Decision Making of the In-season Athlete with Anterior Shoulder Instability

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KEYWORDS

• In-season injury • Bankart tear • Arthroscopic shoulder surgery • Hill–Sachs lesion • Bony Bankart lesion • Return to sport • Remplissage • Latarjet procedure

KEY POINTS

- In-season management of anterior shoulder instability is complex and can be managed initially nonoperatively or operatively depending on an athlete's goals, timing within the season, eligibility, and severity of injury.
- Nonoperative management of in-season anterior shoulder instability leads to high rates of return to sport; however, there are high rates of recurrent instability, particularly in contact sport athletes.
- Operative management of anterior shoulder instability with one of several stabilization procedures significantly decreases risk of recurrence; however, this is often a season-ending option.
- Procedure choice is based on several patient factors, including but not limited to athlete age, sport of choice, prior surgery, and amount of glenoid and humeral head bone loss.

INTRODUCTION

The shoulder is a ball-and-socket joint that relies on an interdependence of static and dynamic stabilizers to maintain function. Injury to any of these structures can lead to instability, both subluxation and frank dislocation. Anterior shoulder instability can occur with non-sport trauma but is also common in contact and overhead athletes. Shoulder instability can lead to pain, cartilage and bone loss, neurovascular injury, and, importantly in athletes, loss of playing time.

Given its relatively shallow socket and wide range of motion, the shoulder is the most commonly unstable joint in the body, particularly in the young contact athlete (**Fig. 1**).[1] Management of anterior shoulder instability is further complicated when the athlete sustains the injury during the season. In those with a first-time dislocation

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Fig. 1. Axillary lateral view of a left shoulder with an anterior shoulder dislocation. There is also evidence of a Hill–Sachs lesion of the posterolateral humeral head.

or subluxation, there are multiple treatment options. There is literature to support immediate surgical stabilization to prevent further instability and subsequent damage to the glenohumeral joint, ligaments, and capsule. Conversely, many team physicians work with athletes and training staff to pursue nonoperative treatment, with expedited rehabilitation until the injured extremity has similar strength and range of motion compared to the uninjured extremity.[2]

Recurrent instability is common in nonoperative management strategies. Previous literature demonstrates with each instability event, the athlete can further damage the joint and potentially worsen bone loss from the glenoid and/or humeral head.[3,4] For these reasons, it is crucial that the athlete, family, and provider understand and discuss the risks and benefits of each treatment pathway and come to an informed decision on which to pursue. These choices depend on timing of injury during the season, type of instability event (dislocation vs subluxation), presence of osseous injury, and the sport being played, including position-specific activity.[5] Other factors include the athlete's short-term and long-term goals, risk-tolerance, and eligibility.

ON-FIELD MANAGEMENT

The on-field management of a suspected anterior shoulder dislocation begins with an understanding of injury mechanism followed by a thorough physical examination. A provider will often find an athlete with an externally rotated extremity and acute shoulder pain. In some instances, a subluxation or dislocation will reduce prior to evaluation, in which the physical examination may be largely normal aside from shoulder pain and apprehension. In a frankly dislocated shoulder, there may be visual asymmetry compared to the contralateral side or anterior prominence about the involved shoulder. Other clues might include a sulcus superiorly or posteriorly with a palpable cavity or subjective feeling of instability by the athlete.

The provider should perform and document a complete neurovascular examination of the affected extremity and compare this to the well-arm, as neurovascular injuries, particularly axillary nerve injuries, can occur. Palpable crepitus or step-offs of the proximal humerus, clavicle, or scapula can clue one into a possible fracture. Other areas of pain should also be investigated, as shoulder instability may occur in tandem with sternoclavicular joint or elbow injuries. The provider should discuss with the athlete about any history of shoulder injuries, instability, or hyperlaxity.

If the provider is confident that the athlete sustained an anterior shoulder dislocation with low suspicion of associated fracture or other injury, it is reasonable and recommended to attempt a reduction prior to any further workup or imaging. After a thorough examination, a timely reduction is helpful as a delay can lead to muscle spasm and increased difficulty of reduction. Reduction maneuvers are generally performed in the locker room or training room but can also be attempted on the field or sideline by a qualified provider.

