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Current Concepts Review

First-time traumatic anterior shoulder dislocation: current concepts

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ABSTRACT

The management of first-time traumatic anterior shoulder dislocations has been a topic of extensive study yet remains controversial. Development of a treatment plan requires an understanding of patient-specific considerations, including demographics, functional demands, and extent of pathology. Each of these can influence rates of recurrence and return to activity. The purpose of this review is to provide a framework for decision-making following a first-time anterior shoulder dislocation, with particular focus on the high-risk young and athletic population. A summary of surgical treatment options and their outcomes is outlined, along with future biomechanical and clinical perspectives.

Current concepts

- Anterior shoulder instability is a common orthopaedic problem, yet there is little consensus on the management after first-time anterior dislocation.
- Treatment strategies are individualized and multifactorial, but goals should include minimizing recurrence and maximizing return to sport and function.
- Recent literature suggests that operative management is superior to nonoperative management in terms of recurrence and return to pre-injury level of activity.
- Surgical options include open or arthroscopic soft tissue stabilization ± Bony augmentation as indicated based on the degree of bone loss.

Future perspectives

- Optimizing management of anterior shoulder instability currently requires a deeper understanding of the specific factors that drive decision-making.
- Randomized controlled trials are forthcoming, comparing different operative interventions for shoulder instability.
- In cases of instability with substantial bone loss, more research is needed to evaluate alternatives to traditional bony augmentation.
- Capsular injury is important to address in shoulder instability; current research is ongoing in attempt to individualize capsular plication to restore native shoulder function and biomechanics.

Introduction

Anterior shoulder instability is very common in sports medicine, especially in young males, athletes, and military personnel, who suffer from dislocations at a rate as high as 3% per year [1,2]. Recent biomechanical studies have demonstrated that after a single dislocation, injury to the joint complex alters the normal biomechanics and increases the risk of recurrent instability, and this disturbance in kinematics compounds with subsequent dislocations [3,4]. These permanent biomechanical alterations and the dose-dependent effects of multiple instability events support recent clinical studies advocating for early surgical stabilization to minimize recurrence and optimize function [5–8].

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Despite these findings, there remains little consensus on the management of first-time traumatic anterior shoulder dislocation, as evidenced by a recent consensus meeting of the ASES Neer Circle with shoulder experts reaching ≥90% agreement in only 5% of first-time anterior shoulder dislocation clinical scenarios [9]. The purpose of this review is to discuss decision-making strategies for first-time traumatic shoulder dislocations, especially in younger, athletic populations. Surgical interventions and specific considerations for treatment will then be discussed, concluding with perspectives on future clinical and biomechanical investigations.

Body

Developing a treatment algorithm for first-time shoulder dislocations involves a multitude of considerations, including patient-specific risk factors, demographics, functional demands, and assessment of bony and soft tissue pathology. Ultimately, decision-making for treatment is based on two goals: minimizing risk of recurrence and maximizing return to sport/activity.

Nonoperative management—do we have to fix it?

Trialing nonoperative management requires an understanding of the natural history following first-time dislocation as it pertains to both return to play and recurrence. Nonoperative management has been well-studied in athletes following a primary anterior shoulder dislocation. One cohort study of high school athletes by Shanley et al. observed that 85% of those treated nonoperatively after a shoulder dislocation returned to preinjury activity levels for a full season without a subsequent recurrent instability event [10]. Similarly, Buss et al. evaluated in-season athletes over a 2-year period following an anterior shoulder dislocation and found that although 10 of 30 athletes suffered sports-related recurrent instability episodes, nearly 90% of athletes returned to sports for a complete season, missing an average of only 10.2 days. Yet, more than 50% (16/30) of these patients did go on to have surgery in the off-season [5]. Given the results of these studies, there is some evidence suggesting successful nonoperative management as a treatment strategy following a first-time shoulder dislocation regarding return to play. However, the long-term outcomes of initial nonoperative management should be discussed. Hovelius et al. performed a prospective, 25-year follow-up study on patients 12–40 years old treated nonoperatively after primary anterior dislocation. Although the study concluded that half of patients 12–25 years old had no recurrence or reached stability over time, approximately 52% of all patients with any level of sport or recreational activity participation had recurrence or surgical stabilization in the study period [11].

