The Passive Compression Test

A New Clinical Test for Superior Labral Tears of the Shoulder

Yang-Soo Kim,* MD, Jung-Man Kim,* MD, Kee-Yong Ha,* MD, Soon Choy,† MD, Min-Wook Joo,* MD, and Yang-Guk Chung,*‡ MD
*From the *Department of Orthopaedic Surgery and the †Department of Preventive Medicine, Kangnam St Mary's Hospital, The Catholic University of Korea, College of Medicine, Seoul, Korea*

Background: Even though there are several physical tests available for superior labrum anterior posterior lesions, there have been very few reports on their accuracy, and none can be regarded as completely predictive for the presence of a superior labrum anterior posterior lesion in the shoulder joint.

Hypothesis: This new clinical test is a useful and accurate technique for detecting superior labral tears in the shoulder joint.

Study Design: Cohort study (diagnosis); Level of evidence, 2.

Methods: This test was conducted independently by 2 physicians before any other diagnostic evaluation. In all cases, the glenohumeral joint was investigated first, and the appropriate treatments were performed on the lesion. A protocol was established to evaluate the sensitivity, specificity, and positive and negative predictive values of this new clinical test. The reproducibility of this test was evaluated with a κ coefficient.

Results: Sixty-one patients (61 shoulders) were examined with the passive compression test, and all underwent arthroscopic surgery. In 31 patients with a positive passive compression test result, 27 had a superior labrum anterior posterior lesion, and in 30 patients with a negative passive compression test result, 6 had a superior labrum anterior posterior lesion. The sensitivity of the test was 81.8%, and the specificity was 85.7%. The positive predictive value was 87.1%, and the negative predictive value was 80.0%. The κ coefficient was 0.771 between the 2 independent examiners ($P < .01$).

Conclusion: The passive compression test is a useful and accurate technique for predicting superior labral tears of the shoulder joint.

Keywords: SLAP lesion; passive compression test; clinical test; shoulder

The diagnosis of superior labrum anterior posterior (SLAP) lesions can be challenging because clinical symptoms and signs are often vague and ill defined. In the original description by Snyder et al,[27] an isolated SLAP lesion can be diagnosed only arthroscopically and may be treated successfully using arthroscopic techniques. Even though there are several physical tests available, there have been only few reports on their accuracy.[9,11,16,28] And physical examination alone is not enough to diagnose a SLAP lesion.[4,8,9,11-14,16,19,21] Guanche et al[9] investigated 7 commonly used clinical tests for glenoid labral lesions and concluded that none of the tests nor combinations of tests were statistically valid for the specific detection of a SLAP lesion. The lack of a reliable clinical test for SLAP lesions has required the use of further studies, such as magnetic resonance imaging (MRI) or MR arthrograms, for an accurate diagnosis.[2,7,10] These studies, however, are expensive, and the MR arthrogram is an invasive procedure.[17]

The authors of the current study developed a new clinical test for the detection of SLAP lesions and prospectively evaluated its usefulness. The object of the current study was to determine whether this new test would be of significant diagnostic value for detecting SLAP lesions. Because this maneuver consisted of passive external rotation and compressing the humeral head onto the glenoid, it was named "the passive compression test."

‡Address correspondence to Yang-Guk Chung, MD, Department of Orthopaedic Surgery, Kangnam St Mary's Hospital, The Catholic University of Korea, 505 Banpo-dong, Seocho-gu, Seoul, Korea (e-mail: ygchung@catholic.ac.kr).

