Pathology and surgical outcomes of unstable painful shoulders

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**Background:** Boileau et al have reported on the unstable, painful shoulder (UPS), which was defined as painful shoulders without any recognized anteroinferior subluxations or dislocations that were associated with roll-over lesions (ie, instability lesions) on imaging or at arthroscopy. However, they included various pathologies, probably due to the ambiguity in their definitions of UPS. We redefined UPS as follows: (1) shoulder pain during daily or sports activities, (2) traumatic onset, (3) no complaint of shoulder instability, and (4) soft-tissue or bony lesions, such as Bankart or humeral avulsion of glenohumeral ligament lesion, confirmed by arthroscopy. The purpose of this study was to retrospectively investigate pathologies of UPS based on our definitions. We also aimed to assess the outcomes after arthroscopic soft-tissue stabilization for UPS.

**Methods:** We reviewed patients who were retrospectively diagnosed as UPS based on our definition and underwent arthroscopic stabilization between January 2007 and September 2018. Patients' demographics, physical and radiographic findings, intraoperative findings, clinical outcomes (Rowe scores, Subjective Shoulder Value [SSV]), and the visual analog scale [VAS] for pain), and return to play sport (RTPS) were investigated.

**Results:** This study included 91 shoulders in 91 patients with a mean age of 23 years (range, 15-51). The mean follow-up was 37 months (range, 24-156). Eighty-seven patients were involved in sports activities: collision/contact, 55 patients (60%); overhead, 26 patients (29%). The pain was reproduced during the anterior apprehension test in 86 shoulders (95%). Normal type (48%) predominated in glenoid morphology followed by fragment (bony Bankart) type (37%). Most fragment-type lesions were seen in collision/contact athletes. Intraoperative findings demonstrated that Bankart lesions were found in all patients and Hill-Sachs lesions only in 42%. Magnetic resonance arthrography in the abducted and externally rotated positions showed a Bankart lesion in 76 shoulders (84%). Rowe score, SSV, and pain VAS significantly improved postoperatively (P < .001 for each). Forty-two of 70 athletes (60%) with > 2-year follow-up returned to the sport at a complete or near-preinjury level. Six (9%) athletes experienced reinjury.

**Conclusion:** All shoulders that were diagnosed as UPS with our definition had a Bankart lesion. There seemed to be two different types of pathologies: Bankart lesions in lax shoulders and bony Bankart lesions in collision/contact athletes. The pain experienced during the anterior apprehension test may be useful for the diagnosis of UPS. Arthroscopic soft-tissue stabilization yielded good clinical outcomes with a high RTPS rate, but the reinjury rate was relatively high.

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Data collection

First, they included patients without any proceeding trauma. Second, they included shoulders without roll-over lesions despite the definitions above. As a result, a variety of pathologies were indicated as causes of UPS, including attraumatic multidirectional shoulder instability (MDI). We questioned whether attraumatic pathologies should be included as causes of UPS and assumed that Bankart lesions would be the main cause of UPS. Based on the question, we redefined UPS as follows: (1) shoulder pain during daily or sports activities, (2) traumatic onset, (3) no complaint of shoulder instability, (4) soft-tissue or bony lesions, such as Bankart or humeral avulsion of glenohumeral ligament (HAGL) lesion, confirmed by arthroscopy.

The purpose of this study was to retrospectively investigate pathologies of UPS based on our definitions. We also aimed to assess the outcomes after arthroscopic soft-tissue stabilization for UPS. We hypothesized that Bankart lesion would be the main cause of UPS. We also hypothesized that arthroscopic soft-tissue stabilization for patients with UPS would yield good clinical outcomes, including a high return to play sport (RTPS) rate.

Materials and methods

This was a retrospective case-series study on the pathology and diagnosis of UPS and treatment outcomes after arthroscopic soft tissue stabilization for UPS. This study was conducted at a single orthopedic sports medicine center, which specializes in shoulder and elbow surgery. The institutional review board of our institute approved the study protocol.