Consideration of nonoperative management depends in part upon the degree of pathology. Soft tissue injuries such as humeral avulsion of the glenohumeral ligament or rotator cuff tears increase the risk of recurrent instability [12]. Additionally, glenoid and/or humeral bone loss, discussed below, have major consequences on biomechanics and recurrence, pushing the surgeon away from nonoperative treatment. In patients without these findings, nonoperative management may be a feasible option, especially in older, less active patients [13].

Deciding between operative versus nonoperative management

Recently, the pendulum has swung toward earlier surgical intervention, particularly in athletes and younger patients. The shift toward operative management of first-time shoulder dislocations stems from high risks of recurrent instability with nonoperative management compared to operative treatment [5,6]. This increased risk of recurrence has been demonstrated in multiple level 1 randomized controlled trials comparing operative and nonoperative management after first-time shoulder dislocation, which have shown substantially diminished risks of recurrence with early stabilization and sustained long-term outcomes, including improved patient reported outcomes, event-free survival, and significantly better return to preinjury activity levels, especially in the young, athletic population [14–16].

An understanding of demographic risk factors is critical in the treatment algorithm. Recent studies have sought to identify patient-specific demographic risk factors that may preclude nonoperative management. Of these risk factors, male athletes and younger individuals are most susceptible to recurrent instability, suggesting that nonoperative management may not be favourable in this population. Regarding type of sport, while previous studies have identified that collision athletes are at increased risk of shoulder instability and recurrence, recent literature has shown similar findings and placed increased focus on overhead athletes [17]. Therefore, young, male, collision, and/or overhead athletes may be the best candidates for immediate surgical stabilization to maximize functional outcomes and prevent recurrent instability.

Delayed versus immediate stabilization—can it wait?

The decision to proceed with early versus delayed operative intervention is multifactorial. In a vacuum, immediate stabilization, particularly for the high-risk patient, is likely preferred to minimize recurrent instability and further damage to the glenohumeral joint complex. The decision on when to operate, especially in athletes, is influenced by a host of factors, including time of sporting season, eligibility, parents and family, future athletic prospects, and input from athletic training and coaching staff.

Decision-making for early versus delayed surgery should be made in the context of two distinct outcome measures: return to play versus risk of recurrence. In a prospective multicentre study evaluating collegiate level football players, Dickens et al. found that in patients with an in-season anterior shoulder instability event who underwent delayed surgical stabilization in the offseason, 90% were able to return to play the subsequent season, while only half who continued nonoperative treatment were able to return [6]. While return to play may be high with delayed management, this must be weighed against higher risks of recurrence with delay. Buss et al. demonstrated that nearly 40% of collegiate contact athletes with a mid-season anterior instability event managed nonoperatively had a subsequent instability event that season [5]. Dickens et al. also investigated in-season collegiate contact athletes and found that only 27% of athletes with an anterior shoulder instability event were able to complete their season without a subsequent instability event [18].

Recurrent instability with delayed surgical management is believed to lead to cumulative anatomic injuries, as well as increased risk of failure following shoulder stabilization. In a study comparing acute and recurrent dislocations, Yiannakopoulos et al. found that the recurrent group had greater glenoid bone loss and Hill-Sachs lesions alongside more advanced capsulolabral damage [8]. Fox et al. compared patients undergoing surgical stabilization after one dislocation versus two documented dislocations and found that immediate surgical stabilization after a first dislocation significantly decreased the risk of recurrent dislocation compared to the two-dislocation cohort [19]. In a separate study, Vaswani et al. found that two dislocations, compared to one, prior to arthroscopic Bankart repair more than doubled rates of postoperative failure [7]. Additionally, further preoperative dislocations resulted in exponentially higher failure rates, supporting the recommendation for immediate stabilization [7].

