



Secondary frozen shoulder after traumatic anterior shoulder instability

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Background: Secondary frozen shoulder after traumatic anterior shoulder instability is rare. The therapeutic management and clinical outcome of this condition are not well known. This study aimed to investigate the characteristics of such rare cases and verify treatment outcomes.

Methods: We reviewed the cases of 12 patients with secondary frozen shoulder after anterior shoulder dislocation or subluxation between April 2007 and March 2018. All patients underwent physical therapy along with an intra-articular injection. Patients with refractory stiffness received arthroscopic mobilization. The range of motion, Rowe score, and University of California, Los Angeles score were evaluated at the first and final visits. A telephone survey was performed to determine the long-term outcomes including recurrent instability, the Oxford Shoulder Score, and the Oxford Instability Score.

Results: The mean age of patients at the first visit was 42.5 years. Two patients underwent surgical treatment, which revealed scar-like tissue of the anteroinferior capsule. The range of motion, Rowe score, and University of California, Los Angeles score significantly improved at a mean follow-up of 15 months. At a mean follow-up of 82 months, the telephone survey revealed recurrent instability in 1 patient who was conservatively treated; the average Oxford Shoulder Score and Oxford Instability Score were 46.4 and 43.2, respectively.

Conclusions: The average patient age observed in this study was higher than the known peak age of traumatic anterior shoulder instability occurrence. Less activity, loss of capsule elasticity, or scarring after a capsular tear may lead to stiffness after traumatic anterior shoulder instability. Conservative treatment can be used as the first-line therapy, followed by effective arthroscopic mobilization when conservative treatment fails.

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In the human body, joint dislocations are most commonly observed in the shoulder, with 95% of dislocations occurring anteriorly. Primary dislocation is mostly observed in young male patients aged approximately 20 years, with the incidence decreasing with age in men but gradually increasing with age in women.^{8,18} Primary anterior shoulder dislocation or subluxation with trauma often progresses to recurrent dislocation particularly in young individuals. Following dislocation or subluxation, the

shoulder shows some degree of limited motion owing to pain or apprehension for some time, which usually spontaneously recovers. However, some patients experience continuous stiffness after dislocation.

Typically, frozen shoulder is a condition characterized by a limited range of motion (ROM) and is categorized into 2 types.²⁴ The first type is primary frozen shoulder, in which an underlying etiology or associated condition cannot be identified. The second type is secondary frozen shoulder, which has some underlying etiology. Secondary frozen shoulder is further divided into 3 types: intrinsic, extrinsic, and systematic. Frozen shoulder after dislocation is categorized as the extrinsic type of secondary frozen shoulder, and its clinical characteristics are still unclear. Moreover, establishing a treatment strategy is difficult. If conservative treatment does not show the desired effect, surgical treatment, such as

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manipulation under anesthesia^{3,21} or arthroscopic capsular release,^{5,14} can be used to treat primary frozen shoulder. However, using such procedures for treating secondary frozen shoulder after dislocation may lead to an adverse effect of recurrent dislocation.

Thus, this study aimed to investigate the characteristics of secondary frozen shoulder after traumatic anterior instability and verify the treatment results.

Materials and methods

Patients

This study included 12 consecutive patients who received a diagnosis of secondary frozen shoulder after traumatic anterior shoulder instability at our institution between April 2007 and March 2018. Traumatic anterior shoulder instability was defined as traumatic anterior dislocation requiring a manual reduction maneuver or traumatic anterior subluxation with a positive clinical test result for anterior instability²² and a Bankart or Hill-Sachs lesions that were confirmed on magnetic resonance imaging (MRI).⁴ Frozen shoulder after instability was defined as limited passive shoulder flexion of less than 120°, lasting for more than 3 months after injury. Patients with brachial plexus injury, axillary nerve palsy, or rotator cuff tear were excluded, along with those older than 60 years, when shoulder motion naturally starts decreasing.¹⁰

Radiographic findings

All patients were assessed using MRI on their first visit to our hospital. Bankart and Hill-Sachs lesions were also evaluated.

Management

All patients underwent physical therapy at our institution in addition to home exercises. An intra-articular steroid injection (with a mixture of 2.5 mg of betamethasone acetate and betamethasone sodium phosphate and 5 mL of 0.5% lidocaine) was administered or joint distension (with a mixture of 2.5 mg of betamethasone acetate and betamethasone sodium phosphate and 20 mL of 0.5% lidocaine) was performed according to the patient's condition. In patients with severe pain, an intra-articular injection was administered first. If injection of the solution into the joint was smoothly flown to the joint without much pain and the symptoms continued thereafter, patients received joint distension at the next visit. If patients complained of pain during administration of the intra-articular injection because of joint expansion and if joint distension was thought to be difficult, the intra-articular injection was repeated at the next visit.