Patient selection

We retrospectively searched patients who underwent arthroscopic shoulder stabilization at our institute between January 2007 and September 2018. The inclusion criteria of this study were as follows: (1) shoulder pain during daily or sports activities, (2) traumatic onset, (3) no complaint of shoulder instability, and (4) soft-tissue or bony lesions, such as Bankart or HAGL lesion, confirmed by arthroscopy. Exclusion criteria were as follows: (1) acute glenoid fracture and (2) revision surgery (Fig. 1).

Surgical procedures

Arthroscopic soft tissue stabilization was applied for all UPS, which is the same procedure as those for traumatic recurrent anterior shoulder instability that were described in previous articles. All surgeries were performed in the beach chair position under general anesthesia by or under close supervision of one of the senior surgeons (H.S., N.T., K.M., and M.T.). Routine diagnostic arthroscopy was performed throughout the glenohumeral joint. Then, the labroligamentous complex was separated from the glenoid neck starting from the 2 o’clock position to the 7 o’clock or 7:30 position (in a right shoulder). After the extensive labral release, a small amount of articular cartilage at the anterioinferior glenoid face was removed to promote tissue healing. The labroligamentous complex was fixed with at least four suture anchors loaded with a #2 high strength suture (Gryphon BR, Depuy Mitek, Andover, Massachusetts, USA; Osteoraptor OS, Smith and Nephew, Andover, Massachusetts, USA), cranially pulling up the complex using a grasper. The bony Bankart lesion was repaired without resection of the fragment. Other pathological lesions such as the superior labrum anterior posterior (SLAP) lesion, capsular tear, HAGL lesion, and rotator cuff tear were also repaired as necessary. Rotator interval closure was performed as an augmentation for patients that were at a high risk of recurrence, such as younger athletes (<20 years) or collision and contact athletes. Hill-Sachs remplissage was also performed for young collision and contact athletes with a Hill-Sachs lesion and glenoid bone loss.

Postoperative protocol

The postoperative protocol was also the same as that for recurrent shoulder instability. After three to four weeks of immobilization using a sling, passive and assisted-active range of motion exercises were initiated while avoiding the provocation of pain. Twelve weeks after surgery, a strengthening program was started, followed by sports practice. Full return to play was allowed at postoperative 4 to 6 months according to the functional recovery of each patient.

Patient assessment

Each patient’s active ranges of motion (forward elevation, external rotation at the side, and internal rotation) were preoperatively and postoperatively examined by one of the experienced shoulder surgeons (H.S., N.T., K.M., and M.T.). Flexion and external rotation were measured using a goniometer. Internal rotation was scored as greater trochanter, 0; buttlock, 2; sacrum, 4; L3, 6; Th12, 8; T7-8, 10. Patients were preoperatively and postoperatively assessed with the Rowe score. Patients were preoperatively examined with glenohumeral hyperlaxity, which was defined as >85° of external rotation at the side, and the anterior apprehension test. Patients were preoperatively and postoperatively assessed with the Rowe score. Subj ective Shoulder Value (SSV), and pain during daily activities or sports using the 100-mm visual analog scale (VAS). We used a questionnaire at the final follow-up to assess RTPS by self-
attritional, and bony types. We also assessed Bankart lesions with magnetic resonance arthrogram (MRA) using a 0.3 T open-type scanner (Airis Vento, Hitachi, Tokyo, Japan) or 1.5 T closed-type scanner (Intera; Philips, Amsterdam, the Netherlands) with a phased-array surface coil. Images were taken in two arm positions: abducted and externally rotated (ABER) position and adducted and internally rotated (ADIR) position.

