Curr Rev Musculoskelet Med (2017) 10:491–498
DOI 10.1007/s12178-017-9440-5

Return to Sports After Shoulder Stabilization Surgery for Anterior Shoulder Instability

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Published online: 26 October 2017

Abstract
Purpose of Review Young athletes continue to experience traumatic shoulder instability and are often plagued by recurrent instability, limiting their return to sport. The purpose of this paper was to review return to sport in athletes after shoulder stabilization surgery for anterior shoulder instability.
Recent Findings Athletes managed nonoperatively demonstrate unacceptably high rates of recurrent instability and are less likely to successfully return to sport. Operative management includes capsuloligamentous repair (arthroscopic versus open) and bone augmentation techniques. While modern arthroscopic techniques have provided favorable outcomes, open techniques have demonstrated lower recurrence rates among young collision athletes. A subset of athletes continue to experience recurrent instability, leading to further investigation of concomitant pathologies, which may put patients at risk of failure following Bankart repair. Bony augmentation procedures remain favorable for patients with glenoid bone loss; however, what constitutes critical bone loss in the decision between anterior labral repair versus bone augmentation has recently been questioned.
Summary Operative management of anterior shoulder instability provides superior results, including lower recurrent instability and return to sport. Future research on patient-specific risk factors may aid surgical decision-making and optimization of outcomes.

This article is part of the Topical Collection on *Management of Anterior Shoulder Instability*

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Keywords Bankart repair · Athletes · Return to sport

Introduction

The glenohumeral articulation is a ball and socket joint with profound mobility, allowing for a variety of movements and rotation. This mobility comes at the expense of stability, as the shoulder is one of the most commonly dislocated joints in the body. The majority of instability events are anterior, following a traumatic event in a young athletic population [1]. Shoulder dislocation rates are estimated at 0.24 per 1000 person-years in the USA [2] with substantially higher rates of dislocation, 1.69–4.35 per 1000 person-years among US military service members [2–4]. Athletes are particularly vulnerable to instability events, which may encompass a spectrum of injury from microinstability to subluxations and glenohumeral dislocation [5]. A recent review of glenohumeral instability events among collegiate athletes found that shoulder instability was reported at a rate of 0.12 per 1000 exposures, with the highest rates in contact sports, namely football, wrestling, and ice hockey. These injuries commonly resulted in time lost in sport, with greater than 10 days missed in 45% of these injured athletes [6].

Although the osseous anatomy of the glenohumeral articulation accommodates movement in six degrees of freedom, the limited bony confinement offers little stability. The shoulder joint relies on both dynamic and static stabilizers for stabilization. The rotator cuff provides dynamic stability via a concavity-compression model [7]. The labrum serves to deepen the glenoid, while the glenohumeral ligaments provide stability throughout varying shoulder ranges of motion [8]. It is important to keep in mind the function of these restraints, as they are often implicated in anterior shoulder instability.

Traumatic anterior subluxations and dislocations in young athletes demonstrate a high rate of Bankart lesions, defined as an avulsion of the anterior inferior labrum and contiguous anterior IGHL from the glenoid. Taylor and Arciero [9] reported the presence of a Bankart lesion in 61 of 63 (97%) patients surgically treated for first time, traumatic, anterior shoulder dislocation. Similarly, upon arthroscopic evaluation of patients with traumatic anterior shoulder dislocations, Norlin et al. [10], Coughlin et al. [11], and Thomas and Matsen [12] confirmed the presence of a Bankart lesion in 100, 91, and 97% of patients, respectively. As evidenced by Owens et al. [13], Bankart lesions may not be limited to traumatic anterior dislocations; 26 of 27 military cadets were found to have a Bankart tear following one anterior subluxation event. The high prevalence of anterior labral tear and other internal derangement following an instability event increase the risk for the development of recurrent instability, as these structures play a vital role as static stabilizers.