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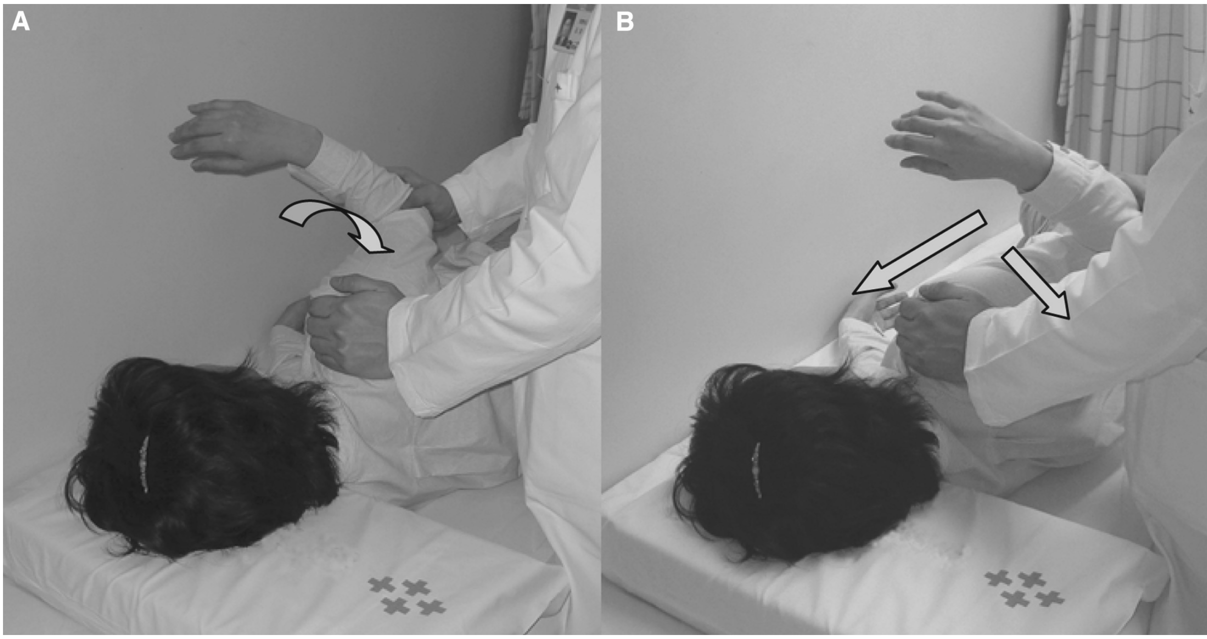

Figure 1. The physician rotates the patient's arm externally with 30° of abduction (A) and then pushes the arm proximally while extending the shoulder (B), which results in the passive compression of the superior labrum onto the glenoid.

MATERIALS AND METHODS

The passive compression test was evaluated on 74 consecutive patients (76 shoulders) who visited the authors' departments for painful shoulder joints from April 2005 to February 2006. However, only 61 patients (61 shoulders) were included in this study. Excluded were patients with fractures around the shoulder joints and with frozen shoulders. There were 57 men and 4 women, with an average age of 32.6 years (range, 19-54). The dominant shoulder was involved in 55 (90.1%) patients. Fifty (81.9%) patients had histories of trauma, including falls onto outstretched arms and injuries associated with swimming, throwing, or playing tennis. The other 11 patients denied any history of trauma to their shoulders. All patients had undergone nonoperative treatments for at least 2 months before surgery. The conservative treatment, which included physical therapy, activity modifications, and steroid injections, was applied according to each patient's clinical presentation. The steroid was injected 3 times at most and at 6-week intervals at least.

This test was conducted independently by 2 physicians at the initial evaluation of each patient before any other diagnostic evaluation was performed, including medical history, radiographic studies, and MR arthrogram imaging. Therefore, the physicians had no previous knowledge of the radiologic and MR arthrogram findings of the shoulder joints. All SLAP lesions and other injuries were verified by arthroscopic examinations, and arthroscopic surgeries were performed without any information about the results of the passive compression tests in every case. In the current study, we followed the classic definition of the SLAP lesion as a disruption of the superior labrum between the 10- and 2-o'clock position of the glenoid.[27] The SLAP lesions were classified into 4 types on the basis of their morphologic patterns according to Snyder's classification.[27]

The surgical procedures were performed with the patients in the lateral decubitus position. The operated arm was pulled with 10 lb (4.5 kg) of weight. In all cases, the glenohumeral joints were evaluated and definitive treatments performed on the lesions. We investigated the whole joint thoroughly with a scope via a posterior viewing portal and examined the stability of the superior labrum with a probe inserted through the superoanterior portal. All the SLAP lesions and the combined lesions were managed arthroscopically. Subsequently, the subacromial space was evaluated, and any coexisting pathological lesions were addressed.

