Management of Anterior Shoulder Instability for the In-Season Athlete

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ABSTRACT

Management of in-season anterior instability poses a unique challenge to providers as they are faced with the conundrum of helping an athlete return to play as quickly as possible, while minimizing the risk of recurrent instability and progressive damage to the glenohumeral joint. The decision for early return to play versus in-season surgery ultimately is a collective decision-making process between the athlete, provider and training staff. However, it is the physician's obligation to properly counsel the athlete on the risks of early return to play following conservative management. Apart from athletes who are in the last season of their career or have other extenuating circumstances, requiring return to play (RTP) in the same season (i.e. upcoming championship or combine), given the high risk of recurrence in athletes managed conservatively, physicians should strongly encourage early surgical stabilization. Surgical management of instability most commonly includes arthroscopic Bankart repair and capsulorrhaphy, however open Bankart repair should be considered in high-risk athletes (i.e. contact athletes, recurrent instability, sub-critical glenoid bone loss). In athletes with critical glenoid bone loss an osseous augmentation procedure should be performed, such as the Latarjet procedure.

INTRODUCTION

Traumatic anterior shoulder instability is a common injury in athletes at all levels, and represents a spectrum of injury ranging from micro-instability to subluxation to dislocation.[1,2] Anterior displacement of the humeral head most commonly results in partial loss of the native glenohumeral contact surfaces, also referred to as a subluxation which comprises up to 85% of primary instability events. Glenohumeral dislocations, however, result in complete loss of contact between the glenoid and humeral head articular surfaces, requiring reduction. Dislocations are less frequent when compared to subluxation and only comprise 15% of new instability events.[3,4] In-season instability poses a unique challenge given athletes' desires to expeditiously return to play (RTP); however, such a vulnerable population must be counseled on the risk of recurrent instability and further damage to the joint, with up to 73% of athletes able to RTP in the same season experiencing a recurrence of instability.[5] Despite the ubiquity and gravity of these injuries, the management of in-season athletes currently lacks consensus. Currently, most clinicians agree that each athlete requires an individualized approach with a particular emphasis placed on completion of pain-free, sport-specific activities prior to resuming competition.[6] Regardless of one's management preferences, the formulation of an appropriate strategy demands an intimate understanding of pathoanatomy, an ability to assess the risk of recurrence, and familiarity with the various treatment options available to the athlete. This review aims to provide insight into current trends in the management of in-season athletes with anterior instability while simultaneously serving as a guide for team physicians tasked with caring for these athletes.

HISTORY

The evaluation of anterior shoulder instability begins with a thorough history, with particular attention paid to prior instability events which could include dislocation, subluxation or both. Additionally, it is important to determine the athlete's type and level of sports activity, time in their competitive season, and future expectations for sports participation. Individuals presenting after a traumatic event should be asked about the mechanism (contact vs non-contact), the severity (subluxation vs dislocation), and the direction of displacement. For those presenting in the absence of a traumatic event, it is important to determine the context in which their sensation of instability occurred. Anterior instability is most often symptomatic when shoulder abduction is coupled with external rotation. Given the shoulder's proximity to the brachial plexus, physicians should also inquire about neurologic symptoms. While sensorimotor deficits are present in less than 6% of all anterior shoulder dislocations, this risk increases to almost 8% if the injury is associated with a fracture of the greater tuberosity or a tear of the rotator cuff. When a neurological injury is present, the structure most commonly involved is the axillary nerve.[7]

PHYSICAL EXAM

Examination of a patient on the field or in the locker room with suspected acute instability should always begin with

observation. An acute anterior shoulder dislocation will typically demonstrate a loss of shoulder contour, a palpable anteroinferior humeral head, and the arm held in adduction and internal rotation. Next, the patient's neurovascular status and range of motion should be assessed. It is critical to note the importance of performing a complete neurovascular exam before and after any reduction maneuver as there is a risk for iatrogenic injury. If at this time the athlete's presentation is concerning for an acute dislocation, it is not unreasonable to acutely attempt a reduction. However, it is important to note that if there is any concern for concomitant fracture, reduction should be delayed until appropriate radiographs have been obtained and the reduction can be performed in a controlled environment under sedation to prevent further displacement of the fracture. Additionally, an on-field reduction should not be attempted more than once if not initially successful as such patients likely will require analgesia and/or sedation. Following reduction, active and passive range of motion as well as a neurologic exam should be re-evaluated

