

# Biceps Load Test: A Clinical Test for Superior Labrum Anterior and Posterior Lesions in Shoulders With Recurrent Anterior Dislocations

Seung-Ho Kim,\* MD, Kwon-Ick Ha, MD, PhD, and Kye-Young Han, MD

*From the Department of Orthopaedic Surgery, Sungkyunkwan University, College of Medicine, Samsung Medical Center, Seoul, Korea*

## ABSTRACT

We describe the biceps load test for evaluating the integrity of the superior glenoid labrum in shoulders with recurrent anterior dislocations. With the shoulder in an abducted, externally rotated position and the forearm supinated, active flexion of the elbow against resistance relieves the discomfort of a standard apprehension test for anterior shoulder instability. A group of 75 patients with proven unilateral anterior shoulder dislocations were prospectively examined in a double-blind fashion with arthroscopic examination and the biceps load test. Sixty-three patients had a negative test and 62 of these had an intact biceps tendon-superior labrum complex; the remaining patient had a type II superior labral anterior and posterior lesion. Twelve patients had positive tests, and 10 had superior labral lesions; the other 2 patients had intact superior labra. Therefore, the biceps load test revealed a sensitivity of 90.9%, a specificity of 96.9%, a positive predictive value of 83%, a negative predictive value of 98%, and a kappa coefficient of 0.846.

The superior labral lesion is a well-documented pathologic finding that occurs in the superior portion of the glenoid labrum. Snyder et al.<sup>18</sup> described four types of superior labral lesions and called them superior labral anterior and posterior (SLAP) lesions. The main symptom in patients with SLAP lesions is nonspecific posterior shoulder pain

that often increases during activities with the arm in the overhead position. A painful popping and a sense of looseness in the shoulder, as well as some positive impingement signs, are also common in these patients. Because the biceps tendon attaches to the superior labrum and the supraglenoid tubercle of the glenoid, its detachment with the superior labrum from the anchorage can cause the loss of some functions in terms of glenohumeral stability. The results of arthroscopic debridement of the type II SLAP lesions are not satisfactory. For this reason, repair of the unstable SLAP lesion (type II) is recommended.<sup>1,2,6,13,16,19,21</sup> The SLAP lesion can occur as an isolated lesion or be combined with the Bankart lesion in patients with recurrent anterior shoulder dislocations.<sup>10,18,21</sup> It can be a continuum of a tear of the antero-inferior labrum from the anterior margin of the glenoid to the superior labrum or, more commonly, a separate lesion concomitant with the Bankart lesion. Generally, it is acceptable to repair both the SLAP lesion and the Bankart lesion simultaneously.

The superior labrum has two anatomic variations of attachment to the glenoid. The normal superior labrum is attached centrally and peripherally to the margin of the glenoid. The other variant, the meniscoid labrum, has only one attachment in the periphery. Thus, even MRI can occasionally produce inaccurate diagnoses.<sup>13,17</sup> According to the original description by Snyder et al.,<sup>18</sup> there are very few physical tests available for diagnosing the isolated SLAP lesion. Even though there are some diagnostic tests available, they are all nonspecific. Furthermore, for SLAP lesions combined with recurrent anterior dislocation of the shoulder, there are no known physical tests available at the moment. The purpose of this report is to provide a new clinical test for SLAP lesions in shoulders with recurrent anterior dislocations. We have named it

\* Address correspondence and reprint requests to Seung-Ho Kim, MD, Department of Orthopaedic Surgery, Sungkyunkwan University, College of Medicine, Samsung Medical Center, 50 Ilwon-Dong, Kangnam-Gu, Seoul, Korea 135-710.

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

the biceps load test, as the test represents the dynamic contribution of the biceps tendon-superior labrum complex.