Patients with refractory stiffness, which continued for more than 3 months after the first visit to our institution, were suggested to undergo arthroscopic mobilization. This was performed by a single surgeon (Y.I.) with the patient under general anesthesia in the beach-chair position. The ROM was assessed with the patient under anesthesia. Initially, a standard posterior portal was used to view the glenohumeral joint, allowing the evaluation of intra-articular pathologic changes. After observation, a radiofrequency device was introduced from the anterior portal, and the rotator interval was released until the coracoid process and conjoint tendon were exposed. The coracohumeral ligament was also resected. The superior capsule above the long head of the biceps was then released until the muscle belly of the supraspinatus was exposed. The anterior to anteroinferior capsule was also cut lateral to the labrum to avoid the deterioration of the anterior labrum, and the subscapularis muscle belly was exposed. If the anterior labrum was detached from the glenoid rim, it was repaired using a suture

anchor. The arthroscope was then placed in the anterior portal, and the posterior capsule was superiorly and inferiorly released. If releasing the inferior capsule was difficult, an additional posteroinferior portal was made, through which the release was performed. After the entire circumference of the capsule was released, posterolateral and anterolateral portals were created for a subacromial procedure. If the subacromial bursa was adhesive, the bursa was débrided. Complete resection of the coracohumeral ligament was also performed through the subacromial space. Finally, the ROM was evaluated, the arthroscope was removed, and manipulation was performed.

Evaluation

The ROM, the 1988 version of the Rowe score,^{16,19} and the University of California, Los Angeles (UCLA) score¹ were evaluated at the first visit, before surgery, and at the final visit. The duration required for the improvement of ROM, defined as a less than 10° difference in flexion compared with the unaffected side, was evaluated. A telephone survey was conducted to assess long-term outcomes including recurrent instability, the Oxford Shoulder Score (OSS), and the Oxford Instability Score (OIS).

Statistical analysis

All statistical analyses were performed using IBM SPSS software (version 22; IBM, Armonk, NY, USA). Differences in the ROM, Rowe score, and UCLA score between the first visit and the final visit were examined with the Mann-Whitney *U* test. *P* < .05 was considered statistically significant.

Results

Patient data are shown in Table I. The mean age at the first visit to our institution was 42.5 ± 7.5 years (range, 27–56 years). Frozen shoulder occurred after the first dislocation, after the first subluxation, and with recurrent dislocation in 5, 3, and 4 patients, respectively. The mean duration between the injury and the first visit was 5.3 ± 3.4 months (range, 1–13 months). MRI revealed Bankart lesions, bony Bankart lesions, and no obvious Bankart lesions in 6, 2, and 4 patients, respectively. Hill-Sachs lesions were detected in 11 patients. No rotator cuff tear was noted, and it was difficult to establish the presence of a capsular tear or humeral avulsion of the glenohumeral ligament from the MRI results.

All patients were followed up at our institution for 15.4 ± 6.5 months (range, 7–29 months). On average, patients received an intra-articular steroid injection 1.6 ± 1.2 times (range, 0–4 times) and underwent joint distension 1.6 ± 1.3 times (range, 0–4 times) through the follow-up. The ROM, Rowe score, and UCLA score at the final visit were significantly improved compared with those at the first visit (Table II).

Ten patients were conservatively treated, and the mean duration required to recover active flexion was 11.8 ± 5.8 months (range, 5–24 months) from the injury and 6.7 ± 3.7 months (range, 2–16 months) from the first visit. The telephone survey conducted at a mean follow-up of 81.3 ± 36.6 months (range, 26–142 months) revealed no other recurrent instability, and the mean OSS and OIS were 46.1 ± 2.8 and 42.5 ± 6.6, respectively. One exception was a patient who had recurrent dislocation at 11 months after surgery while skiing, which was the cause of his original dislocation as well. His shoulder was immobilized for 10 days, and physical therapy including shoulder movement was initiated; thereafter, he did not show limited motion or recurrent dislocation.

