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In-Season Management of Shoulder Instability: How to Evaluate, Treat, and Safely Return to Sport

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Abstract
Purpose of Review Anterior glenohumeral instability is a common injury in contact and collision athletes, and in-season management remains a controversial topic.
Recent Findings Several recent studies have examined non-operative and operative management of in-season athletes after instability events. Non-operative treatment is associated with faster return to play and higher rates of recurrent instability. Dislocations and subluxations have similar rates of recurrent instability but non-operatively treated subluxations have a quicker return to play than dislocations. Operative treatment is often a season ending decision but is associated with high rates of return to sport and significantly lower rates of recurrent instability.
Summary Indications for in-season operative intervention may include critical glenoid bone loss (>15%), an off-track Hill-Sachs lesion, an acutely reparable bony Bankart lesion, high-risk soft tissue injures such as a humeral avulsion of the glenohumeral ligament or displaced anterior labral periosteal sleeve avulsion, recurrent instability, insufficient time remaining in season to rehabilitate from injury, and inability to successfully return to sport with rehabilitation. It is the role of the team physician to appropriately educate athletes on risks and benefits of operative and non-operative treatment strategies and guide athletes through the shared decision-making process that balances these risks against their long-term health and athletic career goals.

Keywords Shoulder instability · Glenohumeral instability · Athlete · Return to play · Sports · In-season management

Introduction

The shoulder is the most mobile joint in the body, and with six degrees of freedom, the overall mobility of the glenohumeral joint uniquely predisposes the athlete's shoulder to instability, making it the most commonly dislocated joint in the body [1]. Accordingly, shoulder instability is especially prevalent in young athletes who participate in contact and collision sports [2–4]. The overall incidence of shoulder instability in the USA has been reported in the literature between 8.0 and 23.9 per 100,000 person-years [1, 5], with higher risk shown among athletes. Wrestling, football, and ice hockey have demonstrated the highest risk among NCAA division I sports [4, 6]. It has been well demonstrated in the literature that young males have an especially high risk, and higher rates of instability are seen with increasing level of competition [3, 5]. Age and activity level have repeatedly been shown to influence recurrence rates [2, 7].

The management of an in-season athlete with shoulder instability is a complex issue, and it is the role of team physician to provide proper guidance and education regarding management strategies and their respective short- and long-term risks and benefits. Ultimately, management requires communication and shared decision-making between the player, physician, coach, athletic trainer, and family members, among other key stakeholders. Each situation requires

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an individualized approach to treatment, and the goal of this review is to provide the team physician with the information necessary to properly assess, educate, and guide the athlete through this complex process.

Evaluation

Physical Examination

The evaluation of an athlete immediately following shoulder instability event begins with Basic Life Support (BLS) and Advanced Trauma Life Support (ATLS) concepts. Once the athlete's airway and cardiopulmonary status have been verified and cervical spine and head trauma have been ruled out, attention is turned to the shoulder. Inspection will often yield deformity after dislocation and asymmetry with a visible sulcus sign on the injured extremity and loss of shoulder contour. With subluxation events or dislocations with spontaneous reductions, this may be less evident, and focal areas of tenderness should be assessed. In equivocal cases, early range of motion can be gently assessed; as limited movement, especially with internal and external rotation, most classically is seen with dislocation events. Furthermore, it is important to document a thorough neurovascular exam at the time of injury, prior to reduction attempts, as axillary nerve injury occurs in between 5 and 35% of primary dislocations [1].

An attempt at closed reduction is recommended in patients with exam findings consistent with dislocation in the absence of crepitus to suggest fracture. Prompt relocation of the glenohumeral joint on the field of play, on the sideline, or in the locker room or training room prior to onset of muscle spasm is ideal, and expert consensus suggests that in this setting, pre-reduction radiographs are not mandatory [8]. Multiple reduction maneuvers have been described, and generally fall into the category of leverage, traction-countertraction, or scapular manipulation, and the literature would suggest that all reduction maneuver techniques are equally effective [9]. The authors preferred reduction techniques (Fast Reliable and Safe (FARES) and Milch techniques) are shown in Fig. 1.