A protocol was established to evaluate the sensitivity, specificity, and positive and negative predictive values of this test. We evaluated the reproducibility of this test with a κ coefficient using the SPSS program (SPSS version 10.0; Chicago, Ill). The 2 independent examiners performed the passive compression test separately, and the results were compared to determine the interobserver reliability.

The Passive Compression Test

The patient was asked to lie down in a lateral position with the affected shoulder up and the physician standing behind the patient. The physician stabilized the patient's affected shoulder by holding the acromioclavicular (AC) joint and controlled the patient's elbow with the other hand. The examiner rotated the patient's shoulder externally with 30° of abduction and then pushed the arm proximally while extending the arm, which resulted in passive compression of the superior labrum onto the glenoid

TABLE 1
Arthroscopic Findings in 61 Shoulders[a]

Diagnosis	Number of Shoulders: Passive Compression Test (+)	Passive Compression Test (–)
SLAP I	2	3
SLAP II	18	2
SLAP III	0	1
SLAP IV	1	0
AC joint DJD	0	2
Bankart lesion	3	4
SLAP II with associated lesion	6	0
Impingement syndrome	1	5
Rotator cuff tear	0	13
Total	31	30

[a]AC, acromioclavicular; DJD, degenerative joint disease.

(Figure 1). The patient was instructed to stay relaxed during this maneuver. The test finding was considered positive if pain or a painful click was elicited in the glenohumeral joint. The same test was repeated separately by the other examiner without knowing the results obtained by the previous examiner to evaluate the reproducibility of the test.

RESULTS

Sixty-one patients (61 shoulders) were examined with the passive compression test, and all underwent arthroscopic surgery on the affected shoulder joints (Table 1). Of the 61 patients, 31 demonstrated a positive passive compression test result and 30 demonstrated a negative test result. The surgical findings in these patients are summarized in Table 1. The MR arthrogram findings were the same as those of arthroscopic surgeries. Of the 31 patients with a positive passive compression test result, 27 had confirmed superior labral tears, while the other 4 patients had intact superior labra, which indicated there were false-positive results in 4 patients. Three of these 4 patients had a Bankart lesion with anterior shoulder instability, and the other patients had an impingement syndrome. Of the 30 patients with a negative passive compression test result, 24 had intact superior labra, whereas the other 6 had confirmed superior labral tears at surgery. The majority of patients with a negative passive compression test result had rotator cuff tears. Therefore, the sensitivity of the test was 81.8%, and the specificity was 85.7%. The positive predictive value was 87.1%, and the negative predictive value was 80.0%. The κ coefficient was 0.771 between the 2 independent examiners ($P < .01$).

Six patients with a positive passive compression test result had associated abnormalities with SLAP lesions. The associated abnormalities included Bankart lesions in 4 patients, articular side partial tear of the supraspinatus tendon in 1 patient, and degeneration of the long head of