Many reduction maneuvers have been described and it is recommended that providers know how to perform at least a couple different techniques. The authors' preferred techniques are the Stimson, Milch, and Cunningham techniques. The Stimson technique utilizes weights to pull traction on the shoulder in a prone patient with their arm off the table. The Milch technique utilizes gentle shoulder external rotation, abduction, and anterior to posterior pressure on the humeral head. Lastly, the Cunningham technique is described as very gently pulling traction on an adducted shoulder while massaging the trapezius, deltoid, and biceps to allow for muscle relaxation.

Generally, the athlete should not return to play for the duration of the game or practice if they suffered a true dislocation requiring relocation; however, there are circumstances in athletes with recurrent instability, usually subluxation events, in which return is considered within that game or practice if the athlete has maintained motion and strength. Immobilization acutely with a sling may provide comfort for the athlete but is not recommended for longer than 1 week.[6]

POSTINJURY CARE

Treatment of first-time shoulder instability requires thought and consideration as well as discussion with the athlete, family members, physician, athletic trainers, and coaches. In some instances, an agent may be involved. Operative and nonoperative options should be discussed and the risks and benefits of both options clarified. Operative versus nonoperative management of acute anterior shoulder instability has been studied at length. There are risks and benefits to both treatment pathways and the patient must make the best decision for them and their goals.

IMAGING

Postinjury shoulder imaging should start with a true anteroposterior, axillary lateral, and west point view radiographs. This series will allow the provider to evaluate for glenoid defects or fractures of the clavicle, scapula, or humerus. A provider can ensure adequate reduction as well as preliminarily gauge glenoid or humeral bony lesions (**Fig. 2**). Stryker notch radiographs are also available to further characterize Hill–Sachs lesions, but these are not often part of a routine series.

While there is no consensus on timing of advanced imaging, MRI is helpful in identifying pathology of the labrum, capsule injury such as humeral avulsion of glenohumeral ligament lesions, and glenoid and humeral osteochondral lesions. In our experience, obtaining an MRI acutely has been useful given the traumatic hemarthrosis which can act as a natural contrast agent. In the subacute setting, a MR arthrogram with intraarticular contrast is utilized, as non-arthrogram MRI studies have been shown to be less sensitive at detecting labral pathology.[7] Unfortunately, MRI has been shown to be inconsistent in measuring glenoid and humeral bone loss and should be used with caution when evaluating bony defects.[8] MRI findings that, in the authors opinion, would push treatment recommendation to early surgery include significant full or partial-thickness rotator cuff tears, acute bony Bankart lesions, or

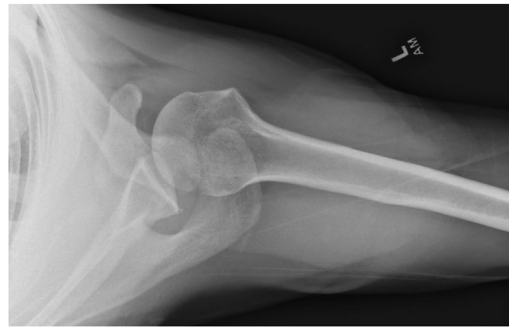

Fig. 2. Postreduction axillary lateral radiograph of a left shoulder with evidence of a Hill–Sachs lesion.

large Hill–Sachs lesions measuring greater than 25% of the circumference of the articular surface.