Once the shoulder joint has been reduced, strength and a stable arc of motion in both abduction and rotation are assessed, with care to assess for mechanical block or crepitations. Often in the case of subluxation events and follow-up evaluation of dislocation events after reduction, specific tests help guide practitioners regarding diagnosis. These tests aim to recreate a sense of instability, apprehension, or pain with dynamic manipulation of the joint. Tests for anterior instability include the apprehension, relocation, and surprise tests, and the load-and-shift test. A positive apprehension test involves eliciting a sense of apprehension or instability with abduction and external rotation of the arm. Next, the relocation test is performed by placing a posterior directed

Fig. 1 The authors preferred reduction techniques. **A** demonstrates the FARES technique involves axial traction with the arm brought into abduction with an oscillating anterior-posterior motion. Once the arm reaches 90° of abduction, external rotation is applied. **B** shows the Milch method which utilizes a combination of external rotation and abduction followed by gentle manipulation of the humeral head to achieve reduction

force on the humeral head leading to resolution of apprehension symptoms. Finally, the surprise test is performed by removing the posterior force on the humeral head and is positive when the patient has return of apprehension symptoms. The combination of a positive result for the apprehension, the relocation, and the surprise test yields a 93.6% positive predictive value for anterior instability. Of the 3 aforementioned tests, the surprise test is the most accurate with a sensitivity of 63.9% and a specificity of 98.9% [10]. For posterior instability, the Kim test (sensitivity of 80% and a specificity of 94%), jerk test (sensitivity of 73% and a specificity of 98%), and push-pull test are commonly performed. When the Jerk and Kim tests are present in combination, there is a 97% sensitivity for presence of a posteroinferior labral lesion [11]. Lastly, careful screening should also be performed to exclude a symptomatic biceps-superior labral complex injury, most commonly with O'Brien's Three Pack testing, Crank test, and/or O'Driscoll's Dynamic Labral Shear Test [12, 13].

Imaging

After physical examination and closed reduction maneuvers, orthogonal plain radiographs are required to confirm a concentric reduction of the glenohumeral joint. Standard images obtained include anteroposterior, scapular Y, and axillary lateral views [8]. Additionally, West Point and Stryker notch views have been well described as adjunctive radiographic views to further evaluate for glenoid and humeral head bone lesions, respectively [5].

In the authors' protocol, MRI is routinely obtained on athletes after an instability event. Hemarthrosis associated with the injury may obviate the need for exogenous contrast when evaluating for labral pathology in the subacute setting. MRI allows for assessment of osseous and capsulolabral pathology that may increase risk of recurrent instability with non-operative management. These include humeral avulsion of the glenohumeral ligament (HAGL), glenolabral articular disruption (GLAD), and anterior labral periosteal sleeve avulsion (ALPSA) lesions. HAGL lesions are associated with glenohumeral dislocation in the absence of a Bankart lesion and have demonstrated high rates of recurrent instability with non-operative (90%) versus operative management (0%) [14]. A GLAD lesion has shown decreased glenohumeral stability in a cadaveric biomechanical model and has been identified as a risk factor for recurrent instability [15]. Medial displacement and non-anatomic healing to the medial glenoid neck is often associated with ALPSA lesions, which yields an incompetent capsulolabral complex leading to recurrent instability [16]. Additionally, the glenoid and humeral head articular surface are evaluated for fracture or attritional bone loss, which, if present, may be further delineated with 3-diminensional (3D) reconstructions with a non-contrast CT scan, or, in some centers, MRI [17]. This can be useful preoperatively for risk stratification and to guide surgical decision-making; however, is not routinely obtained if the athlete elects to proceed with initial non-operative management.

Glenoid Track Assessment and Glenoid Bone Loss

Non-contrast CT scans with 3D reconstructions are currently considered the gold standard imaging modality to quantify glenoid bone loss, assess the glenoid track, and determine distance to dislocation (DTD) [18]. The glenoid track concept has been popularized as the understanding of bipolar bone loss has evolved. Biomechanical studies have demonstrated that the glenohumeral joint articulation has a natural glenoid track (distance from the anterior glenoid to the articular border) of 84% of the glenoid width. The presence of an impaction fracture of the postero-superior humeral head (Hill-Sachs lesion) with a medial extent beyond the width of the natural glenoid track allows the lesion to "engage" the anterior glenoid and dislocate the joint. Under this scheme, this is termed an "Off Track" lesion. On the other hand, Hill-Sachs lesions lateral to the width of the glenoid track cannot engage the anterior glenoid and are considered "On track" [19].

