

CASE REPORT

Irreparable Capsule Tears in Initial Surgery for Glenohumeral Instability: Report of Two Cases Treated with Iliotibial Band Autograft

Kiyohisa Ogawa,¹ Toyohisa Naniwa² and Noriko Okuyama²

¹*Sports Clinic, School of Medicine, Keio University, Tokyo, Japan*

²*Department of Orthopedic Surgery, School of Medicine, Keio University, Tokyo, Japan*

(Received for publication on January 13, 2009)

(Revised for publication on March 4, 2009)

(Accepted for publication on March 19, 2009)

Abstract

Anterior shoulder instability due to massive capsular tearing can usually be repaired by suturing the torn ends together with a satisfactory result. The purposes of this report are to demonstrate the presence of capsular deficiency irreparable by primary sutures even in an initial surgical intervention and to ponder the cause of primary irreparability. We documented the surgical reconstructive technique using the iliotibial band and the subsequent postoperative results in two cases. To our knowledge, there have been no such cases with primarily irreparable capsular tear. (Keio J Med 58 (3) : 185–189, September 2009)

Keywords: shoulder, instability, irreparable capsular tear, reconstruction, iliotibial band

Introduction

Occurring in a first-time traumatic anterior shoulder dislocation is detachment of the ligamento-labro-perios-teal complex from the glenoid edge, or the so-called Bankart lesion. Both clinical and experimental demonstrations have shown that the joint capsule including the inferior glenohumeral ligament (IGHL) is injured independently or concurrently with the Bankart lesion.^{1–6} Tearing may occur at any site, be it laterally, in the mid-substance, or medially. Anterior instability due to capsular tearing can usually be repaired by suturing the torn ends together with a satisfactory result.^{3, 7–11}

We describe two cases experienced during open Bankart procedure, in whom primary capsular repair was infeasible due to capsular deficiency including the IGHL despite an initial surgery to address anterior instability. We also present the presumed cause of primary irreparability and the surgical reconstructive technique we employed. Informed consent was obtained from the patients for this case report.

Case Report

Case 1

A 30-year-old right-handed male visited our clinic with a complaint of left shoulder instability. He had suffered left shoulder subluxation due to a fall during snowboarding 4 years earlier, and had subsequently experienced a total of 12 episodes of subluxation. On examination, decrease of elevation and external rotation was 35° as compared to his normal right shoulder, and the anterior apprehension test was intensively positive. Radiograms revealed a typical postero-lateral notch and mild osteoarthritis on the humeral head. Computed tomography (CT) using air contrast disclosed the bony defect of the antero-inferior glenoid and air-leakage into the subacromial bursa. Arthrography showed contrast medium leakage from the supraspinatus tendon and a triangular bulge in the antero-inferior joint cavity (**Fig. 1a**).

At operation, there was a small slit of the subscapularis communicating with the joint cavity. When the subscap-