Finally, in those with radiographic evidence of glenoid bone loss or significant Hill–Sachs lesions, a computed tomography (CT) scan is useful to characterize associated bone loss and help guide decision making (**Fig. 3**). Some authors advocate for obtaining CT scans on all traumatic shoulder dislocations, as plain radiographs may underestimate the degree of bone loss.[9] There are several described methods to measure glenoid bone loss on CT, including area-based as well as linear-based methods.[10] In area-based measurement, an en face view of the glenoid is obtained, and a best-fit circle is drawn to obtain the area of the native glenoid articular surface. Next, an area measurement is made of the anterior glenoid bony defect and a measurement of defect area/total glenoid area is performed. A linear-based measurement uses the same en face view of the glenoid and starts with a best fit circle, as discussed earlier. A horizontal line is drawn from the anterior-most aspect of the best fit circle to the anterior aspect of the glenoid bone. Bone loss is then calculated as width of bony defect/total anterior to posterior glenoid width. The advantage of the linear-based method is that these measurements can be done in nearly all radiograph-viewing software, while area-based measurements often require more advanced technology.

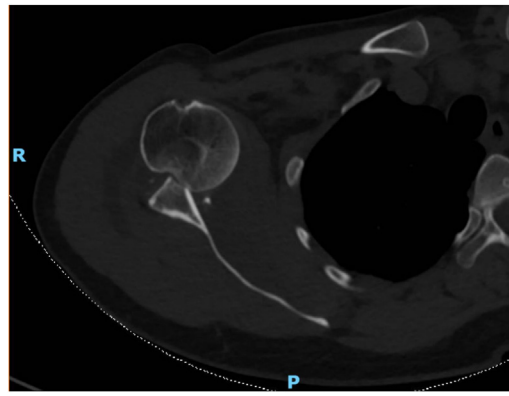

Fig. 3. Axial slice of a CT scan of a right shoulder with an irreducible anterior shoulder dislocation. There is significant anterior glenoid bone loss and a large, engaging Hill–Sachs lesion.

It is the author's opinion that acute bony Bankart lesions, glenoid bony defects of any chronicity measuring greater than 25% of the glenoid width, and Hill–Sachs lesions measuring greater than 25% of the humeral articular width are better served with an early stabilization procedure. While nonoperative management and return to sport is an acceptable option for these athletes, the likelihood of recurrent instability and failure of nonoperative treatment is high.

GLENOID TRACK

In 2007, Yamamoto and colleagues made the first description of glenoid track.[11] This was an attempt to quantify the size of Hill–Sachs lesions that need surgical intervention. They found that in high-risk positions (ie, shoulder external rotation, abduction, and extension) there is a defined area of humeral head cartilage that contacts the glenoid. This was termed as the glenoid track. If a Hill–Sachs lesion was large enough that in external rotation, abduction, and extension, it extended medially in front of the anterior rim of the glenoid, it was at risk of dislocation, and this was termed an "engaging Hill–Sachs lesion." Those Hill–Sachs lesions that are small enough to remain within the glenoid track in high-risk positions were termed "non-engaging Hill–Sachs lesions" and conferred a lower risk of instability.

Di Giacomo and colleagues further clarified and recommended the more accurate terminology of "on-track" or "off-track" lesions.[12] An on-track lesion describes a smaller Hill–Sachs lesion that remains within the glenoid track and is at lower risk of instability. The authors proposed a treatment algorithm based on the amount of glenoid bone loss and whether the Hill–Sachs lesion is on-track or off-track (**Table 1**).

NONOPERATIVE MANAGEMENT

Athletes who wish to return to play during the index season in which they have shoulder instability generally elect for nonoperative management. Studies consistently support that most athletes can return to sport after a short period of relative rest and rehabilitation. Buss and colleagues reported on their series of 30 athletes who sustained in-season anterior shoulder instability and observed that these athletes missed, on average, 10 days of play. Around 90% of these athletes were able to return to their sport that season, though 10 of those that returned (37%) had a recurrent instability event that season.[13]

Dickens and colleagues reported the results of their prospective study of collegiate athletes with in-season anterior shoulder instability and found that 73% were able to

Table 1
Proposed treatment algorithm

Group	Glenoid Defect Size	Hill–Sachs Lesion	Proposed Treatment
I	<10%–15%	On-track lesion	Arthroscopic or open Bankart repair
II	<10%–15%	Off-track lesion	Arthroscopic Bankart repair plus remplissage or open Bankart repair with capsular shift
III	≥25%	On-track lesion	Latarjet
IV	≥25%	Off-track lesion	Latarjet with possible humeral procedure (bone grafting or remplissage) depending on engagement after Latarjet

