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Superior Labrum-Biceps Tendon Complex Lesions of the Shoulder [N]

Mark W. Maffet MD
Gary M. Gartsman MD
Bruce Moseley MD

Department of Orthopedic Surgery, Baylor College of Medicine,
Houston, Texas

The detachment of the superior labrum from anterior to posterior has previously been reported. This lesion has been classified into four types. It was our impression that not all superior labrum abnormalities fit into such a classification system and that the mechanism of injury was distinctly different. During a 5-year period, 84 of 712 (11.8%) patients had significant labral abnormalities; 52 of 84 patients (6.2%) had lesions that fit within the classification system (Type II, 55%; III 4%; IV, 4%), but 32 of 84 patients (38%) had significant findings that could not be classified. These unclassifiable lesions fit into three distinct categories. Two of three patients described a traction injury to the shoulder. Only 8% sustained a fall on an outstretched arm; 75% had a preoperative diagnosis of impingement based on consistent history and provocative testing; however, when examined under anesthesia, 43% of the shoulders were considered to have increased humeral head translation when compared with the other shoulder. Recognition of superior labrum-biceps tendon detachment should prompt the surgeon to investigate glenohumeral instability as the source of a patient's complaints.

With the advent and increasing prevalence of shoulder arthroscopy, more precise definitions of the pathologic anatomy involved in various shoulder conditions are evolving. In addition, new lesions, which were not appreciated previously with open arthrotomy, have been defined. One such entity was initially described by Andrews et al. [2] in their report on biceps tendon lesions in a population of throwing athletes. Although they described a lesion involving only the anterosuperior portion of the glenoid labrum, they reported that a pull on the biceps tendon could lift the labrum off the glenoid. Snyder et al. [25] in 1990 coined the term "SLAP" lesion, superior labrum anterior to posterior, for the disruption of the superior labrum-biceps tendon complex involving tearing or separation or both of the superior labrum beginning posterior to the biceps tendon insertion and extending anteriorly. The population of patients used by Snyder et al. had different mechanisms of injury. They typically suffered a sudden compression force or traction pull on the shoulder. In the retrospective reviews of Snyder et al., [25] the lesions found at the superior labrum-biceps tendon complex were classified into four types. Various methods of treatment were used to address this injury.

We believed that some patterns of biceps tendon-superior labrum lesions observed did not fit into the classification scheme of Snyder et al. [25] and that the mechanisms of injury were typically different. The purpose of the present study was to review the experience of one of us (GMG) in shoulder arthroscopy and to further evaluate the SLAP lesion.

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Address correspondence and reprint requests to: Gary M. Gartsman, MD, Department of Orthopedic Surgery, Baylor College of Medicine, 6560 Fannin, Suite 2100, Houston, TX 77030.

MATERIALS AND METHODS

The records of all patients between April 1987 and April 1992 who had shoulder surgery performed by one of us (GMG) were electronically reviewed. All records had been kept on the Benevolent Dictator software package (Information Health Network, Lansing, MI) during this period. Patients with certain parameters could be extracted from the entire population by using this software.

All patients receiving shoulder operations during this period were identified, and they formed the study group. A subset of this group was collected who received arthroscopic glenohumeral joint exploration or surgery and who were noted to have injury involving the biceps tendon-superior labrum complex. This study group was further evaluated through preoperative history and physical examination, operative reports, and viewing of the operative videotapes.

A standardized preoperative questionnaire was provided to each patient to gather historical data regarding the

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

shoulder. In addition to demographic information, patients provided chief complaints and surgical history, if any, of the index shoulder. Other factors such as the level of sports participation, presence of noise in the joint, mechanism of injury, and history of dislocation were also gathered.

A standard set of data at the patient's initial physical examination was recorded. Specific areas of tenderness, range of motion, pain, presence of crepitus or popping, and impingement signs were tested. Clinical laxity and apprehension were evaluated in abduction-external rotation, abduction with downward force, and downward traction (sulcus test).