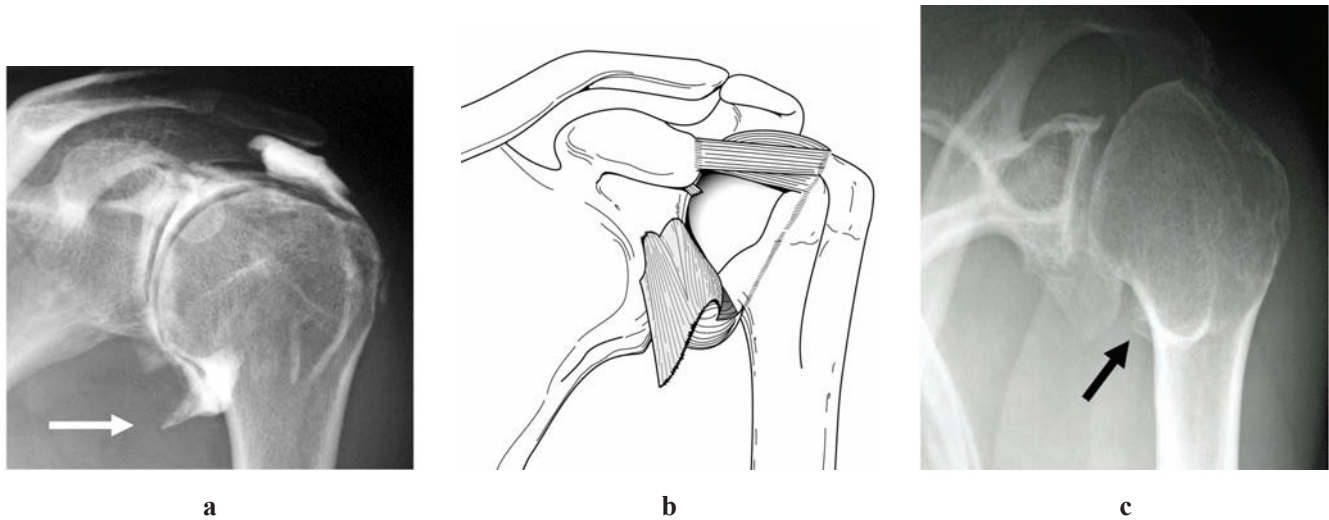


Fig. 1 A 30-year-old male with complete rupture of the supraspinatus tendon. (a): Arthrogram revealing a contrast medium leakage from the supraspinatus tendon into the subacromial bursa and a triangular bulge in the antero-inferior joint cavity, the latter of which we had not preoperatively understood its meaning (white arrow). (b): Schema showing the operative findings. The capsular tear ran longitudinally at its insertion onto the humeral neck down to the lowermost neck and then extended obliquely to midway of the capsule along the fiber bundles of the IGHL. The torn capsule was reflected anteromedially. (c): A 45° craniocaudal radiogram at the time of follow-up detecting mild osteoarthritis and a spur formation on the medial humeral surgical neck (black arrow). The spur formation on the neck is inferred to represent a form of spontaneous healing consequent on detachment of a part of the IGHL along with that of the adjoining periosteum.

ularis tendon was cut longitudinally and reflected medially, the humeral head was immediately exposed underneath. The capsular tear ran longitudinally at the insertion onto the humeral anatomical neck down to its lowermost end and then extended obliquely along the IGHL fiber bundles. The torn capsule was reflected anteromedially with the attached deep muscle layer of the subscapularis (**Fig. 1b**) and no Bankart lesion was exhibited. The torn capsule was fragile and contracted, and was impossible to suture it onto the original site even with the shoulder in neutral rotation. With the shoulder held in 90° abduction and external rotation in the scapular plane, the humeral head was pushed backward and controlled manually against its anterior protrusion. In this position, the torn part along the IGHL fiber bundles ran transversely over the inferior one-third of the head and was sutured side to side. An irregularly tetragonal capsular defect thence remained between the capsular stump and the anatomical neck. While maintaining the apprehension position, the region encompassing the capsular defect was covered with the patient's iliotibial band (ITB) in such a way that its main fiber bundles were aligned horizontally. The ITB was then sutured onto both the labrum and the torn end of the capsule medially, onto the IGHL inferiorly, and onto the deep dissected stump of the subscapularis tendon laterally. With the arm at the side and at 60° of external rotation, the ITB was further sutured to the coracohumeral ligament. After an anterior acromioplasty, the completely torn supraspinatus tendon

was sutured to the original site. Finally resutured was the subscapularis tendon.

A follow-up at 11 years post-operatively revealed radiographic evidence of a spur formation on the medial humeral neck and mild osteoarthritis (**Fig. 1c**). The Rowe's score was 95 points with 15° restriction in external rotation as compared to the normal joint.¹² The patient had no apprehension toward any further dislocation in occupation (home electronic appliance repair), or recreational sports (e.g., skiing, snowboarding, tennis).

Case 2

A 36-year-old right-handed male was examined with a complaint of right shoulder instability. He first suffered dislocation due to forced extension of the joint 10 years earlier when he took a hard fall during skiing. He incurred only a total of 3 episodes of dislocation thereafter but had serious apprehension concerning possible further dislocation. On examination, range of motion was restricted 30° in elevation and 50° in external rotation as compared to his left shoulder and the anterior apprehension test was strongly positive. Radiograms demonstrated a small postero-lateral notch on the humeral head. Pneumoarthro-CTs revealed detachment of the anterior labrum, an antero-inferior glenoid defect, and a sharply demarcated contrast medium outflow into the subscapularis.