On the other hand, patients presenting to the office with a history of recurrent instability may have more subtle shoulder asymmetry and physical exam findings. In addition to the typical physical exam which should include inspection, palpation, ROM and strength testing, in this population, provocative tests are frequently performed to assess the type and degree of instability including but not limited to, the apprehension test, relocation test, sulcus sign and the surprise test. The apprehension test can be performed with the patient laying supine at the edge of the bed to support the scapula. The arm is brought into 90 degrees of abduction and subsequently external rotation. As the arm is brought into increasingly more external rotation the patient, if positive, will have subjective feelings of instability and become apprehensive with further external rotation. The relocation test can be performed in this position by placing a posterior directed force on the proximal humerus. If the patient endorses relief of the apprehension with this maneuver, then the test is considered to be positive. The surprise test then includes abrupt discontinuation of the posterior directed force on the proximal humerus, as performed during the relocation test resulting in immediate return of apprehension if positive. Of note, when apprehension, rather than pain, is used as the criteria for these special tests the positive predictive value of each tests increases. While the surprise test is considered to be the most accurate special test, when the apprehension, relocation, and surprises tests are all positive, the positive predictive value for anterior instability approaches 94%.[9] Finally, patients should be assessed for generalized hyperlaxity using the Beighton Scale. Patients with scores of ≥2 are 2.5 times more likely to experience shoulder instability and may be at risk for recurrent dislocations.[10,11]

PATHOANATOMY

Athletic injuries to the shoulder can cause derangement to the normal glenohumeral anatomy. Dislocation or subluxation events can harm the bony, ligamentous and other soft tissue structures of the shoulder. The most common pathology to the shoulder after a first-time instability event is a tear of the anterior inferior glenoid labrum, also known as a Bankart lesion. This is found in 97% and 96% of all patients sustaining a first-time anterior dislocation and subluxation event, respectively.[12] Furthermore, anterior shoulder dislocations can cause fracture of the anterior-inferior glenoid, commonly termed a "Bony Bankart Lesion."[13,14] Similar to Bankart lesions, the anterior labroligamentous periosteal sleeve avulsion (ALPSA) lesion can occur which involves stripping and displacement of the anterior scapular periosteum in a sleeve-like fashion. This differs from a Bankart lesion, which is a tearing of that scapular periosteum below the labrum with the lesion scarring in a medialized position. ALPSA lesions have been found to have a higher rate of failure after surgical repair.[15,16] While a Bankart lesion occurs when the labrum is torn from the glenoid with concomitant glenohumeral ligament stretching, the glenohumeral ligaments may be torn from the humerus and are referred to as HAGL lesions (humeral avulsions of the glenohumeral ligament).[6] While HAGL injuries were previously thought to be rare, occurring in less than 10 % of patients sustaining an anterior instability event, certain populations may be at greater risk. Recent data by Owens et al. demonstrates that female athletes may be at increased risk for HAGL lesions, with 25% of female collegiate athletes suffering from anterior instability having evidence of a HAGL lesion on post-injury imaging.[17,18] Vigilant surveillance for HAGL lesions is extremely important, as they can often be missed, and have been shown to be a culprit for recurrent instability.