Adapted from Di Giacomo G, Itoi E, Burkhart SS. Evolving concept of bipolar bone loss and the Hill-Sachs lesion: from "engaging/non-engaging" lesion to "on-track/off-track" lesion. Arthroscopy. 2014;30(1):90-98. https://doi.org/10.1016/j.arthro.2013.10.004

return to sport during the index season.[14] Twenty-one of 33 athletes who returned to play had a recurrent instability event (64%). Despite this, 67% of the athletes who returned to sport were able to complete the season. In this cohort, median time lost to competition after instability was just 5 days. The most common reason for inability to return to sport was failure to attain sufficient shoulder function. These athletes who could not return to sport were all involved in contact sports.[14] Shanley and colleagues followed 129 high school athletes with instability through the next season and found that 85% of those treated nonoperatively were able to play through the next season without missing time related to their shoulder instability.[15]

These studies and several others demonstrate reasonably high rates of return to sport; however, this is not without risk to the athlete. Each occurrence of instability puts the athletes' neurovascular structures and joint at risk. Axillary nerve injuries have been reported in 5% to 35% of first-time dislocations, and though more seldom, they also occur in the setting of recurrent instability.[16,17] It is our clinical experience that axillary nerve injuries are uncommon and transient, however, they do occur, and athletes and families should be aware of this risk.

In addition, studies have illuminated the correlation between number of instability events and worsened glenohumeral bone loss. Rugg and colleagues found that patients with a single dislocation had, on average, 6.9% glenoid bone loss, while those with 2 or more dislocations had glenoid bone loss approaching 20%.[3] Dickens and colleagues reported on a prospectively followed cohort of over 700 athletes and monitored for instability. They found first time dislocators had an average of 6.8% glenoid bone loss.[18] This contrasted with those who had recurrent instability in which the average bone loss was 22.8%. Hettrich and colleagues evaluated nearly 900 patients with anterior shoulder instability and found the factor most associated with glenoid bone loss and Hill–Sachs lesions of the humerus was an increasing number of dislocations.[4]

Overall, the data suggest initial nonoperative management of anterior shoulder instability is a reasonable option for those who wish to finish the season. These data do, though, clarify that recurrent instability is prevalent and those who have recurrent instability events generally develop greater bone loss. This can complicate treatment options for athletes, as increased glenoid bone loss makes subsequent arthroscopic Bankart repair more likely to fail.[19,20] In these cases, the athlete may need more invasive techniques, such as a Latarjet or other bone block grafting procedures (**Box 1**).

Timing of instability within the season, as well as position played, should also be factored in when evaluating a patient and making treatment decisions. A football

Box 1
Relative indications for early nonoperative management with return to sport for athletes with in-season anterior shoulder instability

- First-time instability
- Subluxation event versus frank dislocation
- Normal postreduction radiographs without evidence of bony Bankart lesion or significant Hill–Sachs lesion
- Normal neurovascular examination
- Progress with rehabilitation and a pain-free shoulder with range of motion that is symmetric to the contralateral upper extremity
- Instability early in the season with adequate time for rehabilitation
- Athlete's final year of eligibility
- Ability to perform sport-specific drills/activities

linebacker who has an instability event in the second game of the season will be counseled differently than a softball player with instability in the playoffs. As detailed earlier, several days to weeks of rehabilitation is recommended prior to returning to sport, and an injury near the end of the season may limit an athlete's ability to rehab appropriately. In these cases, we generally recommend early stabilization.

An athlete's sport and position should be factored into decision making, as well. Overhead and throwing athletes, for example, often place their shoulders in positions of risk for instability. These athletes generally need more time for rehabilitation and progression through sport-specific drills can be slower. In some cases, return to sport within the season may not be possible due to pain or feelings of instability. Position differences also play a role in decision making, as a wide receiver in football may find it more difficult to return to the same level of play as a running back.

