Current Trends in the Management of Recurrent Anterior Shoulder Instability

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Abstract
The glenohumeral joint is innately complex and comprised of both static and dynamic stabilizers. Anterior glenohumeral instability has been estimated to have an incidence of 11.2 cases per 100,000 persons and typically follows a traumatic injury. Although there are specific instances when conservative management is advocated, a majority of these patients are treated with operative stabilization. Recent advancements in arthroscopy have created a shift from the traditional open stabilization procedures towards more minimally invasive arthroscopic stabilization procedures. This comprehensive review will summarize current concepts involved in evaluating patients with anterior glenohumeral instability and specifically focus on those patients who suffer from recurrent instability.

Glenohumeral joint stability requires an intricate combination of both static and dynamic stabilizers. Anterior glenohumeral instability has been estimated to have an incidence of 11.2 cases per 100,000 persons and typically follows a traumatic injury. For patients with recurrent instability, generally, surgical stabilization is warranted. Historically, the capsulolabral disruption was treated with open stabilization. In the early to mid-1990s, arthroscopic stabilization procedures were being described and subsequently performed more consistently. Although outcome studies from this era were promising at that time, they were still considered to be inferior to the gold standard open stabilization procedures. With recent improvements in arthroscopic stabilization techniques, including suture anchors, a review of the current literature indicates that it is possible to arthroscopically mirror the principles of open anterior shoulder stabilization in select patients, therefore, making it possible to obtain similar outcomes.1-4

Despite the recent technical advances and promising long-term outcomes of arthroscopic glenohumeral stabilization, failures still occur. These failures are defined as redislocation or subluxation, apprehension, or postoperative pain and stiffness (Table 1).5 Treatment of failures still remains a challenge for the orthopaedic surgeon to evaluate and treat. The current paper reviews the principles of failed arthroscopic anterior shoulder stabilization and details the necessary diagnostic workup involved in the assessment of these patients. We will outline the current surgical options available and discuss the variables to consider when deciding on the appropriate surgical management.

Etiology of Failed Shoulder Stabilization
The incidence of failure of previous anterior glenohumeral stabilization has been estimated to range from 4 to 18% when modern arthroscopic techniques are employed and suture anchors are utilized.6-8 There are certain patient risk factors that are known to negatively impact outcome and increase the risk of failure, and these should be identified at the time of initial work up (Table 2).1,5,9-11 Recognition and appropriate consideration of these risk factors preoperatively may increase the chance of a successful outcome for glenohumeral stabilization. In patients with recurrent instability, these risk factors must be more critically assessed, and a methodical approach must be taken to determine the underlying etiology of continued or recurrent glenohumeral instability. A thorough understanding of glenohumeral biomechanics and current concepts in surgical management is necessary in order to minimize any lapses in diagnoses or surgical technique that may predispose a patient to repeat failure.

In a review of the literature, unaddressed capsular laxity and Bankart lesions12 have been cited as the most common pathologies associated with continued instability after sur-
Instability or pain following previous anterior stabilization procedures (Table 2). When capsular laxity or Bankart lesions are the cause of failed stabilization, any repeat surgery that fails to address these issues will likely also lead to failure. Two other commonly found pathologies in previously failed stabilization are bone defects on the glenoid and Hill-Sachs lesions of the humeral head. Multiple studies have proven an association of these injuries with decreased outcomes and increased failure rates. Boileau and associates showed a 75% recurrence rate when glenoid bone loss is more than 25%, and stretched IGHL and anterior laxity are present.

Failures in technique at the time of original surgery may also contribute to recurrent instability (Table 2). Examples of common failures in technique include use of less than three suture anchors to restore capsule-labral complex, incorrect drill hole placement in the top 1/3 of the glenoid, inadequate restoration of glenoid concavity, and failure to detect and treat concomitant pathology, such as SLAP tears, rotator cuff tears, HAGL lesions, and so forth. Identification and treatment of these additional pathologies is critical to a successful outcome.

Evaluation

History

A thorough and directed history is an essential part of the initial work up of the patient with continued glenohumeral instability or pain following previous anterior stabilization. Salient points to be addressed during the interview include the initial mechanism of injury, any history of repeat trauma to the shoulder, previous shoulder surgeries, and the specific position of the shoulder that elicits pain or instability. When dealing with postoperative failures, the timing from surgery to the onset of symptoms is important. It is also helpful to determine if the patient’s preoperative symptoms ever resolved after surgery as a failure of resolution may imply a misdiagnosis or inadequate surgical technique or fixation.