Synthesizing the literature, the decision on nonoperative versus delayed surgery versus immediate surgery following a first-time dislocation is multifactorial, involving an understanding of functional demand, gender, age, anatomic risk factors, and sports-specific circumstances. An increasing amount of evidence favours immediate stabilization, especially for higher risk groups including younger males and higher-level contact athletes. Once operative management is chosen, selecting the appropriate stabilization procedure should focus on restoring native anatomy, minimizing recurrence, and maximizing function. Discussion of specific procedures, with important considerations of each, follows below.

Discussion

Surgical management of anterior shoulder instability falls into three major categories: arthroscopic soft tissue stabilization, open soft tissue stabilization, and bony augmentation procedures. When properly indicated, all procedures accomplish the goal of minimizing recurrence and allowing return to activity. Ultimately, selecting a specific surgical technique depends on surgeon preference and expertise, anatomic risk factors, and patient preferences. At present in the United States, soft tissue stabilization, whether arthroscopic or open, is generally favoured in instances of minimal glenoid bone loss. Remplissage may be added depending on the extent of the Hill-Sachs lesion, as discussed below or on surgeon preference alone. In instances of critical glenoid bone loss of ≥20%, bony augmentation procedures are typically selected. In the category of "subcritical glenoid bone loss" (typically 10–20% but defined in the literature as up to 25%) [20–22], treatment options remain controversial, with literature supporting arthroscopic versus open soft tissue stabilization, with or without remplissage, or bony augmentation. These procedures will be discussed in detail below. Fig. 1 provides a framework and summary for the different operative techniques after first-time shoulder dislocation. It is adapted from an algorithm originally developed to treat recurrent instability [23], with a shift in focus on first-time anterior shoulder dislocation.

Assessing bipolar bone loss

The definition of critical glenoid bone loss has changed over time. Historically, 20–25% glenoid bone loss was considered the threshold for which soft tissue stabilization is unacceptable due to recurrence and the loss of biokinematic restoration [24]. However, more recent studies have found that "subcritical" bone loss of 17–25% predicts poor patient function [20], and even as little as 13.5% glenoid bone loss is associated with poor clinical outcomes [25].

The glenoid track concept, described by Yamamoto et al., has been used to quantify bipolar bone loss and to identify clinically relevant Hill-Sachs lesions [26] (Fig. 2). Off-track Hill-Sachs lesions have increased risk of engaging the glenoid, thus precipitating an instability event, due to their position out of the physiologic glenoid track. Notably, glenoid-sided defects diminish the glenoid track, which in turn increases the likelihood of a Hill-Sachs lesion to be off-track. Literature has shown that off-track Hill-Sachs lesions are correlated with high rates of instability and postoperative recurrence following arthroscopic Bankart repair alone, while recurrence rates are diminished 8-fold following the addition of remplissage to address an off-track Hill-Sachs lesion [27].

In addition to off-track lesions, recent literature has identified on-track lesions with small distances-to-dislocation (DTD), or "near-track lesions," as predictors of recurrent instability. Li et al. described the glenoid track as a continuous variable rather than a binary concept and demonstrated that on-track lesions with DTD <8 mm were predictive of failure after primary arthroscopic Bankart repair, especially in individuals ≤20 years old [28]. Similarly, Yamamoto et al. studied 50 patients with on-track Hill-Sachs lesions, calculating Hill-Sachs occupancy (defined as Hill-Sachs interval divided by glenoid track width, reported as percentage). The glenoid track was divided into four zones based on percentage of the Hill-Sachs occupancy, and the authors found that patients with on-track lesions, but Hill-Sachs occupancy ≥75% (peripheral-track lesion) showed significantly worse patient reported outcomes [29]. While the literature on this topic is still developing, it has shed light on the importance of determining the glenoid track (Fig. 2), as well as considering adjunct procedures such as remplissage to address humeral-sided defects.

