

Identification and Treatment of Existing Copathology in Anterior Shoulder Instability Repair



Brian Forsythe, M.D., Rachel M. Frank, M.D., Mohammed Ahmed, B.S.,
Nikhil N. Verma, M.D., Brian J. Cole, M.D., M.B.A., Anthony A. Romeo, M.D.,
Matthew T. Provencher, M.D., and Shane J. Nho, M.D., M.S.

Abstract: Recurrent anterior instability is a common finding after traumatic glenohumeral dislocation in the young, athletic patient population. A variety of concomitant pathologies may be present in addition to the classic Bankart lesion, including glenoid bone loss; humeral head bone loss; rotator interval pathology; complex/large capsular injuries including humeral avulsions of the glenohumeral ligaments (HAGL lesions), SLAP tears, near circumferential labral tears, and anterior labral periosteal sleeve avulsions (ALPSA lesions); and rotator cuff tears. Normal anatomic variations masquerading as pathology also may be present. Recognition and treatment of these associated pathologies are necessary to improve function and symptoms of pain and to confer anterior shoulder stability. This review will focus on the history, physical examination findings, imaging findings, and recommended treatment options for common sources of copathology in anterior shoulder instability repair.

In a young active population, instability is the most common shoulder affliction. Patients can have a variety of pathologies concomitant with or in lieu of a traditional Bankart lesion. If all pathology is not recognized or treated appropriately, the patients' shoulder instability, pain, and diminished function may persist. Treating patients with multiple foci of pathology thus represents a diagnostic and therapeutic dilemma. The objective of this report is to facilitate the recognition and treatment of several types of potentially confounding concomitant shoulder pathologies in otherwise active patients with instability.

Recurrent anterior instability is a common finding after traumatic glenohumeral dislocation in the active population.¹⁻⁵ The basis for treatment of shoulder instability begins with a thorough preoperative history and physical examination, followed by careful evaluation, interpretation, and clinical correlation of imaging studies. Once the etiologic factors contributing to instability are identified, it is imperative to determine the presence or absence of copathologies. This is especially important preoperatively (to plan for specific repair strategies) and intraoperatively to prevent otherwise avoidable postoperative complications.⁶

Surgical intervention is of course guided by the underlying pathology. However, patient demographic characteristics, activity level, and expectations must also be taken into consideration. For instance, throwers and overhead workers subject the rotator cuff, superior glenoid, and subacromial soft tissues to repeated strains. These patients often present with multiple foci of chronic, cumulative pathology,⁷⁻⁹ whereas contact athletes may subject the anteroinferior labrum, capsule, and glenoid to repeated trauma, placing them at higher risk of recurrent instability after surgery.

A variety of concomitant pathology may be present in addition to the classic Bankart lesion, including glenoid bone loss; humeral head bone loss; rotator interval pathology; complex/large capsular injuries including humeral avulsions of the glenohumeral ligaments (HAGL lesions), SLAP tears, near circumferential labral

From the Department of Orthopaedic Surgery, Rush University Medical Center (B.F., R.M.F., M.A., N.N.V., B.J.C., A.A.R., S.J.N.), Chicago, Illinois; and Department of Orthopaedic Surgery, Massachusetts General Hospital (M.T.P.), Boston, Massachusetts, U.S.A.

The authors report the following potential conflict of interest or source of funding: B.F. receives support from Orthopaedic Research and Education Foundation. R.M.F., M.A., N.N.V., B.J.C., A.A.R., and M.T.P. receive support from Orthopaedic Research and Education Foundation. S.J.N. is a consultant and receives royalties from Pivot Medical, Stryker, and Ossur and receives research support from Pivot Medical, Stryker, and Allosource.

Received September 29, 2013; accepted June 11, 2014.

Address correspondence to Brian Forsythe, M.D., Midwest Orthopaedics at Rush, Department of Orthopaedic Surgery, Rush University Medical Center, 1611 West Harrison Street, Suite 400, Chicago, IL 60612, U.S.A. E-mail: brian.forsythe@rushortho.com

© 2015 by the Arthroscopy Association of North America

0749-8063/13701/\$36.00

<http://dx.doi.org/10.1016/j.arthro.2014.06.014>

tears, and anterior labral periosteal sleeve avulsions (ALPSA lesions); and rotator cuff tears (RCTs). Normal anatomic variations masquerading as pathology also may be present. Recognition and treatment of these associated pathologies are necessary to improve function and symptoms of pain and to confer anterior shoulder stability.

History

When a patient presents to the clinic after an anterior shoulder dislocation or subluxation event, the history and examination need to be closely scrutinized. It is important, first and foremost, to ensure that the correct diagnosis is made. Patients with recurrent anterior instability typically complain of instability during the midranges of motion (especially if associated with glenoid and/or humeral head bone loss), pain with the arm in the provocative position of abduction and external rotation, and an increasingly progressive ease of instability events. In contrast, the most frequent complaint in patients with primary multidirectional instability (MDI) is generalized or deep posterior shoulder pain, which is often accompanied by decreased athletic performance, as well as loss of strength.¹⁰⁻¹³ Activities commonly associated with MDI include overhead throwing, tennis, butterfly and freestyle swimming, weight lifting, and football in a lineman position. Primary MDI is suspected in a young patient with multiple nonspecific complaints of activity-related shoulder pain, weakness, or paresthesias rather than symptoms of instability. Finally, symptoms in patients with primary posterior instability occur or intensify with the arm in the provocative position of forward flexion, adduction, and internal rotation. In throwers, symptoms typically occur during follow-through, whereas in swimmers, symptoms typically occur during the pull-through phase.

For all patients, the clinician should ask about generalized ligamentous laxity, history of instability events, mechanisms of injury, prior treatment, and overall activity goals and expectations. These historical facts are pertinent to determining the eventual surgical stabilization plan and can be extremely helpful in evaluating for other pathologies coexisting with the capsulolabral disruptions associated with instability.

Physical Examination

On examination, both shoulders should be evaluated, with observation of any obvious asymmetry, abnormal motion, muscle atrophy, swelling, scapular winging, and tracking. The asymptomatic shoulder may be examined first to gain patient confidence and relaxation.¹⁴⁻¹⁶ Wide scars may suggest a collagen disorder.¹⁷ Scapulothoracic dyskinesia should be carefully evaluated.¹⁸⁻²⁰ A shoulder examination to document instability is performed in the office and should be confirmed by an examination under anesthesia.²¹

In posterior instability,²² the location of pain may be variable and occur along the posterior joint line,^{19,23} biceps tendon, or the superior aspect of the rotator cuff. Subjective apprehension in posterior instability is uncommon.¹³ The posterior apprehension or stress test may reproduce symptoms.^{19,23,24} Range-of-motion testing in patients with posterior instability usually yields normal and symmetrical findings,^{19,25,26} although an increase in external rotation and mild loss of internal rotation may be observed. Additional posterior instability tests include the jerk test,^{27,28} the posterior stress test,²⁹ the Kim test,³⁰ and the load-and-shift test.¹⁵ It is important to note that patients with a painful jerk test have shown a higher failure rate with nonoperative treatment.³⁰ Combining the Kim and jerk tests has been shown to have 97% sensitivity for posterior instability.³⁰ Neurologic and vascular symptoms are generally absent in posterior instability.

MDI is associated with apprehension during range of motion,¹⁷ and patients have tenderness along the medial angle of the scapula and anterior rotator cuff. Internal rotation strength is decreased up to 30% in MDI²⁰ and serves to emphasize the dynamic muscular dysfunction in this condition. Anterior impingement may also be present in failed MDI repair cases because of increased excursion of the humeral head into the cuff tendons. Moreover, recurrent MDI may present with multiple nonspecific shoulder complaints of pain, paresthesias, and problems while carrying a weight at the side.^{31,32} Subluxation events during sleep may be common. Excessive inferior translation of the humerus on the glenoid is often associated with posterior subluxation^{10,23,33} and may indicate bidirectional instability or MDI if the inferior sulcus test reproduces the patient's symptoms. MDI should have a clearly symptomatic sulcus component (Fig 1).³²⁻³⁵ This may be reproduced with the arm in 90° of abduction while applying a downward force on the proximal humerus to cause inferior displacement.³² Finally, generalized ligamentous laxity has been associated with glenohumeral instability and should be assessed in patients with recurrent instability.^{10,36} Generalized ligamentous laxity has been documented in 40% to 75% of patients who underwent surgery for MDI^{20,37} and has been associated with decreased surgical success rates.