Radiographic evaluation

All radiographic findings were assessed by an experienced shoulder surgeon (S.H.). We assessed preoperative glenoid morphology with three-dimensionally (3D) reconstructed CT images (Alexion, Toshiba, Tochigi, Japan). The scanning parameters were as follows: image matrix, 512 × 512; pixel size, 0.5 × 0.5 mm; slice pitch, 0.5 mm. Glenoid morphology was evaluated with the en face view of the glenoid using Digital Imaging and Communications in Medicine (DICOM) viewer (ShadeQuest/ViewC, Yokogawa Medical Solutions, Tokyo, Japan) and classified into three types: normal, attritional, and bony types.

Preoperative findings

Glenohumeral hyperlaxity was seen in 35 (38%) shoulders (Table II). The anterior apprehension test was positive only in 18 shoulders (20%), while the pain was reproduced during the test in 86 shoulders (95%).

Intraoperative findings

All 91 shoulders had a Bankart lesion, and arthroscopic Bankart repair was performed in all shoulders (Table IV). Hill-Sachs lesions were found in 38 (42%) shoulders. Rotator interval closure was carried out as an augmentation in 36 shoulders. Hill-Sachs remplissage was performed in four shoulders in combination with rotator interval closure. Concomitant SLAP lesion, capsular tear, HAGL lesion, and rotator cuff tear were seen in 32 (35%), two (2%), one (1%), and two (2%) shoulders, respectively, and all lesions were repaired (Table IV).

Clinical outcomes

Seventy-three out of 91 shoulders (80%) were followed up for more than 24 months after surgery (Fig. 1). The mean follow-up was 44 months (range, 24-72 months). There were no significant

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**Table I**

| Patient demographics.          | Data |
|-------------------------------|------|
| Total number of shoulders     | 91   |
| Sex, n (%)                    |      |
| Male                          | 79 (87) |
| Female                        | 12 (13) |
| Age at surgery, years (range) | 23 (15-51) |
| Affected shoulder, n (%)      |      |
| Dominant                      | 63 (69) |
| Nondominant                   | 28 (31) |
| Types of sports, n (%)        |      |
| Collision/contact             | 55 (60) |
| Overhead                      | 26 (29) |
| Others                        | 6 (7) |
| None                          | 4 (4) |
| Initial injury, n (%)         |      |
| Falling                       | 31 (34) |
| Head-first sliding            | 18 (20) |
| Tackling                      | 15 (15) |
| Others                        | 27 (31) |
| Time between injury and diagnosis, months (range) | 9 (1-64) |

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**Table II**

| Initial injury, n (%)          | Data |
|-------------------------------|------|
| Falling                       | 31 (34) |
| Head-first sliding            | 18 (20) |
| Tackling                      | 15 (15) |
| Others                        | 27 (31) |
| Total number of shoulders     | 91   |
| Sex, n (%)                    |      |
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| Overhead                      | 26 (29) |
| Others                        | 6 (7) |
| None                          | 4 (4) |
| Time between injury and diagnosis, months (range) | 9 (1-64) |
Preoperative findings.

| Clinical findings                  | No. of shoulders (%) |
|------------------------------------|----------------------|
| Hyperlaxity                        | 35 (38)              |
| Anterior apprehension test, instability | 18 (20)             |
| Anterior apprehension test, pain    | 86 (95)              |

| Radiographic findings               |                      |
|------------------------------------|----------------------|
| Glenoid morphology on 3DCT          |                      |
| Normal                             | 45 (49)              |
| Fragment (Bony Bankart)            | 33 (37)              |
| Attritional                        | 13 (14)              |
| Bankart lesion on MRA              |                      |
| ADIR                               | 76 (84)              |
| ABER                               | 77 (85)              |

MRA, magnetic resonance arthrogram; ADIR, adducted and internally rotated position; ABER, abducted and externally rotated position.