Although the presence of a Bankart lesion is a well-documented risk factor for recurrent anterior shoulder instability, age and activity level play an important role as well. Hovelius et al. [14] showed recurrent instability occurred significantly more often in patients who were 23 years old or younger at time of initial dislocation (52%), compared to those who were older than 30 (18%). Additionally, the risk of recurrent instability events is highest among young athletes participating in contact sports, which has been found to range 39–94% [15••, 16–18]. Despite this wide range of reported recurrent instability, the initial treatment of young athletes experiencing shoulder instability still remains controversial.

Return to Play Following Nonoperative Management

Rehabilitation and return to play following first time acute traumatic dislocation have provided conflicting data. Aronen and Regan [18] reported a 25% recurrence rate among 20 midshipmen following a prolonged rehabilitation program at the Naval Academy. Conversely, in their study of recurrent instability among WestPoint cadets, Wheeler et al. [17] and Arciero et al. [19] report recurrence rates of 92 and 80%, respectively. Buss et al. [20] reviewed the ability of in-season athletes to return to sport following an anterior instability event treated conservatively with early mobilization, therapy, and bracing when applicable. Although they found 90% of participants were able to return to competition after a mean 10 days lost from sport, 37% of these athletes demonstrated recurrent instability. Furthermore, 46% of patients who were able to return to sport underwent surgical stabilization upon completion of their season. More recently, Dickens et al. [15••] prospectively examined the natural history of nonoperative treatment following traumatic anterior shoulder instability in 45 collegiate athletes. Following an accelerated rehab protocol, 73% of athletes were able to return to sport after a median 5 days lost from competition. Of these participants, only 27% were able to successfully complete the season without a recurrent instability event.

Anterior shoulder instability encompasses a wide variety of injury mechanisms, associated pathologies, and athlete demands, which may distort comparisons of nonoperative management. Concomitant pathologic lesions have been shown to increase rates of recurrent instability and would seemingly place athletes who are managed nonoperatively at a greater risk for treatment failure [21, 22, 23••]. Heterogeneity among athletes and sport-specific demands add to the complexity of nonoperative management. Additionally, the literature poorly defines what constitutes collision versus contact sport and the clinical implications of sport categorization. While nonoperative management may play a role for some athletes, it is difficult to draw conclusions off the vast diversity of anterior shoulder instability; the complexity of etiology, concomitant pathology, sport demands, patient-specific factors, rehabilitation variability, and so forth may account for the widely reported range of recurrent instability in athletes following nonoperative treatment.

Bracing

Motion-limiting braces prevent abduction, extension, and external rotation, thereby supplementing a vulnerable position for anterior instability. Theoretically, this would appear to be a helpful adjunct to athletes wishing to return to sport without subsequent recurrent instability; however, this has not been supported by recent literature. These braces limit overhead activity and therefore would be less applicable for overhead athletes. Buss et al. [20] noted 70% of athletes returning to sport adopted a brace and reported subjective improvement in stability; however, recurrent instability rates were not significantly different among those who did and did not wear a brace. Dickens et al. [15••] demonstrated similar findings; bracing was used in 61% of athletes returning to sport; however, there was no correlation between brace use and rates of recurrent instability. Although there have not been any prospective randomized trials on the efficacy of brace wear in return to sport in nonoperatively managed athletes, the studies that have included brace wear do not conclusively support reduction in recurrent instability.

Concomitant Pathology

Despite being able to return to competition, athletes managed nonoperatively are frequently fraught with a high incidence of recurrent instability. The long-term outcomes of recurrent instability remain debated; however, literature suggest there may be deleterious consequences of prolonged instability.