## MATERIALS AND METHODS

This new diagnostic test and other physical tests for the SLAP lesions were evaluated in 75 successive patients with unilateral recurrent anterior shoulder dislocations and a Bankart lesion. Patients with multidirectional instability were excluded from this study. These tests were conducted by two authors who had no previous knowledge of the MRI findings of the superior labrum. All patients were examined twice, at different times. The initial tests were performed during outpatient evaluation by the senior author (SHK), and the other tests were performed on the day of admission for surgery by a trained hospital resident. The diagnosis of recurrent anterior shoulder dislocation was made using only a physical examination in some cases, while plain radiographs and MRI findings were also used for the diagnosis in other cases. During the arthroscopic examination, all patients were found to have abnormalities consistent with anterior shoulder dislocations.

Of the 75 patients, 64 were men and 11 were women. The average age was 24.8 years (range, 16 to 41). There were 59 right and 16 left shoulders. In 61 of the 75 patients (81.3%), the dominant shoulder was involved. The causes of initial injury included basketball, soccer, volleyball, tennis, baseball, swimming, and significant falls. In 13 patients (17%), minor trauma was the cause of initial dislocation.

There were no significant differences between the patients with SLAP lesions and those with an intact superior labrum in terms of age, involvement of dominant shoulders, cause of initial dislocation, number of dislocations, and the elapsed time from initial dislocation to time of surgery. The SLAP lesions occurred only in men; all women had intact superior labra. Associated findings were similar in both groups. Eleven patients had partial-thickness rotator cuff tears, three of which were of significant size and were repaired arthroscopically. Other combined lesions included loose bodies in 3 patients, partial tears of the subscapularis tendon in 4, and articular cartilage injuries of the humeral head or glenoid in 12. All patients underwent arthroscopic anterior stabilization using FASTak (Arthrex, Naples, Florida) or mini-Revo (Linvatec, Largo, Florida) screws. The same model suture anchor was used for arthroscopic capsulorrhaphy for the Bankart lesion in all patients with a SLAP lesion.

### Biceps Load Test

The test is performed with the patient in the supine position. The examiner sits adjacent to the patient on the same side as the affected shoulder and gently grasps the patient's wrist and elbow. The arm to be examined is abducted at 90°, with the forearm in the supinated position. The patient is allowed to relax, and an anterior apprehension test is performed. When the patient be-

comes apprehensive during the external rotation of the shoulder, external rotation is stopped. The patient is then asked to flex the elbow while the examiner resists the flexion with one hand and asks how the apprehension has changed, if at all (Fig. 1). If the apprehension is lessened, or if the patient feels more comfortable than before the test, the test is negative for a SLAP lesion. If the apprehension has not changed, or if the shoulder becomes more painful, the test is positive. The test is repeated and the patient is instructed not to pull the whole upper extremity but to bend the elbow against the examiner's resistance. The examiner should be sitting adjacent to the shoulder to be examined at the same height as the patient, and he or she should also face the patient at a right angle. The direction of the examiner's resistance should be on the same plane as the patient's arm so as not to change the degree of abduction and rotation of the shoulder. The forearm should be kept in the supinated position during the test.

### Statistics

The biceps load test was compared with the other tests, which included the anterior apprehension test, the impingement test I,<sup>11</sup> the biceps tension test,<sup>6</sup> and the compression-rotation test.<sup>5</sup> The reliability of the biceps load test was evaluated by determining its accuracy and reproducibility. The test's accuracy was assessed by using the predictive value, sensitivity, and specificity. The reproducibility of the test was assessed by comparing the test results of the two independent examiners. The kappa coefficient was used to determine the interobserver variation of the two examiners. The SPSS program (SPSS, Chicago, Illinois) was used for all analysis, with the statistical significance level set at  $P = 0.05$ .

## RESULTS

Of the 75 patients, the biceps load test was negative in 63 and positive in 12. Of the 63 patients with a negative test,



**Figure 1.** In the biceps load test the forearm is supinated during the biceps muscle contraction with the shoulder in abduction and external rotation.