Relationship between types of sports and glenoid morphology.

| Types of sports | Glenoid morphology |
|-----------------|--------------------|
|                 | Normal (n = 45)    | Fragment (n = 33) | Attritional (n = 13) |
| Collision/contact| 21 (47%)           | 28 (85%)          | 6 (46%)              |
| Overhead        | 20 (44%)           | 2 (6%)            | 4 (31%)              |
| Others          | 2 (4%)             | 2 (6%)            | 2 (15%)              |
| None            | 2 (4%)             | 1 (3%)            | 1 (33%)              |

Intraoperative findings.

|                                      | No. of shoulders (%) |
|--------------------------------------|----------------------|
| Bankart lesion                       | 91 (100)             |
| Hill-Sachs lesion                    | 38 (42)              |
| SLAP lesion                          | 32 (35)              |
| Rotator cuff tear                    | 2 (2)                |
| Capsular tear                        | 2 (2)                |
| HAGL lesion                          | 1 (1)                |

SLAP, superior labrum anterior to posterior; HAGL, humeral avulsion of the inferior glenohumeral ligament.

Preoperative and postoperative active ranges of motion (Table V). VAS for pain, SSV, and Rowe scores significantly improved after surgery (P < .001 for each).

Seventy of 73 patients preoperatively participated in sports activities. The mean time to sport return was 7 months (range, 3-36), and 42 (60%) patients returned completely or to a near-preinjury level (grade 1 or 2 in Cho’s grading) based on the self-assessment (Table VI). Six shoulders (9%) experienced reinjury. Of the six shoulders with recurrence, five shoulders were involved in collision or contact sports (Table VII). Three shoulders only had Bankart repair, two of which had hyperlaxity of the glenohumeral joint. No shoulders had Hill-Sachs remplissage. All patients experienced reinjury around postoperative 1 year except for one non-collision/contact athlete (54 months). There were no significant differences in types of sports, hand dominance, augmentation procedures, and hyperlaxity by sport return level (Table VIII).

Discussion

This study demonstrated that all shoulders that were diagnosed as UPS based on our definition had a Bankart lesion, confirming the first hypothesis. Preoperative CT showed almost half of the shoulders with normal glenoid morphology. Most patients participated in sports activities, especially collision/contact and overhead sports. The anterior apprehension test was positive only in 20% of shoulders, but the pain was reproduced in most shoulders. Arthroscopic soft-tissue stabilization yielded good clinical outcomes, including a high RTPS rate, confirming the second hypothesis, although the reinjury rate was relatively high.

Although Boileau’s definitions of UPS are widely accepted, they do not include traumatic onset. Due to this issue, it is possible that shoulders with only capsular laxity were included in their patients, which may be compatible with MDI. As we believe that MDI is a different pathology than UPS, we included traumatic onset in our definition of UPS to contrast the two disorders. As a result, all shoulders had a Bankart lesion in this study, which we propose to be the principal cause of UPS.

It has been reported that UPS is common in young, female, and overhead athletes. In this study, 38% of patients had glenohumeral joints with hyperlaxity, and glenoid morphology was normal in almost half of the shoulders. The incidence of normal glenoid morphology was considerably high compared to the previous report on traumatic anterior shoulder instability. In addition, more than half of the shoulders did not have a Hill-Sachs lesion. These findings suggest that the laxity of the glenohumeral joint is high in many patients. Labral injuries that were added to lax shoulders may have caused subclinical instability and pain. Laxity of the glenohumeral joints is a possible factor associated with UPS, although it may not be a primary cause.

The subjects of this study included more contact/collision than overhead athletes, and most contact/collision athletes had a fragment-type Bankart lesion. Funk has also reported that some rugby players had subclinical shoulder instability without frank dislocation, which was associated with shoulder pain. This study suggested that bony glenoid lesions in contact/collision athletes may have caused the shoulder pain due to subclinical instability. Thus, we suppose that UPS includes two different pathologies: (1) Bankart lesions in lax shoulders and (2) bony Bankart lesions in collision/contact athletes.