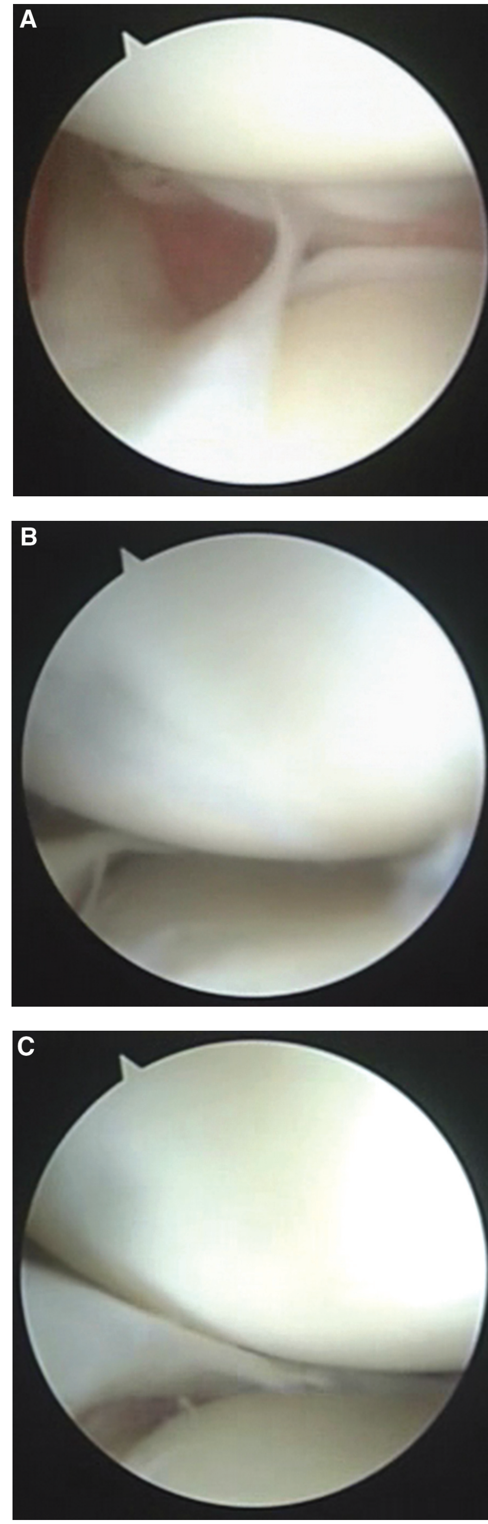

Figure 2. The passive compression test during an arthroscopic examination of the affected shoulder revealed that the unstable superior labrum (A) was displaced a little from the superior glenoid rim with external rotation of the shoulder (B). The displacement of the labrum is aggravated when the arm was passively pushed proximally (C).

the biceps tendon in 1 patient. All patients with a Bankart lesion underwent arthroscopic anterior stabilization, and the patient with the partial tear of the supraspinatus tendon underwent arthroscopic repair with a transtendon suture technique after completion of the SLAP lesion repair.[29] There was no significant difference between the patients with a positive passive compression test result and those with a negative passive compression test result with respect to age, interval from the time of symptom onset to surgery, and which shoulder underwent surgery.

The mechanical action of the unstable biceps–superior labrum complex in the passive compression test was reproduced during arthroscopic surgery (Figure 2). When the arm was passively pushed proximally with external rotation and abduction, the long head of the biceps tendon was pulled laterally; thereby, the bicipital-labral complex was placed under tension mechanically as described by Burkhart as a peel-back mechanism.[6] The tension from the biceps tendon displaced the unstable superior labrum away from the superior glenoid rim, which accounted for the painful clicking or the pain itself and resulted in a positive passive compression test result.

DISCUSSION

In this study, the sensitivity and specificity of the passive compression test (81.8% and 85.7%, respectively) were relatively lower than those of the original reports of several other clinical tests.[3,16,20,21] There has been, however, no agreement on the diagnostic accuracy of those tests. O'Brien[21] reported that his test was 100% sensitive and 98.5% specific for labral lesions. In contrast, Guanche et al[9] stated that O'Brien's test was only 63% sensitive and 73% specific for all labral lesions, including SLAP lesions, in their study that compared several clinical tests for diagnosing labral lesions. According to the original report of the crank test by Liu et al,[16] the sensitivity was 91% and the specificity was 93% for the diagnosis of glenoid labral tears. However, Stetson and Templin[28] reported that the crank test showed only a 46% sensitivity and 56% specificity for the diagnosis of SLAP lesions. Another recent study also reported a very disappointing result in that the crank test had only a 39% sensitivity and 67% specificity for SLAP lesions.[9] There has also been debate concerning the diagnostic accuracy of the Speed test, the compression-rotation test, and the Yergason test for SLAP lesions.[9,16,20,21,28] Therefore, none can be regarded as highly predictive for SLAP lesions. The reproducibility of this new test evaluated by performing the test by 2 independent physicians was very high with a high κ coefficient. Future duplication of our results by other investigators would further validate this test.