Imaging Studies

For initial evaluation of the shoulder, a standard shoulder radiograph series (Fig 2) is the preferred modality. Several additional views that are helpful in evaluating bony causes of instability include the serendipity view, Grashey view, West Point axillary view, Stryker notch view, scapular Y view, Garth view (apical-oblique view), and Didiee view (Table 1).

Advanced imaging modalities with magnetic resonance imaging (MRI) and computed tomography are



Fig 1. Physical examination of a right shoulder showing the sulcus sign in (A) external rotation and (B) a neutral position.

extremely helpful in evaluating copathology associated with recurrent anterior instability. MRI is useful in evaluating the rotator cuff, labrum, glenohumeral ligaments, cartilage, and capsule. When performed with the administration of intra-articular gadolinium, subtle intra-articular pathology is better appreciated. Indirect MRI arthrography, in which intravenous gadopentetate dimeglumine is administered, is less invasive and is

often better tolerated than direct arthrography. It can be valuable in displaying inflammatory conditions and is indicated in diagnosing chronic Bankart lesions and their variants, in diagnosing SLAP lesions, and in performing postoperative evaluation of the shoulder. Direct MRI arthrography is the diagnostic tool of choice for evaluation of the rotator cuff and labrum in young athletes and is indicated in diagnosing rotator interval

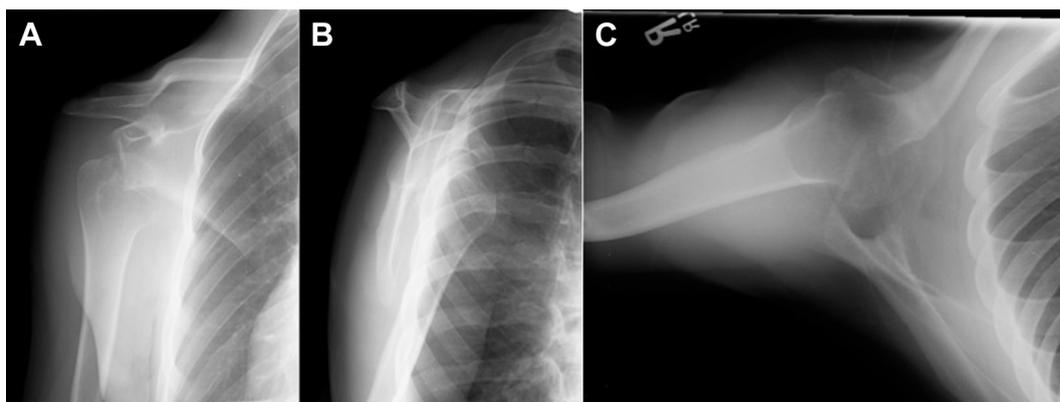


Fig 2. (A) Anteroposterior, (B) scapular Y, and (C) axillary radiographs of a right shoulder showing anteroinferior glenohumeral dislocation.

Table 1. Summary of Specialized Radiographic Studies Used in Evaluation of Patient With Shoulder Instability

View	Technique
Serendipity view	The serendipity view is a 40° cephalic tilt view of the SC joint and the medial one-third of the clavicle. It is indicated in SC joint separations and fractures of the clavicle.
Grashey view	The Grashey view lines up the glenoid so that it is perpendicular to the plane of the x-ray beam, allowing for evaluation of the glenohumeral joint space.
West Point axillary view	The West Point axillary view is a tangential view of the anteroinferior rim of the glenoid. This view is useful in identifying bony Bankart lesions or attritional bone loss of the anteroinferior glenoid.
Stryker notch view	In the Stryker notch view, a cassette is placed under the affected shoulder and the palm of the hand of the affected extremity is placed on the forehead with the fingers pointing toward the back of the head. The x-ray beam tilts 10° toward the head, centered over the coracoid process.
Scapular Y view	The scapular Y view helps to confirm the diagnosis of a posterior shoulder dislocation. The anterior portion of the affected shoulder is placed against the x-ray plate while the other shoulder is rotated out approximately 40°, and the x-ray tube is then placed posteriorly along the spine of the scapula.
Garth view (apical-oblique view)	The Garth view, also known as the apical-oblique view, is used in patients with shoulder instability. It helps to evaluate the anterior and inferior glenoid rim for calcification and fractures subsequent to dislocation. In this technique the x-ray beam is directed at a 45° angle through the glenohumeral joint toward the cassette, which is placed posterior and parallel to the scapular spine.
Didiee view	To allow for visualization of the glenohumeral alignment while also detecting fractures, loose bodies, calcification, and degenerative changes, the Didiee view is preferred. The patient lies prone with the arm abducted and slightly flexed at the elbow. The back of the patient's hand on the affected extremity should lie on the iliac crest. The film cassette is positioned under the shoulder, and the radiograph is taken from a lateral standpoint directed toward the humerus at 45°.

SC, sternoclavicular.

lesions, SLAP tears, ALPSA lesions, and Bankart lesions and their variants. Computed tomography (Fig 3) is useful in patients with a history of instability surgery and patients with midrange-of-motion instability because it can nicely show anterior or posterior glenoid insufficiency, engaging Hill-Sachs lesions, and reverse Hill-Sachs lesions. Finally, ultrasonography has become an important diagnostic tool in orthopaedics, especially for tendon pathology of the shoulder. It is cost-effective and portable and has a high rate of acceptance from patients. In patients for whom MRI is not an option, ultrasonography is the diagnostic tool of choice when evaluating the rotator cuff. It also has been shown to have satisfactory sensitivities and specificities in the assessment of postoperative rotator cuffs. Moreover, ultrasonography is useful in imaging-guided shoulder

interventions, such as the aspiration and injection of paralabral cysts.

Treatment

In the young patient population, the treatment options for primary traumatic shoulder anterior shoulder instability include either nonoperative or surgical management. The age and activity level of the patient are critical factors, with younger patients at substantially higher risk of recurrent instability if undergoing initial nonoperative management.¹ With advances in arthroscopic approaches and instrumentation, arthroscopic techniques have evolved to become the gold standard for treating most cases of primary and recurrent anterior shoulder instability. Recent studies have shown that the results of arthroscopic repair for

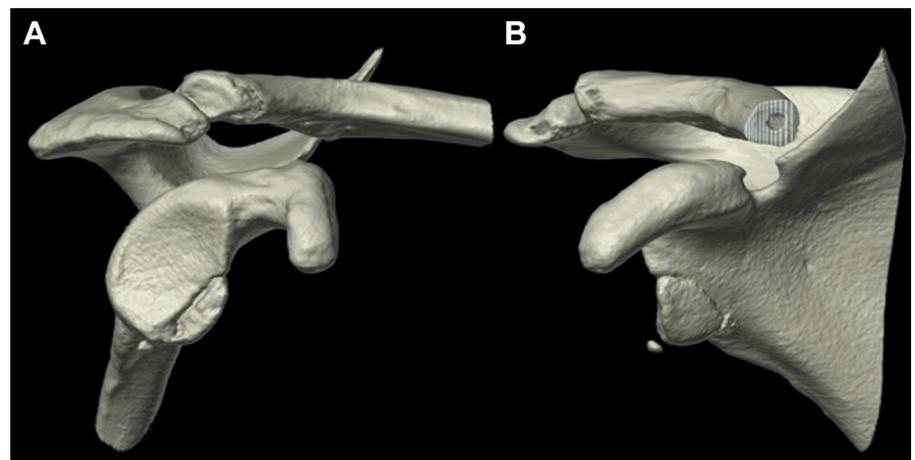


Fig 3. Three-dimensional CT reconstruction images of a right shoulder showing an anteroinferior glenoid bony Bankart lesion of approximately 20% to 25% of the glenoid width (A, viewed laterally; B, coronal cut, viewed from anterior aspect).

