Pectoralis major tendon transfer for subscapularis deficiency following multiple failed instability surgeries: A case report

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Abstract

Here, we report a case of a 30-year-old man with a diagnosis of complex shoulder instability, who was treated successfully by pectoralis major transfer following a series of failed instability correction surgeries. The patient was admitted to our outpatient clinic with an approximately 6-year history of chronic shoulder instability following several failed operations, including open Bankart repair, open capsular plication and Bankart repair, open capsule repair, arthroscopic Bankart repair, and Bristow-Latarjet procedure. Physical examination revealed persistent shoulder pain, weakness, and a limited range of motion. Imaging studies demonstrated complete subscapularis muscle atrophy with Goutallier grade 4 fatty infiltration. The decision for revision surgery was made owing to his shoulder findings and clinical symptoms. The intraoperative assessment revealed the subscapularis muscle to be fully atrophic and irreparable. The pectoralis major muscle was transferred from the intertubercular groove of the humerus to the lesser tuberosity. Postoperatively, the patient had 4 weeks of shoulder immobilization. Physical examination demonstrated an improved shoulder range of motion without evidence of recurrent shoulder instability. The authors encountered no sign of dislocation for 2.5 years of follow-up after the surgery. In conclusion, subscapularis muscle atrophy or insufficiency should be considered in the differential diagnosis of patients with failed shoulder instability surgeries. Pectoralis major tendon transfer may be successfully performed for the surgical treatment of such patients.

Introduction

The shoulder joint is one of the most mobile joints in the body; it has multidirectional planes of motion and rotation, increasing the risk of dislocation (1). Shoulder dislocation is a commonly encountered pathological condition in orthopedic surgery. Approximately 50% of all joint dislocations are related to the shoulder joint (2). Glenohumeral dislocation is frequently seen in young populations, and its prevalence is reported to be 0.24 per 1,000 person-years in the United States (3). Young men are shown to be especially under risk. Anterior shoulder dislocation is substantially more frequent although dislocations may occur in all directions (4). Major risk factors identified are involvement in contact sports, young age, and hyperlaxity (5).

Shoulder instability can be defined as a pathologic and symptomatic increase in the humeral translation on the glenoid (6). Trauma, abnormal muscle patterns, and structural abnormalities may contribute to shoulder instability, which may be classified as anterior, posterior, or multidirectional instabilities. Capsulolabral injuries, bony defects, and rotator cuff tears lead to anterior instability typically following atraumatic anterior dislocation (7). Insufficiency of subscapularis, however, mainly causes anterosuperior instability of the shoulder. This condition is generally related to forward flexion limitation owing to the change of center of rotation (8).

Shoulder instability management includes several types of surgical techniques. The first technique is anatomic Bankart repair, i.e., reconstruction of the avulsed labrum and the capsule at the glenoid (9). The second technique aims at the mechanical anterior block i.e., using bone blocks. In the Bristow-Latarjet procedure, the coracoid process is transferred to the anterior glenoid along with its soft tissue adhesions to constitute an anteroinferior musculotendinous sling in addition to its bone block effect, whereas in the Eden-Hybinette procedure, the iliac bone autograft is used to repair the bony defects in the glenoid (10, 11). Third technique can be described as capsule repair or capsular plication in which the excessively loose joint capsule is tightened to prevent dislocation and multidirectional instability. There are other techniques, such as humerus and glenoid osteotomies for glenohumeral alignment modification and Magnuson-Stack and Patti-Platt procedures in which anterior structures are tightened to limit external rotation (12). However, the two aforementioned techniques are rarely used.

Anterior instability may recur after previous stabilization surgeries at reported rates of 7%-12% (13). Revision surgery is almost always challenging because of adhesions, compromised structures, and scar tissue formation. It is of utmost importance to determine the potential factors that may lead to failed surgery, and preoperative planning must be done accordingly. When recurrent shoulder instability is detected, the surgeon must decide whether a previous surgical mistake or an underlying unsolved pathologic condition accounts for the current instability.
We present this case report of a patient with a history of complex shoulder instability who underwent numerous failed surgeries, namely, open and arthroscopic Bankart repair, Latarjet procedure, open capsular repair, and open capsular plication. Despite all attempts, the patient had recurrent instability induced by the loss of anterior support of the glenohumeral joint owing to subscapularis atrophy. An excellent result using pectoralis major transfer as a combined or subsequent surgery option for failed instability surgery in patients with chronic subscapularis rupture is presented.

**Case Presentation**

A 30-year-old male, right-hand-dominant patient was admitted to our outpatient clinic with a right shoulder instability history of approximately 6 years. He had an industrial injury in which a heavy sack fell on his right shoulder. He underwent a series of failed procedures, namely, open Bankart repair (6 years ago), open capsular plication and Bankart repair (5 years ago), open capsule repair (4 years ago), arthroscopic Bankart repair (3 years ago), and Bristow-Latarjet procedure (2.5 years ago). He suffered recurrent shoulder instability, pain, and weakness and had a limited range of motion. Constant and Rowe scores were calculated to be 35 and 5, respectively. Physical examination revealed active forward flexion of 90°, passive flexion of 120°, and abduction of 80°. External rotation range let his hand to be placed behind his head in elbow forward position; internal rotation range was at waist level (L3). Apprehension tests yielded positive results. Additional anterior shoulder instability provocative tests were also noted as positive. No subscapularis function was observed during the bear hug and belly press tests. The limitation of active forward flexion was attributed to anterosuperior instability owing to the degeneration of subscapularis muscle as a result of previous surgical interventions. There was no sensory or motor function loss, and deltoid function was intact.