Accurate quantification of glenoid bone loss is of paramount importance, as increased bone loss, even seemingly nominal amounts, is associated with higher shoulder instability recurrence rates. Critical glenoid bone loss, defined as the cut-off above which the surgical procedure should include bony augmentation, has historically been set as 20–25%, and is associated with rates of failure with arthroscopic Bankart repair as high as 75% [20••]. Recently, the threshold for critical bone loss has been debated and several authors suggest a lower threshold between 13.5 and 20% [21–24]. Based on the current evidence, the authors consider 15% to be an accurate threshold for critical bone loss. The concept of subcritical bone loss, generally reported as greater than 13.5%, has also been discussed, and patients treated with arthroscopic Bankart repair in the setting of subcritical bone loss have demonstrated inferior patient reported outcome measures in an active duty military population [25]. Significantly higher rates of recurrent instability have also been shown in American college football players with subcritical bone loss compared to those without (100% vs. 0%) [26].

In addition to glenoid bone loss and glenoid track assessment, there has been increasing literature evaluating humeral head bone loss measured as the depth width and length of the Hill-Sachs lesion. Another important radiographic concept is the DTD, which is measured as how close an "On track" lesion is to becoming an "Off-track" lesion. This was introduced by Li et al. and is measured as the glenoid track (GT) minus the

Hill-Sachs interval (HSI) using the formula DTD = GT-HSI [27••]. Using the DTD, Barrow et al. showed an exponential increase in risk of recurrent instability as the DTD dropped below 10 mm. They also demonstrated high rates of failure (>12.3%) with arthroscopic Bankart repair in collision athletes with a DTD ≤ 24 mm [28•]. The DTD includes greater assessment of the Hill-Sachs lesion and highlights the importance of evaluating for bipolar bone loss with shoulder instability.

One of the major risks of non-operative treatment of shoulder instability in athletes is increasing degrees of both glenoid and humeral bone loss associated with recurrent instability events. Dickens et al. prospectively followed high-risk athletes for initial and recurrent instability events. Imaging in the form of MRI at enrollment and post-instability event were compared and bone loss calculated. All subjects with prior instability had >3 instability events prior to enrollment in the study and were compared with first-time instability subjects. They found that first-time instability resulted in an average of 6.8% bone loss (4 out of 23 shoulders >13.5% bone loss, none greater than 20% bone loss). This was in contrast to the recurrent instability group whose baseline bone loss was calculated at 10.2% and increased to 22.8% with all patients having >20% bone loss after recurrent instability event [20]. Shin et al. demonstrated similar findings in their study comparing outcomes of first-time and recurrent dislocations, with a higher prevalence of glenoid erosion (11% vs. 0%) and ALPSA lesions (29% vs.12%) in the recurrent dislocation group [29]. The MOON shoulder group has also performed large multicenter analyses comparing bone loss between primary and recurrent dislocations, and also found increased glenoid bone loss in the recurrent dislocation groups (18.8% with 2–5 dislocations, 20% with >5 dislocations vs. 6.9% with 1 dislocation). Interestingly, there was no difference in bone loss noted between the 2–5 dislocation group and the >5 dislocation group; however, there was a significant increase in associated biceps pathology (13.3% vs. 2.9%) [30]. Recently, the MOON shoulder group examined risk factors for bone loss in anterior instability and found number of prior shoulder dislocations to be the greatest risk factor for bone loss (glenoid, humeral, and combined bipolar). In their study, each additional dislocation event increased the chances of glenoid bone loss by 81% and the chance of developing a lesion with >10% bone loss by 157% [31]. With high recurrence rates and increased bone loss with recurrent dislocations, a compelling argument can be made for early surgical stabilization in high-risk athletes.

Treatment

Management of the in-season athlete following a shoulder instability event is both complex and multifactorial, and it requires an individualized approach with collaborative discussions with the athlete, athletic trainer, family members, and coaching staff. Many variables must be accounted for, and include the following: the athlete's age, any history of prior instability, mechanism of injury, limb dominance, the sport and position demands of the athlete, the timing of the injury within the season, and individual career goals. Additionally, the previously detailed imaging characteristics including glenoid bone loss, Hill-Sachs lesions, evaluation of the glenoid track, and any additional pathoanatomy present that may influence rates of recurrence or initial management.