Operative reports and videotapes were carefully reviewed. Laxity was tested preoperatively under anesthesia and under direct visualization during arthroscopy. A sequential examination of all the glenohumeral structures was performed and recorded as were any surgical procedures. For those patients with a preoperative diagnosis of impingement syndrome, a subacromial decompression was performed in the manner described by Gartsman. [9]

RESULTS

A total of 1604 consecutive shoulder operations were evaluated that were performed from April 1987 to April 1992. Each was electronically reviewed as described above. Of these cases, 892 (56%) were open procedures, and 712 (44%) were diagnostic or operative arthroscopy or both. The operative records for the 712 arthroscopic surgeries demonstrated that 206 patients (29%) had some abnormality of the superior labrum. Isolated minor fraying of this portion of the labrum was seen in 122 (122 of 712; 17%) and was not treated because it was believed that these changes merely represented the normal process of aging (patients' ages, 17 to 63 years). The remaining 84 patients (84 of 712; 11.7%) form the basis of this study.

Seventy-four (88%) were men and 10 (12%) were women. Forty-nine right and 35 left shoulders were involved; 57% of the lesions were located in the dominant shoulders.

Shoulder pain was the major complaint in 99% (Table 1) . The average time from onset of the shoulder complaint until initial evaluation in the author's office was 15 months. Eleven patients had received previous arthroscopic treatment to the shoulder, and four had had previous open shoulder surgery.

The mechanisms of injury to the shoulders were recorded (Table 2) . Forty-four of the 67 patients (66%) for whom this

TABLE 1 -- Chief complaints	
Complaints	**%**
Pain	99
Aching(soreness)	21
Loss of strength	18
Loss ofmotion	12
Goingout	9
Swelling	4
Numbness	1
Deformity	0
Weakness	0
Stiffness	0

TABLE 2 -- Mechanisms of injury	
Mechanisms	**%**
Fall ontoshoulder	15
Lifting heavy object	13
Traumaticdislocation	13
Insidious onset	9
Sudden anteriortraction	8
Abduction and external rotation	8
Fall onto outstretched arm	8
Gradual with repetitive lifting	6
Motor vehicle accident	6
Sudden upward traction	3
Unknown mechanism during sports	1
Lateral traction	1

parameter was available had a traction injury. Nine had a traumatic dislocation. The direction of the traction varied, with a pull in an inferior direction being the most common (Fig. 1) . Abduction-external rotation injuries occurred with a vigorous throw or swinging a heavy hammer. Anterior traction occurring while water skiing was common. Upward traction occurred in two patients when they slipped and fell from a height and grabbed on to something to halt their falls. The most common mechanism of injury in the study group of Snyder et al. [25] was a fall onto an outstretched arm. This mechanism of injury was described in only six patients in this study.

Only 1 of the 50 patients participating in sports reported the ability to perform at an equal level as before the symptoms

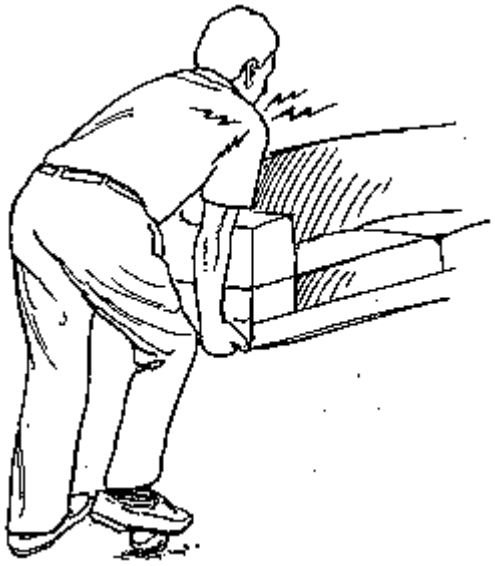

Figure 1. A common mechanism of injury: Two people are carrying a heavy object when one suddenly lets go of his end. This causes an inferior traction pull on the shoulder of the other.

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began. Thirty-six said that no sports were then possible (Tables 3 and 4) . Twelve of 68 described symptoms of shoulder locking at some point after their injuries.

A dislocation of the shoulder occurred as the initial injury in 13 of 80 patients (16%). Six of these had recurrent dislocations (range, 2 to 20).