An X-ray revealed two screws; no apparent anchors of previous surgeries are seen (Figure 1). Magnetic resonance imaging revealed complete subscapularis muscle atrophy with Goutallier grade 4 fatty infiltration (Figure 2). Other rotator cuff muscles were intact. Electromyography results showed motor and sensory functions of the arm to be intact, including the suprascapularis nerve, long thoracic nerve, and axillary nerve; however, the suprascapularis nerve and long thoracic nerve had partial axonal degeneration.

Revision surgery was indicated because of signs and symptoms, such as instability, pain, and limited range of motion. Obvious anterior instability was noted via positive load and shift tests under general anesthesia. The deltopectoral approach was used in the surgery. Intra-operative assessment revealed the subscapularis muscle to be fully atrophic and irreparable. The pectoralis major muscle was transferred from the humerus intertubercular groove to the lesser tuberosity and fixed with two anchors (Figure 3-5).

HIGHLIGHTS

- In complex shoulder instability cases, each factor contributing to biomechanical restoration of the shoulder should be analyzed to identify underlying pathology.
- Subscapularis muscle atrophy or insufficiency should be considered in the differential diagnosis of patients with failed shoulder instability surgeries.
- Pectoralis major tendon transfer can be a successful intervention for the surgical treatment of such patients.

Postoperatively, the patient had 4 weeks of shoulder immobilization with sling. From week 5 onward, he started pendulum exercises and continued to use the sling. After 10 weeks, he started to perform an active range of motion exercises. Physical examination 3 months after the surgery demonstrated abduction of 160°, forward flexion of 170° (Figure 6), external rotation of 40°, and internal rotation range of level L5. He did not have positive results for apprehension tests or any other instability evidence. His Constant and Rowe scores were calculated to be 85 and 95, respectively. We did not encounter any sign of dislocation for 2.5 years of follow-up after the surgery. Patient’s informed consent was obtained to publish the details and the photographs of his medical condition.

**Discussion**

Subscapularis tendon is shown to be a critical contributor to anterior stability, providing a balanced force couple around the glenohumeral joint (14). In addition, chronic subscapularis tendon muscle unit in-
sufficiency may lead to anterosuperior deviation of the humeral head because of the absence of anterior restraint, which can eventually result in pain, limited range of motion, and weakness (15, 16). Although subscapularis tears can occur as a result of degenerative processes or overuse, they are commonly encountered followed by trauma (17). Moreover, subscapularis function is shown to be critical in shoulder instability surgical success. Sachs et al. observed 30 patients with traumatic shoulder instability who underwent open Bankart repair and concluded that the integrity of the subscapularis repair was the most crucial factor in the patients’ perceived surgical success (18). As a result, subscapularis insufficiency may coexist with anterior subluxation and instability as presented in this case. Furthermore, patients usually have delayed diagnosis because of the relative infrequency of subscapularis tendon tears and inadequate magnetic resonance evaluation owing to low sensitivity, which in turn, results in retraction and fatty degeneration, leading to often irreparable chronic subscapularis deficiency (19, 20). Irreparable tears pose pressure on the glenoid, exacerbating the dynamic instability of the shoulder. To reestablish anterior joint mechanics, limited options for therapeutic intervention are offered (21). The choice of treatment is decided upon by reviewing the patient’s age, symptoms, and presence of glenohumeral osteoarthritis (22). Although arthroplasty may be appropriate in older populations, tendon transfer, i.e., salvage procedure selection in a young, active adult with a well-preserved glenohumeral joint may be especially challenging for the clinician. Pectoralis major tendon transfer was first described by Wirth in 1997 as an alternative method in the treatment of irreparable subscapularis tears (23). Anatomically, pectoralis major provides an internal rotational force on the glenoid, restoring damaged anterior stability. Moreover, it is hypothesized that functional similarity between pectoralis major and...
In conclusion, subscapularis accounts for shortened rehabilitation process using biofeedback programs (24). It has been demonstrated that pectoralis major tendon transfer provides significant clinical improvement specifically in pain and range of motion, lasting up to 10 years after surgery. It is important that the patient has an intact deltoid and a functioning glenohumeral joint (25). Elhassan et al. performed a very comprehensive study regarding pectoralis major tendon transfer in three patient groups with irreparable tears of subscapularis; patients who had subscapularis insufficiency because of unsuccessful previous procedures for shoulder instability and patients who had subscapularis tendon rupture associated with a massive rotator cuff tear benefited greatly, whereas results were not encouraging for those with subscapularis ruptures following shoulder replacement (26).

In this case, recurrent anterior instability of the patient could not be avoided despite repetitive surgical procedures because of the underlying unsolved pathologic condition. It is critical to acknowledge chronic subscapularis deficiency as a potential underlying reason in complex and challenging instability cases to be able to consider it among differential diagnoses.

The abovementioned pectoralis tendon transfer procedure, achieving significant improvement in pain and range of motion in a patient who suffered recurrent shoulder instability for 6 years despite 5 failed surgeries, emphasizes the importance of considering each individual factor contributing to biomechanical restoration of the shoulder during investigation of the underlying pathology.

In conclusion, subscapularis muscle atrophy or insufficiency should always be included in differential diagnosis of failed shoulder instability surgeries. Pectoralis major tendon transfer is a successful technique to be performed in these complex cases.

**Informed Consent:** Patient’s informed consent was obtained to publish the details and the photographs of his medical condition in the case.

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