As mentioned previously, anatomic changes in the bony architecture can result from anterior instability and increase one's risk for recurrent shoulder instability. This can occur with acute fracture of the anterior inferior glenoid at the time of the index instability event or can be a more chronic, progressive process due to recurrent subluxation/dislocation or possibly recurrent micro-instability leading to attritional glenoid bone loss (GBL). Bone defects in the humeral head can also occur after dislocation or subluxation events. These humeral head injuries are termed Hill-Sachs lesions, and occur with impact of the posterolateral humerus into the glenoid. As expected, patients with complete dislocation, when compared to subluxation, are at an increased risk for osseous defects to the glenoid and humeral head. For example studies of first-time dislocators have shown 22% of patients to have evidence of osseous glenoid defects and 90% with Hill-Sachs lesions following an anterior dislocation.[19] Conversely, in a study of patients with first-time subluxation events, only 11% and 7% of patients have evidence

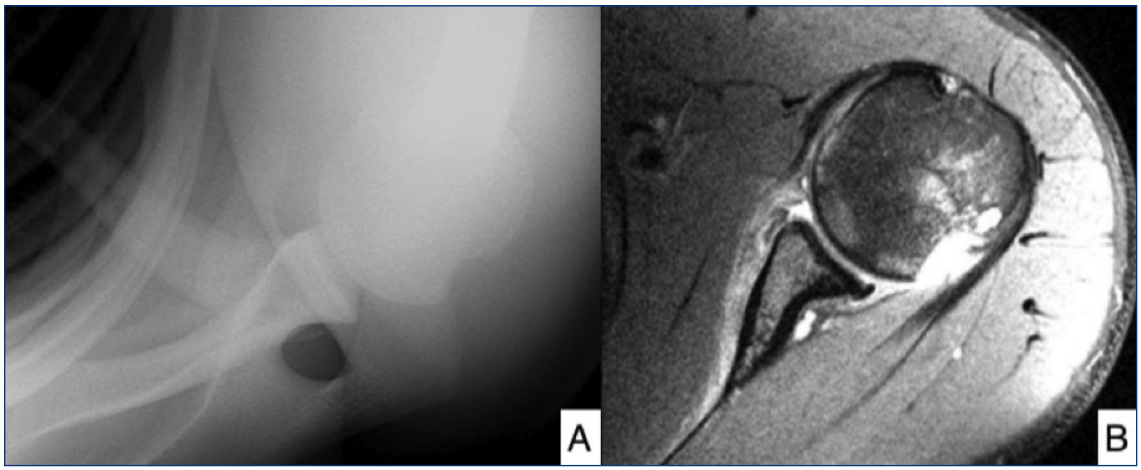


Figure 1. Axillary lateral radiograph [**A**] and axial MRI [**B**] demonstrating a large Hill-Sachs lesion with concomitant anterior glenoid bone loss.

Figure 2. Anteroposterior view of the left shoulder with evidence of anteroinferior dislocation concomitant bony Bankart and Hill-Sachs lesions.

of glenoid and humeral head osseous defects, respectively.[12] Bipolar bone loss, which is a term used to describe an injury when there is simultaneous GBL and a concurrent Hill-Sachs lesion, can also be an important cause of recurrent anterior stability, and must be appropriately identified and addressed. **(Figure 1)**. Furthermore, when a Hill-Sachs lesion is deemed to be "off-track", resulting in engagement of the humeral head defect with the glenoid, the risk of instability substantially increases.[20] Those which are "on-track" may override the glenoid surface and be at less risk of an instability moment.[6,20]

IMAGING

Imaging should begin with plain radiographs of the shoulder after the injury. Three views of the shoulder are obtained, with a true anteroposterior, an axillary or West Point view, and a scapular Y view **(Figure 2)**. Attention should be paid to ensuring a concentric reduction of the glenohumeral joint and observing for any fractures. Computed tomography (CT) scans are useful to assess the bony architecture of both the glenoid surface and the humeral head. More recently 3D CT scans have been helpful in more precisely measuring GBL.[21] Magnetic resonance imaging (MRI) is the best study for evaluating the soft tissue structures in the shoulder joint, including the rotator cuff, labrum, other ligamentous structures, as well as looking at bony edema. MRI arthrogram is more sensitive in evaluating and characterizing labral tears and for visualizing HAGLs.