Bracing

There are several braces on the market (Sully, Aryse, Duke, etc.) each with the goal of limiting positions of risk (ie, shoulder abduction, extension, and external rotation; **Fig. 4**). These braces, though, have not proven to reduce risk of recurrent instability. Chu and colleagues and Ulkar and colleagues both performed biomechanical studies showing bracing to be positive in improving joint position sense in those with prior instability;

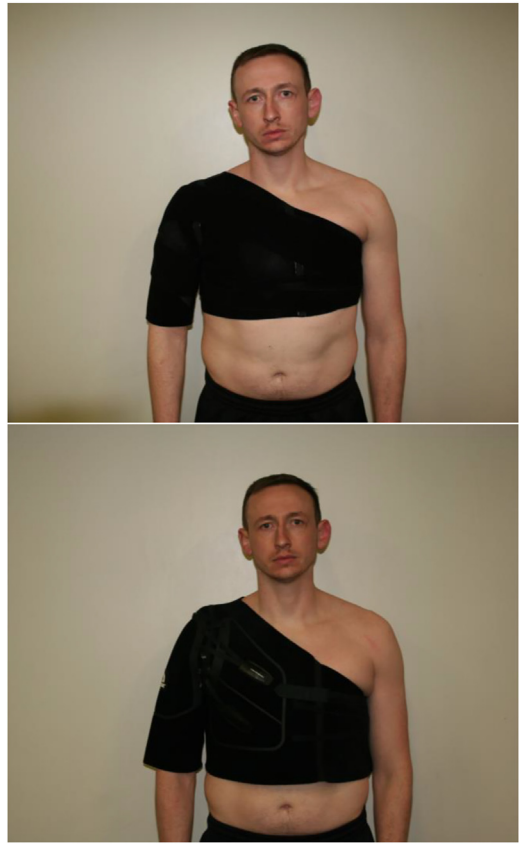

Fig. 4. Example of a Sully brace (top) and an Aryse SFast brace (bottom) for shoulder instability.

however, no studies have shown bracing to decrease risk of recurrent instability.[21–24] Bracing is a useful tool and may help athletes feel more comfortable returning to sport, but the clinical effectiveness in terms of recurrent instability is still unknown. No brace has been shown superior to another.[25,26] Unfortunately, many of the available braces are cumbersome and may not be tolerated by elite athletes. In addition, braces are often not practical in overhead or throwing athletes. Braces, though, have the potential to increase an athlete's confidence and should be discussed on an individualized basis as part of the nonoperative versus operative discussion.

OPERATIVE MANAGEMENT

In some scenarios, an athlete may be near the end of the season, have multiple years of eligibility remaining, or may be risk-averse and decide not to return to sport that season. In addition, injury-specific factors like fractures, irreducible dislocations, large osseous defects, among others may be present. In these cases, early surgery is recommended to decrease risk of recurrent instability. Specific procedure selection is guided by patient factors, such as age, presence of bony defects, sport type, competition level, and future goals.

In our opinion, most athletes can return to play; however, there are factors that would make us more strongly consider early operative stabilization. Acute bony Bankart lesions or glenoid bone loss greater than 25% is unlikely to provide the athlete with a stable shoulder. In addition, significant rotator cuff pathology or associated fracture is likely to do better when treated acutely. Failed trial of rehabilitation with decreased range of motion and persistent pain, or the inability of an athlete to perform their sport-specific tasks would be other factors that might support early surgery (**Box 2**). Lastly, if an athlete suffered repeat dislocation requiring manual reduction, then increasing consideration of surgical intervention is warranted.