Open versus arthroscopic Bankart stabilization

Open Bankart stabilization

In young collision athletes, open Bankart repair has traditionally been a durable option, with recurrence rates less than 1% at short and long-term follow-up, even in cases of bipolar bone loss [30,31]. The advantages of open Bankart repair are increased visualization of the capsule and ability to plicate the capsule more freely and aggressively than with arthroscopic methods. However, well-known complications include a larger incision and dissection, disruption of the subscapularis, potential

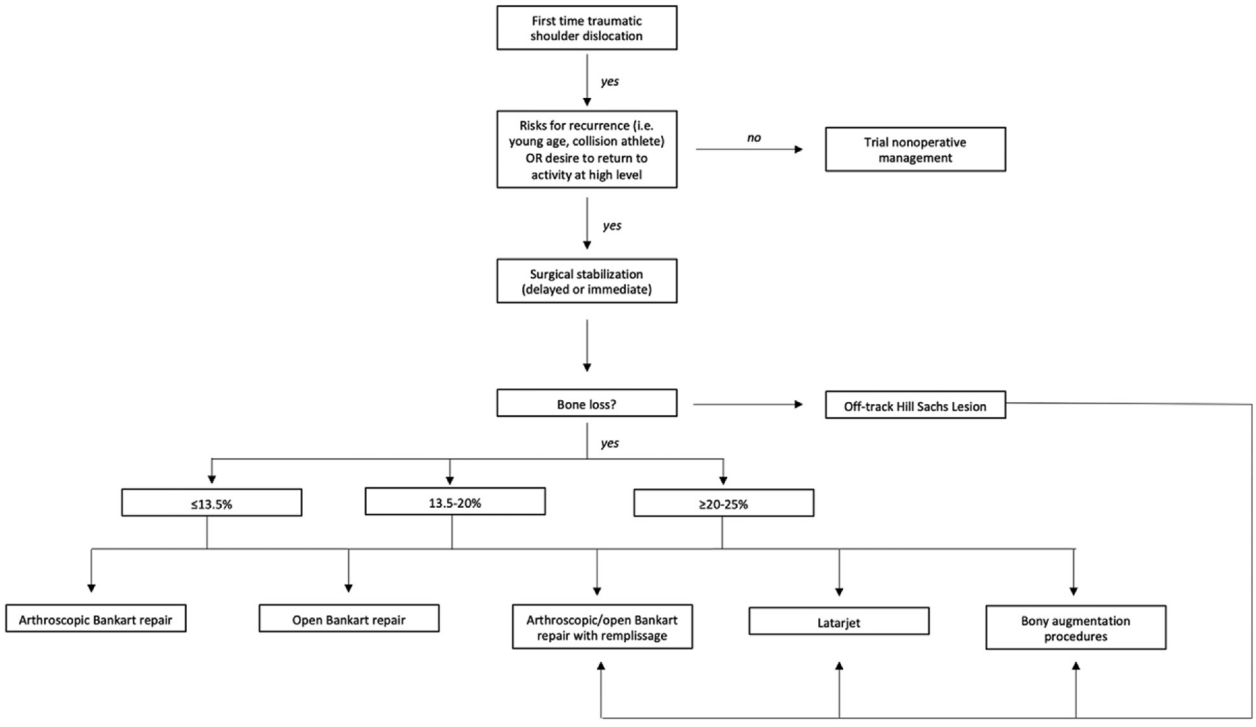

Fig. 1. Treatment algorithm of first-time traumatic anterior shoulder dislocation, adapted from an algorithm for recurrent anterior shoulder instability by Hughes et al. [23] Subcritical glenoid bone loss defined as 13.5%–20%.