The pathologic changes associated with first time instability events have been well documented [9–13]; however, the spectrum of associated pathologic lesions appears to increase with recurrent instability events [24]. Yiannakopoulos et al. [24] were able to demonstrate a statistically significant increase in the incidence of Bankart lesions (97 vs 78%), Hills-Sachs lesions (93 vs 65%), inverted pear glenoid morphology (15 vs 0%), and capsular laxity (30 vs 9%) in chronic versus acute instability. While the presence of an ALPSA lesion was noted in patients with recurrent instability (13%), it was not found in first time instability events. Habermeyer et al. [25] proposed a chronologic classification of successively worsening labroligamentous pathology associated with recurrent instability that progressed from Bankart tear to capsulolabral degeneration with recurrent instability. In patients with chronic instability, it is important to recognize the implications of progressive intra-articular pathology, as this may contribute to poor surgical outcomes and increased recurrence rate, especially among contact athletes [26–28]. It is also important to consider the profound rates of recurrent instability and deleterious effects of chronic instability when determining the optimal treatment for athletes with anterior shoulder instability.

Return to Play Following Operative Management

While absolute indications remain debated, common justifications for surgical management of anterior shoulder instability include recurrent instability despite exhaustive nonoperative management and/or failure to return to sport. Absolute and relative surgical indications are summarized in Table 1 below [29].

Results Following Nonoperative Versus Operative Management

When compared with nonoperative management of acute anterior instability, surgical stabilization has demonstrated superior results, including lower recurrence rates, and improved return to sport. Outcomes from several studies that evaluated surgical management of anterior shoulder instability are summarized in Table 2 below. In their systematic review comparing nonoperative and surgical treatment of traumatic anterior instability, Brophy et al. [45] found surgical treatment had significantly lower rates of recurrent instability at 2 years (7 vs 46%) and at longer term, ranging 3–10 years (10 vs 58%). Kirkley et al. [46] found that surgical stabilization provided lower recurrence rates (16 vs 47%) at 2 years. They also showed statistically significant improved WOSI scores among surgically treated patients, with 20% improvement in return to sport scores in the surgically treated cohort. In a recent prospective study, Dickens et al. [30••] confirmed a higher incidence of return to sport among 29 collegiate athletes who underwent arthroscopic stabilization, compared to nonoperative management. In their study, 90% of athletes who underwent surgery were able to return to sport in the subsequent season without recurrent instability. Athletes who underwent surgical stabilization were 5.8 times more likely return to competition without recurrent instability in the subsequent season compared to athletes who pursued nonoperative treatment [30••].

Surgical Treatment Strategies

The optimal surgical management of anterior instability continues to be refined as surgical techniques continue to evolve. Available surgical stabilization procedures include soft tissue (arthroscopic versus open Bankart repair) and bone augmentation (Latarjet) procedures. Historically, open procedures were favored with cited recurrence rates ranging from 3 to 9% [47, 48], compared to 5–33% seen with arthroscopic procedures [15••, 31, 49–53]. Interestingly, a recent systematic review found no significant difference in recurrent instability between current generation arthroscopic suture anchor and open Bankart repair (8.5 vs 8%). Additionally, there were no differences in return to sport rates between arthroscopic (87%)

Table 1 Absolute and relative surgical indications [29]

Absolute indications	• > 50% rotator cuff tear
	• Glenoid defect > 20%
	• Hills-Sachs lesion > 25%
	• Concomitant fracture requiring surgery
	• Irreducible dislocation
	• Failed rehab/recurrent instability with attempted return to sports
Relative indications	• > 2 dislocations in same season
	• Participation in overhead or contact sports
	• Injury at the end of the season with insufficient rehab time
	• > 13.5% glenoid bone loss
	• Bony Bankart lesions
	• Age < 20 years