At operation, when the upper half of the subscapularis

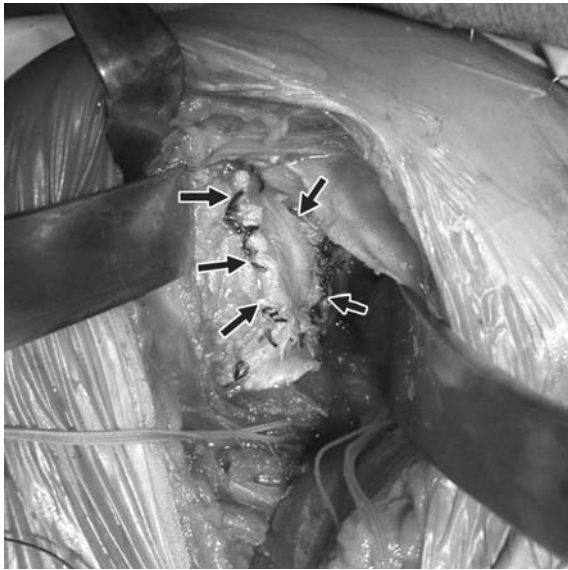


Fig. 2 Photogram showing an autologous ITB graft filling the capsular defect (black arrows). It was sutured medially onto the glenoid margin in line with Rowe's modification of the Bankart procedure, onto the IGHL inferiorly, and laterally onto the deep dissected stump of the subscapularis tendon.

was cut and reflected medially, the capsule was noted to be torn at its junction with the labrum down to the 4 o'clock position, with the tear thence running obliquely in an inferolateral direction along the IGHL fiber bundles and reaching the lowermost end of the humeral neck. The labrum at the 1-to-5-o'clock position was detached and medially transposed. Suturing of the capsular torn end onto the original site was infeasible with the shoulder in neutral rotation. With the same technique and shoulder position employed in Case 1, the capsular defect was filled with an autologous ITB graft. Medially, the grafted ITB was sutured onto the glenoid margin (**Fig. 2**).

At 3 years post-operatively, there was no disturbance to his daily living activities. The range of shoulder motion was restricted 20° in elevation and 20° in external rotation, and the Rowe's score was 90 points.¹²

Discussion

The IGHL itself functions as the primary check against the forward translation of the humeral head in the apprehension position.^{13,14} This ligament has its insertions medially on the labrum and the anterior aspect of the scapular neck and laterally on the humeral anatomical neck,^{1,6} while the main collagen fiber bundles are oriented in a radial fashion so as to bind these insertions.¹⁵ Mechanical experiments have shown that disruption of the IGHL can occur at any site along its course, includ-

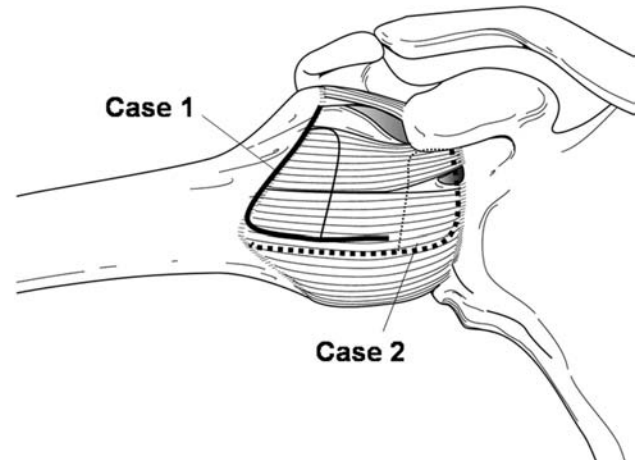


Fig. 3 Scheme showing the course of capsular tears in the present two cases with the shoulder in the apprehension position (bold line or dotted lines). In this shoulder position, the caudal part of the IGHL tear proceeding along the orientation of its main fiber bundle runs in a horizontal direction and lies just anterior to the humeral head. The entire shape of the tear, therefore, is basically L-shaped irrespective of the site of the IGHL rupture. Therefore, the resultant capsular defects due to contraction of the torn capsule are irregularly tetragonal (fine line or dotted lines).