If re-injury is the cause of repeat instability, the mechanism should be well documented. It has been shown that recurrence of symptoms after repeat trauma lends for a better prognosis with revision surgery. Glenoid bone loss may be suspected if the patient complains of instability in midranges of motion, or the patient experiences dislocations that are occurring more frequently with everyday activities. An engaging Hill-Sachs lesion will sometimes be described as a “catching sensation” with normal range of motion. Compliance with prior rehabilitation efforts and patient understanding of his or her condition must also be assessed, as many studies have reported these to be significant factors in stabilization failures.

Physical Examination

Inspection is imperative when examining this patient population. One should look for any apparent deformity, scapular dyskinesia, or rotator cuff atrophy. A thorough neurovascular examination should be performed to rule out potential axillary nerve injury, rotator cuff tear, or vascular injury.

Assessment of range of motion and provocative tests should follow and should be done bilaterally in order to compare to uninjured extremity. The goal of provocative tests is to recreate instability or symptoms to help the clinician confirm a diagnosis. Instability can be viewed as a spectrum of pathology, as it may range from traumatic instability that leads to apprehension to instability characterized by pain when the arm is abducted and externally rotated.

There are multiple tests described in the literature that are used to assess all patients with glenohumeral instability, most of which have low specificity. The most widely used tests are the apprehension test, the sulcus sign, and the load-and-shift test. The apprehension test is the classic test described to evaluate for anterior instability. It can be performed with the patient standing, sitting, or supine, and the test places the anterior band of the inferior glenohumeral ligament (IGHL) and anterior capsule under stress (Fig. 1). A positive test indicates soft tissue instability. With bony defects of the glenohumeral joint, the patient may experience instability at lower angles of abduction and external rotation. Bushnell and colleagues described the term “bony apprehension test” when discussing instability at lower degrees of abduction. In their discussion, the bony apprehension test was described using the same maneuver of the apprehension test, however, with only 45° of abduction.
A sulcus sign is an indication of inferior instability and is considered positive when there is excessive inferior translation of the humeral head from the lateral acromion with an inferior force. Although commonly used, it must be remembered that the role of the sulcus sign has been questioned in the past, as it will always be positive in individuals with generalized hypermobility. Despite this, it is still widely used by clinicians as one of the staple provocative tests to evaluate for glenohumeral instability.

The load-and-shift test assesses the integrity of the glenoid concavity. With this test, a load is applied to compress the humeral head into the glenoid while anterior and posterior translations are performed. In the presence of bone loss, the “bumper” effect is lost, and the humeral head may subluxate or dislocate from the glenoid. Similarly, anterior and posterior drawer testing involves stabilization of the scapula and attempts to either translate the humeral head over the anterior or posterior glenoid rims, which can be used to grade the degree of instability.

Lastly, when examining a patient with failed glenohumeral stabilization, he or she should be assessed for ligamentous hyperlaxity, as this is a known risk factor for failed stabilization surgeries. External rotation greater than 90° at the side is suggestive of anterior ligamentous hyperlaxity; asymmetrical hyperabduction of more than 20° compared to the contralateral arm is indicative of a stretched inferior glenohumeral ligament.

**Imaging**

For those patients being evaluated for recurrent shoulder instability following surgical stabilization, standard radiographs of the shoulder (including anterior posterior, scapular-Y, and axillary views) should be obtained. These views can be useful in identifying defects of the glenoid and humeral head. The West Point, apical oblique (Garth), and Didie views may also be useful in quantification of glenoid bone loss. Hill-Sachs lesions have classically been best viewed with a combination of internal rotation and a Stryker-Notch view.

Computed tomography (CT) imaging has become the mainstay of preoperative evaluation for assessment and quantification of defects in the glenoid and on the humeral head as this is relatively cheap and well tolerated by patients. It has demonstrated a high correlation with arthroscopic examination in determining the extent of humeral or glenoid bone loss, as well as identifying previous incorrect anchor placement or number. CT scans along with three-dimensional reconstructions play a vital role in the work up of patients with recurrent instability.