On physical examination, 43 patients had tenderness to palpation immediately proximal to the area of the supraspinatus insertion. The range of motion of the involved shoulder was normal in only 14 of the patients, but the loss was minor, averaging only 3 vertebral levels of behind-the-back internal rotation. External rotation loss averaged 10° at neutral and 12° when measured at 90° of abduction. Crepitus was demonstrated in 21, and popping in 19. Various impingement signs were evaluated. The primary impingement sign (Neer [19]) was positive in 57 (68%), and the secondary impingement sign (Hawkins and Kennedy [11]) was positive in 41 (49%). Instability was diagnosed when one or more of the provocative tests were positive. The test was positive if, during the performance of the test, the patient noted apprehension (a feeling of the shoulder slipping out of the socket). If pain but not apprehension was elicited during the provocative test, this was recorded separately. Only when the movement produced apprehension was the term "instability" employed. Twenty-four patients were noted to have instability when downward traction was placed with the arm held at the side during the Rowe test (Fig. 2) . Seven patients had positive tests when the arm was placed in abduction-external rotation and four patients with abduction-downward force.

In addition to the clinical examination described above, an additional 13 patients were found to have significant laxity when manipulation under anesthesia was performed in the operating room. Thirty shoulders subluxated and seven could be dislocated. Subluxation was noted in 27 with the shoulder in abduction-external rotation, 24 anteriorly, 13 inferiorly (6 in this direction alone), and 3 posteriorly. In the three patients subluxating posteriorly, this was not an isolated finding and in all three was combined with multidirectional instability.

A diagnostic glenohumeral arthroscopy was performed in all patients, and a subacromial decompression was performed in those with a preoperative diagnosis of impingement syndrome (63 patients).

The operative videotapes of all patients were carefully reviewed, and the biceps tendon-superior labrum lesion as well as any other associated pathologic abnormalities were noted. Those patients whose only abnormality was a Type I superior labral lesion as described by Snyder et al., [25] that is, those with fraying of the superior labrum without separation, were excluded from the study.

TABLE 3 -- Pain magnitude

Magnitude	**%**
Slight pain	1
Onlyafter unusual activity	10
Moderate pain	42
Markedpain	40
Complete disability	6

TABLE 4 -- Level of sports

Level	**%**
Equalperformance	2
Same sports, decreased level	6
Active indifferent sports	10
Significantly limited	10
No sportspossible	72

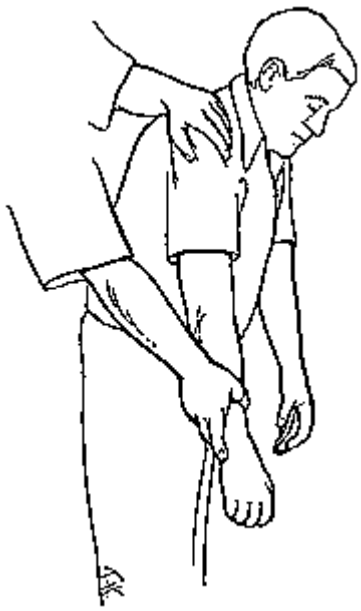

Figure 2. The Rowe test for inferior instability.

Fifty-two patients (62%) had lesions that fit within the classification system of Snyder et al. [25] (Type II, 55%; III, 4%; and IV, 4%). Type II lesions (Fig. 3) involve separation of the biceps tendon-superior labrum

complex from the superior glenoid margin with or without superior labral fraying. Type III lesions involve bucket-handle tears of the superior labrum. In Type IV lesions, the bucket-handle tear extends into the substance of the biceps tendon.

Thirty-two patients (38%) in this study had significant biceps tendon-superior labrum injury that did not fit into the classification system proposed by Snyder et al. [25] Fourteen had a continuation of a Bankart lesion superiorly to include the biceps tendon and superior labrum (Fig. 4) . Seven had either an anterior or posterior labrum flap tear in conjunction with the biceps tendon separation superiorly (Fig. 5) . In 11 patients the biceps tendon-superior labrum separation extended anteriorly to include the middle glenohumeral ligament (Fig. 6) . Sixty-one of the 84 patients had fraying of the superior labrum in addition to the above-described lesions.

