Nonrandomized prospective study.

Methods: Results of diagnostic shoulder arthroscopy were compared with those of the preoperative tests and magnetic resonance imaging for 65 patients who had symptoms of shoulder pain.

Results: The crank test result was positive in 29 patients (45%), and the O'Brien test was positive in 41 patients (63%). The crank test had a positive predictive value of 41%, was 56% specific, 46% sensitive, and had a negative predictive value of 61%. The O'Brien test had a positive predictive value of 34%, was 31% specific, 54% sensitive, and had a negative predictive value of 50%. Magnetic resonance imaging had a positive predictive value of 63%, was 92% specific, 42% sensitive, and had a negative predictive value of 83%.

Conclusions: The O'Brien and crank tests were not sensitive clinical indicators for detecting glenoid labral tears and other tears of the anterior and posterior labrum. Results were often falsely positive for patients with other shoulder conditions, including impingement or rotator cuff tears.

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Tears of the anterior superior portion of the labrum of the shoulder in the area of the biceps muscle anchor insertion were first described in 1985 by Andrews et al.¹ in a clinical review of 73 athletes injured during throwing activity. Snyder et al.¹² coined the term "SLAP lesion" (superior labrum, anterior to posterior) in their 1990 report. Although SLAP lesions are uncommon, they can be a source of significant disability. Snyder et al. described four different types, with type II SLAP lesions being the most common (Table 1). In a previous study of isolated SLAP lesions and other tears of the glenoid labrum, we found no sensitive clinical test for their detection.¹³ The symptoms of SLAP lesions can mimic those of impingement syn-

drome, pathologic conditions of the rotator cuff or the acromioclavicular joint, or other shoulder disorders.¹³ In 1996, Liu et al.⁷ described the crank test and found it to be 91% sensitive in detecting glenoid labral tears, including SLAP lesions. O'Brien et al.⁹ described the active compression test, the so-called "O'Brien test," to clinically diagnose labral tears and pathologic conditions of the acromioclavicular joint. Of 56 patients who had a positive O'Brien test result and underwent a subsequent operation, 53 (95%) were found to have a labral tear.⁹

Both the crank and the O'Brien tests have been touted as new diagnostic tests that are sensitive clinical indicators of glenoid labral tears and pathologic conditions of the superior labrum of the shoulder. The purpose of this study was to compare the use of these two tests to detect pathologic conditions of the labrum of the shoulder in a group of patients who had shoulder pain.

MATERIALS AND METHODS

In a nonrandomized prospective study, we examined 65 patients, 45 men and 20 women with an average age of

* Presented as a poster presentation at the American Academy of Orthopaedic Surgeons 67th annual meeting, Orlando, Florida, March 2000, and at the American Shoulder and Elbow Society specialty day meeting, Anaheim, California, February 1999.

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No author or related institution has received any financial benefit from research in this study.

TABLE 1
Snyder Classification of SLAP Lesions¹²

Type	Description
I	Superior labrum has marked fraying with a degenerative appearance, but the peripheral labral edge remains firmly attached to the glenoid, and the attachment of the biceps tendon to the labrum is intact.
II	Fraying and degenerative changes similar to those of type I. The superior labrum and attached biceps tendon are stripped off the underlying glenoid.
III	A bucket-handle tear in the superior labrum. The central portion of the tear is displaceable into the joint, while the peripheral portion of the labrum remains firmly attached to the underlying glenoid and to the biceps tendon, which also remains intact.
IV	Bucket-handle tears of the superior labrum similar to those of type III, but the tear extends into the biceps tendon. The biceps tendon has an attached partial tear that tends to displace with the labral flap into the joint.