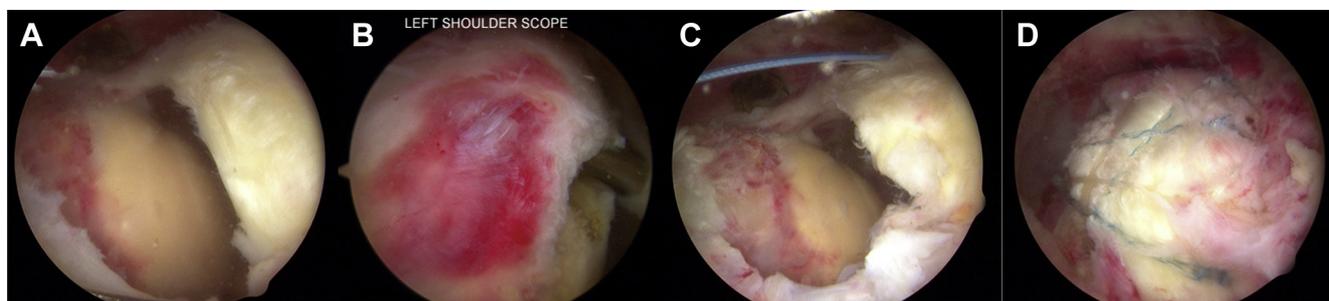


Fig 4. Arthroscopic images of a left shoulder in the beach-chair position, viewed from the posterior portal, showing (A, B) a full-thickness RCT and (C, D) subsequent repair.

primary shoulder instability are comparable with those of open techniques and yield fewer complications.³⁸⁻⁴⁵ Arthroscopic revision stabilization, when indicated, has also produced reasonably acceptable results.⁴⁶⁻⁵¹

Pathology associated with anterior capsule or labral pathology—including rotator cuff lesions⁵²⁻⁶² (Fig 4); SLAP lesions⁶³⁻⁷⁰ (Fig 5); extensive labral tears, including circumferential labral tears,^{71,72} 270° labral tears,⁷³ and posterior labral tears²² (Fig 6); ALPSA lesions^{74,75} (Fig 7); small cartilage lesions; and rotator interval lesions⁷⁶⁻⁸¹—can typically be managed arthroscopically. Of note is the recent awareness of the long head of the biceps tendon (LHBT) (Fig 8) as a pain generator, such as with entrapment of the LHBT and instability of the LHBT.^{82,83} Pathology of the LHBT can be managed with arthroscopic tenotomy, arthroscopic tenodesis, or open tenodesis techniques.⁸⁴⁻⁸⁶ HAGL (Fig 9) and reverse HAGL lesions may be treated by arthroscopic or open techniques, depending on the extent of the pathology and the surgeon's experience level. In particular, poor capsular quality may require open reconstruction of the deficient capsule with allograft or autograft in an effort to improve the static restraint of the glenohumeral ligaments. Alternatively, a bone augmentation procedure such as the Latarjet procedure may be considered to provide an anterior restraint to the humerus with the attached conjoined tendon.

Glenoid bone loss^{43,47,87-91} (Fig 10) and large Hill-Sachs lesions^{92,93} (Fig 11) may require open surgical approaches, depending on the size of the lesions. The recommended treatment strategies for glenoid bone loss include soft tissue—only repair in cases with less than 15% loss and open bony augmentation with iliac crest autograft,⁹⁴ coracoid transfer (Bristow, Latarjet),^{2,95-97} or distal tibial allograft reconstruction⁹⁸⁻¹⁰⁰ in cases with greater than 25% loss. Treatment of patients with 15% to 25% glenoid loss is somewhat controversial, with several authors reporting success with arthroscopic capsulolabral repair (with or without incorporation of the fragment)^{4,46,49,101} but other authors reporting unacceptable failure rates when performed without bony augmentation.⁴⁷ In patients with Hill-Sachs lesions of the humeral head that engage with the anterior glenoid, surgical options include bone grafting with allograft or autograft; treatment with synthetic plugs; or filling of the bony lesions with transfer of the infraspinatus tendon, known as remplissage. Humeroplasty or disimpaction of the defect and, in severe cases, humeral head resurfacing have also been described.

Authors' Recommendations

The following sections provide a summary of our recommendations for treatment of copathology (Fig 12, Table 2). Of note, several of the treatment strategies are



Fig 5. (A) MRI scan (right shoulder, proton-density fat-saturated coronal view) of a type II SLAP tear and (B, C) arthroscopic images of a right shoulder in the lateral decubitus position, viewed from the posterior portal, showing (B) the SLAP lesion and (C) subsequent repair.

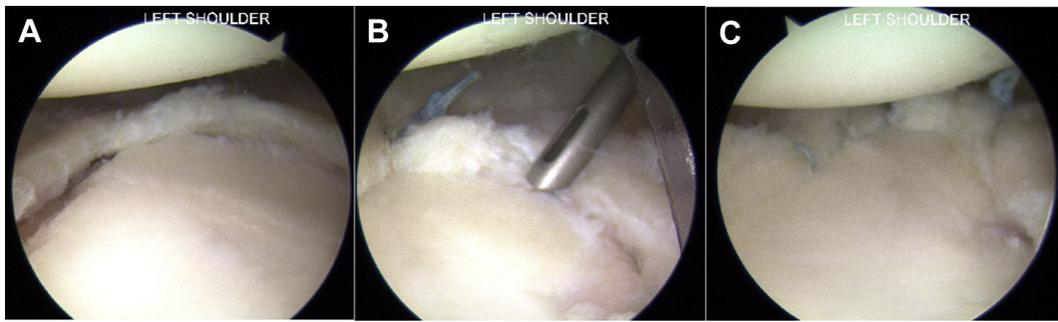


Fig 6. Arthroscopic images of a left shoulder in the lateral decubitus position, viewed from the accessory anterosuperolateral portal, showing (A) a posteroinferior labral tear and (B, C) subsequent repair.

controversial, and surgeons should make treatment decisions on a patient-specific basis. Recently, there has been an exponential increase in the number of publications discussing both classic and novel treatment approaches for many of the copathologies associated with anterior glenohumeral instability. It can be difficult to apply the available literature to an individual patient because there is significant variability both among different studies and even sometimes within the same study (i.e., if data are collected over a longer period and the author changes his or her surgical technique). Nevertheless, although there certainly is no gold

standard for the management of the various copathologies in these challenging cases of recurrent anterior instability, we offer a summary of our recommended approaches for each of these conditions.

Glenoid Bone Loss. We recommend attempting to restore the native glenohumeral anatomy whenever possible, and in high-level athletes, bony augmentation procedures are often preferred in cases of 15% bone loss or greater. For lesions of less than 10% to 15%, our arthroscopic procedure of choice involves anatomic labral repair with or without capsular plication, incorporating the

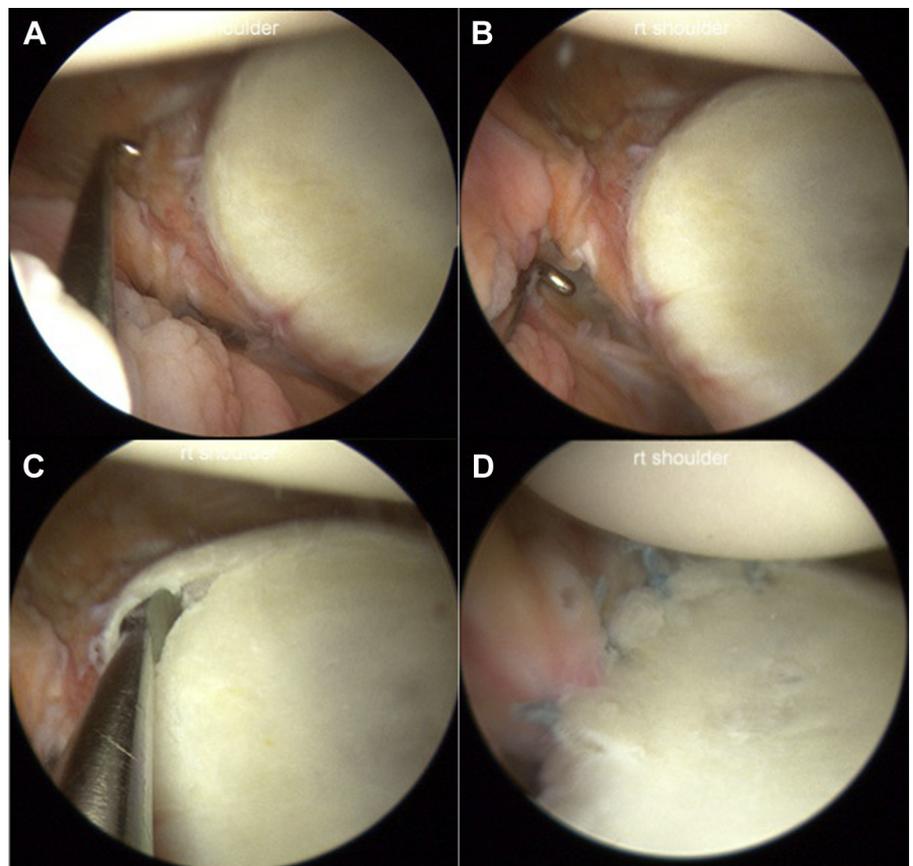


Fig 7. Arthroscopic images of a right shoulder in the lateral decubitus position, viewed from the accessory anterosuperolateral portal, showing (A, B) an ALPSA lesion and (C, D) subsequent repair.