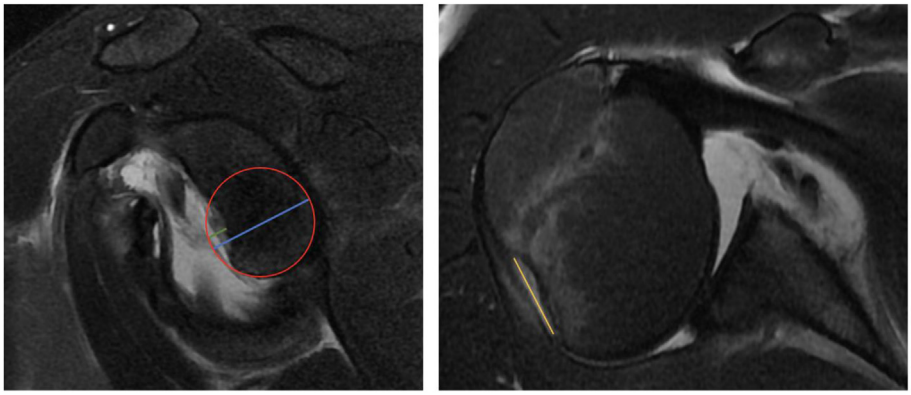

Fig. 2. Determination of the Glenoid Track (GT) [26] and distance to dislocation (DTD) [28]. Red circle = circle approximation of glenoid using posterior inferior glenoid; light blue line = diameter (D) of glenoid; green line = width (d) of glenoid bone loss. GT = (0.83*D) – d. Yellow line = Hill-Sachs interval (HSI). DTD = GT – HSI. If DTD ≤0, the Hill-Sachs lesion is "off-track".

loss of external rotation, and post-capsulorraphy induced arthropathy. These risks should be considered when deciding on treatment strategy and preoperative counselling.

Arthroscopic Stabilization (Bankart repair, Bony Bankart repair, and Bankart repair + remplissage)

Arthroscopic Bankart repair has largely supplanted open Bankart repair over the past several decades, particularly in cases of minimal glenoid and/or humeral bone loss, due to its minimally-invasive approach and ability to address concomitant injuries such as posterior labrum tears [32]. While literature regarding arthroscopic versus open Bankart repair demonstrates similar rates of complications, recurrence, and patient reported outcomes with modern arthroscopic techniques [33,34], controversy remains regarding the durability of arthroscopic Bankart repair for high-risk patients, where recurrence has been reported to be as high as 70% [35]. Successful outcome following arthroscopic Bankart repair is predicated on appropriate patient selection, preserved soft tissue quality, and meticulous surgical technique, including suture anchor placement, the number of sutures passed, and a minimum of three anchors to diminish risk of recurrence [36]. Even with proper surgical technique, risk of recurrence is especially high with arthroscopic Bankart repair alone in the presence of concomitant bony injury including glenoid fracture and large off-track Hill-Sachs lesions. In their case series, Locher et al. found an 8.3-fold increase in recurrence in those with off-track Hill-Sachs lesions treated with isolated arthroscopic Bankart repair [27]. In another case series evaluating the active military population with minimum 4-year follow-up, Scanaliato et al. demonstrated that the addition of a remplissage for an off-track Hill-Sachs lesions resulted in a 90% rate of return to activity with a less than 5% failure rate [37]. Park et al. concluded in their two-year follow-up study that patients with off-track Hill-Sachs lesions treated with arthroscopic Bankart repair with remplissage had similar recurrence and clinical outcomes compared to those with on-track Hill-Sachs lesions [38].

Furthermore, apart from humeral head injury, glenoid fracture with a resultant large bone fragment (bony Bankart lesion) can accompany labral injury after first-time dislocation. It is important to address this defect in order to prevent defect size enlargement and decrease the risk of recurrent instability events [39,40]. While the glenoid fractures can be managed with open visualization and screw fixation, arthroscopic techniques involving glenoid rim suture anchors or cannulated screws have been more recently described [41–43]. Millett and Braun described the "bone Bankart bridge" technique for reduction and internal fixation of the bony Bankart lesion. The procedure involves placing a suture anchor medial to the glenoid neck fracture and passing these sutures around the bony fragment through the soft tissue including the inferior glenohumeral ligament complex. Then, the sutures of the first anchor are loaded into a second anchor that is placed on the glenoid face, creating a 2-point fixation that compresses the fragment back into the intact portion of the glenoid [44]. Nearly three-year follow-up data after this procedure have shown promising results, with improved patient reported outcomes, high patient satisfaction, and low failure rate [45]. Thus, addressing bipolar bone loss with bony Bankart fixation and/or remplissage after first-time dislocation is important. In cases where increased bone loss precludes isolated fixation, considering bony augmentation options may be necessary.