IN-SEASON MANAGEMENT

The management of shoulder instability in an in-season athlete is highly individualized to the athlete and situation and involves a collective-decision making process with the athlete (and often parents), the provider, and the training staff. When counseling an athlete, it is important to take into consideration many factors including whether the athlete has a history of previous dislocations, the timing of the in-season injury, the sport and position played, the level of play, the handedness of the athlete, the risk of recurrence, and the long-term goals of the athlete. It is paramount that the athlete balances their desire to RTP as soon as possible with the high risk of recurrent instability and potential for further damage to the glenohumeral joint. Given this risk of cumulative damage to the joint with subsequent instability events, the current authors strongly encourage in-season surgery even for first-time dislocators, especially for athletes early or in the middle of their career. However, early return is not unreasonable under certain circumstances that would compel an athlete to desire rapid RTP during the same season, such as the injury occurring during the last season of their career or prior to an upcoming championship.

NONOPERATIVE MANAGEMENT

Depending on the pathology of the dislocation, nonoperative management may be desired for the in-season athlete

as it allows for quicker RTP. This is a more reasonable trial if advanced imaging reveals no osseous abnormalities and is limited to only labral injury. The goal of conservative treatment is a functional shoulder with equal rotator and scapular strength, and the ability to perform sport-specific activities without pain.

There is no standard post-reduction course, but in general there is a period of immobilization, followed by supervised rehab protocols. Immobilization can be in either internal or external rotation, and there is some debate as to the best position. A 2019 Cochran review of seven trials and 704 patients showed no conclusive benefit of immobilization in internal versus external rotation in regards to re-dislocation risk.[22] The length of immobilization is variable and oftentimes is physician and patient dependent; active in-season athletes may prefer a shorter period of immobilization to allow for quicker RTP. Paterson et al. concluded no statistical difference in instability for younger patients less than 30 years old, reporting the rate of recurrent instability to be 41% in athletes immobilized for 1 week or less and 37% for athletes immobilized >3 weeks(p=0.52).[23] Hovelius et al. looked at 257 patients prospectively after anterior traumatic shoulder dislocation and found no difference in recurrence rates between early mobilization versus immobilization for 3–4 weeks.[24] Following a period of immobilization, rehab treatment is generally aimed at strengthening peri-scapular muscles in addition to those involved with shoulder internal rotation and adduction, with the goal of an athlete being able to perform sport-specific activities with no apprehension or pain.[25]

Multiple studies have found nonoperative management to have a quicker RTP, with the cost of a high likelihood of recurrent instability events. Buss et al found 87% of athletes RTP with a mean of 10 days; however, they reported a significant recurrence rate of 1.4 per athlete-season.[26] A prospective study of 27 nonoperative versus 38 arthroscopically stabilized adolescent shoulders found a 70.3% recurrent instability rate compared to 13.1% in the operative group.[27] With such high recurrence rates associated with early RTP following non-surgical management of anterior instability, it is important that athletes fully understand the reparations of recurrent instability, which includes cumulative damage to the glenohumeral joint, specifically GBL. Alarmingly, a prospective study of collegiate athletes demonstrates an average GBL of 6.8% after a first-time dislocation which increased to a mean of GBL of 22.8% after a single episode of recurrence, suggesting critical GBL after only two episodes of instability.[28] With this amount of GBL after only 1 additional instability event, athletes must understand they are at risk for inferior outcomes after arthroscopic stabilization surgery and may require a more complex surgery to address the osseous defects.[29]

SURGICAL MANAGEMENT

Indications

Early surgical intervention, even in first-time dislocators, is highly recommended in athletes without an extenuating circumstance requiring rapid RTP. Furthermore, if an athlete is not able to perform sports-related activities after a period of brief immobilization and rehabilitation, immediate surgery should be recommended. Apart from athletes with a simple instability event, there are some associated injuries that are considered absolute and relative indications for immediate in-season surgery. These injuries include large rotator cuff tears, GBL (13.5% in collision athletes and 25% in non-contact athletes), bony pathology such as a proximal humerus fracture, and off-track Hill-Sachs lesions (**Table 1).**

Table 1. Indications for early surgery in athletes with anterior shoulder instability events