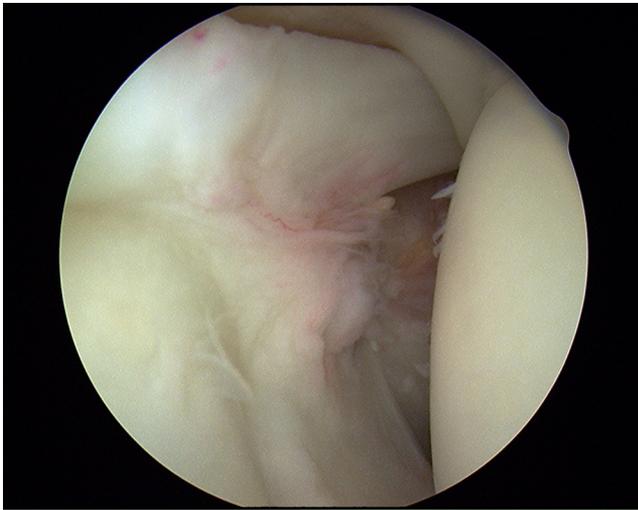


Fig 8. Arthroscopic image of a right shoulder in the beach-chair position, viewed from the posterior portal, showing the LHBt as it inserts onto the superior labrum/supraglenoid tubercle.

bony fragment with suture anchors whenever feasible. Removing cartilage from a detached, osteochondral Bankart fragment will facilitate its healing against the glenoid rim, enabling it to function as a buttress beneath capsular tissue that is advanced and repaired to the intact glenoid rim. We recommend using 2 double-loaded suture anchors at the superior (3-o'clock position) and inferior (5- or 6-o'clock position) borders of a bony Bankart lesion to facilitate simultaneous capsular plication and bony fragment incorporation. All sutures are passed before suture knot tying to facilitate suture passage around the fragment. Our procedure of choice for patients with 15% or greater bone loss is the congruent-arc Latarjet procedure,^{102,103} with repair of the labrum when possible. Although coracoid transfer procedures have been shown to yield favorable outcomes with respect to recurrence rates, the associated risks of arthrosis, motion loss, and subscapularis dysfunction remain a concern with long-term follow-up.^{104,105} Recently, we have used fresh distal tibial osteochondral allograft^{100,106,107} in an

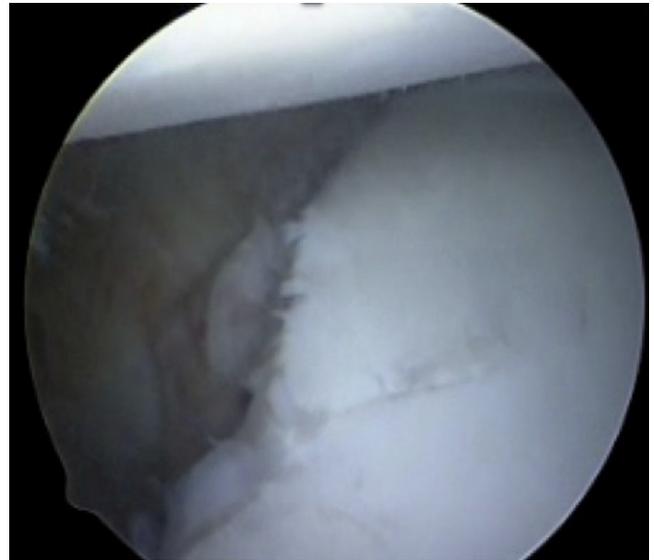


Fig 10. Arthroscopic image of a left shoulder in the lateral decubitus position, viewed from the accessory anterosuperolateral portal, showing anteroinferior glenoid bone loss in the setting of chronic anteroinferior instability.

attempt to restore both the osseous and cartilaginous anatomy. Although this procedure has proved successful in the short-term (A.A.R., M.T.P., unpublished data, July 2014), further evaluation of long-term outcomes, including the possibility of graft resorption, is warranted before this technique can be universally recommended. For open anteroinferior glenoid reconstruction procedures, we use a longitudinal split of the subscapularis tendon¹⁰⁸ in an effort to avoid long-term complications of atrophy, tendon rupture, and weakness.

Humeral Head Bone Loss. After one performs anterior glenoid reconstruction and before one decides on humeral head reconstruction, we recommend re-evaluating the overall glenohumeral congruency and tracking with the shoulder in maximum abduction and external rotation. Once the glenoid arc has been restored, even large Hill-Sachs lesions (i.e., over 30% to 40% of the surface area of the humeral head) may

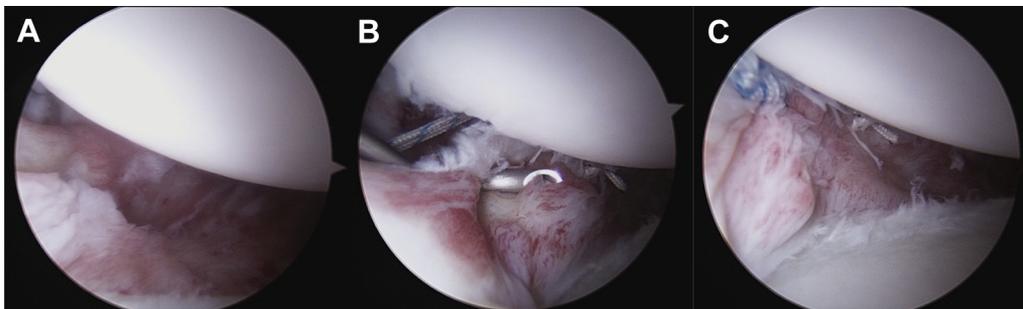


Fig 9. Arthroscopic photographs of a right shoulder in the lateral decubitus position, viewed from the accessory anterosuperolateral portal, showing (A) an anterior HAGL lesion and (B, C) repair.

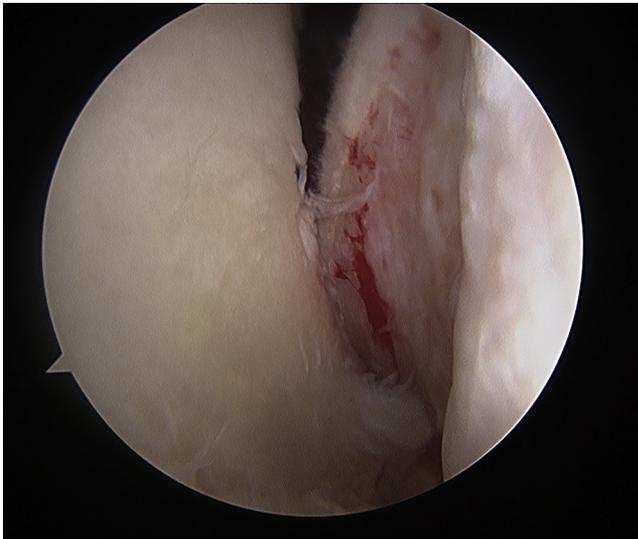


Fig 11. Arthroscopic image of a left shoulder in the beach-chair position, viewed from the posterior portal, showing an engaging Hill-Sachs lesion.

no longer engage the anterior glenoid rim (i.e., the tire no longer falls into the pothole). If, however, the humeral head defect continues to engage and therefore contributes to residual instability, despite adequate restoration of the glenoid arc, augmentation with fresh osteochondral allograft (from the humeral head or femoral head) is our preferred approach.^{92,107} Arthroscopic remplissage, especially for defects comprising between 20% and 40% of the humeral head, is a viable option, particularly in cases of unipolar humeral head defects (i.e., no significant glenoid bone loss) in the setting of glenohumeral instability.¹⁰⁹ As noted by Boileau et al.,¹⁰⁹ this procedure yields a high return-to-sport rate with a low recurrence rate (2%) at a mean of 2 years after surgery in appropriately indicated patients.