Magnetic resonance imaging and arthrography (MRI, MRA) are also widely used as they allow for visualization of rotator cuff pathology and other concomitant soft tissue lesions (SLAP, ALPSA, HAGL). Using MR arthrography on re-evaluation of patients with a failed surgical stabilization has been shown to achieve of 93.3% in detection of Hill-Sachs lesions, 76.2% for glenoid or humeral cartilage abnormalities, and 87.2% for rotator cuff injury.

**Treatment**

In certain instances, a patient may be a poor surgical candidate, or may be at high risk of repeat surgical failure. For these patients, nonoperative treatment modalities are acceptable. Conservative treatment should consist of a prolonged course of physical therapy with the goal of symptomatic management and avoidance of provocative positions that incite shoulder instability for a minimum of 10 to 12 weeks.

The surgical treatment of patients who have failed previous arthroscopic anterior stabilization techniques should address the underlying etiology of failure. This section will discuss both arthroscopic and open stabilization and explore the indications for each. For purposes of this review, we separate glenoid bone deficiency from soft tissue pathology as etiologies of anterior instability and address them as two distinct entities.

Ideally, the cause of the persistent instability is known prior to undergoing revision surgery through imaging and physical exam; however, occasionally, a surgeon’s presumed diagnosis can be proven to be incomplete or incorrect at the time of surgery. By keeping these current concepts in mind and re-confirming the etiology of instability during surgery, the chance of future failed stabilization can be decreased by more appropriately addressing the underlying cause of instability.

When addressing glenoid bone loss as the cause of failed stabilization, quantifying the amount of bone deficiency will aid in deciding the best surgical treatment option. This quantification of bone loss can be done at the time of surgery, using the glenoid bare spot as a central landmark as described by Burkhart and coworkers (Fig. 2). Traditionally, glenoid bone loss has been divided into minimal (0% to 20%), moderate (20% to 30%), and significant (over 30%).

When glenoid bone loss is found to be minimal, case specific soft tissue stabilization can be performed ar-
throscopically with good success. In these instances, the literature supports soft tissue stabilization alone and does not recommend any bony reconstruction. Isolated soft-tissue stabilization with an all-arthroscopic revision Bankart repair can be successfully performed in symptomatic patients with unidirectional instability and absence of a Hill-Sachs lesion or a non-engaging lesion. For an isolated Bankart lesion, usage of three or more suture anchors is recommended, and it has been shown that a posterior repair may help to balance the stability of repair.  

When glenoid bone loss is between 20% to 30%, both arthroscopic and open revision surgery have been advocated for in the literature. Although some reports show arthroscopic revision surgery to have comparable outcomes to open stabilization revision surgery, surgeon preference and the underlying patient diagnosis should impact what type of revision surgery will be performed. With moderate bone loss, bone incorporation or augmentation should be the main objective, as alterations in biomechanical stability are noted to begin at these levels of glenoid bone loss.  

Achieving this arthroscopically is technically difficult and has been shown to be less reliable. If a bone fragment is available, incorporation is advisable. Latarjet, iliac crest bone graft (ICBG), or allograft procedures could be considered to reconstitute normal bony anatomy and concavity of the glenoid. Although there are case reports that show successful stabilization of patients with this moderate bone loss, these results have not been easily reproduced and appear to be the exception, rather than the rule. Arthroscopic revision in these circumstances is technically challenging and highly dependent on surgeon ability. If a surgeon does not have much experience with arthroscopically reconstituting the concavity of the glenoid for bony defects from 20% to 30%, than open surgical stabilization is recommended.  

In patients with significant glenoid bone loss of more than 30%, procedures that involve augmentation of the bony glenoid, including the Latarjet, ICBG, or allograft, are the current mainstay of surgical treatment (Fig. 3). The modified Bristow-Latarjet has demonstrated high success rates, and open procedures continue to develop. Arthroscopic surgery for treatment of large glenoid defects is beginning to emerge in the literature; however, long-term outcomes are needed. The first documented arthroscopic Latarjet was reported in 2007, and this was specifically used to address large glenoid bone defects with concomitant HAGL lesions. There have been multiple studies since that time that have shown good to excellent outcomes when arthroscopy is used to address significant glenoid bone defects. Despite these promising results, there remains a learning curve, which may present the greatest obstacle to acceptable outcomes with new arthroscopic procedures. Currently, given the lack of long-term outcomes...
and most surgeons’ lack of comfort with these procedures, a majority of the cases are treated with open stabilization, which remains the gold standard of care. Figure 4 demonstrates the senior investigator’s preferred treatment algorithm when addressing patients with recurrent anterior glenohumeral instability secondary to glenoid bone loss.