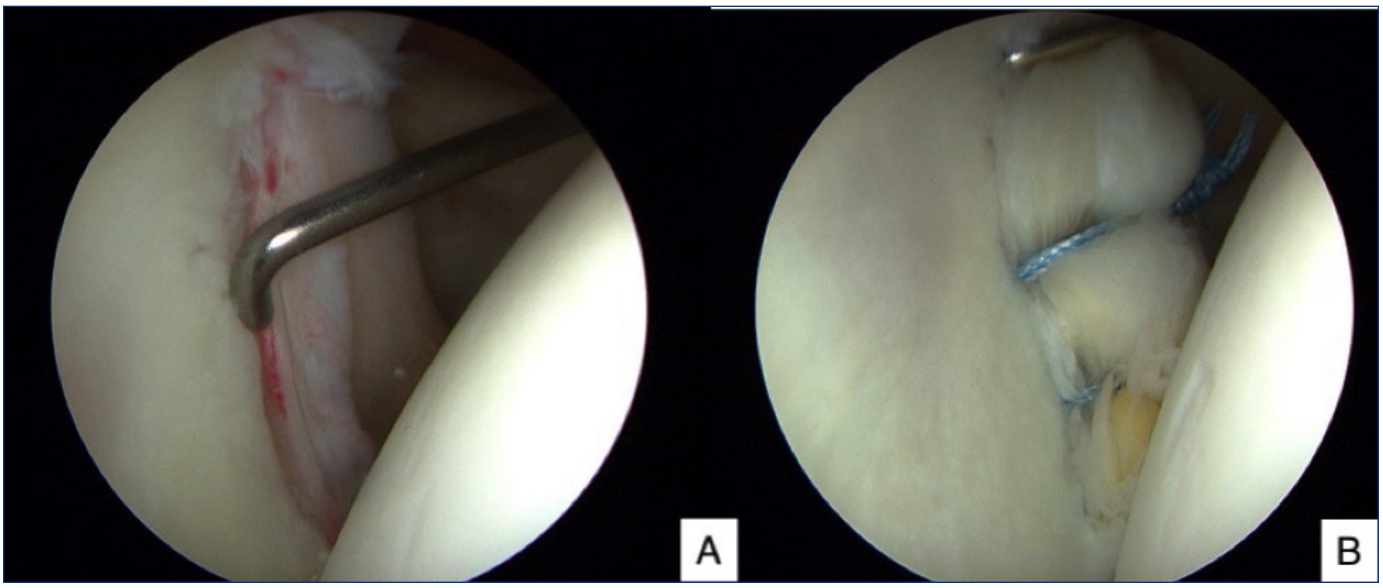
Indications for Early Surgery
Absolute Indications
• Glenoid bone loss >25%
• >50% rotator cuff tear
• Off-track Hill Sachs Lesions
• Irreducible dislocation
• Failed trial of rehabilitation
• Inability to tolerate shoulder restrictions
• Inability to perform sport-specific drills without pain or apprehension
Relative Indications
• Recurrent dislocations in same season
• Collision/contact athlete
• End of the season injury
• <20 years old
• Subcritical Glenoid bone loss > 13.5%

If surgery is deemed to be indicated for an in-season athlete, the surgical options that exist include arthroscopic versus open capsuloligamentous repair +/– a bony augmentation procedure. Conditions that are considered when determining the best method of shoulder stabilization include whether the athlete is a collision or contact athlete, history of recurrent instability and the presence of bony defects (i.e., GBL or Hill-Sachs lesion)

Capsulolabral Repair

Repair of the anterior-inferior labrum (Bankart repair) and capsulorrhaphy can be performed open or arthroscopically **(Figure 3)**. Historically, open repair was the procedure of choice due to early data which demonstrated decrease recurrence rates; however, as surgeons have become more facile at arthroscopy and there has been an improvement in both instrumentation and surgeon repair techniques, this belief has been disproved.[30–33] Given these recent findings,

Figure 3. Arthroscopic view from posterior viewing portal demonstrating a Bankart lesion before [**A**] and after [**B**] repair/capsulorrhaphy.