TABLE 1  
Statistical Analysis of the Interobserver Reliability of the  
Biceps Load Test

		Examiner II <sup>a</sup>		Total
		Positive	Negative	
Examiner I <sup>a</sup>	Positive	10	2	12
	Negative	1	62	63
Total		11	64	75

<sup>a</sup> Kappa value of cross-tabulation between examiner I and II was 0.846.

the biceps tendon-superior labrum complex was intact in 62 cases and only 1 patient had a type II SLAP lesion. In the 12 patients with positive results, 10 were confirmed to have type II SLAP lesions and 2 had intact superior labra. Accordingly, the sensitivity of the test was 90.9% and the specificity was 96.9%. The positive and negative predictive values were 83% and 98%, respectively. The senior author reported 12 positive tests and the second examiner described 11 positive results. The kappa coefficient for the interobserver reproducibility was 0.846 (Table 1).

The anterior apprehension test was positive in all patients, but it did not differentiate between patients with SLAP lesions and those with intact superior labra. The impingement sign I was positive in 44 patients (59%). The biceps tension test proved to be positive in 22 patients (29%) and negative in 53 (71%). Of the 22 patients with positive biceps tension tests, 8 had true SLAP lesions and 14 had intact superior labra. Of the 53 patients with negative results, 3 had SLAP lesions (sensitivity, 72.7%; specificity, 78.1%; positive predictive value, 36%; negative predictive value, 94%). The compression-rotation test detected only three SLAP lesions.

## DISCUSSION

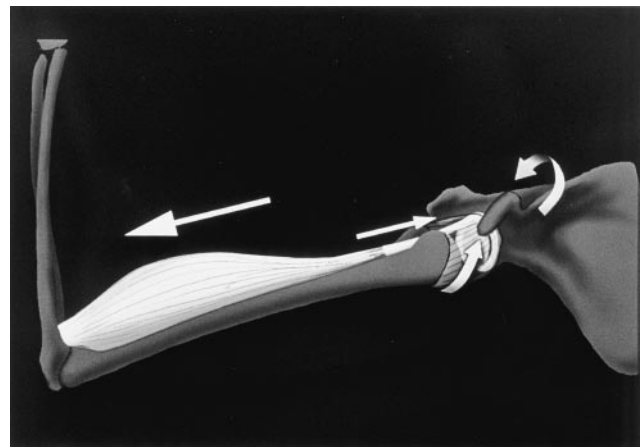
Four types of SLAP lesions were first described by Snyder et al.<sup>18</sup> However, Maffet et al.<sup>10</sup> later added three more types of superior labral lesions. Biomechanical experiments have demonstrated that the biceps tendon-superior labrum complex has an important role in the stabilization of the glenohumeral joint.<sup>8,9</sup> In much of the literature, repair of type II SLAP lesions is strongly recommended.<sup>1,2,6,13,14,16,19,21</sup> In a study by Cordasco et al.,<sup>4</sup> arthroscopic debridement of a type II SLAP lesion provided excellent pain relief in 78% (21 of 27) of the patients; however, the effectiveness of this pain relief had diminished at the 2-year follow-up. Although lesions of the superior labrum that destabilize the biceps tendon insertion (type II and IV) are not usually associated with overt instability, the patient may show a subtle increase in shoulder laxity on physical examination.<sup>13</sup> An experimentally created unstable superior labral lesion can lead to multidirectional increases in the glenohumeral translation of the cadaveric specimen.<sup>12</sup> These findings justify the repair of unstable superior labral lesions.

