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Revision Arthroscopic Shoulder Stabilization

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Introduction

Multiple demographic, anatomic, and technical factors have been targeted as risk factors for recurrent instability following surgical stabilization. Demographic factors that are highly predictive of recurrent instability include younger patient age, participation in overhead or contact sports, and male gender. Among the intrinsic patient factors that have been implicated, younger patient age is the most well-delineated factor leading to recurrent instability. Voos and colleagues reported a recurrence rate of 37.5% for patients younger than 20 years of age compared with 15.3% for patients older than 20 years.[1] Similarly, Porcellini et al demonstrated a recurrence rate of 13.3% in patients aged 22 years and younger compared with 6.3% in patients older than 22 years.[2] Participation in contact or overhead sports also dramatically increases a patient's risk of recurrent instability. Owens and colleagues reported mean 11.7-year follow-up data on 39 contact athletes managed with arthroscopic Bankart repair.[3] At final follow-up, 14.3% had experienced a recurrent dislocation, 21.4% had experienced a subluxation event, and 14.3% had undergone revision stabilization surgery. Male gender has also been demonstrated to be a risk factor for recurrent instability. Balg and Boileau demonstrated a recurrence rate of 17% in men compared to 2% in women at an average of 31.2 months after arthroscopic Bankart repair.[4]

Anatomic factors that commonly contribute to recurrent instability include significant glenoid bone loss, the presence of an engaging Hill-Sachs lesion, and increased ligamentous laxity. Glenoid bone loss involving more than 25% of the glenoid surface has been demonstrated to be highly predictive of failure for primary repair attempts.[5] In the revision setting, glenoid bone loss more than 20% has a high rate of failure with revision arthroscopic repair.[6] Moreover, the presence of both an engaging Hill-Sachs lesion and glenoid bone loss of greater than 25% confers nearly a 10-fold increased risk of recurrence compared to those without (51.5% vs 5.5%). Higher rates of failure have also been shown in patients with ligamentous laxity. Balg and Boileau demonstrated that patients with shoulder hyperlaxity (defined by external rotation [ER] > 85 degrees with the shoulder adducted) had a recurrence rate of 18.9% compared with 4.9% in those without hyperlaxity.[4]

Ryu RKN, Angelo RL, Abrams JS, eds. *The Shoulder: AANA Advanced Arthroscopic Surgical Techniques* (pp 39-48).

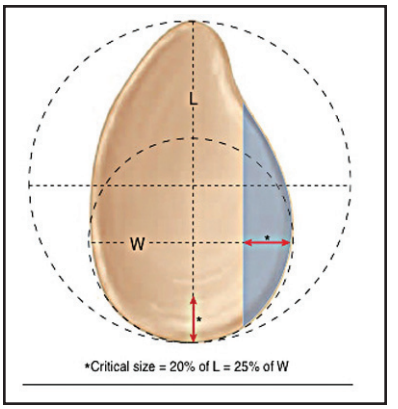

Figure 4-1. Evaluation of glenoid bone loss based on 3D computed tomography reconstruction. The gray area represents bone loss. In a revision setting, if the glenoid bone loss is >10%, then consideration should be given to an open bone block stabilization procedure.

In patients with failed primary stabilization, the surgical technique must be thoroughly evaluated to determine the etiology of failure. In a series of 16 patients, Arce et al found that 75% of primary failures were attributable to a suboptimal surgical technique.[7] Technical missteps can be subdivided into preoperative, intraoperative, and postoperative errors. Preoperatively, failure to recognize posterior instability, multidirectional instability, significant glenoid bone loss, an engaging Hill-Sachs lesion, or humeral avulsion of the glenohumeral ligaments (HAGL lesion) may lead to inadequate restoration of the anatomy and compromise the stability of the joint. Intraoperatively, failure to sufficiently mobilize the labrum and attached capsule will not restore proper capsular tension and glenoid concavity compression. Additionally, inappropriate placements of the anchor medially on the glenoid neck will malreduce the capsulolabral complex and, in turn, compromise the stability of the construct. Postoperatively, patients must be strongly cautioned regarding the risks of contact sports and the importance of avoiding "at-risk" positions.