Table 2 Outcomes following surgical management of anterior shoulder instability

Study (year)	# of shoulders	Procedure	Return To preinjury sport	Instability recurrence	
Dickens (2017) [30••]	29	Arthroscopic	90%	3%	
Mazzocca (2005) [31]	18	Arthroscopic	100%	Contact athletes 0%	Collision athletes 15%
Castagna (2012) [32]	65	Arthroscopic	100% (81%[a])	21%	
Saper (2017) [33••]	39	Arthroscopic	89% (78%[a])	10%	
Phadnis (2015) [23••]	141	Arthroscopic	NR	14%	
Balg (2007) [22]	131	Arthroscopic	NR	15%	
Dickens (2017) [34••]	50	Arthroscopic	100%	6%	
Aboalata (2017) [35••]	143	Arthroscopic	80% (50%[a])	18%	
Bottoni (2006) [36]	32	Arthroscopic	97%	3%	
	29	Open	100%	7%	
Rhee (2006) [37]	16	Arthroscopic	63%[b]	25%	
	32	Open	90%[b]	13%	
Yamamoto (2015) [38••]	49	Arthroscopic	76% (51%[a])	Contact Athletes 14%	Noncontact Athletes 4%
	51	Open	75% (48%[a])	10%	5%
Pagnani (2002) [39]	58	Open	90%	3%	
Blonna (2016) [40]	30	Arthroscopic	90%	10%	
	30	Latarjet	83%	0%	
Cerciello (2012) [41]	28	Latarjet	96% (71%[a])	4%	
Neyton (2012) [42]	37	Latarjet	65% (56%[a])	0%	
Privitera (2014) [43••]	42	Latarjet	72% (54%[a])	5%	
Beranger (2016) [44••]	47	Latarjet	78% (64%[a])	NR	

[a] Defined as same level as preinjury level of competition

[b] Defined as > 90% preinjury level of competition

and open (89%) techniques or patient-reported Rowe or Constant scores [54]. Furthermore, Bottoni et al. [36] found no significant differences in return to duty, recurrence rate, or patient-reported outcomes among 61 military patients who were randomized to arthroscopic versus open Bankart repair.

Arthroscopic Bankart Repair

While open Bankart repair is often deemed the "gold standard," some studies demonstrate that arthroscopic techniques have produced favorable outcomes regarding recurrent instability and return to competition [55, 56]. Mazzocca and colleagues [31] examined the results of arthroscopic stabilization within collision and contact athletes < 20 years old. While 100% patients returned to competition, recurrent instability was found in 15% of collision athletes, compared to 0% in contact athletes [31]. In their retrospective study of 65 young athletes, aged 13–18, who underwent arthroscopic stabilization following an acute traumatic instability event, Castagna's group [32] found 81% of patients returned to their pre-injury level of competition. During a mean follow-up period of 63 months, 21% patients had recurrence, which was not found to have a significant impact on patient-reported outcomes. Further analysis of sport participation revealed a statistically significant ($p = 0.0021$) increased incidence of recurrence among rugby and water polo players [32]. Similarly, Saper et al. [33••] reviewed outcomes of 37 athletes (< 19 years) who underwent arthroscopic Bankart repairs. At a minimum 4-year follow-up, they found 89% of athletes returned to sports postoperatively; of those, 78% returned to their pre-injury level of competition. Overall, 10% of shoulders experienced recurrent instability postoperatively, which was not correlated to sport classification. Recently, Robins and colleagues [57••] evaluated return to play in division I collegiate football players who underwent surgical stabilization for anterior, posterior, or combined instability. Within the anterior stabilization cohort, return to play at pre-injury levels or higher was seen in 82 and 89% of patients after arthroscopic or open stabilization, respectively. Overall incidence of symptomatic instability recurrence was 10%; however, this includes all postoperative athletes, rather than anterior stabilization alone.

There is a paucity of literature on long-term outcomes following arthroscopic stabilization surgery. Aboalata et al. [35••] recently reported on 143 patients who underwent arthroscopic stabilization with 13-year follow-up. They found

an overall 18% rate of recurrent instability, with significantly higher rates among younger, < 20 years (39%) than older, and > 30 years (13%) patients. Overall return to sport was 80%, with 50% reportedly returning to pre-injury level of competition.