Non-operative Treatment

Non-operative treatment is often the only management strategy that may allow an athlete to return to sport during the index season of an instability event. Generally, the literature suggests a much higher rate of recurrent instability with non-operative compared with operative treatment, with instability rates varying between studies based on athlete demographics and risk factors such as age, participation in contact and collision sports, and level of competition, as well as duration of follow-up.

A classic article on non-operative treatment by Buss et al. demonstrated a 90% return to sport rate within the same season after an instability event in a study of 30 high school and collegiate athletes treated non-operatively. The average time to return to play was 10.2 days, and of those who returned, 37% suffered a repeat instability event [32].

More recently, Dickens et al. performed a multicenter prospective study evaluating return to play and rates of recurrent instability in NCAA division I athletes with in-season instability events found a 73% RTP rate, with an average of 5 days for RTP. Of those who were able to return to sport, 64% sustained at least one additional instability event during the remainder of the season, and only 27% of all athletes were able to finish the season without a recurrent instability event. Subluxations were 5.3× more likely to return to sport than dislocations, and returned faster (mean RTP 3 days vs. 7 days). Additionally, the authors found that the Simple Shoulder Test (SST) score at the time of initial evaluation was predictive of the time to RTP with higher scores correlated with faster RTP [33].

A systematic review and meta-analysis of adolescent athletes demonstrated recurrence rates of 72.3% with non-operative treatment, 13.2% with operative treatment after primary instability event, and 22.3% with operative treatment after recurrent instability event. They found that athletes less than 14 years old had lower recurrence rates (44%) than those greater than 14; however, they concluded that there remains a significantly high risk of recurrence in this young population. Additionally, they found lower return to play (RTP) rates with non-operative treatment (41.3%), compared to primary operative treatment (95.3%), or operative treatment after recurrent instability (77.6%) [34].

In contrast to the previously described meta-analysis and systematic review, Shanley et al. have recently reported much lower rates of recurrent instability (6.2%) and very high rates of return to play (85%) in the subsequent season following an instability event with non-operative management in their cohort of high school athletes. These results have not been replicated in the literature, and long-term follow-up of these athletes is not reported, but this work strongly supports an initial course of non-operative treatment in young athletes [35••].

In further support of non-operative treatment of first-time instability events in young athletes, Tokish et al. developed the Non-operative Instability Severity Index Score (NISIS). This scoring system was created based on 6 risk factors (age >15, bone loss, type of instability, sport (contact vs. non-contact), sex, and arm dominance). They retrospectively reviewed 57 adolescent athletes and found that a NISIS score of <7 yielded a 97% chance of successful return to sport (defined as completion of at least one subsequent season without recurrent instability or time lost secondary to disability the index shoulder) with non-operative management. Athletes who scored ≥7 had a 59% chance of successful return to sport with non-operative management. They concluded that non-operative management of adolescent athletes with a NISIS score <7 is associated with good outcomes, and the NISIS is a useful tool in risk stratification of high school aged athletes with shoulder instability [36•].

More recently, the NISIS has been evaluated to retrospectively assess its ability to predict failure in a larger population-based cohort study of competitive and recreational athletes under 40 years old with long-term follow-up by Marigi et al. They stratified patients by NISIS with a score of <7 as the cut-off for low risk as suggested by Tokish et al. The high-risk group (NISIS ≥ 7) had an overall failure rate of 60.3% with non-operative treatment compared to 48.9% failure rate in the low-risk (NISIS < 7) group. This study yielded a lower return to sport rate with non-operative management than Tokish et al., but did include a much older cohort of patients with first-time and recurrent instability, and had significantly longer follow-up. The study still found the NISIS score cut-off of ≥7 to be predictive of failure of non-operative management (60.3% failure rate). The authors of the study suggest the use of the NISIS as a decision-making aid when discussing treatment options with athletes after instability events [37].