Several mechanisms have been proposed to explain the development of SLAP lesions.[5,6,15,18,22,26,27] If 1 test could reenact the mechanism of development of SLAP lesions, it might be an ideal test for detecting superior labrum lesions. The passive compression test was conceived on the basis of this concept. The mechanism of the passive compression test can be theorized with a combination of 3 motions. The first motion is external rotation of the arm. During external rotation of the humeral head, the bicipital groove is placed in a position far behind the glenohumeral joint (Figure 3A). The long head of the biceps tendon will be under tensile force as it wraps around the lesser tuberosity.[15] This posteriorly directed tensile force will cause the superior labrum to shift from the superior glenoid rim, which is similar to the peel-back phenomenon described by Burkhart.[6] The second motion is extension of the shoulder joint. The combination of shoulder extension with external rotation reproduces the position of the late cocking phase of throwing. In a biomechanical cadaveric study, Rodosky

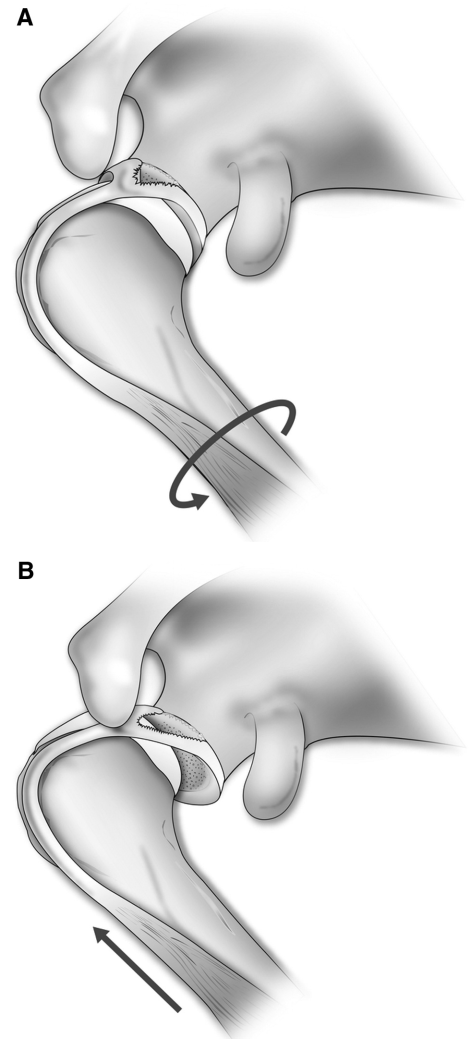

Figure 3. (A) With external rotation of the arm, the bicipital groove is placed in a position far lateral to the glenohumeral joint. The long head of the biceps tendon would be under tensile force as it wraps around the lesser tuberosity, which results in shifting of the superior labrum from the superior glenoid rim. (B) Proximal migration of the humeral head aggravates the displacement of the unstable labrum, and the superior labrum is displaced passively with the humeral head on the glenoid.

et al[25] and Pradhan et al[23,24] noted that external rotation and abduction of the arm during the late cocking phase of the throwing motion increased the torsional stress at the origin of the long head of the biceps tendon and its attachment to the superior glenoid rim. Kuhn et al[15] also recognized that type II SLAP lesions developed easily in the late cocking position, which was with the arm in more than 125° of external rotation and 60° of glenohumeral abduction. The third motion is compressing the humeral head proximally to the shoulder joint. The proximal compression force of the humeral head can aggravate the passive displacement of the unstable superior labrum on the glenoid, similar to the McMurray test at the knee joint (Figure 3B). In the original report by Snyder,[27] he described the most common injury mechanism of SLAP lesions, which was a compression force to the shoulder, usually as a result of a fall onto an outstretched arm. All 3 motions should be performed at the same time. Eventually, this maneuver produces the maximal traction force on the biceps–superior labrum complex by compressing the humeral head. Eccentric loading of the long head of the biceps tendon in the late cocking position during throwing is thought to be a critical component for the development of type II SLAP lesions.[1,6,19,27]