Other associated injuries were documented during exploration of the glenohumeral joint. Nineteen patients

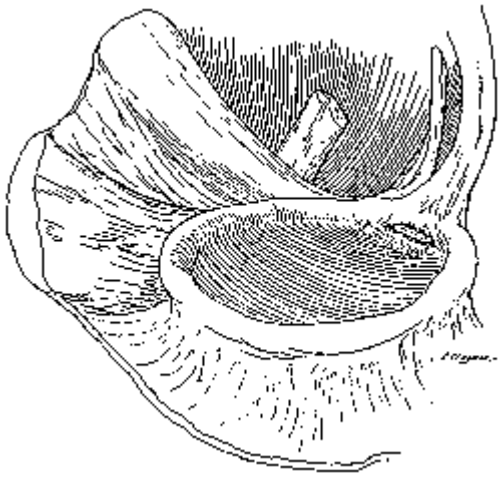

Figure 3. Type II SLAP lesion. Note the superior labrum-biceps tendon complex separation from the glenoid rim.

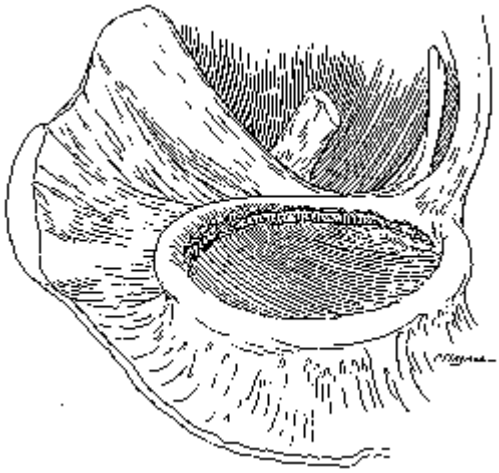

Figure 4. Type V SLAP lesion. An anterior-inferior Bankart lesion continues superiorly to include separation of the biceps tendon.

were noted to have a Bankart lesion. Fourteen of these were included in the Bankart-plus group, but five additional patients had Bankart lesions distinctly separate from their SLAP lesions. Four of these five patients had Type II lesions. Sixteen patients were noted to have tearing of the posterior labrum, 31 of the anterior

labrum (12 without the presence of a Bankart lesion), and 5 of the inferior labrum. Seven patients had separation of the anterosuperior portion of the labrum from the glenoid rim that was

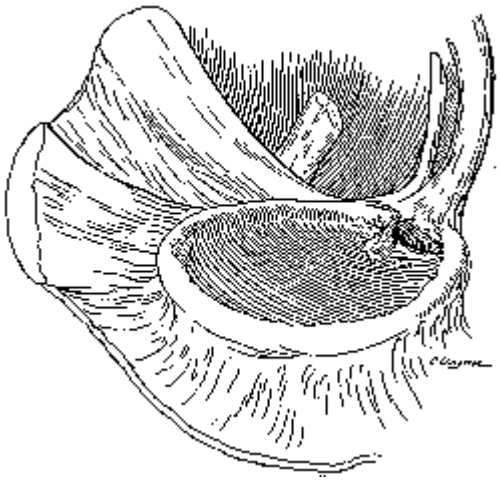

Figure 5. Type VI SLAP lesion. An unstable flap tear of the labrum is present in addition to biceps tendon separation.

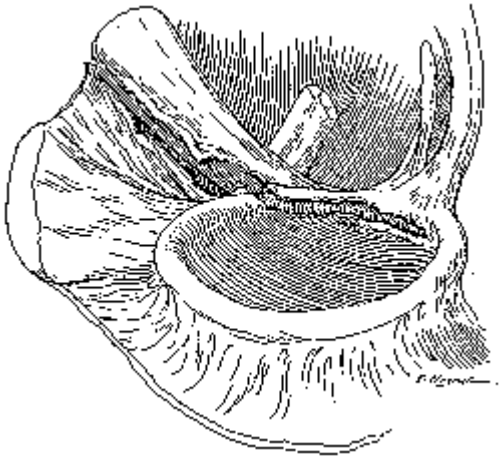

Figure 6. Type VII SLAP lesion. The superior labrum-biceps tendon separation extends anteriorly beneath the middle glenohumeral ligament.

believed to be a variant of normal. Evaluation of the rotator cuff demonstrated significant findings in 40 of 84 patients (48%). Thirty-two were noted to have a partial rotator cuff tear. Four patients were found to have a complete tear. Four additional patients had an interval tear of the rotator cuff. Findings consistent with an interval tear (a tear between the superior subscapularis border and the anterior margin of the supraspinatus tendon) included tearing in at least two of the following locations: the anterior border of the supraspinatus, the biceps tendon at its exit from the

joint, the superior border of the subscapularis, or the superior glenohumeral ligament. A Hill-Sachs lesion was found in 20 patients, all of whom were noted to have laxity on their examinations under anesthesia.