Table II
Preoperative findings.

| Clinical findings                  | No. of shoulders (%) |
|------------------------------------|----------------------|
| Hyperlaxity                        | 35 (38)              |
| Anterior apprehension test, instability | 18 (20)             |
| Anterior apprehension test, pain    | 86 (95)              |

| Radiographic findings               |                      |
|------------------------------------|----------------------|
| Glenoid morphology on 3DCT          |                      |
| Normal                             | 45 (49)              |
| Fragment (Bony Bankart)            | 33 (37)              |
| Attritional                        | 13 (14)              |
| Bankart lesion on MRA              |                      |
| ADIR                               | 76 (84)              |
| ABER                               | 77 (85)              |

MRA, magnetic resonance arthrogram; ADIR, adducted and internally rotated position; ABER, abducted and externally rotated position.

Table III
Relationship between types of sports and glenoid morphology.

| Types of sports | Glenoid morphology |
|-----------------|--------------------|
|                 | Normal (n = 45)    | Fragment (n = 33) | Attritional (n = 13) |
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| Overhead        | 20 (44%)           | 2 (6%)            | 4 (31%)              |
| Others          | 2 (4%)             | 2 (6%)            | 2 (15%)              |
| None            | 2 (4%)             | 1 (3%)            | 1 (33%)              |

Intraoperative findings.

|                                      | No. of shoulders (%) |
|--------------------------------------|----------------------|
| Bankart lesion                       | 91 (100)             |
| Hill-Sachs lesion                    | 38 (42)              |
| SLAP lesion                          | 32 (35)              |
| Rotator cuff tear                    | 2 (2)                |
| Capsular tear                        | 2 (2)                |
| HAGL lesion                          | 1 (1)                |

SLAP, superior labrum anterior to posterior; HAGL, humeral avulsion of the inferior glenohumeral ligament.

Table V
Preoperative and postoperative shoulder function.

| Active range of motion | Preop. | Postop. | P value |
|------------------------|--------|---------|---------|
| Forward elevation, degrees | 169 (140-180) | 168 (135-180) | .08     |
| External rotation, degrees | 65 (60-90)   | 62 (20-90)   | .8      |
| Pain VAS                | 9 (4-10)   | 9 (4-10)   | .9      |
| Rowe score              | 71 (20-100)| 95 (45-100)| <.001   |
| SSV score               | 42 (0-95) | 86 (0-100)| <.001   |

VAS, visual analog scale; SSV, subjective shoulder value.

Values are given as mean (range).

"Active internal rotation was scored as greater trochanter, 0; buttocks, 2; sacrum, 4; L3, 6; Th12, 8; Th7-8, 10."
In this study, 3DCT evaluation revealed that the prevalence of bony Bankart lesions in UPS was considerably higher than previously reported. The discrepancy might be due to differences in the evaluation methods, as well as the difference in study subjects. As previous studies did not use 3DCT, bony lesions may have been overlooked. In addition, preoperative MRA detected Bankart lesions in 83% of shoulders in the ADIR position and 85% in the ABER position. MRA in the ABER position has been reported to have a superior ability of labral injury detection to the ADIR position. We believe that 3DCT and MRA in the ABER position positively contribute to the diagnosis and understanding of the pathologies in patients with suspected UPS. However, surgical treatment should be applied to shoulders even if a Bankart lesion cannot be observed on MRA as long as they demonstrate the clinical features of UPS.

There may be difficulties in making a diagnosis of UPS because there are no unique clinical tests or radiographic examinations exist. In this study, the pain was reproduced during the anterior apprehension test in 94% of shoulders. This finding should be helpful for the diagnosis of UPS in painful shoulders with a traumatic onset, but this type of pain is sometimes observed in other pathologies such as SLAP or MDI. The diagnosis of UPS should be made comprehensively with a careful patient interview, physical examinations, and radiographic examinations.