Without question, non-operative treatment of the in-season athlete with shoulder instability allows for faster return to play compared to operative treatment, with most studies reporting 1 to 3 weeks depending on the athlete's sport and level of competition, with subluxations having a quicker return to play than dislocations (Table 1). Recurrence rates after non-operative treatment are highly variable in the literature, ranging from 6.2 to 64% with anterior instability, and as high as 71% with posterior instability. As mentioned, recurrence risk likely is multifactorial, requires an individualized approach, and risks and benefits of non-operative treatment should be thoroughly iterated with the athlete before initiating treatment.

Bracing

No studies have shown decreased rates of recurrent instability with brace use; however, many non-operative protocols suggest brace use with return to play for symptomatic relief and reassurance [1, 38, 39]. Functional bracing serves to limit shoulder range of motion from reaching an "at risk" position of instability, typically combined abduction and external rotation. However, this may also have the untoward effect of hindering overhead athletes from functional motion required for sport, particularly with involvement of the dominant extremity. Braces can be applied separately with varying degrees of constraint,

Table 1 Non-operative treatment outcomes

Sport	Return to play %	Average time to RTP (Dislocation/Subluxation)	Dislocation% / Subluxation%	Recurrent instability	Study
High school	85%	-	51%/49%	6.2%	Shanley [35]
High school and college	90%	10.2 days	NR	37%	Buss [32]
NCAA DI (index season)	73%	5.0 days (7d/3d)	58%/42%	64%	Dickens [33]
NCAA DI (subsequent season)	40% (completed season)	NR	NR	60%	Dickens [42]
NFL	92% (overall)	2.5 wks (3.0 wks/0.0 wks)	82%/18%	55%	Okoroha [48]
NFL	97%	5.43 wks	NR	50%	Khalil [47]
NBA	100%	5.7 wks (7.1 wks/3.6 wks)	56%/44%	24%	Lu [49]
NHL	98.5% (overall)	25.6 games	100%/0%	14.3%	Swindell [50]

Table 1 demonstrates high rates of return to play during the index season after instability event with quicker average return to play timeframe and higher rates of recurrent instability while some other proprietary versions can be integrated into the protective pads for greater ease of application (Fig. 2). Potential benefits of bracing depend on sport-specific demands of the athlete and should be approached on an individualized basis.

Physical Therapy and Return to Play Criteria

Most studies suggest return to play once an athlete has demonstrated progression through an expedited rehabilitation regimen that emphasizes a three-phase recovery. The initial phase consists of sling use as needed for 1–3 days in combination with cryotherapy and gentle range of motion exercises. Phase one culminates in the recovery of full painless range of motion. The second phase involves shoulder stabilization exercises and strengthening of the dynamic stabilizers of the shoulder (rotator cuff and periscapular muscles). Completion of phase two is signified by symmetric strength relative to the contralateral side. Once these milestones are met and the shoulder remains stable without signs of apprehension, then a return to sport program is initiated (phase three) focusing on sport-specific skills and graduated return to play [1, 33, 38, 39, 40, 41–43].

Psychological Readiness for Return to Play

Recently, psychological readiness for return to play has been identified as an important factor for determining a player's ability to return to sport after injury. The Shoulder Instability Return to Sport after Injury (SIRSI) score is a validated tool modeled off of the ACL Return to Sport after Injury (ACL-RSI) score. The SIRSI has been developed for assessing psychological readiness for return to sport after a shoulder instability event regardless of operative or non-operative treatment [44]. The SIRSI score has demonstrated a high predictive value for predicting an athlete's ability to successfully return to sport. A cut-off for psychological readiness for return to sport of ≥55 has been suggested, and Rossi et al. showed a 2.9-fold increased odds of return to sports with each 10-point increment increase on SIRSI scoring [45•].

Operative Treatment

Multiple studies have shown lower recurrence rates and higher rates of RTP after arthroscopic Bankart repair versus non-operative treatment for a first-time shoulder instability event. In a recent systematic review and meta-analysis by Hurley et al., the rate of recurrent instability among the operatively treated cohort was 9.7%, compared to 67.4% in the non-operatively treated cohort. They also found a higher rate of return to pre-injury play among the operative group (92.8%) compared to those treated non-operatively (80.8%) [46].