The clinical tests can be classified into active and passive forms. In the active forms, such as the O'Brien compression test, the biceps load test, and the Speed test, the patients should use their muscles during the examination.[3,12] However, in passive tests, the patients do not need to use their muscles. The examiner does all maneuvers, and the patients can remain relaxed. Like the crank test, the passive compression test is included among the passive forms.[16] An active test is not suitable for patients who suffer from severe pain around the joints or who have restricted motion from any cause. For example, in patients with SLAP lesions that are combined with rotator cuff tears, it is very difficult to interpret the result of an active test because of muscle weakness and pain that originates from the rotator cuff tears. In a passive test, the patient can feel more comfortable without any need of painful active motion, and the examiner can avoid the influence of a torn rotator cuff tendon. In this study, no patient with a positive passive compression test result had a rotator cuff tear. We believe that the passive compression test has advantages in the differentiation of SLAP lesions from rotator cuff tendon tears.

There were some limitations in this study. We compared the patients with SLAP lesions with those with other pathological lesions. Ideally, however, the study should have included an additional normal control group. To minimize this drawback, we should have reevaluated the patients with the passive compression test after their surgeries because the test should revert to a negative one after the labral abnormality has been fixed. Nine patients were reevaluated at 6 months after SLAP lesion repairs, and all patients except 1 had a negative passive compression test result. The patient with a positive passive compression test result had undergone simultaneous surgical repairs of a Bankart lesion and a SLAP lesion.

In the present study, there were 4 patients with false-positive results. One patient turned out to have an impingement syndrome, and the other 3 patients proved to have anterior instability with Bankart lesions. On the basis of these results, the passive compression test has a relatively high false-positive rate in the patient with anterior instability. Therefore, several physical tests, such as the anterior apprehension test and anterior drawer test, should be performed additionally when anterior instability of the shoulder is suspected.

We conclude that the passive compression test is a useful and accurate maneuver for detecting superior labral tears in shoulder joints because it is reproducible during arthroscopic surgery and it has the biomechanical validity to explain the mechanism of injury. The accuracy of this test in the detection of SLAP lesions will be increased if isolated anterior instability of the shoulder is ruled out by another clinical test during physical examination.

REFERENCES

1. Andrews JR, Carson WG Jr, McLeod WD. Glenoid labrum tears related to the long head of the biceps. *Am J Sports Med.* 1985;13:337-341.
2. Bencardino JT, Beltran J, Rosenberg ZS, et al. Superior labrum anterior-posterior lesions: diagnosis with MR arthrography of the shoulder. *Radiology.* 2000;214:267-271.
3. Bennett WF. Specificity of the Speed's test: arthroscopic technique for evaluating the biceps tendon at the level of the bicipital groove. *Arthroscopy.* 1998;14:789-796.
4. Berg EE, Ciullo JV. A clinical test for superior glenoid labral or 'SLAP' lesions. *Clin J Sport Med.* 1998;8:121-123.
5. Bey MJ, Elders GJ, Huston LJ, Kuhn JE, Blasier RB, Soslowsky LJ. The mechanism of creation of superior labrum, anterior, and posterior lesions in a dynamic biomechanical model of the shoulder: the role of inferior subluxation. *J Shoulder Elbow Surg.* 1998;7:397-401.
6. Burkhart SS, Morgan CD. The peel-back mechanism: its role in producing and extending posterior type II SLAP lesions and its effect on SLAP repair rehabilitation. *Arthroscopy.* 1998;14:637-640.
7. Cvitanic O, Tirman PF, Feller JF, Bost FW, Minter J, Carroll KW. Using abduction and external rotation of the shoulder to increase the sensitivity of MR arthrography in revealing tears of the anterior glenoid labrum. *AJR Am J Roentgenol.* 1997;169:837-844.
8. Field LD, Savoie FH 3rd. Arthroscopic suture repair of superior labral detachment lesions of the shoulder. *Am J Sports Med.* 1993;21:783-790.
9. Guanche CA, Jones DC. Clinical testing for tears of the glenoid labrum. *Arthroscopy.* 2003;19:517-523.
10. Jee WH, McCauley TR, Katz LD, Matheny JM, Ruwe PA, Daigneault JP. Superior labral anterior posterior (SLAP) lesions of the glenoid labrum: reliability and accuracy of MR arthrography for diagnosis. *Radiology.* 2001;218:127-132.
11. Kibler WB. Specificity and sensitivity of the anterior slide test in throwing athletes with superior glenoid labral tears. *Arthroscopy.* 1995;11:296-300.
12. Kim SH, Ha KI, Ahn JH, Choi HJ. Biceps load test II: a clinical test for SLAP lesions of the shoulder. *Arthroscopy.* 2001;17:160-164.
13. Kim SH, Ha KI, Han KY. Biceps load test: a clinical test for superior labrum anterior and posterior lesions in shoulders with recurrent anterior dislocations. *Am J Sports Med.* 1999;27:300-303.
14. Kim TK, Queale WS, Cosgarea AJ, McFarland EG. Clinical features of the different types of SLAP lesions: an analysis of 139 cases. Superior labrum anterior posterior. *J Bone Joint Surg Am.* 2003;85:66-71.
15. Kuhn JE, Lindholm SR, Huston LJ, Soslowsky LJ, Blasier RB. Failure of the biceps superior labral complex: a cadaveric biomechanical investigation comparing the late cocking and early deceleration positions of throwing. *Arthroscopy.* 2003;19:373-379.
16. Liu SH, Henry MH, Nuccion SL. A prospective evaluation of a new physical examination in predicting glenoid labral tears. *Am J Sports Med.* 1996;24:721-725.
17. Liu SH, Henry MH, Nuccion S, Shapiro MS, Dorey F. Diagnosis of glenoid labral tears. A comparison between magnetic resonance imaging and clinical examinations. *Am J Sports Med.* 1996;24:149-154.