45.9 years (range, 18 to 75), for initial symptoms of shoulder pain. The average duration of the patients' symptoms before examination was 12 months (range, 3 days to 10 years). The right shoulder was involved in 41 patients and the left in 24; the dominant side was involved in 45 shoulders and the nondominant in 20. Forty-eight patients had associated night pain, 44 had pain with activities that placed the arm in the overhead position, and 40 had mechanical symptoms such as popping, catching, or locking of the shoulder. The mechanisms of injury included falls (17), lifting a heavy object (16), a direct blow (5), a repetitive overhead activity (5), motor vehicle accidents (3), a traction injury (1), a pulling injury (1), or there was an insidious onset (17).

The senior author (WBS) performed a complete shoulder examination that included the crank test and the O'Brien test. On physical examination, 61 patients had a positive impingement I (Neer) test, 57 had a positive impingement II (Hawkins) test, 25 had associated subacromial crepitus, 35 had a positive supraspinatus test, and 39 had a positive biceps tension test (Speed). Twenty-two patients had a positive anterior apprehension test and 13 had a positive relocation test. Twenty-seven patients had tenderness at the acromioclavicular joint and also had a positive crossover adduction test.

The crank test was performed with the patient in the upright or supine position. The shoulder was elevated 160° in the scapular plane, an axial load was applied by the examiner, and the humerus was internally and externally rotated. Pain elicited during this test, typically with external rotation, was a positive indication for a pathologic condition of the labrum and was found in 29 patients. Also, a click may or may not be felt that reproduces the patient's symptoms of pain or catching.⁷

The O'Brien test was performed with the patient in the upright sitting position. The shoulder was elevated 90° with the arm in full extension. The arm was then adducted 10° and internally rotated with the thumb pointed downward. A downward force was applied to the arm by the examiner. This force was repeated with supination of the arm. Pain or clicking inside the joint with this test was

a positive indicator for a labral or SLAP tear. Pain elicited on the top of the shoulder at the acromioclavicular joint indicated a pathologic condition of the acromioclavicular joint.⁹ The O'Brien test result was positive in 41 patients.

The 65 patients underwent a minimum of 3 months of nonoperative treatment that included rest, physical therapy, use of nonsteroidal antiinflammatory drugs, and a subacromial cortisone injection when indicated for isolated subacromial bursitis or a partial rotator cuff tear. Twenty-three patients received a subacromial injection of cortisone (80 mg), but it relieved symptoms in only five patients. The nonoperative therapy was unsuccessful, and surgery was indicated.

Magnetic resonance imaging was performed on 49 patients according to a standard protocol with use of a 1.5-T magnet and a dedicated shoulder coil. No intravenous or intraarticular gadolinium was used in any of the scans. Sixteen patients elected not to undergo an MRI scan because of the added expense.

Diagnostic shoulder arthroscopy with a complete 15-point glenohumeral examination was performed on all 65 patients. Special attention was directed at the glenoid labrum and biceps anchor insertions for any evidence of a significant pathologic condition of the labrum, and all results were recorded. Slight fraying of the superior labrum consistent with a type I SLAP lesion was considered a normal variant. Fraying of the anterior and posterior labrum was also considered a normal variant. All other superior labral tears were considered pathologic and were either type II, type III, type IV, or complex SLAP lesions that were a combination of types II, III, and IV (Table 1). Tears of the anterior and posterior labrum were also recorded.

RESULTS

Intraoperatively, the biceps tendon was normal in 53 patients, was partially torn in 9 patients, and completely torn in 3. There were 25 complete and 21 partial tears of the rotator cuff, and 19 rotator cuffs were normal. The anterior labrum was normal in 55 patients and torn in 10 patients; the posterior labrum was normal in 62 patients and torn in 3 patients. Both the anterior and posterior labrum were torn in one patient. There were nine type II SLAP lesions, and one patient had a type II SLAP lesion and a posterior labral tear. One patient had a type IV SLAP lesion along with a tear of the anterior and posterior labrum, and one patient had a type IV SLAP lesion and an anterior labral tear. Fifty-eight patients had significant inflammation of the subacromial space that required arthroscopic subacromial decompression, and seven had no evidence of bursitis.

