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

1Sports Clinic, School of Medicine, Keio University, Tokyo, Japan
2Department 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-periossteal 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.5,7–11

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 35º 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-
ularis tendon was cut longitudinally and reflected medially, the humeral head was immediately exposed underneath. The capsular tear ran longitudinally at its insertion onto the lowermost neck 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. 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 anteroinferior glenoid defect, and a sharply demarcated contrast medium outflow into the subscapularis.

At operation, when the upper half of the subscapularis
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 20º in elevation and 20º 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, including, most medially, detachment of the ligamento-labroperiosteal 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-
tle 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