Rotator Interval Lesions. We caution against routine rotator interval closure in cases of recurrent glenohumeral instability. In specific cases anterior instability may be improved but at the cost of postoperative stiffness in external rotation. The associated loss of external rotation must be weighed against the patients' specific functional demands, particularly in athletes and overhead throwers. We do not typically recommend rotator interval closure in cases of MDI or posterior or isolated inferior instability. For treatment of rotator interval lesions associated with arthroscopic Bankart repair, our preferred approach¹¹⁰ is a variation of the well-described technique of Calvo et al.¹¹¹ A suture passer is used to capture the upper or lower margin of the rotator interval capsule through a slightly recessed cannula placed in the anterosuperior portal. A No. 0 polydioxanone suture is then retrieved from the joint, through the recessed anterior cannula, with a

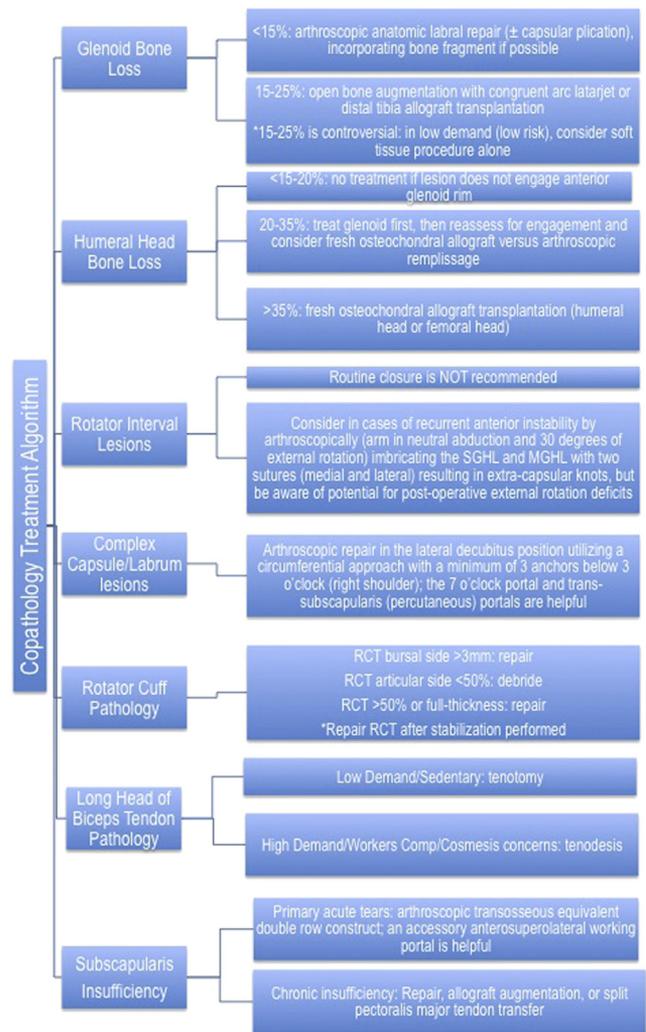


Fig 12. Treatment algorithm for management of copathology associated with anterior glenohumeral instability. (MGHL, middle glenohumeral ligament; SGHL, superior glenohumeral ligament.)

bird-beak or crochet hook, after penetration of the opposite (upper or lower) margin of the rotator interval capsule. The suture is tied through the anterosuperior cannula to close the anterior capsule with a sliding knot. The degree of tightening is observed and titrated under direct visualization, and the knot or knots remain extracapsular.

Table 2. Summary of Copathologies Associated With Anterior Instability

Glenoid bone loss
Humeral head bone loss (Hill-Sachs lesions)
Rotator interval lesion
Complex capsule/labrum pathology and management
SLAP tear
Extensive labral tear
ALPSA lesion
RCT
Subscapularis insufficiency

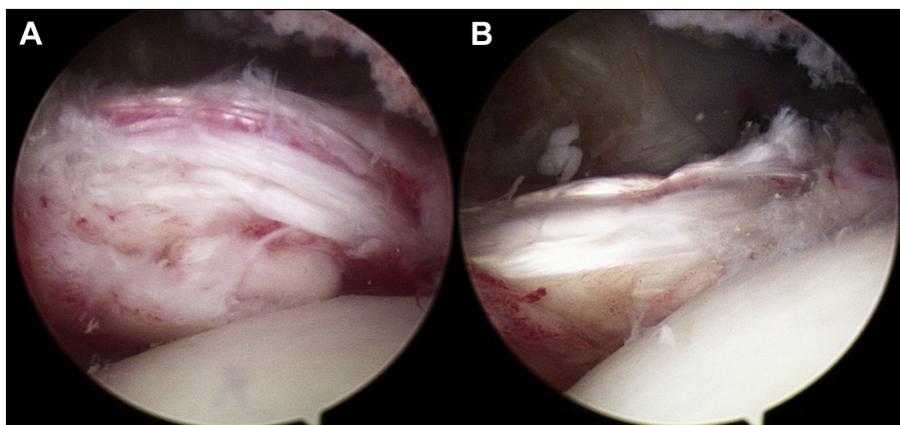


Fig 13. Arthroscopic images of a right shoulder in the beach-chair position, viewed from the posterior portal, showing a subscapularis tendon tear (A) before and (B) after intra-articular repair to the lesser tuberosity footprint with suture anchors, with an approach through anterior and accessory anterosuperolateral portal cannulae.

Complex Capsule/Labrum Pathology and Management.

We advocate strongly for a circumferential approach to capsule and labrum repair^{71,72} so long as the patient's complaints and findings on examination under anesthesia warrant repair. Particular attention should be paid in patients who require capsular plication in addition to labrum repair.^{112,113} We advocate for a minimum of 3 anchors below the equator (3-o'clock position for a right shoulder). We approach these repairs from the lateral decubitus position, aided by the use of a 7-o'clock portal.¹¹⁴ The use of a curved drill guide or trans-subscapularis portal for inferior anchor placement can significantly improve the trajectory and position of the anchor sites; however, a biomechanical study has not found these strategies to be superior biomechanically when compared with standard approaches.¹¹⁵ With respect to the sequencing of pan-labral repairs and optimization of arthroscopic visualization, we recommend starting posteriorly (below the 9-o'clock position) and then progressing inferiorly (to the 6-o'clock position) and then anteriorly (to the 3-o'clock position). Arthroscopic treatment of a pan-labral injury should conclude with SLAP lesion repair (between the 10- and 1-o'clock positions).

Rotator Cuff Pathology. The relation between RCTs and labral tears near the biceps anchor was first established by Andrews et al.¹¹⁶ in throwers. The literature, however, does not provide clear treatment guidelines. Concomitant repair of RCTs and labral lesions (including SLAP lesions) remains controversial, especially in middle-aged patients who are thought to be prone to stiffness.¹¹⁷⁻¹²⁰ An alternative option includes concomitant RCT repair and combined LHBT treatment with either tenotomy or tenodesis; the outcomes of these techniques remain controversial as well, with some authors showing superior results when compared with RCT repair with SLAP repair.¹²¹ We recommend mini-open subpectoral biceps tenodesis with concomitant RCT repair for high-demand laborers and Workers' Compensation

patients to preserve supination strength and to minimize the chances of a Popeye deformity. More sedentary patients may be treated with biceps tenotomy alone.

Subscapularis Insufficiency. Subscapularis tendon tears are associated with severe posterior or anterior instability events,¹¹ generally in patients older than 40 years. Insufficiency or dysfunction of the subscapularis has also been reported to occur in 4% to 54% of open instability operations.^{104,122} Clinically significant subscapularis dysfunction may affect as many as 70% of patients after an open instability repair.¹⁰⁴ This complication must be considered in patients undergoing revision instability repair after a failed open procedure. Preoperative planning in patients with suspected subscapularis dysfunction includes an MRI scan to evaluate the integrity and quality of the tendon insertion on the less tuberosity. More importantly, however, a sagittal oblique MRI scan may be used to evaluate the subscapularis muscle belly for atrophy and fatty infiltration. Surgical management (Fig 13) may include subscapularis repair, allograft reconstruction/augmentation, or split pectoralis major tendon transfer. For primary subscapularis tendon repairs that occur as a result of instability, our preference is an arthroscopic transosseous-equivalent double-row construct. This repair is facilitated by use of an accessory anterosuperolateral working portal.

Conclusions

In patients with shoulder instability, there may be a wide array of concomitant pathologies present beyond just the classic Bankart lesion. These copathologies consist of glenoid and humeral bone loss, rotator interval pathology, HAGL lesions, RCTs, SLAP tears, near circumferential labral tears, MDI, and ALPSA lesions. Non-pathologic normal anatomic variants may also be present. It is essential that these associated pathologies are recognized and subsequently treated. Failure to do so may result in an inability to improve function and

anterior shoulder stability and to alleviate symptoms of pain.

Unrecognized labral injuries, such as extensive labral tears, are more easily treated arthroscopically with predictable results. Patients with anterior glenoid bone loss can be adequately treated with revision stabilization procedures; however, open procedures are often indicated for patients with severe glenoid bone loss requiring bony reconstruction. Open approaches are also indicated in patients with subscapularis deficiency or engaging Hill-Sachs lesions, which are believed to play a role in the recurrent instability. Regardless of the method of revision stabilization, the results of surgical repair and stabilization are typically not as good as those of the primary intervention, and patients should be counseled appropriately before undergoing any surgical intervention.