The result of the crank test performed during the physical examination was positive in 29 patients; of these, 12 (41%) had evidence of tears of the glenoid labrum seen during the diagnostic shoulder arthroscopic procedure (Table 2). Of the 17 patients who had a positive crank test but no signs of a pathologic condition of the labrum, all had evidence of bursitis in the subacromial space and 13 had either a full-thickness (7) or partial-thickness (6) ro-

TABLE 2
Summary of Physical Examination Findings and
Arthroscopic Findings

Test result	Number of patients
Crank test	
True positive	12
False positive	17 ^a
True negative	22
False negative	14
O'Brien test	
True positive	14
False positive	27 ^b
True negative	12
False negative	12

^a All 17 patients had evidence of bursitis in the subacromial space, 13 had either a full-thickness (7) or partial-thickness (6) rotator cuff tears.

^b Twenty-six patients had evidence of bursitis in the subacromial space and 20 had either full-thickness (9) or partial-thickness (11) rotator cuff tears.

tator cuff tear. Thus, the crank test had a positive predictive value of 41%, was 56% specific, 46% sensitive, and had a 61% negative predictive value.

The O'Brien test results were positive for a labral tear with pain localized inside the shoulder in 41 patients (63%); 14 of these (34%) had arthroscopic evidence of tears of the glenoid labrum (Table 2). Of the 27 patients who had a positive O'Brien test but no pathologic condition of the labrum, 26 had evidence of bursitis in the subacromial space and 20 had either a full-thickness (9) or a partial-thickness (11) rotator cuff tear. The O'Brien test had a positive predictive value of 34%, was 31% specific, 54% sensitive, and had a negative predictive value of 50%.

Of the 49 patients who underwent MRI before surgery, 10 (20%) had MRI evidence of a labral tear, and 7 (70%) had tears of the glenoid labrum seen during the diagnostic arthroscopic procedure. Preoperative MRI had a positive predictive value of 63%, was 92% specific, 42% sensitive, and had a negative predictive value of 83%.

When a positive MRI test result was combined with a positive O'Brien test result, the positive predictive value increased to 71% and specificity to 82%, but the sensitivity was still low at 50%. A positive MRI combined with a positive crank test increased the positive predictive value to 60% and the specificity to 67%, but the sensitivity remained low at 43%.

DISCUSSION

The biceps tendon and the superior labral complex play an important stabilizing role in the shoulder joint.^{6,10,11} Glenoid labral tears, including superior labral tears and other pathologic conditions involving the biceps muscle anchor and insertion, are difficult to diagnose preoperatively. A comprehensive look at the patient's history may reveal trauma, in particular a fall on an outstretched hand or a fall directly on the shoulder. However, other patients, including athletes, may have no specific history of a particular injury but rather only repetitive overhead arm activities that constitute a traction mechanism of injury.

Patients also may report mechanical symptoms of the shoulder that include clicking, popping, or catching.

Clinical tests to detect glenoid labral tears of the shoulder have been described by various authors, and each has considered their test to be a sensitive indicator of a superior labral pathologic condition.^{3-5,7,9} Unfortunately, there has been no verification or duplication of such results by any independent examiners. We examined two of these tests to determine whether the authors' results could be duplicated.

On physical examination, patients with superior and other labral pathologic conditions may have symptoms that mimic impingement, instability, pathologic conditions of the rotator cuff, and even those of the acromioclavicular joint. In a recent retrospective review of isolated SLAP lesions of the shoulder, no clinical test was found that was sensitive in detecting superior labral tears.¹³ In that study, more than half of the patients had clinical signs of impingement and a rotator cuff tear, but no evidence of bursitis or a rotator cuff tear at the time of diagnostic shoulder arthroscopy. In addition, more than a third of patients with isolated SLAP tears had pain in the apprehension position, mimicking anterior instability, but had a negative relocation test.¹³ Another retrospective review showed that superior labral tears may also mimic pathologic conditions of the acromioclavicular joint.² Fifteen patients who had continued pain after an open Mumford procedure later were found to have superior labral tears with diagnostic arthroscopy.²