This study demonstrated that 9% of athletes experienced reinjury. Most reinjuries occurred in collision/contact athletes around postoperative 1 year, and no shoulders had Hill-Sachs remplissage. In addition, half of the reinjured patients showed hyperlaxity of the glenohumeral joint, and two out of the three shoulders with hyperlaxity had no augmentation procedures. Our previous study on glenohumeral joint, and two out of the three shoulders with hyperlaxity had no augmentation procedures. In this study, the pain was reproduced during the anterior apprehension test in 94% of shoulders. This finding should be helpful for the diagnosis of UPS in painful shoulders with a traumatic onset, but this type of pain is sometimes observed in other pathologies such as SLAP or MDI. The diagnosis of UPS should be made comprehensively with a careful patient interview, physical examinations, and radiographic examinations.

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This study demonstrated that 9% of patients experienced reinjury. Most reinjuries occurred in collision/contact athletes. In addition, half of the reinjured patients showed hyperlaxity of the glenohumeral joint, and two out of the three shoulders with hyperlaxity had no augmentation procedures. Our previous study on collision athletes with traumatic anterior shoulder instability indicated that arthroscopic Bankart repair with selective augmentations yielded good clinical outcomes with a low recurrence rate (3.5%).

Other studies have also proved that Hill-Sachs remplissage is an effective arthroscopic augmentation procedure to minimize the recurrence rate. We may consider adding some augmentation procedures for UPS depending on each patient’s risks such as sports, bone morphology, and joint laxity to prevent postoperative reinjury.

This study had several limitations. First, this was a retrospective case-series study. Further research such as case-control or randomized studies may be required to validate our new definition of UPS. Second, this was a mid-term follow-up study. The results may vary with a longer-term follow-up. Third, the follow-up rate for clinical outcomes was not sufficient. Despite these limitations, we believe that this study will provide insightful information on the diagnosis and treatment of UPS.

Conclusion

All shoulders that were diagnosed as UPS with our definition had a Bankart lesion. There seemed to be two different types of pathologies: Bankart lesions in lax shoulders and bony-type Bankart lesions in collision/contact athletes. The pain experienced during the anterior apprehension test may be useful for the diagnosis of UPS. Arthroscopic soft-tissue stabilization yielded good clinical outcomes with a high RTPS rate, but the reinjury rate was relatively high.

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Table VII
Details of patients with reinjury.

| Patients | Sports       | Age | Sex | Hyperlaxity | Glenoid morphology | Augmentation procedures | Time to reinjury |
|----------|--------------|-----|-----|-------------|--------------------|-------------------------|-----------------|
| 1        | Collision/contact | 15  | Male | Yes         | Fragment            | RIC                     | 7               |
| 2        | Collision/contact | 26  | Male | No          | Fragment            | RIC                     | 11              |
| 3        | Collision/contact | 35  | Male | No          | Fragment            | RIC                     | 10              |
| 4        | Collision/contact | 23  | Male | Yes         | Attritional         | None                    | 15              |
| 5        | Collision/contact | 24  | Female | No      | Norcal               | None                    | 5               |
| 6        | Others        | 43  | Female | Yes       | Fragment            | None                    | 54              |

RIC, rotator interval closure.

Table VIII
Comparisons by sport return level.

|                  | Chö's grading | P value |
|------------------|---------------|---------|
| Grade 1 & 2      | Grade 3 & 4   |         |
| No. of shoulders | 42            | 28      |
| Collision/contact| 28 (67%)      | 19 (68%) |
| Dominant shoulders| 32 (76%)    | 18 (64%) |
| Augmentations    | 32 (73%)      | 18 (64%) |
| RIC              | 20 (48%)      | 9 (32%)  |
| RIC & HSR        | 3 (7%)        | 0 (0%)   |
| Hyperlaxity      | 17 (40%)      | 13 (46%) |

RIC, rotator interval closure; HSR, Hill-Sachs remplissage.
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