References

- Hovellius L. Shoulder dislocation in Swedish ice hockey players. *Am J Sports Med* 1978;6:373-377.
- Hovellius L, Sandstrom B, Saebo M. One hundred eighteen Bristow-Latarjet repairs for recurrent anterior dislocation of the shoulder prospectively followed for fifteen years: Study II—The evolution of dislocation arthropathy. *J Shoulder Elbow Surg* 2006;15:279-289.
- Piasecki DP, Verma NN, Romeo AA, Levine WN, Bach BR Jr, Provencher MT. Glenoid bone deficiency in recurrent anterior shoulder instability: Diagnosis and management. *J Am Acad Orthop Surg* 2009;17:482-493.
- Sugaya H, Moriishi J, Kanisawa I, Tsuchiya A. Arthroscopic osseous Bankart repair for chronic recurrent traumatic anterior glenohumeral instability. *J Bone Joint Surg Am* 2005;87:1752-1760.
- Bankart AS. Recurrent or habitual dislocation of the shoulder-joint. *BMJ* 1923;2:1132-1133.
- Kang RW, Frank RM, Nho SJ, et al. Complications associated with anterior shoulder instability repair. *Arthroscopy* 2009;25:909-920.
- Field LD, Savoie FH III. Arthroscopic suture repair of superior labral detachment lesions of the shoulder. *Am J Sports Med* 1993;21:783-790. discussion 790.
- Morgan CD, Burkhart SS, Palmeri M, Gillespie M. Type II SLAP lesions: Three subtypes and their relationships to superior instability and rotator cuff tears. *Arthroscopy* 1998;14:553-565.
- Samani JE, Marston SB, Buss DD. Arthroscopic stabilization of type II SLAP lesions using an absorbable tack. *Arthroscopy* 2001;17:19-24.
- Altchek DW, Warren RF, Skyhar MJ, Ortiz G. T-plasty modification of the Bankart procedure for multidirectional instability of the anterior and inferior types. *J Bone Joint Surg Am* 1991;73:105-112.
- Bradley JP, Forsythe B, Mascarenhas R. Arthroscopic management of posterior shoulder instability: Diagnosis, indications, and technique. *Clin Sports Med* 2008;27:649-670.
- Hawkins RJ, Belle RM. Posterior instability of the shoulder. *Instr Course Lect* 1989;38:211-215.
- Schwartz E, Warren RF, O'Brien SJ, Fronek J. Posterior shoulder instability. *Orthop Clin North Am* 1987;18:409-419.
- Bahk M, Keyurapan E, Tasaki A, Sauers EL, McFarland EG. Laxity testing of the shoulder: A review. *Am J Sports Med* 2007;35:131-144.
- Gerber C, Ganz R. Clinical assessment of instability of the shoulder. With special reference to anterior and posterior drawer tests. *J Bone Joint Surg Br* 1984;66:551-556.
- Millett PJ, Clavert P, Hatch GF III, Warner JJ. Recurrent posterior shoulder instability. *J Am Acad Orthop Surg* 2006;14:464-476.
- An YH, Friedman RJ. Multidirectional instability of the glenohumeral joint. *Orthop Clin North Am* 2000;31:275-285.
- Kibler WB. The role of the scapula in athletic shoulder function. *Am J Sports Med* 1998;26:325-337.
- Petersen SA. Posterior shoulder instability. *Orthop Clin North Am* 2000;31:263-274.
- Warner JJ, Micheli LJ, Arslanian LE, Kennedy J, Kennedy R. Patterns of flexibility, laxity, and strength in normal shoulders and shoulders with instability and impingement. *Am J Sports Med* 1990;18:366-375.
- Cofield RH, Nessler JP, Weinstabl R. Diagnosis of shoulder instability by examination under anesthesia. *Clin Orthop Relat Res* 1993;291:45-53.
- Provencher MT, LeClere LE, King S, et al. Posterior instability of the shoulder: Diagnosis and management. *Am J Sports Med* 2011;39:874-886.
- Hawkins RJ, Koppert G, Johnston G. Recurrent posterior instability (subluxation) of the shoulder. *J Bone Joint Surg Am* 1984;66:169-174.
- Bigliani LU, Pollock RG, McIlveen SJ, Endrizzi DP, Flatow EL. Shift of the posteroinferior aspect of the capsule for recurrent posterior glenohumeral instability. *J Bone Joint Surg Am* 1995;77:1011-1020.
- Fronek J, Warren RF, Bowen M. Posterior subluxation of the glenohumeral joint. *J Bone Joint Surg Am* 1989;71:205-216.
- Tibone JE, Bradley JP. The treatment of posterior subluxation in athletes. *Clin Orthop Relat Res* 1993;291:124-137.
- Kim SH, Park JC, Park JS, Oh I. Painful jerk test: A predictor of success in nonoperative treatment of posteroinferior instability of the shoulder. *Am J Sports Med* 2004;32:1849-1855.
- Munro W, Healy R. The validity and accuracy of clinical tests used to detect labral pathology of the shoulder—A systematic review. *Man Ther* 2009;14:119-130.
- Pollock RG, Bigliani LU. Recurrent posterior shoulder instability. Diagnosis and treatment. *Clin Orthop Relat Res* 1993;291:85-96.
- Kim S-H, Oh I, Park J-S, Shin S-K, Jeong W-K. Intra-articular repair of an isolated partial articular-surface tear of the subscapularis tendon. *Am J Sports Med* 2005;33:1825-1830.
- Jacobson SR, Speer KP, Moor JT, et al. Reliability of radiographic assessment of acromial morphology. *J Shoulder Elbow Surg* 1995;4:449-453.