ing, most medially, detachment of the ligamento-labro-periosteal complex from the glenoid margin corresponding to the Bankart lesion, then the junction of the ligament with the labrum, midsubstance, and the insertion on the humeral anatomical neck.^{5,6} In the clinical setting, the Bankart lesion is known to occur in most cases of initial traumatic anterior dislocation while in some cases the IGHL is torn at the junction of the ligament with the labrum, midsubstance, and at the insertion on the humeral neck; hence consistent with the results of experiments.^{1,4} Tearing of the IGHL constitutes one of the main causes of recurrent anterior dislocation, as is the case with the Bankart lesion, and it arises at any site along its course just as in initial traumatic dislocation.^{3,7-11} In the present series, the site of tearing was the insertion on the humeral neck (Case 1), or the junction of the ligament with the labrum (Case 2). It is impossible to prove completely the existence of capsular tear from the preoperative clinical findings and imaging including MRI.

In our cases of IGHL tear including the two cases described herein, the caudal part of the tear runs obliquely along the orientation of the main fiber bundle of the IGHL, irrespective of the tear site.⁸ In the apprehension position, this course of tearing along the IGHL main fiber-bundle runs in a horizontal direction and lies just anterior to the humeral head. With the arm in this position, the entire shape of the tear is therefore basically L-shaped irrespective of the site of the IGHL rupture (**Fig. 3**). The maximum principal nonrecoverable strain direction does not coincide with the principal fiber bun-

dle direction of the IGHL in studies in which a three-dimensional loading was applied via the humeral head with the whole IGHL shape maintained intact.¹⁶ Therefore, it might not be unusual that tears occur in the direction consistent with the principal fiber bundle direction. The L-shaped tears enable a substantially enormous transposition of the torn capsular flap including the IGHL.

The deep layer of subscapularis has its insertion on the anterior capsule.¹⁷ Even in the case with the capsular tear, the torn end is not largely transposed insofar as integrity of the deep layer of the subscapularis inserted on the capsule and the remainder of this muscle is maintained. However, if separation occurs between the deep layer and the remainder of the subscapularis muscle, the torn part of the capsule is largely transposed due to traction exerted by the deep layer of the subscapularis. Traction by this deep layer of subscapularis inserted on the torn capsular flap was evident in Case 1 of the present study. If the deep layer of the subscapularis separates from the capsule, it makes the torn capsular part free. This phenomenon was seen in Case 2. The capsular flap substantially transposed, which is no longer extended in association with shoulder joint movement, gradually contracts.

If the torn and contracted capsule is sutured to the original site, it causes a marked restriction on external rotation which may constitute a factor contributing to the development of osteoarthritis following surgery for anterior shoulder instability.¹⁸ Therefore, the shortened IGHL must be complemented to restore its physiological length. The length to be made up should be determined in the apprehension position at which the greatest strain is imposed on the IGHL and the graft is sutured with the arm in this position. As the principal collagen fiber bundles of the IGHL run in a practically horizontal direction in this position, the major fiber bundles of the graft should also be oriented in a horizontal direction accordingly. Because the torn capsular flap is fragile, the graft is sutured on the glenoid margin or labrum medially and on the humeral anatomical neck or the deep layer of the subscapularis tendon laterally so as to cover the defect and flap. Inferiorly, it is sutured side to side onto the upper margin of the intact IGHL. When the superior portion of the graft is sutured to the residual upper capsule with the arm in apprehension position, external rotation with the arm at the side is restricted. It should thus be sutured to the coracohumeral ligament with the arm at the side and in the externally rotated position. Iliotibial band reconstruction was reported by Iannotti *et al.* in patients with capsular and subscapularis deficiency after two or more failed surgeries.¹⁹ In the cases they documented, a graft was folded twice into three layers because of the subscapularis as the anterior dynamic stabilizer also being injured. Use of a single layer of graft is considered to be sufficient in terms of strength for initial surgery as in

the present series. In a review of the literature, we could find no case with primarily irreparable capsular tear and therefore no reconstructive technique for it.