Two patients underwent arthroscopic mobilization at 10 and 11 months after injury, which was 4 and 5 months, respectively, after

Table 1
Patient characteristics, clinical course, and outcomes of all patients

Patient No.	Sex	Age, yr	Type of instability	No. of dislocations or subluxations	Duration between injury and first visit, mo	Duration of improvement of ROM* from first visit, mo	Surgical intervention	Period between first and final visits, mo	Follow-up period, mo	Instability recurrence	OSS at final follow-up	OIS at final follow-up
1	M	43	Dislocation	4	3	7	No	9	142	No	48	47
2	M	43	Dislocation	1	1	4	No	12	108	Yes	47	46
3	F	43	Dislocation	35	13	5	No	10	98	No	43	27
4	M	27	Dislocation	1	4	6	No	12	98	No	47	42
5	M	40	Dislocation	1	2	7	No	12	96	No	48	46
6	F	36	Dislocation	1	6	5	No	18	95	No	48	47
7	F	40	Subluxation	1	4	2	No	7	86	No	48	48
8	M	48	Subluxation	1	1	6	No	12	38	No	45	39
9	F	56	Subluxation	1	8	16	No	18	26	No	48	48
10	F	53	Dislocation	1	9	8	No	24	26	No	39	35
11	F	45	Dislocation	1	6	9	Yes	22	110	No	48	48
12	M	36	Subluxation	1	6	10	Yes	29	59	No	48	45

ROM, range of motion; OSS, Oxford Shoulder Score; OIS, Oxford Instability Score; M, male; F, female.

* Improvement of ROM was defined as a less than 10° difference in flexion compared with the unaffected side.

the first visit. Intraoperative findings revealed hypertrophy and scar-like tissue of the anteroinferior capsule, which was suspected to be the result of scarring after the capsule tear (Figs. 1 and 2). One patient also had a detached anterior labrum (Fig. 2), and thus the labrum was repaired after capsular release (Fig. 3). The ROM, Rowe score, and UCLA score at the first visit, before surgery, and at the final visit are shown in Figure 4. In the 2 aforementioned patients, active flexion recovered 5 months after surgery. Neither patient had recurrent instability as assessed by the telephone survey at 110 and 59 months after surgery. At final follow-up, the OSS was 48 and 48, respectively, and the OIS was 48 and 45, respectively.

Discussion

In this study, we reported a small number of cases of secondary frozen shoulder after traumatic anterior shoulder instability. After anterior dislocation or subluxation, some patients experience temporary restriction of shoulder movement because of pain or immobilization. However, in most patients, their movement spontaneously recovers; therefore, patients who show continuation of a limited ROM are rare. At our institution, only 12 such cases were observed over a period of 11 years. To our knowledge, only 1 study related to this condition has been published to date,¹² which reported on 10 patients who received manipulation after development of secondary frozen shoulder after dislocation. Therefore, data regarding patient characteristics, pathologic conditions, treatment strategies, or treatment courses for secondary frozen shoulder after traumatic anterior shoulder instability are scarce.

Anterior shoulder instability most frequently occurs in patients aged approximately 20 years. The average age of patients in this study was 42.5 ± 7.5 years, which is higher than the known peak age of patients with traumatic anterior shoulder instability.^{8,18}

Table II
Clinical outcomes of all patients

	First visit	Final visit	P value
ROM			
Flexion, °	104.2 ± 15.0	172.1 ± 8.8	.002
Extension, °	29.2 ± 12.2	47.5 ± 10.7	.002
Abduction, °	82.5 ± 23.4	168.8 ± 16.2	.002
External rotation, °	16.7 ± 18.3	57.1 ± 15.2	.002
Internal rotation	L3 ± 3	T8 ± 1	.005
Rowe score	58.7 ± 7.4	91.8 ± 5.5	.002
UCLA score	17.0 ± 2.0	33.0 ± 2.0	.002

ROM, range of motion; UCLA, University of California, Los Angeles.

Reduced activity in older patients compared with that in younger patients or loss of capsule elasticity may contribute to secondary frozen shoulder after instability. Castagna et al² investigated age-related changes in elastic fibers and found that older patients had decreases in elastin density and the percentage of area covered by elastin fibers in their shoulder capsules. Age-related structural changes in the joint capsule may predispose older patients to joint contracture after trauma. Another reason for secondary frozen shoulder may be scarring after a capsular tear. In our study, 2 patients who underwent arthroscopic surgery showed scar-like tissue in the anteroinferior capsule, which suggests post-traumatic changes after capsular tears. Capsular tears are likely to occur in older patients,^{11,13} which is consistent with the patient ages in our study. In addition, 33% of our patients showed no obvious Bankart lesion on MRI. Especially in these patients, a capsular lesion may be the cause of anterior instability and thus scar formation may have led to secondary frozen shoulder.