32. Neer CS II. Involuntary inferior and multidirectional instability of the shoulder: Etiology, recognition, and treatment. *Instr Course Lect* 1985;34:232-238.
33. Neer CS II, Foster CR. Inferior capsular shift for involuntary inferior and multidirectional instability of the shoulder. A preliminary report. *J Bone Joint Surg Am* 1980;62:897-908.
34. Lo IK, Bishop JY, Miniaci A, Flatow EL. Multidirectional instability: Surgical decision making. *Instr Course Lect* 2004;53:565-572.
35. McFarland EG, Kim TK, Park HB, Neira CA, Gutierrez MI. The effect of variation in definition on the diagnosis of multidirectional instability of the shoulder. *J Bone Joint Surg Am* 2003;85:2138-2144.
36. Cordasco FA. Understanding multidirectional instability of the shoulder. *J Athl Train* 2000;35:278-285.
37. Schenk TJ, Brems JJ. Multidirectional instability of the shoulder: Pathophysiology, diagnosis, and management. *J Am Acad Orthop Surg* 1998;6:65-72.
38. Kropf EJ, Tjoumakaris FP, Sekiya JK. Arthroscopic shoulder stabilization: Is there ever a need to open? *Arthroscopy* 2007;23:779-784.
39. Millar NL, Murrell GA. The effectiveness of arthroscopic stabilisation for failed open shoulder instability surgery. *J Bone Joint Surg Br* 2008;90:745-750.
40. Levine WN, Arroyo JS, Pollock RG, Flatow EL, Bigliani LU. Open revision stabilization surgery for recurrent anterior glenohumeral instability. *Am J Sports Med* 2000;28:156-160.
41. Franceschi F, Longo UG, Ruzzini L, Rizzello G, Maffulli N, Denaro V. Arthroscopic salvage of failed arthroscopic Bankart repair: A prospective study with a minimum follow-up of 4 years. *Am J Sports Med* 2008;36:1330-1336.
42. Kim SH, Ha KI. Bankart repair in traumatic anterior shoulder instability: Open versus arthroscopic technique. *Arthroscopy* 2002;18:755-763.
43. Millett PJ, Braun S. The "bony Bankart bridge" procedure: A new arthroscopic technique for reduction and internal fixation of a bony Bankart lesion. *Arthroscopy* 2009;25:102-105.
44. Provencher MT, Mologne TS, Hongo M, Zhao K, Tasto JP, An KN. Arthroscopic versus open rotator interval closure: Biomechanical evaluation of stability and motion. *Arthroscopy* 2007;23:583-592.
45. Owens BD, Deberardino TM, Nelson BJ, et al. Long-term follow-up of acute arthroscopic Bankart repair for initial anterior shoulder dislocations in young athletes. *Am J Sports Med* 2009;37:669-673.
46. Meehan RE, Petersen SA. Results and factors affecting outcome of revision surgery for shoulder instability. *J Shoulder Elbow Surg* 2005;14:31-37.
47. Mologne TS, Provencher MT, Menzel KA, Vachon TA, Dewing CB. Arthroscopic stabilization in patients with an inverted pear glenoid: Results in patients with bone loss of the anterior glenoid. *Am J Sports Med* 2007;35:1276-1283.
48. Neri BR, Tuckman DV, Bravman JT, Yim D, Sahajpal DT, Rokito AS. Arthroscopic revision of Bankart repair. *J Shoulder Elbow Surg* 2007;16:419-424.
49. Creighton RA, Romeo AA, Brown FM Jr, Hayden JK, Verma NN. Revision arthroscopic shoulder instability repair. *Arthroscopy* 2007;23:703-709.
50. Patel RV, Apostle K, Leith JM, Regan WD. Revision arthroscopic capsulolabral reconstruction for recurrent instability of the shoulder. *J Bone Joint Surg Br* 2008;90:1462-1467.
51. Sisto DJ. Revision of failed arthroscopic Bankart repairs. *Am J Sports Med* 2007;35:537-541.
52. Neer CS II, Craig EV, Fukuda H. Cuff-tear arthropathy. *J Bone Joint Surg Am* 1983;65:1232-1244.
53. Williams GR Jr, Rockwood CA Jr, Bigliani LU, Iannotti JP, Stanwood W. Rotator cuff tears: Why do we repair them? *J Bone Joint Surg Am* 2004;86:2764-2776.
54. Goutallier D, Postel JM, Bernageau J, Lavau L, Voisin MC. Fatty muscle degeneration in cuff ruptures. Pre- and postoperative evaluation by CT scan. *Clin Orthop Relat Res* 1994;304:78-83.
55. Goutallier D, Postel JM, Bernageau J, Lavau L, Voisin MC. Fatty infiltration of disrupted rotator cuff muscles. *Rev Rhum Engl Ed* 1995;62:415-422.
56. Gladstone JN, Bishop JY, Lo IK, Flatow EL. Fatty infiltration and atrophy of the rotator cuff do not improve after rotator cuff repair and correlate with poor functional outcome. *Am J Sports Med* 2007;35:719-728.
57. Craig EV. The posterior mechanism of acute anterior shoulder dislocations. *Clin Orthop Relat Res* 1984;190:212-216.
58. Araghi A, Prasarn M, St Clair S, Zuckerman JD. Recurrent anterior glenohumeral instability with onset after forty years of age: The role of the anterior mechanism. *Bull Hosp Jt Dis* 2005;62:99-101.
59. Porcellini G, Caranzano F, Campi F, Paladini P. Instability and rotator cuff tear. *Med Sport Sci* 2012;57:41-52.
60. Porcellini G, Caranzano F, Campi F, Pellegrini A, Paladini P. Glenohumeral instability and rotator cuff tear. *Sports Med Arthrosc* 2011;19:395-400.
61. Gomberawalla MM, Sekiya JK. Rotator cuff tear and glenohumeral instability: A systematic review. *Clin Orthop Relat Res* 2014;472:2448-2456.
62. Porcellini G, Paladini P, Campi F, Paganelli M. Shoulder instability and related rotator cuff tears: Arthroscopic findings and treatment in patients aged 40 to 60 years. *Arthroscopy* 2006;22:270-276.
63. Snyder SJ, Karzel RP, Del Pizzo W, Ferkel RD, Friedman MJ. SLAP lesions of the shoulder. *Arthroscopy* 1990;6:274-279.
64. Pagnani MJ, Speer KP, Altchek DW, Warren RF, Dines DM. Arthroscopic fixation of superior labral lesions using a biodegradable implant: A preliminary report. *Arthroscopy* 1995;11:194-198.
65. Rodosky MW, Harner CD, Fu FH. The role of the long head of the biceps muscle and superior glenoid labrum in anterior stability of the shoulder. *Am J Sports Med* 1994;22:121-130.
66. Fealy S, Kingham TP, Altchek DW. Mini-open rotator cuff repair using a two-row fixation technique: Outcomes analysis in patients with small, moderate, and large rotator cuff tears. *Arthroscopy* 2002;18:665-670.
67. Warner JJ, Tetreault P, Lehtinen J, Zurakowski D. Arthroscopic versus mini-open rotator cuff repair: A cohort comparison study. *Arthroscopy* 2005;21:328-332.
68. Burkart A, Debski R, Musahl V, McMahon P, Woo SL. Biomechanical tests for type II SLAP lesions of the

- shoulder joint before and after arthroscopic repair. *Orthopade* 2003;32:600-607 [in German].
69. Burkart A, Debski RE, Musahl V, McMahon PJ. Glenohumeral translations are only partially restored after repair of a simulated type II superior labral lesion. *Am J Sports Med* 2003;31:56-63.
 70. McMahon PJ, Burkart A, Musahl V, Debski RE. Glenohumeral translations are increased after a type II superior labrum anterior-posterior lesion: A cadaveric study of severity of passive stabilizer injury. *J Shoulder Elbow Surg* 2004;13:39-44.
 71. Tokish JM, McBratney CM, Solomon DJ, Leclere L, Dewing CB, Provencher MT. Arthroscopic repair of circumferential lesions of the glenoid labrum: Surgical technique. *J Bone Joint Surg Am* 2010;92(suppl 1 pt 2):130-144.
 72. Tokish JM, McBratney CM, Solomon DJ, Leclere L, Dewing CB, Provencher MT. Arthroscopic repair of circumferential lesions of the glenoid labrum. *J Bone Joint Surg Am* 2009;91:2795-2802.
 73. Mazzocca AD, Cote MP, Solovyova O, Rizvi SH, Mostofi A, Arciero RA. Traumatic shoulder instability involving anterior, inferior, and posterior labral injury: A prospective clinical evaluation of arthroscopic repair of 270 degrees labral tears. *Am J Sports Med* 2011;39:1687-1696.
 74. Neviasser TJ. The anterior labroligamentous periosteal sleeve avulsion lesion: A cause of anterior instability of the shoulder. *Arthroscopy* 1993;9:17-21.
 75. Ozbaydar M, Elhassan B, Diller D, Massimini D, Higgins LD, Warner JJ. Results of arthroscopic capsulolabral repair: Bankart lesion versus anterior labroligamentous periosteal sleeve avulsion lesion. *Arthroscopy* 2008;24:1277-1283.
 76. Bennett WF. Subscapularis, medial, and lateral head coracohumeral ligament insertion anatomy. Arthroscopic appearance and incidence of "hidden" rotator interval lesions. *Arthroscopy* 2001;17:173-180.
 77. Treacy SH, Field LD, Savoie FH. Rotator interval capsule closure: An arthroscopic technique. *Arthroscopy* 1997;13:103-106.
 78. Harryman DT II, Sidles JA, Harris SL, Matsen FA III. The role of the rotator interval capsule in passive motion and stability of the shoulder. *J Bone Joint Surg Am* 1992;74:53-66.
 79. Mologne TS, Zhao K, Hongo M, Romeo AA, An KN, Provencher MT. The addition of rotator interval closure after arthroscopic repair of either anterior or posterior shoulder instability: Effect on glenohumeral translation and range of motion. *Am J Sports Med* 2008;36:1123-1131.
 80. Chiang ER, Wang JP, Wang ST, Ma HL, Liu CL, Chen TH. Arthroscopic posteroinferior capsular plication and rotator interval closure after Bankart repair in patients with traumatic anterior glenohumeral instability—A minimum follow-up of 5 years. *Injury* 2010;41:1075-1078.
 81. Chechik O, Maman E, Dolkart O, Khashan M, Shabtai L, Mozes G. Arthroscopic rotator interval closure in shoulder instability repair: A retrospective study. *J Shoulder Elbow Surg* 2010;19:1056-1062.
 82. Lafosse L, Reiland Y, Baier GP, Toussaint B, Jost B. Anterior and posterior instability of the long head of the biceps tendon in rotator cuff tears: A new classification based on arthroscopic observations. *Arthroscopy* 2007;23:73-80.
 83. Boileau P, Ahrens PM, Hatzidakis AM. Entrapment of the long head of the biceps tendon: The hourglass biceps—A cause of pain and locking of the shoulder. *J Shoulder Elbow Surg* 2004;13:249-257.
 84. Slenker NR, Lawson K, Ciccotti MG, Dodson CC, Cohen SB. Biceps tenotomy versus tenodesis: Clinical outcomes. *Arthroscopy* 2012;28:576-582.
 85. Nho SJ, Strauss EJ, Lenart BA, et al. Long head of the biceps tendinopathy: Diagnosis and management. *J Am Acad Orthop Surg* 2010;18:645-656.
 86. Szabo I, Boileau P, Walch G. The proximal biceps as a pain generator and results of tenotomy. *Sports Med Arthrosc* 2008;16:180-186.
 87. Boileau P, Villalba M, Hery JY, Balg F, Ahrens P, Neyton L. Risk factors for recurrence of shoulder instability after arthroscopic Bankart repair. *J Bone Joint Surg Am* 2006;88:1755-1763.
 88. Burkhart SS, De Beer JF. Traumatic glenohumeral bone defects and their relationship to failure of arthroscopic Bankart repairs: Significance of the inverted-pear glenoid and the humeral engaging Hill-Sachs lesion. *Arthroscopy* 2000;16:677-694.
 89. Lynch JR, Clinton JM, Dewing CB, Warne WJ, Matsen FA III. Treatment of osseous defects associated with anterior shoulder instability. *J Shoulder Elbow Surg* 2009;18:317-328.
 90. Rowe CR, Zarins B, Ciullo JV. Recurrent anterior dislocation of the shoulder after surgical repair. Apparent causes of failure and treatment. *J Bone Joint Surg Am* 1984;66:159-168.
 91. Tauber M, Resch H, Forstner R, Raffl M, Schauer J. Reasons for failure after surgical repair of anterior shoulder instability. *J Shoulder Elbow Surg* 2004;13:279-285.
 92. Provencher MT, Frank RM, Leclere LE, et al. The Hill-Sachs lesion: Diagnosis, classification, and management. *J Am Acad Orthop Surg* 2012;20:242-252.
 93. Purchase RJ, Wolf EM, Hobgood ER, Pollock ME, Smalley CC. Hill-Sachs "remplissage": An arthroscopic solution for the engaging Hill-Sachs lesion. *Arthroscopy* 2008;24:723-726.
 94. Scheibel M, Nikulka C, Dick A, Schroeder RJ, Gerber Popp A, Haas NP. Autogenous bone grafting for chronic anteroinferior glenoid defects via a complete subscapularis tenotomy approach. *Arch Orthop Trauma Surg* 2008;128:1317-1325.
 95. Schroeder DT, Provencher MT, Mologne TS, Muldoon MP, Cox JS. The modified Bristow procedure for anterior shoulder instability: 26-year outcomes in Naval Academy midshipmen. *Am J Sports Med* 2006;34:778-786.
 96. Boileau P, Bicknell RT, El Fegoun AB, Chuinard C. Arthroscopic Bristow procedure for anterior instability in shoulders with a stretched or deficient capsule: The "belt-and-suspenders" operative technique and preliminary results. *Arthroscopy* 2007;23:593-601.
 97. Burkhart SS, De Beer JF, Barth JR, Cresswell T, Roberts C, Richards DP. Results of modified Latarjet