Bony augmentation procedures

In the first-time dislocator, up to 33% of patients experience subcritical bone loss, leaving patients at risk for biomechanical alterations in shoulder function and increased risk of instability [46]. Previous investigations have demonstrated that up to nearly two-thirds of patients with bone loss resulting in an "inverted pear" glenoid configuration addressed with only soft-tissue stabilization suffer from recurrent instability [24,47]. Therefore, bony augmentation procedures may be necessary to restore motion and prevent recurrent instability in patients with critical, or even subcritical, glenoid bone loss.

Latarjet

Latarjet restores anterior shoulder stability by three different mechanisms, referred to as the "triple effect." First, dynamic stability is conferred by the conjoint tendon acting as a sling on the inferior subscapularis, especially during abduction and external rotation. Second, the capsule is reconstructed with the coracoacromial ligament. Finally, the coracoid bone block restores or extends the glenoid morphology and the glenoid track, increasing the functional arc of motion necessary to dislocate the humeral head [48] (Fig. 3).

With the transfer, the coracoid can be positioned with the inferior aspect aligned with the anterior glenoid, called the classic technique, or can be rotated 90° to use the inferior surface as the face increasing its functional surface area, called the congruent arc technique [48]. While the congruent arc technique has been shown to provide more stability by increasing the surface area of the glenoid [49], the technique comes with the added difficulty of a smaller area to place screws, increasing the risk of intraoperative fracture. Additionally, Latarjet can be performed either arthroscopically or open. The goal of all-arthroscopic Latarjet is accurate graft placement, better cosmesis, and improvements in postoperative stiffness [50]; however, questions about the feasibility of all-arthroscopic Latarjet arise given the steep learning curve and complication profile.

Clinically, Latarjet has been shown to be effective, with reports of 2-year redislocation rates at 0.8% and long-term satisfaction rates as high as 98% [51]. Additionally, Latarjet yields significant improvement in patient reported outcomes and return to sport. Multiple studies have compared arthroscopic Bankart repair with remplissage versus Latarjet for off-track lesions in patients with <25% glenoid bone loss and found

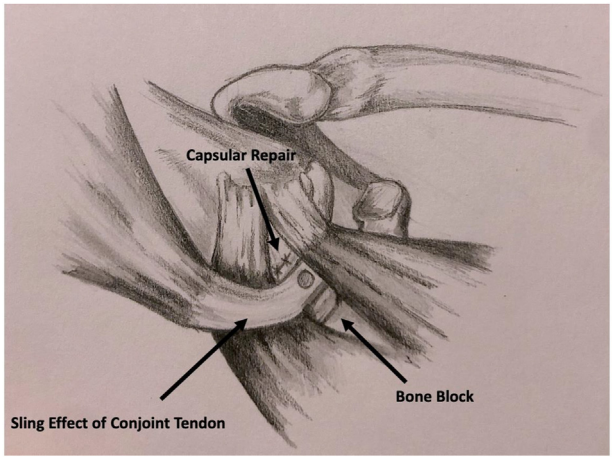

Fig. 3. The triple blocking effect seen in Latarjet, comprised of capsular repair, coracoid bone block transfer, and sling effect of the conjoint tendon. *Illustrated by Jonathan F. Dalton.*

that patient reported outcomes, range of motion, pain, and rates of recurrence and return to play were similar between both procedures [52]. Yet, Yang et al. concluded that collision athletes and those with >15% bone loss benefitted more from Latarjet than arthroscopic Bankart repair with remplissage with respect to patient reported outcomes, recurrence of instability, and revision rates [53].

The benefits of Latarjet must be weighed against the risks of complication, reported to be as high as 25%, including graft fracture, malpositioning, arthrosis, and screw breakage [54]. These complications have been shown, albeit with limited short-to-medium-term clinical significance, to be especially problematic in the young and athletic population. Meticulous surgical technique and surgeon expertise are necessary for achieving a successful outcome.