A multicenter prospective study of National Collegiate Athletic Association (NCAA) athletes by Dickens et al. evaluated the ability of athletes with remaining eligibility to return to sport in the subsequent season following a first-time shoulder instability event. The authors compared operative (74%) and non-operatively (26%) managed athletes and found a much higher rate of successful return to play without recurrent instability during the following season in the operative group (90%) compared to the non-operative group (40%). Overall, they found that athletes were 5.8-fold more likely to complete the following season without an instability event if they were treated operatively during or after the initial instability season versus non-operatively. Additionally, they did not find any difference in recurrence rates or return to play rates during the subsequent season among those treated operatively after their initial instability event compared to those who attempted to return to play and sustained multiple instability events in the index season prior to operative stabilization [42].

In a retrospective analysis examining outcomes of National Football League (NFL) athletes managed operatively (64%) and non-operatively (36%) after a first-time dislocation event, they found greater career longevity (4.1 vs. 2.8 seasons played after injury), lower rates of recurrent instability (27% vs. 50%), and a greater time interval to recurrent instability among those who sustained recurrent instability events (105.7 weeks vs. 24.7 weeks) in the operatively treated cohort. The time to return to play was significantly longer in the operative group than the non-operative group (36.6 weeks vs. 5.4 weeks) [47]. Similar results were demonstrated in another study of NFL athletes by Okoroha et al. with operative and

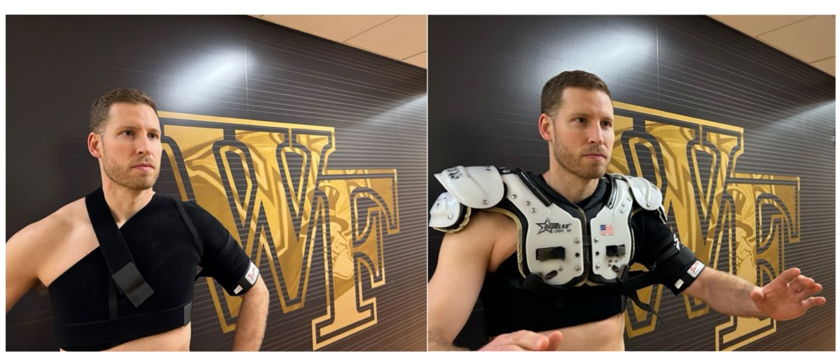

Fig. 2 Functional shoulder braces. Figure 2 shows a DonJoy Sully shoulder stabilizer brace on the left which is worn underneath pads. On the right is shown a Sully brace with a shoulder pad attachment (DonJoy) that allows the brace to be incorporated into the pads

non-operative recurrence rates of 26% and 55%, respectively. However, their study found a much shorter interval to recurrent instability in both operative and non-operatively treated groups (54 weeks vs. 5 weeks) [48].

Lu et al. retrospectively reviewed shoulder instability in National Basketball Association (NBA) players and found similar results to Dickens et al. among NCAA athletes. They reported a 100% rate of return to play, with non-operatively treated athletes returning to play quicker than operatively treated athletes (5.7 weeks vs. 18.7 weeks). Dislocations had significantly longer return to play with non-operative management than subluxations (7.1 weeks vs. 3.6 weeks). Operatively treated athletes had lower recurrent instability rates (8% vs. 24%) and a longer interval between a recurrent instability event (70 weeks vs. 28.5 weeks) [49].

Among National Hockey League (NHL) athletes, one study retrospectively evaluated operative or non-operative treatment of shoulder instability and found a lower recurrent rate with operative treatment (0%) compared to non-operative treatment (14%) [50]. Rangavajjula et al. found high rates of return to sport (100%) following operative treatment of shoulder instability with an average of 4.3 months to return to play and no difference in player performance preoperatively versus postoperatively [51]. Another study of NHL players demonstrated a 100% return to play rate, but reduced career longevity (4.4 seasons vs. 6.0 seasons) after arthroscopic Bankart repair surgery compared to matched controls without shoulder instability [52].

In summary, outcomes of operative management of shoulder instability result in high rates of return to play with low rates of recurrent instability across multiple studies evaluating several different sports (Table 2). Generally, the time to return to play is longer in operatively treated athletes, and surgery may be performed after the season if the player is able to return to play during the index season of injury. Surgical management (either season ending or following the completion of the season) has been shown to lead to lower rates of recurrent instability, a higher chance of completing future seasons, and fewer games missed.