Open Bankart Repair

Despite overall positive results, arthroscopic stabilization may not be best suited for all athletes. Previously mentioned studies suggest arthroscopic failure may be more frequent in collision athletes [31, 32]. Young males participating in collision sports are at especially high risk for failure [16] and may benefit from an open stabilization procedure. Rhee et al. [37] examined the rates of recurrent instability between collision athletes following arthroscopic versus open Bankart repair. The overall rate of recurrent instability (16.5%) was higher in the arthroscopic group (25%) than athletes who underwent open repair (12.5%). Additionally, athletes with open repair were more likely to return to sport without limitation, defined as > 90% preinjury activity, than those treated arthroscopically (90 vs 63%). Yamamoto et al. [38••] found no difference in recurrent instability between noncontact athletes following open (5%) versus arthroscopic (4%) Bankart repair. However, the recurrence rate of instability following arthroscopic repair nearly tripled in contact athletes (14%). As demonstrated by Pagnani and Dome [39], open Bankart repair can produce favorable results in contact athletes. Recurrent instability was found in 3% of 58 young football players, average age of 18, following open Bankart repair. Overall, 90% of athletes were able to return to play, including 100% participation among collegiate and professional athletes. A recent study by Virk et al. [58••] compared time to recurrence in failed Bankart repairs and found the time to failure was significantly different in favor of open repair, 34.2 months compared to 12.6 months in the arthroscopic group. Time to recurrence could present a factor to consider when deciding optimal treatment.

Evaluation of Bankart Repair Failures

Although both arthroscopic and open stabilization have been shown to produce overall positive outcomes, a significant number of athletes experience recurrent instability and/or are unable to return to sport. In order to optimize outcomes, patients should be critically evaluated for concomitant pathologies that may put them at a higher risk of failure following surgery or preclude them from an arthroscopic approach. Ozbaydar et al. [21] examined failed arthroscopic stabilization and found statistically significant higher rates of recurrent instability in the presence of ALPSA lesions (19%), when compared to Bankart lesions alone (7%). They also determined a significantly higher average number of preoperative instability events among patients with ALPSA (12.3) versus discrete Bankart (4.9) lesions, suggesting a deleterious progression of intra-articular pathology with recurrent instability events. Balg and Boileau [22] developed a pre-operative questionnaire, the instability severity index score (ISIS), in an attempt to determine risk factors for recurrent instability following arthroscopic stabilization. In their study of 131 patients, 14.5% developed recurrent instability following arthroscopic Bankart repair. Through recurrence factor analysis, the following risk factors were derived with an assigned score: age < 20 years (2), contact or overhead athlete (1), competitive sport participation (2), hyperlaxity (1), presence of a Hill-Sachs lesion (2), glenoid bone loss (2). Patients with a score < 6 had 10% recurrence rate, while those scoring > 6 demonstrated 70% recurrence ($p < 0.001$) [22]. More recently, Phadnis et al. [23••] assessed the utility of ISIS by retrospectively applying the scoring system to 141 patients who underwent arthroscopic stabilization. Overall, they found a 13.5% failure rate; however, there was a 70% risk of recurrent instability with ISIS > 4, opposed to 4% risk with ISIS < 4.

As mentioned previously, the glenoid may experience attritional bone loss with subsequent instability events, thereby placing patients undergoing capsuloligamentous repair at risk for failure [22, 23••, 54, 59]. The significance of glenoid bone loss on arthroscopic failure was emphasized by Burkhart et al. [59], who found 67% instability recurrence with either an "inverted pear"-shaped glenoid and/or an engaging Hill-Sachs lesion. Furthermore, recurrent instability rates were dramatically increased among contact athletes with bone loss (89%) versus those without (6.5%). Historically, 20–25% glenoid bone loss was deemed "significant enough" to recommend open bone augmentation procedures; however, recent studies have drawn into question what constitutes "critical bone loss," suggesting lower amounts may contribute to poorer outcomes and recurrent instability.

A recent study of 169 arthroscopic Bankart repairs found significant differences in outcomes with a critical bone loss of 17.3%. Patients with < 17.3% bone loss demonstrated significantly lower rates of recurrent instability (3.7 vs 42.9%) and improved SANE scores (92.9 vs 83.8) compared to patients with > 17.3% bone loss [60••]. Similarly, Shaha et al. [61••] suggested > 13.5% glenoid bone loss portends poorer patient-reported outcomes and higher rates of recurrent instability (22 vs 5%) following arthroscopic Bankart repair. Correspondingly, Dickens et al. [34••] found bone loss > 13.5% was predictive of recurrent instability following arthroscopic stabilization in collegiate football players.