Both the crank test and the O'Brien test were described in the initial clinical reports as sensitive clinical indicators of glenoid labral lesions, with a greater than 90% sensitivity.^{7,9} However, in the current study, neither the crank test nor the O'Brien test enabled us to accurately predict or diagnose labral tears. By definition, a sensitive test is a good screening method because it identifies most people who have the condition in question. In this study, neither the crank test nor the O'Brien test had a sensitivity value greater than 54%, and MRI was even less sensitive for detecting labral lesions, with a sensitivity of 42%. Therefore, none of these tests can be recommended as a screening test for glenoid labral tears. When a positive MRI test was combined with a positive crank or O'Brien test, there was no appreciable increase in sensitivity.

By definition, a specific test is a good diagnostic method because it identifies most of the people who do not have the condition in question. However, the crank and O'Brien tests had low rates of specificity. Magnetic resonance imaging, however, was found to be very specific in ruling out patients who do not have a superior labral tear, with a specificity of 92%, compared with 31% for the O'Brien test and 56% for the crank test. When a positive MRI result was combined with a positive O'Brien test result, the specificity increased to 82%. A positive MRI scan with a positive crank test result increased the specificity to 67%.

It is important to note the difference between the characteristics of our patient population and that of Liu et al.⁷ in their article describing the crank test. The average age in our study group was significantly higher than that of their patient population (45.9 years compared with 28).

We also included patients with a rotator cuff tear in our study group: 25 patients with a full-thickness rotator cuff tear and 21 with a partial tear (71%). Liu et al. eliminated most patients with a rotator cuff tear from their study group, and only 10 had a partial-thickness rotator cuff tear. This difference may have influenced the results because sensitivity and specificity of the tests may change in a patient population such as ours that has more degenerative pathologic conditions of the shoulder. The crank test may be more sensitive in a select group of younger patients without rotator cuff tears. Further studies of a younger patient population are needed.

Recently, the biceps load test II has also been described as an effective diagnostic test for SLAP lesions.⁴ In a prospective, double-blind study of 127 patients, the biceps load test II had a sensitivity of 89.7%, a specificity of 96.9%, and a positive predictive value of 92.1%. In 1999, the biceps load test I was also described as a sensitive test for SLAP lesions in patients with recurrent anterior shoulder dislocations.⁵ However, as with the crank test and the O'Brien test studies, these studies were performed by the same authors who originally described the test, a possible cause of bias in the study design. Just as independent examiners have not validated the O'Brien and crank tests, neither have they done so for the biceps load test II.

Kibler³ described the "anterior slide test," a method of applying an anteriorly and superiorly directed force to the glenohumeral joint, for detecting superior labral lesions. McFarland et al.⁸ recently reported on the clinical assessment of three common tests for detecting superior labral anterior-posterior (SLAP) lesions. They found that the anterior slide test had a sensitivity of only 8%, was 84% specific, had a positive predictive value of only 5%, and a negative predictive value of 90%. Kibler had originally described a sensitivity of 78.4% and a specificity of 91.5%.

McFarland et al. also reported on the "active compression test" or O'Brien test for detecting SLAP lesions and found a sensitivity of 47%, specificity of 55%, a positive predictive value of 10%, and a negative predictive value of 91%. We found a similar sensitivity of 54%, with a specificity of only 31%. Therefore, at this time, we cannot

recommend the active compression test as a good screening test because it only detects SLAP lesions in 47% to 54% of cases.

Labral lesions of the shoulder are difficult to diagnose clinically and patients may have symptoms that mimic or accompany other pathologic conditions of the shoulder, so it is important to maintain a high index of suspicion. Other diagnostic modalities, such as MRI scanning with intraarticular gadolinium, may prove helpful in obtaining an accurate diagnosis. However, at this time, when non-operative measures have failed, we believe that accurate and complete diagnostic arthroscopy of the shoulder is the standard procedure for detecting SLAP lesions and other pathologic conditions of the labrum.

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