Surgical Procedures

Multiple procedures have been described for treatment of shoulder instability from arthroscopic labral repair to open Bankart repair to open (or arthroscopic) anterior bone block procedure. Surgical indications depend largely on preoperative imaging findings and aggregated individual risk factors, with differing rates of return to sport and timing of return to play for each procedure. Balg and Boileau published a landmark study outlining risk factors for recurrent instability after arthroscopic Bankart repair, and found younger age, contact or forced overhead activities, competitive sports participation, presence of bony lesions (Hill-Sachs or glenoid bone loss) on plain radiographs, and joint hyperlaxity all increased risk of recurrent instability [7]. Based upon these risk factors, they developed a weighted scoring system (the Injury Severity Index Score) to predict failure of arthroscopic Bankart repair. They found that patients with a score of 6 or more had a 70% risk of recurrent instability and concluded that these patients should undergo a bony augmentation procedure instead of an arthroscopic Bankart repair. Other authors have since suggested a lower threshold score ≥4 for bony augmentation [54], whereas other authors have failed to validate this measure in an at risk patient population [55, 56].

Recently, Giacomo et al. modified the scoring system, replacing the weighted points from plain film radiographic assessment with 3D CT reconstruction assessment of the glenoid track (on-track versus off track). They found a twofold decrease in necessity for bony augmentation surgery as well as better outcomes in the arthroscopic Bankart group with their Glenoid Track Instability Management Score compared to the group treated according to the Injury Severity Index Score [57•]. Another recent systematic review of primary arthroscopic Bankart repairs found off-track lesions, increased glenoid bone loss, higher Instability Severity Index Score, increased level of sports participation, fewer number of anchors used (<3), and younger age to be consistently associated with failure of arthroscopic Bankart repair [58]. A thoughtful assessment of each patient and their individual risk profile is necessary to indicate the appropriate initial surgical procedure to minimize recurrent instability.

Table 2 Operative treatment outcomes

Sport	Return to play %	Average time to RTP	Recurrent instability	Study
High school	72%	NR	6.3%	Shanley [35]
NCAA	90%	NR	3%	Dickens [42]
NCAA football	85.4%	NR	10.3%	Robins [53]
NFL	92% (overall)	39.3 wks	26.1%	Okoroha [48]
NFL	89%	36.6 wks	27%	Khalil [47]
NBA	100%	18.7 wks	8%	Lu [49]
NHL	98.5% (overall)	23.3 games	0%	Swindell [50]

Table 2 demonstrates high rates of return to play similar to non-operative treatment with slower return to play timeframe and lower rates of recurrent instability

Long-term Outcomes

Long-term outcome data from surgical management of shoulder instability demonstrates generally higher rates of recurrent instability and variable rates of post-traumatic or post-instability arthropathy. A systematic review of long-term outcomes of shoulder instability managed with arthroscopic Bankart repair with a minimum 10-year follow-up found high rates of return to play (77.6%) with concerning long-term rates of recurrent instability (31.2%) and revision surgery (17%). The authors also found radiographic evidence of arthropathy in 59.4% of patients [59].

In another long-term follow-up study of 180 patients who underwent arthroscopic Bankart repair, recurrent instability was seen in 18% of patients followed for an average of 13 years (minimum 10-year follow-up). Younger age at initial dislocation (<20 years old) and less than 6 months of post-operative rehabilitation were associated with higher rates of recurrent instability. Additionally, they found significantly higher rates of post-traumatic arthritis in patients with multiple instability events prior to surgery. These findings led the authors to recommend arthroscopic stabilization in young active patients with initial shoulder instability events [60].

We have seen improvements in recurrent instability rates as our understanding of bipolar bone loss has evolved, and the threshold for treating shoulder instability with bony augmentation has become more liberal. However, it remains to be seen if long-term outcomes will demonstrate sustained results.

Physical Therapy and Return to Play Criteria

Historically, time-driven guidelines along with subjective assessments of range of motion and strength have guided return to sport decision-making after arthroscopic Bankart repair [61]. Recent literature has shown lower rates of recurrent instability (5% vs. 22%) with implementation of criteria based return to sport testing, which is hypothesized to identify subtle areas of weakness that athletes cope with in functional assessments but may predispose them to higher rates of recurrent instability events [62••]. This has been widely adopted in ACL reconstruction rehabilitation and its use in both operative and non-operative treatment of shoulder instability rehabilitation and return to play has shown promising results.