References

1. Nicola T: Acute anterior dislocation of the shoulder. *J Bone Joint Surg Am* 1949; **31-A**: 153–159
2. Bigliani LU, Polloch RG, Soslowky LJ, Flatow EL, Pawluk RJ, Mow VC: Tensile properties of the inferior glenohumeral ligament. *J Orthop Res* 1992; **10**: 187–197
3. Wolf EM, Cheng JC, Dickson K: Humeral avulsion of glenohumeral ligaments as a cause of anterior shoulder dislocation. *Arthroscopy* 1995; **11**: 600–607
4. Taylor DC, Arciero RA: Pathologic changes associated with shoulder dislocations: Arthroscopic and physical examination findings in first-time, traumatic anterior dislocations. *Am J Sports Med* 1997; **25**: 306–311
5. McMahon PJ, Tibone JE, Cawley PW, Hamilton C, Fechter JD, Elattrache NS, Lee TQ: The anterior band of the inferior glenohumeral ligament: Biomechanical properties from tensile testing in the position of apprehension. *J Shoulder Elbow Surg* 1998; **7**: 467–471
6. McMahon PJ, Dettling J, Sandusky MD, Tibone JE, Lee TQ: The anterior band of the inferior glenohumeral ligament: Assessment of its permanent deformation and the anatomy of its glenoid attachment. *J Bone Joint Surg Br* 1999; **81-B**: 406–413
7. Bach BR, Warren RF, Fronck J: Disruption of the lateral capsule of the shoulder. *J Bone Joint Surg Br* 1988; **70-B**: 274–276
8. Ogawa K, Yoshida A: Extensive shoulder capsule tearing as a main cause of recurrent anterior shoulder dislocation. *J Shoulder Elbow Surg* 1997; **6**: 1–5
9. Bokor DJ, Conboy VB, Olson C: Anterior instability of the glenohumeral joint with humeral avulsion of the glenohumeral ligament: A review of 41 cases. *J Bone Joint Surg Br* 1999; **81-B**: 93–96
10. Mizuno N, Yoneda M, Hayashida K, Nakagawa S, Mae T, Izawa K: Recurrent anterior shoulder dislocation caused by a midsubstance complete capsular tear. *J Bone Joint Surg Am* 2005; **87-A**: 2717–2723
11. Rhee YG, Ha JH, Park KJ: Clinical outcome of anterior shoulder instability with capsular midsubstance tear: A comparison of isolated midsubstance tear and midsubstance tear with Bankart lesion. *J Shoulder Elbow Surg* 2006; **15**: 586–590
12. Rowe CR, Patel D, Southmayd WW: The Bankart procedure: A long-term end-result study. *J Bone Joint Surg Am* 1978; **60-A**: 1–16
13. Turkel SJ, Panio MW, Marshall JL, Girgis FG: Stabilizing mechanisms preventing anterior dislocation of the glenohumeral joint. *J Bone Joint Surg Am* 1981; **63-A**: 1208–1217
14. O'Brien SJ, Neves MC, Armoczky SP, Rozbruch SR, Dicarolo EF, Warren RF, Schwartz R, Wickiewicz TL: The anatomy and histology of the inferior glenohumeral ligament complex of the shoulder. *Am J Sports Med* 1990; **18**: 449–456
15. Gohlke F, Essigkrug B, Schmitz F: The pattern of the collagen fiber bundles of the capsule of the glenohumeral joint. *J Shoulder Elbow Surg* 1992; **3**: 111–128
16. Malicky DM, Kuhn JE, Frisancho JC, Lindholm SR, Raz JA, Soslowky LJ: Nonrecoverable strain fields of the anteroinferior glenohumeral capsule under subluxation. *J Shoulder Elbow Surg* 2002; **11**: 529–540
17. Clark J, Sidles JA, Matsen FA: The relationship of the glenohumeral joint capsule to the rotator cuff. *Clin Orthop Relat Res* 1990; **254**: 29–34
18. Rosenberg BN, Richmond JC, Levine WN: Long-term followup

- of Bankart reconstruction. Incidence of late degenerative glenohumeral arthrosis. *Am J Sports Med* 1995; **23**: 538–544
19. Iannotti JP, Antoniou J, Williams GR, Ramsey ML: Iliotibial band reconstruction for treatment of glenohumeral instability associated with irreparable capsular deficiency. *J Shoulder Elbow Surg* 2002; **11**: 618–623