Arthroscopic Stabilization procedures

Previous literature has shown operative stabilization to decrease the risk of recurrent instability. Arciero and colleagues published their prospective series of nonoperative

Box 2
Absolute and relative indications for early surgical management without return to play

Indications for early surgery
- Absolute
  - Significant partial-thickness or full-thickness rotator cuff tear
  - Glenoid bony defect greater than 25%
  - Hill–Sachs lesion greater than 25% humeral head articular surface
  - Associated fracture (humeral, clavicle, etc.)
  - Irreducible dislocations or nonconcentric reductions due to interposed tissue/incarcerated fragments
  - Failed trial of rehabilitation with continued pain, inability to obtain symmetric range of motion and strength compared to contralateral extremity
  - Inability to perform sport-specific drills
- Relative
  - Acute bony Bankart injury
  - Recurrent instability events within the same season, especially repeat dislocation requiring manual reduction
  - Overhead or throwing athletes unable to perform in their sport
  - Injury occurs late in the season without time for adequate rehabilitation
  - Multiple years of eligibility remaining
  - Contact sport athletes

versus operative treatment of first-time shoulder dislocators.[27] They observed that in the nonoperative group, defined as 4 weeks of immobilization followed by rehabilitation, 80% of athletes had recurrent instability, while in the arthroscopic stabilization group, only 14% had recurrent instability at nearly 3 year follow-up. In a prospective, randomized study evaluating nonoperative versus operative management of first-time dislocations, Bottoni and colleagues found that 75% of nonoperatively treated athletes had recurrent instability compared to 11% of those treated with arthroscopic stabilization.[28] Hurley and colleagues performed a meta-analysis encompassing 10 prospective studies including 569 patients with first-time anterior shoulder dislocations and found that 10% of those treated with arthroscopic Bankart repair recurred while 67% of those treated nonoperatively had another instability event.[29]

Stabilization procedures come in several varieties. The most common is arthroscopic Bankart repair, which accounts for nearly 90% of stabilization procedures performed in the United States today in place of open Bankart repair which was the gold standard previously.[30–37]

Other surgical adjuncts may help decrease recurrence in the setting of arthroscopic stabilization. Di Giacomo and colleagues advocate for remplissage in cases of subcritical glenoid bone loss with Hill–Sachs lesions.[12] Remplissage is a soft tissue surgical technique to anchor the infraspinatus tendon into a Hill–Sachs lesion on the posterosuperior humeral head, effectively filling the void caused by the lesion and making dislocation more difficult. Many authors have evaluated the risks and benefits of remplissage and the data, taken together, do support the use of remplissage in some cases of large, engaging Hill–Sachs lesions, particularly when the anterior glenoid bone loss is subcritical.[38–41]

More recently in the literature there have been descriptions of arthroscopic Latarjet and bone grafting procedures.[42,43] Preliminary data are positive; however, these procedures have a steep learning curve and have not been widely adopted.[44]

Open Stabilization Procedures

Although much less common today, open Bankart repair plus or minus capsular shift is a classic way to deal with anterior shoulder instability. Labral repair with anchors in addition to capsular tightening through either a subscapularis tenotomy or split is a powerful way to treat anterior instability. Neviaser and colleagues reported on 127 patients, including 107 athletes, with mean follow up of 17 years.[45] They reported 1 (0.8%) recurrent dislocation and 1 (0.8%) recurrent subluxation with 98 of 107 athletes returning to sport. Pagnani reported on 103 patients, with 83 athletes, who underwent open capsular and labrum repair.[46] At a minimum of 2 year there was a 2% (2 of 103) rate of recurrent instability with one dislocation and one subluxation. Two of 83 contact athletes had recurrence.

Other open procedures continue to be useful in some circumstances, as patients with significant Hill–Sachs lesions, multiple dislocations, or glenoid bone defects have increased risk of recurrent instability with isolated arthroscopic Bankart repair.[47,48] For these patients, open Latarjet or allograft bone block procedures may decrease risk of recurrence. Many authors have attempted to identify a critical amount of glenoid bone loss to identify which patients benefit most from these bony procedures.