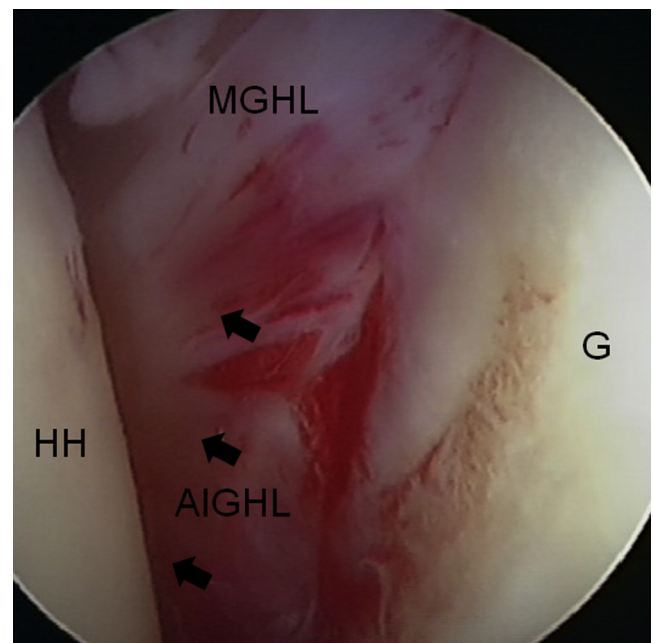


Figure 1 Arthroscopic image from posterior portal in case 11. * indicate hypertrophy and scar-like tissue of the anteroinferior capsule. MGHL, middle glenohumeral ligament; G, glenoid; HH, humeral head; AIGHL, anteroinferior glenohumeral ligament.

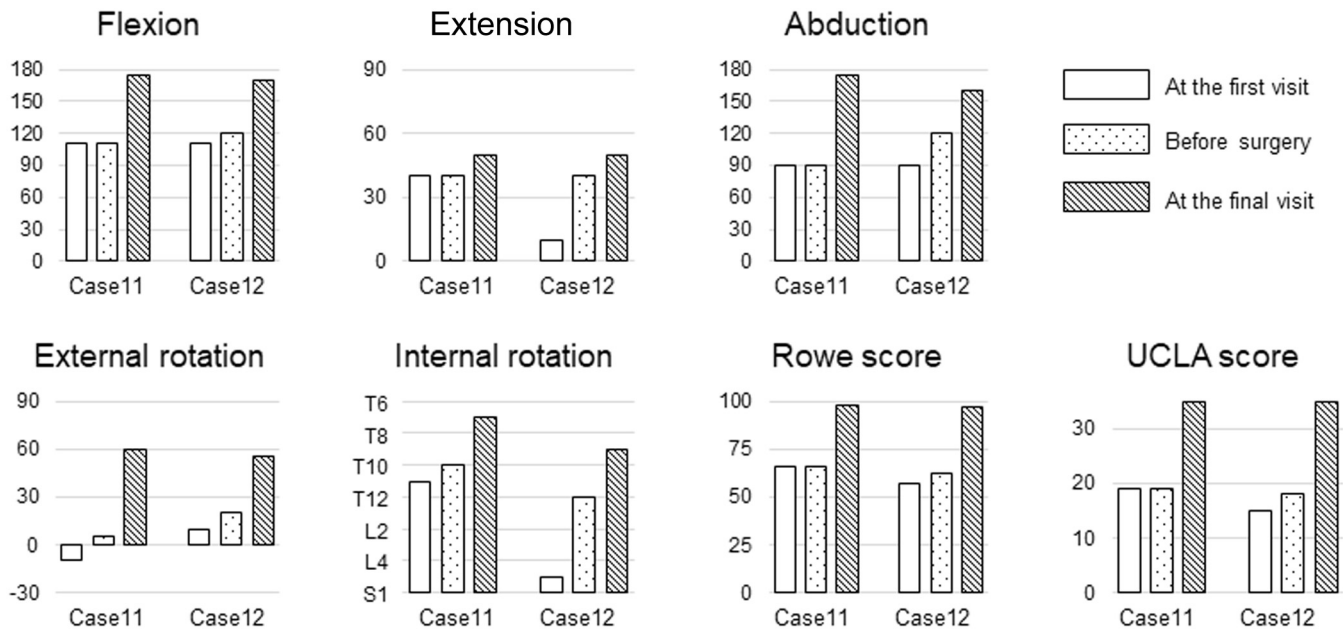


Figure 4 Clinical outcomes of the 2 patients who underwent surgical treatment. Flexion, extension, abduction, and external rotation are presented in degrees. UCLA, University of California, Los Angeles.

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