A SLAP lesion can occur as an isolated lesion or in the shoulder with recurrent anterior dislocations. Warner et al.<sup>21</sup> described the arthroscopic repair of combined Ban-

gart and SLAP lesions. The diagnosis of recurrent anterior shoulder dislocations can be relatively simple in most cases; patient history and physical examination are enough. Magnetic resonance imaging is a supplementary tool to confirm the anteroinferior labral lesion. However, the diagnosis of the SLAP lesion is not as simple. Most often, the definitive diagnosis is based on arthroscopic examination. Physical findings and MRI examination are not specific to the SLAP lesion.<sup>5,6,13,17,18</sup> Preoperative knowledge of the combined SLAP lesion in the shoulder with recurrent anterior dislocations will give the surgeon a more consistent plan of surgical intervention. Nevertheless, a physical test for the combined SLAP lesion in the shoulder with recurrent anterior dislocations has not yet been fully described, to the best of our knowledge. With these tests, we could not differentiate between shoulders with combined SLAP lesions and shoulder instability and those with pure anterior instability without SLAP lesions. In our patients, the impingement test, anterior apprehension test, and compression-rotation test were not reliable enough to detect the combined SLAP lesions in the shoulders with recurrent anterior dislocations. The biceps tension test showed higher sensitivity and specificity than the other tests; however, this test was not accurate because it had a very low positive predictive value.

The reliability of a diagnostic test depends on the accuracy and reproducibility of the test results. The predictive values are by far the most important clinical measures of accuracy.<sup>20</sup> The biceps load test had very high positive and negative predictive values and was very sensitive and specific for the combined SLAP lesion in the shoulder with recurrent anterior dislocations. Reproducibility for this test was very high. The kappa coefficient was 0.846. In our experience, the test was very simple to learn and more sensitive and specific than any other test or examination.

Various experiments served as the biomechanical basis of the biceps load test. Rodosky et al.<sup>15</sup> noted that abduction and external rotation of the shoulder during the cock-



**Figure 2.** Contraction of the biceps muscle causes tension on the biceps tendon-superior labrum complex and increases glenohumeral stability with the arm in the abducted and externally rotated position.

ing phase of the throwing cycle stresses the origin of the long head of the biceps muscle and its attachment to the posterior labrum. Glousman et al.<sup>7</sup> demonstrated in their dynamic EMG studies that the biceps muscles are extremely active in a throwing athlete when the shoulder is placed in the vulnerable abducted and externally rotated position. The biceps muscle contraction increases the torsional rigidity of the glenohumeral joint and, in the abducted and externally rotated position, the long head of the biceps tendon acts as an internal rotator of the shoulder.<sup>15</sup> The intact superior labrum is continuous with the anterior labrum and the superior middle and inferior glenohumeral ligaments.<sup>3</sup> The long head of the biceps tendon acts as a load sharer along with the inferior glenohumeral ligament in the abducted and externally rotated position. Existence of a superior labral lesion results in a significant increase in the inferior glenohumeral ligament strain.<sup>15</sup>

The biceps load test theory can be summarized as a combination of three mechanisms. First, contraction of the biceps muscle in a shoulder with an intact superior labral attachment increases torsional rigidity of the glenohumeral joint, which decreases the anteriorly directed force in the abducted and externally rotated position. Second, contraction of the biceps muscle diminishes the stress placed on the inferior glenohumeral ligament with the shoulder in the position of the anterior apprehension test. Third, contraction of the biceps muscle can reduce the partially subluxated humeral head by the internal rotation force of the humeral head. During the biceps load test, because internal rotation of the humeral head is precluded by the examiner, the internal rotation force can be exerted on the glenoid as an external rotation force, which results in partial humeral head reduction (Fig. 2).

The biceps load test provides further clinical clues to assist in clarifying the contribution of the biceps tendon-superior labrum complex to glenohumeral stability because the contraction of the biceps muscle in shoulders with intact superior labra reduces apprehension in the apprehensive position. Furthermore, the biceps load test provides evidence for the role of the biceps tendon in the mechanism of action in translating or rotating the humeral head within the confines of the glenoid.

To successfully perform the biceps load test, the examiner should sit adjacent to the patient and resist the active elbow flexion of the patient strictly in the opposite direction of the vector of the biceps tendon force, which is in line with the arm. The forearm should be maintained in a

supinated position throughout the test. Furthermore, the patient is instructed not to just pull the whole upper extremity but to bend the forearm. In conclusion, the biceps load test is a reliable diagnostic physical examination for combined SLAP lesions in shoulders with recurrent anterior dislocations.