Operative arthroscopy was performed in most cases. Fifty-nine patients had some form of intervention directed at the biceps tendon-superior labrum lesion. Fifty-four had shaving of the frayed superior labrum. Five had abrasion to the superior rim of the glenoid rim to encourage healing. No patient had surgical fixation

of the labrum separation. Fifty-six patients had an arthroscopic subacromial decompression performed for the diagnosis of impingement.

DISCUSSION

The importance of the biceps tendon-superior labrum complex lesions is not well understood. As has been previously noted, substantial variation in the glenoid labrum can exist within the range of normal. Kohn [14] in 1987 found an abundance of labral fibrillation, rupture, ossification, and detachment in his study of 106 cadaveric shoulders with no known history of shoulder symptoms. Because of these findings, he questioned the clinical significance of labral lesions in general. Others have described patterns of labral lesion that may appear abnormal but are really normal anatomic variants. Johnson [13] described an anterosuperior sublabral foramen that mimics a labral detachment in this region. Snyder [24] studied 200 consecutive shoulder arthroscopies and found a 12% incidence of the sublabral hole. He found, in addition, a subgroup of patients with a cordlike middle glenohumeral ligament attaching to the anterosuperior labrum above the sublabral foramen causing the appearance of an extra-large sublabral hole. Despite the dramatic appearance, he believed that this was also a normal finding. As Moseley and Overgaard [18] described, the middle glenohumeral ligament itself can also have substantial normal variation.

Andrews et al. [2] found tears in the superior labrum in the region of the biceps tendon in 73 throwing athletes. Forty-two of these were in the anterosuperior region, 17 extended from the anterosuperior to posterosuperior region with 7 including a partial tear in the biceps tendon. They speculated that the pathophysiology of this lesion involved a pull on the superior glenoid labrum from the biceps tendon. Using muscle stimulation, they confirmed the ability of the biceps long head to lift the superior labrum off the glenoid rim when the biceps muscle is stimulated. Gartsman [9] reported 16 biceps-labrum complex abnormalities in his series of 165 acromioplasties for lesions of the rotator cuff.

Snyder et al. [25] collected a series of 27 patients with biceps tendon-superior labrum complex lesions. These patients had tears that extended from the anterosuperior to the posterosuperior aspect of the superior labrum. They classified these lesions into 4 different types. Type I (11%) involved fraying of the superior labrum. Type II (41%) had detachment of the biceps tendon with or without fraying. Type III (33%) involved a bucket-handle tear of the superior labrum. Type IV (15%) was similar to Type III but with the tear extending up into the biceps tendon. Associated lesion was common with 41% having a rotator cuff tear (26% partial and 15% full thickness), 11% with acromioclavicular arthritis, and 15% with anterior instability. They postulated a typical mechanism involving a fall on an outstretched, slightly abducted and forward flexed arm (13 of 27). Eight of 27 were found to have a traction injury.

In the present study, an incidence of 11.8% (84 of 712) was found for significant lesion involving the biceps tendon-superior labrum complex. Snyder [24] found an incidence of 3.9% (27 of 700). Those patients with Type I superior labral fraying were excluded from the present study because it appeared to be part of normal aging and not a lesion from an injury or an injury that was significant enough to lead to shoulder dysfunction; 62% had lesions that fit into the classification of Snyder et al. [25] Of those who did not, three constant variations were seen.

Fourteen patients (17%) had a continuation of a Bankart detachment that continued superiorly to involve the anterosuperior labrum and the biceps tendon-superior labrum complex (Fig. 4) . Garth et al. [8] in 1987 reviewed occult instability of the shoulder in athletes and evaluated the arthroscopic findings. They described one case of a labral avulsion that extended "from the anterior inferior quadrant superiorly to include the biceps insertion and extending to 1 o'clock on the posterior superior labrum of the glenoid." This description matches those of the 14 patients in this group.