arthroscopic stabilization has increased dramatically, as it has the advantages of decreased pain, improved postoperative range of motion and faster rehabilitation allowing expeditious RTP.[32–34] More recent data has demonstrated low recurrence rates following arthroscopic Bankart repair with recurrence rates as low as 5% and RTP rates exceeding 90%.[35–37]

Despite this data, it is imperative to consider patient selection, as open Bankart repair may be favorable in a select cohort of patients who are at increased risk for recurrent instability after arthroscopic repair. This includes high-risk contact/collision athletes, athletes under 20 years old, athletes with known ligamentous laxity, subcritical GBL (13.5%–25%), or athletes that require a revision procedure.[29,37,38] Recent data has demonstrated recurrence rates of >50% in contact athletes undergoing arthroscopic stabilization procedures.[39] Conversely, Hennrikus et al. demonstrated only a 5% recurrence rate after open Bankart repair in 21 adolescent contact athletes.[40] Despite these findings, further research must be performed elucidating the role of open versus arthroscopic Bankart repair in high-risk athletes as the current studies which exist are limited by their small sample sizes and lack of prospective data.

Addressing Bony Defects

As discussed above, in addition to capsulolabral injury, anterior instability can also be associated with bony defects including both Hill-Sachs lesions and anterior GBL. It is imperative to address each of these pathologies to prevent recurrent instability. There has been a recent interest in the role that Hill-Sach's lesions, specifically those that engage with the glenoid (off-track lesions), may play in increasing the rate of recurrence with recent data demonstrating off-track HS lesions increasing one's risk of recurrent instability following arthroscopic Bankart repair by a factor of eight.[41] To address this, the arthroscopic *remplissage* was introduced which consists of capsulotenodesis of the posterior capsule and the infraspinatus into the HS defect which prevents engagement between the glenoid and humeral head defect.[42]

Following an anterior dislocation event, up to 90% of athletes may experience associated GBL, with the risk and amount of bone loss increasing with every episode of recurrence.[13] It is imperative that surgeons address GBL to decrease the risk of recurrence. While early data suggested glenoid augmentation when GBL exceeded a critical level of 25%, more recent data the critical level of GBL may be even lower in athletes at 13.5 %.[38] To address GBL, various autogenous and allogenic bone-grafting techniques exist. The most commonly performed technique is transfer of the coracoid to the anterior-inferior glenoid, restoring the osseous anatomy of the glenoid, acting as a bony buttress preventing anterior dislocation.[43] More recent techniques involve reconstruction using distal tibia or iliac crest allograft. However, these procedures are typically reserved for revision surgeries and are still lacking long-term prospective data.[44,45]

CONCLUSION

Anterior shoulder instability is extremely common in athletes and requires an in-depth knowledge of the pathoanatomy, natural history and the various management options related to these injuries. The optimal in-season management of athletes with a first-time shoulder instability event continues to be controversial. Ultimately the decision to perform immediate surgery versus RTP following a short course of rehab is a collective decision-making process and it is up to the physician to properly counsel the patient. If the athlete is under extenuating circumstances that require

rapid RTP (i.e., upcoming combine, post-season play) or is in the last season of their career, it is not unreasonable for the athlete to RTP during the same season. For all other athletes, especially athletes early in their career, and those at high risk for recurrence (young contact/collision athletes) or have a history of recurrent instability, immediate surgery is recommended to prevent further damage to the shoulder joint, which includes GBL and humeral head defects. In patients that do elect to have surgery, it is very important to look closely at the surgical candidate, including their risk for recurrent instability, whether they have associated defects about the glenoid and/or humeral head to determine the most suitable procedure. In athletes with pure capsuloligamentous injury and no history of previous instability or who are low risk for recurrent instability, arthroscopic Bankart repair with capsulorrhaphy is the procedure of choice. If an athlete is at high risk for recurrence, open Bankart repair should be considered. Additionally, if a patient has an off-track HS lesion, a simultaneous remplissage procedure should be performed. Finally, in the setting of critical (>25% GBL) or sub-critical (>13.5%) GBL in contact athletes, a glenoid osseous augmentation procedure should be performed to decrease the risk of recurrent instability.

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