Bone Augmentation Procedure

Patients with glenoid insufficiency will require bony reconstructive procedures to address their instability, rather than capsuloligamentous repair alone. Although the degree

continues to be debated, acknowledgment of glenoid bone loss is important for optimizing outcome and return to play in athletes. Neyton and colleagues [42] found favorable results among 34 union rugby players following Latarjet procedure. At a mean follow-up of 12 years, there were no recurrent instability events. Although 65% of players returned to rugby, only one patient did not return due to their shoulder. Cerciello [41] demonstrated excellent results in their retrospective review of 26 soccer players who underwent Latarjet for anterior instability. Postoperatively, 96% of players returned to competition and only one player experienced a traumatic dislocation.

Similarly, Privitera et al. [43••] evaluated clinical outcomes among 39 collision or contact athletes following Latarjet for recurrent anterior instability with glenoid bone loss. At a mean follow-up of 46 months, two athletes experienced recurrent instability. Additionally, 72% of athletes were able to return to their contact or collision sport; 54% endorsed preoperative level of competition while 18% reported decreased activity level [43••]. Beranger et al. [44••] found favorable return to sport outcomes among 47 athletes following Latarjet procedure for chronic anterior instability and ISIS score above 3. After a mean of 6 months, 78% of athletes were able to return to the same preinjury sport, while 64% were able to continue at a pre-injury level of competition. Interestingly, participation in overhead sport was a risk factor for not returning to preinjury sport or level of competition [44••].

While bony augmentation procedures have produced favorable results in athletes with glenoid insufficiency, its superiority for instability in athletes without glenoid defects has been questioned. A recent study comparing arthroscopic Bankart repair versus open Bristow-Latarjet in patients with anterior instability and < 20% glenoid bone loss found higher return to sport rates among the arthroscopic cohort (90 vs 83%). There were more episodes of recurrent instability among the arthroscopic group (3 vs 0); however, this difference did not reach statistical significance [40].

Conclusion

Any athlete participating at a competitive level continues to be at an increased risk for anterior shoulder instability, especially younger collision athletes. Although conservative management affords in-season return to sport, few athletes will return to pre-injury level of competition without experiencing recurrent instability. Recurrent instability has been shown to contribute to progression of intra-articular pathology and potential worse outcomes. Surgical stabilization offers athletes the best chance of asymptomatic return to sport. Return to sport ranged from 63 to 100% among athletes who underwent arthroscopic Bankart repair, with lower rates among collision athletes. Likewise, recurrent instability rates varied from 0 to 25%, with higher rates among collision athletes. Open Bankart repair yielded comparable rates of return to sport (75–100%) and lower overall incidence of recurrent instability among collision athletes (3–13%). Latarjet appeared to provide reliable outcomes among athletes with glenoid bone loss; 65–96% of athletes were able to return to sport with low overall incidence of recurrent instability (0–5%).

Despite overall positive outcomes with both arthroscopic and open Bankart repairs, a subset of patients will continue to experience recurrent instability. Recognition of patient-specific variables that may present an increased risk for recurrent instability following soft tissue repair cannot be understated. Young collision athletes demonstrate high risk of recurrent instability and therefore may be better suited for an open stabilization procedure. Likewise, patients with concomitant lesions and/or glenoid bone loss must be critically evaluated when considering strictly capsuloligamentous repair versus bony augmentation. Regardless of technique used to address anterior shoulder instability, the goals remain the same: restore stability while optimizing functional capacity, to allow successful return to sport.

Compliance with Ethical Standards

Conflict of Interest Both authors declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

Disclaimer The views expressed in this presentation are those of the author and do not necessarily reflect the official policy or position of the Department of the Army, Department of the Navy, the Defense Health Agency, the Department of Defense, nor the US Government.

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