**Engaging Hill-Sachs**

Over the years, the treatment of engaging Hill-Sachs lesions has presented a challenge for the orthopaedic surgeon. In the past, arthroscopic treatment of these lesions yielded unreliable results, leading most surgeons to perform open stabilization. With new advancements in treatments and arthroscopic portal placements, the engaging Hill-Sachs lesion is no longer a contraindication to arthroscopic surgery. The arthroscopic remplissage technique can be reliably utilized when there is minimal or no glenoid bone loss. This technique involves capsulotenodesis of the posterior capsule and infraspinatus tendon to fill the Hill-Sachs lesion.51,52 An important consideration with this non-anatomic technique is that it may result in restricted motion.53 Re and associates proposed an anatomic, arthroscopic humeralplasty for treatment of large Hill-Sachs lesions that may have contributed to prior surgical failures.54 Recent recommendations for a humeralplasty center around acute injuries of less than 3 weeks and should generally be preserved for a patient who presents with a traumatic failure in a previously stabilized glenohumeral joint (Fig. 4).53,55

**Unaddressed Capsular Laxity**

Another major cause of failed stabilization procedures is continued capsular laxity. This can be addressed at revision with a capsular shift, either open or arthroscopic. A rotator interval (RI) closure has also been recommended as possible treatment for patients in this instance57; however, there has been some controversy with this technique alone as a means to address redundancy as this does not address potential posterior or inferior instability or laxity. The main concern with surgically addressing capsular laxity is a loss of external rotation, especially in overhead-throwing athletes.28,58,59

In 2007, in lieu of a capsular shift for the treatment of excessive capsular laxity, Boileau and colleagues described the “Belt-and-Suspenders” technique. This technique combines a Bristow tenodesis with a standard intra-articular Bankart repair. In their description, they combined a Bristow tenodesis with a standard intra-articular Bankart repair to recreate the glenoid concavity and reinforce the inferior glenohumeral ligaments and lower the subscapularis.60

**Suture Impingement**

Instability may not be the presenting complaint of patients who have failed prior stabilization surgery. A patient may present with persistent pain despite restored stability. These patients are still considered to have failed previous stabilization and should be assessed closely. In these instances, evaluation for potential suture impingement or anchor abrasion should be initiated. If this diagnosis is confirmed via radiograph or MRI, suture removal should be performed after 4 to 6 months of observation as symptoms may resolve without intervention during this time period. If symptoms still persist beyond 6 months, it has been shown that delaying surgery further can lead to anchor abrasion causing irreversible bone damage, and surgery should be performed to remove the offending suture or anchor.61

**Conclusion**

Recurrent shoulder instability is a difficult problem to address. It is of paramount importance to avoid it by getting it right the first time, with proper patient selection and surgical technique. Through a thorough history and physical exam, review of previous operative reports, imaging studies, and arthroscopy images, one can try to elucidate the cause of recurrent instability. While current success rates for arthroscopic revision shoulder stabilization range between 73% to 86%,11,14,60,62,63 and those of open revision range between 78% to 93%,2,64-66 these repeat procedures still fall short of the excellent outcomes reported for initial arthroscopic stabilization surgery. With advancements in technique and more accurate diagnoses, these outcomes will likely continue to rise, and patients will more reliably be able to return to prior functioning levels.

In those patients who are deemed operative candidates for revision surgery, the surgeon must keep in mind basic principles in addressing shoulder instability in order to op-
timize outcome of revision surgery. The main goals of revision surgery are to restore glenoid anatomy and concavity, optimize soft tissue tension, and safely minimize soft tissue trauma. Outcome should never be compromised in favor of arthroscopic surgery, particularly when open stabilization is well indicated. Surgeon preference and comfort level undoubtedly play a role in deciding between arthroscopic versus open procedures; however, as long as basic principles are adhered to, functional outcome can be optimized.

Disclosure Statement
None of the authors have a financial or proprietary interest in the subject matter or materials discussed, including, but not limited to, employment, consultancies, stock ownership, honoraria, and paid expert testimony.

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