18. Maffet MW, Gartsman GM, Moseley B. Superior labrum-biceps tendon complex lesions of the shoulder. *Am J Sports Med.* 1995;23:93-98.
19. Mimori K, Muneta T, Nakagawa T, Shinomiya K. A new pain provocation test for superior labral tears of the shoulder. *Am J Sports Med.* 1999;27:137-142.
20. Morgan CD, Burkhart SS, Palmeri M, Gillespie M. Type II SLAP lesions: 3 subtypes and their relationships to superior instability and rotator cuff tears. *Arthroscopy.* 1998;14:553-565.
21. O'Brien SJ, Pagnani MJ, Fealy S, McGlynn SR, Wilson JB. The active compression test: a new and effective test for diagnosing labral tears and acromioclavicular joint abnormality. *Am J Sports Med.* 1998;26:610-613.
22. Pagnani MJ, Deng XH, Warren RF, Torzilli PA, Altchek DW. Effect of lesions of the superior portion of the glenoid labrum on glenohumeral translation. *J Bone Joint Surg Am.* 1995;77:1003-1010.
23. Pradhan RL, Itoi E, Hatakeyama Y, Urayama M, Sato K. Superior labral strain during the throwing motion. A cadaveric study. *Am J Sports Med.* 2001;29:488-492.
24. Pradhan RL, Itoi E, Kido T, Hatakeyama Y, Urayama M, Sato K. Effects of biceps loading and arm rotation on the superior labrum in the cadaveric shoulder. *Tohoku J Exp Med.* 2000;190:261-269.
25. 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.* 1994;22:121-130.
26. Snyder SJ, Banas MP, Karzel RP. An analysis of 140 injuries to the superior glenoid labrum. *J Shoulder Elbow Surg.* 1995;4:243-248.
27. Snyder SJ, Karzel RP, Del Pizzo W, Ferkel RD, Friedman MJ. SLAP lesions of the shoulder. *Arthroscopy.* 1990;6:274-279.
28. Stetson WB, Templin K. The crank test, the O'Brien test, and routine magnetic resonance imaging scans in the diagnosis of labral tears. *Am J Sports Med.* 2002;30:806-809.
29. Waibl B, Buess E. Partial-thickness articular surface supraspinatus tears: a new transtendon suture technique. *Arthroscopy.* 2005;21:376-381.