## REFERENCES

1. Arciero RA, Taylor DC, Snyder RJ, et al: Arthroscopic bioabsorbable tack stabilization of initial anterior shoulder dislocations: A preliminary report. *Arthroscopy* 11: 410-417, 1995
2. Burkhart SS, Fox DL: Arthroscopic repair of a type IV SLAP lesion: The red-on-white lesion as a component of anterior instability [Case report]. *Arthroscopy* 9: 488-492, 1993
3. Cooper DE, Amoczky SP, O'Brien SJ, et al: Anatomy, histology, and vascularity of the glenoid labrum: An anatomical study. *J Bone Joint Surg* 74A: 46-52, 1992
4. Cordasco FA, Steinmann S, Flatow EL, et al: Arthroscopic treatment of glenoid labral tears. *Am J Sports Med* 21: 425-431, 1993
5. Craig EV: Shoulder arthroscopy in the throwing athlete. *Clin Sports Med* 15: 673-700, 1996
6. Field LD, Savoie FH III: Arthroscopic suture repair of superior labral detachment lesions of the shoulder. *Am J Sports Med* 21: 783-790, 1993
7. Glousman R, Jobe F, Tibone J, et al: Dynamic electromyographic analysis of the throwing shoulder with glenohumeral instability. *J Bone Joint Surg* 70A: 220-226, 1988
8. Howell SM, Galinat BJ: The glenoid-labral socket: A constrained articular surface. *Clin Orthop* 243: 122-125, 1989
9. Lippitt SB, Vanderhooft JE, Harris SL, et al: Glenohumeral stability from concavity-compression: A quantitative analysis. *J Shoulder Elbow Surg* 2: 27-35, 1993
10. Maffet MW, Gartsman GM, Moseley B: Superior labrum-biceps tendon complex lesions of the shoulder. *Am J Sports Med* 23: 93-98, 1995
11. Neer CS II: Anterior acromioplasty for the chronic impingement syndrome in the shoulder. A preliminary report. *J Bone Joint Surg* 54A: 41-50, 1972
12. Pagnani MJ, Deng X-H, Warren RF, et al: Effect of lesions of the superior portion of the glenoid labrum on glenohumeral translation. *J Bone Joint Surg* 77A: 1003-1010, 1995
13. Pagnani MJ, Speer KP, Altchek DW, et al: Arthroscopic fixation of superior labral lesions using a biodegradable implant: A preliminary report. *Arthroscopy* 11: 194-198, 1995
14. Rames RD, Karzel R: Injuries to the glenoid labrum, including SLAP lesions. *Orthop Clin North Am* 24: 45-53, 1993
15. Rodosky MW, Harner CD, Fu FH: The role of the long head of the biceps muscle and superior glenoid labrum in anterior stability of the shoulder. *Am J Sports Med* 22: 121-130, 1994
16. Samani JE, Marsten S, Rodosky MW, et al: The arthroscopic stabilization of type II SLAP lesions using a biodegradable tack. *Arthroscopy* 13: 376, 1997
17. Smith AM, McCauley TR, Jokl P: SLAP lesions of the glenoid labrum diagnosed with MR imaging. *Skeletal Radiol* 22: 507-510, 1993
18. Snyder SJ, Karzel RP, Del Pizzo W, et al: SLAP lesions of the shoulder. *Arthroscopy* 6: 274-279, 1990
19. Stetson WB, Karzel RP, Banas MP, et al: Long-term clinical follow-up of 140 consecutive patients with injury to the superior glenoid labrum. *Arthroscopy* 13: 376-377, 1997
20. Thomas G: Reliability of diagnostic test. *Acta Obstet Gynecol Scand (Suppl)* 166: 9-14, 1997
21. Warner JJP, Kann S, Marks P: Arthroscopic repair of combined Bankart and superior labral detachment anterior and posterior lesions: Technique and preliminary results. *Arthroscopy* 10: 383-391, 1994