- reconstruction in patients with anteroinferior instability and significant bone loss. *Arthroscopy* 2007;23:1033-1041.
98. Haaker RG, Eickhoff U, Klammer HL. Intraarticular autogenous bone grafting in recurrent shoulder dislocations. *Mil Med* 1993;158:164-169.
 99. Warner JJ, Gill TJ, O'Hollerhan JD, Pathare N, Millett PJ. Anatomical glenoid reconstruction for recurrent anterior glenohumeral instability with glenoid deficiency using an autogenous tricortical iliac crest bone graft. *Am J Sports Med* 2006;34:205-212.
 100. Provencher MT, Ghodadra N, LeClere L, Solomon DJ, Romeo AA. Anatomic osteochondral glenoid reconstruction for recurrent glenohumeral instability with glenoid deficiency using a distal tibia allograft. *Arthroscopy* 2009;25:446-452.
 101. Pagnani MJ. Open capsular repair without bone block for recurrent anterior shoulder instability in patients with and without bony defects of the glenoid and/or humeral head. *Am J Sports Med* 2008;36:1805-1812.
 102. de Beer JF, Roberts C. Glenoid bone defects—Open Latarjet with congruent arc modification. *Orthop Clin North Am* 2010;41:407-415.
 103. Bhatia S, Frank RM, Ghodadra NS, et al. The outcomes and surgical techniques of the Latarjet procedure. *Arthroscopy* 2014;30:227-235.
 104. Scheibel M, Nikulka C, Dick A, Schroeder RJ, Popp AG, Haas NP. Structural integrity and clinical function of the subscapularis musculotendinous unit after arthroscopic and open shoulder stabilization. *Am J Sports Med* 2007;35:1153-1161.
 105. Cheung EV, Sperling JW, Hatstrup SJ, Cofield RH. Long-term outcome of anterior stabilization of the shoulder. *J Shoulder Elbow Surg* 2008;17:265-270.
 106. Bhatia S, Van Thiel GS, Gupta D, et al. Comparison of glenohumeral contact pressures and contact areas after glenoid reconstruction with Latarjet or distal tibial osteochondral allografts. *Am J Sports Med* 2013;41:1900-1908.
 107. Provencher MT, LeClere LE, Ghodadra N, Solomon DJ. Postsurgical glenohumeral anchor arthropathy treated with a fresh distal tibia allograft to the glenoid and a fresh allograft to the humeral head. *J Shoulder Elbow Surg* 2010;19:e6-e11.
 108. Boileau P, Mercier N, Old J. Arthroscopic Bankart-Bristow-Latarjet (2B3) procedure: How to do it and tricks to make it easier and safe. *Orthop Clin North Am* 2010;41:381-392.
 109. Boileau P, O'Shea K, Vargas P, Pinedo M, Old J, Zumstein M. Anatomical and functional results after arthroscopic Hill-Sachs remplissage. *J Bone Joint Surg Am* 2012;94:618-626.
 110. Frank RM, Golijanan P, Gross DJ, Provencher MT. The arthroscopic rotator interval closure: Why, when, and how? *Oper Tech Sports Med* in press, available online 12 February, 2014. doi:10.1053/j.otsm.2014.02.005.
 111. Calvo A, Martinez AA, Domingo J, Herrera A. Rotator interval closure after arthroscopic capsulolabral repair: A technical variation. *Arthroscopy* 2005;21:765.
 112. Nho SJ, Frank RM, Van Thiel GS, et al. A biomechanical analysis of anterior Bankart repair using suture anchors. *Am J Sports Med* 2010;38:1405-1412.
 113. Nho SJ, Frank RM, Van Thiel GS, et al. A biomechanical analysis of shoulder stabilization: Posteroinferior glenohumeral capsular plication. *Am J Sports Med* 2010;38:1413-1439.
 114. Cvetanovich GL, McCormick F, Erickson BJ, et al. The posterolateral portal: Optimizing anchor placement and labral repair at the inferior glenoid. *Arthrosc Tech* 2013;2:e201-e204.
 115. Frank RM, Mall NA, Gupta D, et al. Inferior suture anchor placement during arthroscopic Bankart repair: Influence of portal placement and curved drill guide. *Am J Sports Med* 2014;42:1182-1189.
 116. Andrews JR, Carson WG Jr, McLeod WD. Glenoid labrum tears related to the long head of the biceps. *Am J Sports Med* 1985;13:337-341.
 117. Forsythe B, Martin SD. Concomitant arthroscopic SLAP and rotator cuff repair: Surgical technique. *J Bone Joint Surg Am* 2011;93:1-9 (suppl 1).
 118. Voos JE, Pearle AD, Mattern CJ, Cordasco FA, Allen AA, Warren RF. Outcomes of combined arthroscopic rotator cuff and labral repair. *Am J Sports Med* 2007;35:1174-1179.
 119. Abbot AE, Li X, Busconi BD. Arthroscopic treatment of concomitant superior labral anterior posterior (SLAP) lesions and rotator cuff tears in patients over the age of 45 years. *Am J Sports Med* 2009;37:1358-1362.
 120. Franceschi F, Longo UG, Ruzzini L, Rizzello G, Maffulli N, Denaro V. No advantages in repairing a type II superior labrum anterior and posterior (SLAP) lesion when associated with rotator cuff repair in patients over age 50: A randomized controlled trial. *Am J Sports Med* 2008;36:247-253.
 121. Kim SJ, Lee IS, Kim SH, Woo CM, Chun YM. Arthroscopic repair of concomitant type II SLAP lesions in large to massive rotator cuff tears: Comparison with biceps tenotomy. *Am J Sports Med* 2012;40:2786-2793.
 122. Sachs RA, Williams B, Stone ML, Paxton L, Kuney M. Open Bankart repair: Correlation of results with post-operative subscapularis function. *Am J Sports Med* 2005;33:1458-1462.