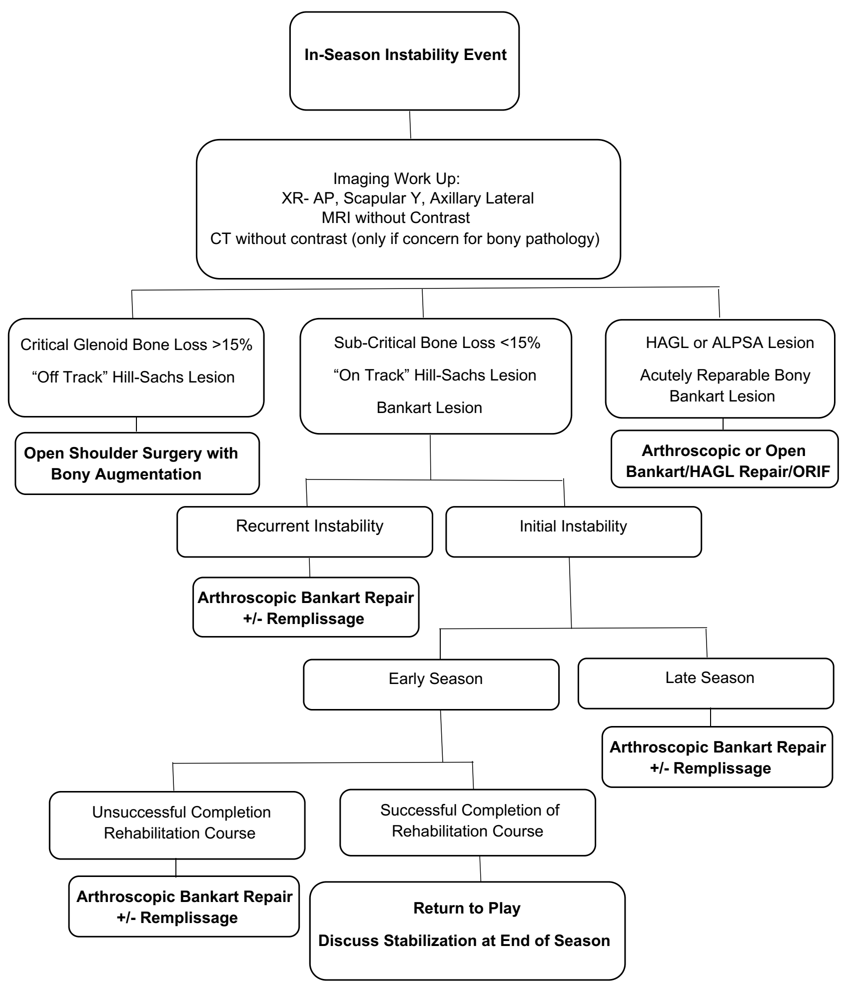

Fig. 3 In-season management of shoulder instability treatment algorithm. Figure 3 demonstrates the author's preferred treatment algorithm for in-season management of shoulder instability, which should be combined with analysis of athlete's goals and detailed discussion of risks and benefits based on literature presented within this review

Return to Sport Treatment Algorithm

Management of shoulder instability is a controversial topic and even among expert shoulder surgeons, very low consensus exists regarding treatment options [63]. Treatment decisions are largely based off of the individualized goals and risk profile of the athlete, but the authors propose the following algorithm modified from Owens et al. [39] as a framework to guide discussion (Fig. 3).

Conclusions

In-season management of shoulder instability requires a thorough patient history and imaging evaluation followed by a thoughtful discussion and shared decision-making process regarding risks and benefits of operative and non-operative management. Factors such as glenoid bone loss and off-track Hill Sachs lesions may require early intervention, rather than delayed operative treatment. The available literature has revealed lower rates of recurrent instability and high rates of return to sport with operative management at the time of injury or conclusion of season, whereas non-operative treatment facilitates earlier return to the field of play despite heightened risk of worsening pathoanatomy due to increased recurrence.

Declarations

Conflict of Interest Benjamin S. Albertson, MD
The author has no relevant financial or non-financial interests to disclose
Nicholas Anthony Trasolini, MD
DJ Orthopaedics: paid presenter or speaker
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