Eleven patients had an extension of their biceps tendon-superior labrum separation anteriorly to involve the area below the middle glenohumeral ligament (Fig. 6) . This pattern is similar to that described by Snyder [24] and was believed by him to be a normal anatomic variation. The patients in our study, however, had

separation of the biceps tendon to different degrees in addition to the anterosuperior quadrant sublabral foramen extending below the middle glenohumeral ligament that Snyder described.

The third variation was one in which a biceps tendon separation was accompanied by either an anterior- or posterior-based flap tear of the superior labrum (Fig. 5) . Tears of the glenoid labrum have been extensively studied. [1] [3] [4] [5] [6] [10] [15] [16] [17] These tears can be associated with glenohumeral joint instability, and, in the presence of a shoulder with no objective laxity, can cause functional instability.

Patients with a stable shoulder can have a feeling of the shoulder "going out" because of labral tears that become interposed between the humeral head and glenoid, preventing the congruent fit so essential to concavity compression and normal glenohumeral stability. This was termed "functional instability" by Pappas et al. [21] They found that debridement of these labral tears resolved the patient's feeling of instability.

True instability problems can also masquerade as symptoms consistent with other pathologic syndromes. Impingement symptoms can occur in patients with subtle forms of instability and has been termed "secondary impingement" or "pseudoimpingement." [7] [9] [12] [20] This process is thought to be due to increased glenohumeral joint translation causing increased traction stress on the rotator cuff. This stress, especially in the supraspinatus tendon, incites the inflammatory cascade.

Determination of the difference between primary and secondary mechanical impingement is critical in planning treatment. Jobe and Kvitne [12] believed that primary impingement occurred as a degenerative process in older patients (35 years of age and over) while secondary impingement ("instability complex") occurred in younger throwing athletes subjecting their shoulders to chronic repetitive microtrauma. They offered the relocation test as a means of differentiating the two groups.

In the present study, 63 of 84 (75%) of the patients had a preoperative diagnosis of impingement syndrome. All of the patients complained of pain within the involved shoulder; 56% had a positive Neer impingement sign; 49% had a positive impingement sign with abduction-internal rotation, Hawkins' sign. Only 24 patients were believed during clinical manipulation to have laxity preoperatively. Five of these had a high index of suspicion because of a history of dislocation; however, at surgery their signs of instability became more apparent; 44.5% of the patients had laxity on examination under anesthesia and during diagnostic arthroscopy. This included 30% of the Type II patients; 0%, Type III; 66%, Type IV; 100%, Type V; 28%, Type VI; and 50%, Type VII. In addition, 21 of 84 patients had Hill-Sachs lesions, and 5 patients, other than the 14 with Type V lesions, had Bankart lesions.

The relationship between the SLAP lesion and shoulder translation was examined by Rodosky et al. [22] [23] A biomechanical study was performed on cadaveric shoulders before and after a lesion was made in the biceps tendon-superior labrum complex. The torsional rigidity and inferior glenohumeral ligament strain were measured. Torsional rigidity decreased 26%, and inferior glenohumeral ligament strain increased 33% after the lesion was created.

It is believed that the appearance of a biceps tendon-superior labrum separation during diagnostic arthroscopy should alert the surgeon to the possible existence of subtle instability that may be the cause of the patient's pain or dysfunction. This instability may be present even when the patient manifests signs of impingement syndrome.

That shoulder instability and SLAP lesions coexist is clear. What has not been proved is their precise interrelationship. We cannot, on the basis of this study, conclude which of four possible situations did in fact occur. 1) Patients with a preexisting SLAP lesion, congenital or acquired, are most susceptible to damage from a traction injury. 2) A sudden translation (a subluxation or dislocation) caused the avulsion of the biceps-

labrum complex. 3) The translation primarily injured the shoulder primary restrains (glenohumeral ligaments) and the loss of stability allowed increased translation and subsequent labrum separation. 4) The biceps-labrum complex abnormality and instability damage are independent events.

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