Current data support consideration of the bony procedures in those with 13% to 20% or more glenoid bone loss.[19] Other factors that might support primary Latarjet or bone block procedure include competitive contact sport participation, generalized ligamentous laxity, multiple dislocations, or younger age.[49] These procedures

have a higher risk profile than arthroscopic procedures, as neurovascular injury, screw breakage, graft resorption or fracture, and wound dehiscence can occur.[50,51] Despite this, patients who are indicated for Latarjet return to sport at high rates and have improved patient-reported outcome scores and low rates of recurrent instability.[49,52,53]

PSYCHOLOGICAL READINESS FOR RETURN TO PLAY

Not only does an athlete need to prove physical readiness to return to play after shoulder instability, but they also need to be psychologically prepared to return to play. Gerometta and colleagues proposed and validated a psychological readiness assessment for athletes modeled after the Anterior Cruciate Ligament-Return to Sport after Injury scale. It is termed the Shoulder Instability-Return to Sport after Injury scale (SIRSI). The SIRSI asks an athlete a series of questions on a Likert-type scale to evaluate their mental readiness and safety to return to play. The SIRSI has been shown to predict with high accuracy an athlete's ability to return to sport. It is our recommendation that team physicians and trainers work in conjunction with athletes to ensure not only their physical but mental readiness to return to play regardless of whether they undergo operative or nonoperative management for their shoulder instability.[54,55]

DISCUSSION

Treatment of an in-season anterior shoulder dislocation is a dilemma requiring thought and shared decision making. Multiple factors should be considered including timing of the injury during the season, type of instability event (dislocation vs subluxation), any osseous involvement (both fracture and attritional bone loss), and sport-specific characteristics (level of competition, position, etc.)[5] Other factors include the athlete's short-term and long-term goals, risk-tolerance, and eligibility. Initial nonoperative management is a reasonable option for most athletes, and return to sport rates are high, but the athlete must understand that recurrent instability is likely. Each additional instability event increases the likelihood of bony lesions of the glenoid and/or humerus, which may make the shoulder more unstable, and complicates future operative planning.

Nonoperative management includes rest from competition, targeted physical therapy focusing on regaining shoulder range of motion and strength, and possible bracing modalities. Bracing can be helpful, and some athletes prefer to brace; however, no substantial data support the use of bracing for decreasing recurrence rates.

After the season, operative stabilization is recommended. In those without significant glenoid or humeral bony defects, arthroscopic Bankart repair significantly decreases risk of recurrent instability. In those with bony defects, a Latarjet procedure, allograft bone block procedure, or arthroscopic Bankart repair with remplissage should be considered. Each of the surgical options listed earlier lead to low rates of recurrent instability with high rates of return to sport.

SUMMARY

Management of anterior shoulder instability in an in-season athlete is complex and requires shared decision making among all parties involved. Return to sport rates are high, even in contact and overhead athletes; however, recurrence rates are also high, so athletes should be made aware of this risk prior to returning to sport. It is generally safe for athletes to return to their sport when the injured shoulder has similar strength and range of motion compared to the uninjured extremity. In those with

recurrent instability, several arthroscopic and open surgical options are available depending on age, glenoid and humeral bony defects, surgeon preference, eligibility, among other factors. Operative stabilization continues to be very successful at decreasing rates of recurrent instability.

CLINICS CARE POINTS

- Carefully selected athletes with in-season anterior shoulder instability can return to sport at high rates; however, they should know that recurrent instability rates are also high.
- In-season athletes who are near the end of the season or have multiple years of eligibility remaining should consider early operative stabilization. These procedures are safe, have high rates of return to sport, and significantly decrease recurrent instability rates.
- Athletes who elect nonoperative treatment are considered safe to perform an expedited physical therapy program and return to sport when they are (1) pain-free and (2) have symmetric range of motion and strength compared to the contralateral side.

DISCLOSURE

B.R. Wolf is a board or committee member for the American Orthopedic Society for Sports Medicine, the American Board of Orthopedic Surgery, and the Mid-America Orthopedic Association. He is on the Editorial or Governing Board for the Orthopedic Journal of Sports Medicine. He receives IP royalties, is a paid consultant, or paid presenter/speaker for CONMED Linvatec. G.V. Christensen and O.C. O'Reilly certify that they have no disclosures.

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