Future perspectives

Future study of optimal management strategies for anterior shoulder instability should focus on identifying the optimal stabilization procedure for a given patient considering their demographics and pathology. Higher level investigations are necessary. One such ongoing study is the Open versus Arthroscopic Stabilization of Shoulder Instability with Subcritical Bone Loss (OASIS) trial, a multicenter randomized controlled trial involving military and civilian sites investigating arthroscopic Bankart repair with or without remplissage versus open Bankart repair versus Latarjet in the setting of subcritical (10–20%) glenoid bone loss. Another ongoing study is the Shoulder Instability Trial Comparing Arthroscopic Stabilization Benefits Compared with Latarjet Procedure Evaluation [55]. The goal of this pilot study is to assess the feasibility of a definitive trial to determine the effect of arthroscopic Bankart repair with remplissage versus Latarjet on recurrent dislocation rates and functional outcomes over a 24-month period in patients with recurrent anterior shoulder instability and subcritical bone loss.

While addressing bone loss remains a critical concern, irreversible capsular injury after dislocation is also an area of research interest. Shoulder dislocation/instability can result in permanent deformation of the capsule. Applying an individualized, anatomic technique to capsular plication may allow surgeons to theoretically restore native shoulder kinematics and minimize recurrence. Biomechanical studies are currently underway to assess the role of capsular injury, specifically determining the role of nonrecoverable strain after dislocation on shoulder biomechanics and kinematics [3,56] and whether this information could be used to guide individualized capsular plication techniques to restore native anatomy.

The management of traumatic first-time shoulder dislocation depends on a multitude of patient-specific factors. Ultimately, selecting appropriate management requires an understanding of the patient's injury complex, alterations of glenohumeral joint biomechanics, and how specific surgical techniques restore them, and an appreciation of external factors such as sport, age, and gender. While prior work has elucidated factors associated with decreased function and increased rates of recurrence, further research is needed to establish individualized algorithms that will result in durable long-term outcomes for return to activity and sport, diminished recurrence, and low rates of surgical complications.

Conflict of interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: Michael T Freehill reports a relationship with Smith and Nephew Inc that includes: consulting or advisory. Michael T Freehill reports a relationship with Tornier Inc that includes: consulting or advisory. Michael Freehill reports a relationship with Stryker Orthopaedics that includes: consulting or advisory. Michael T Freehill reports a relationship with Biorez that includes: consulting or advisory. Michael T Freehill reports a relationship with Integra that includes: consulting or advisory. Michael T Freehill reports a relationship with Sparta Biopharma that includes: consulting or advisory. Michael T Freehill reports a relationship with National Institutes of Health that includes: non-financial support. Michael T Freehill reports a relationship with Major League Baseball that includes: non-financial support. Michael T Freehill reports a relationship with Smith and Nephew Inc that includes: equity or stocks. Michael T Freehill reports a relationship with Smith and Nephew Inc that includes: non-financial support. Michael T Freehill reports a relationship with RTI that includes: non-financial support. Michael T Freehill reports a relationship with Arthrex Inc that includes: non-financial support. Michael T Freehill reports a relationship with American Shoulder and Elbow Surgeons that includes: board membership. Michael T Freehill reports a relationship with American Orthopaedic Society for Sports Medicine that includes: board membership. Michael T Freehill reports a relationship with Arthroscopy Association of North America that includes: board membership. Michael T Freehill reports a relationship with International Society of Arthroscopy Knee Surgery and Orthopaedic Sports Medicine that includes: board membership. Albert Lin reports a relationship with American Academy of Orthopaedic Surgeons that includes: board membership. Albert Lin reports a relationship with American Orthopaedic Association that includes: board membership. Albert Lin reports a relationship with American Orthopaedic Society for Sports Medicine that includes: board membership. Albert Lin reports a relationship with American Shoulder and Elbow Surgeons that includes: board membership. Albert Lin reports a relationship with Annals in Joint that includes: board membership. Albert Lin reports a relationship with Arthrex Inc that includes: consulting or advisory. Albert Lin reports a relationship with Arthroscopy that includes: board membership. Albert Lin reports a relationship with International Society of Arthroscopy Knee Surgery and Orthopaedic Sports Medicine that includes: board membership. Albert Lin reports a relationship with Knee surgery, Sports Traumatology, Arthroscopy that includes: board membership. Albert Lin reports a relationship with Tornier Inc that includes: consulting or advisory.

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