A 10-point preoperative instability severity index score (ISIS) has been created to stratify patients with regard to risk of recurrent instability and to guide surgical decision making in primary shoulder instability surgery.[4] The score is based on patient age, level of sport, type of sport, presence of hyperlaxity, presence of a Hill-Sachs lesion, and presence of glenoid bone loss. In Balg and Boileau's study, patients with a score of 3 or less had a recurrence rate of 5%, whereas those with a score of more than 6 had a recurrence rate of 70%. The authors recommended that patients with scores >6 be managed with an open bone block procedure. Certainly, treatment of patients with ISIS of 4 to 6 with arthroscopic vs open stabilization remains controversial.

Indications

- Recurrent instability in patients with minimal glenoid bone loss and satisfactory capsular tissue

Controversial Indications

- Recurrent instability in patients with 15% to 20% glenoid bone loss
- Isolated large, engaging Hill-Sachs lesion requiring concurrent remplissage

Contraindications

- Glenoid bone loss >20% (Figure 4-1)
- Engaging, "off-track" Hill-Sachs lesion and glenoid bone loss
- Poor capsular tissue due to genetic, traumatic, or prior surgery

Figure 4-2. 17M failed previous Bankart repair. 3D computed tomography shows minimal anterior inferior glenoid bone loss and 3 previously placed anchors.

- Voluntary dislocations, secondary gain
- Patients with multiple risk factors for recurrence (ie, elevated ISIS)

Pertinent Physical Findings

- The contralateral shoulder should be examined to establish baseline range of motion (ROM), stability, and laxity.
- The posterior jerk test should be performed carefully to rule out posterior instability.
- Gagey sign, the presence of hyperabduction > 20 degrees compared to contralateral shoulder, can be seen in inferior capsular laxity or MDI.
- Passive ER, with the shoulder adducted, greater than 85 degrees is suggestive of anterior capsular hyperlaxity. A sulcus sign may also suggest capsular laxity.
- Other joints should be examined for signs of hyperlaxity (eg, finger hyperextension, elbow hyperextension, ability to passively oppose each thumb to the flexor surface of the arm, etc).
- Rotator cuff strength should be assessed.
- A careful neurologic examination should be performed to rule out iatrogenic or injury-related compromise of the axillary nerve or brachial plexus.
- Concomitant injuries to the biceps tendon, superior labral anteroposterior, and acromioclavicular joint should be ruled out.

Pertinent Imaging

- If available, review of initial preoperative imaging including radiographs and advanced imaging is helpful to confirm correct initial diagnosis and surgical indication.
- If available, review index procedure arthroscopic images.
- If available, previous operative reports should be reviewed to determine previous anchor number, size, position, and composition (eg, biocomposite, PEEK, metal) to anticipate intraoperative challenges.
- Post-failure magnetic resonance arthrogram to assess the extent of soft tissue pathology
- Post-failure 3D reconstruction computed tomography with humeral head subtraction to quantitate glenoid bone loss and localize prior anchor positions (Figure 4-2).

Equipment

When performing a revision arthroscopic stabilization with augmentation, the standard shoulder arthroscopic Bankart repair equipment is adequate with few modifications. The standard instruments include the following:

- Power, arthroscopic rasp to prepare the capsule, arthroscopic periosteal elevator (45 degrees) to elevate the labrum
- Wissinger rods (pointed switching stick)
- Small hooded burr to prepare the bone bed
- Suture-passing device with multiple angles and an absorbable monofilament passing suture (#1 PDS [polydioxanone])
- Suture retriever
- Arthroscopic knot pusher
- Arthroscopic suture cutter
- Cannulas with sufficient diameter to accommodate all instruments needed for each step of the surgery (6- to 9-mm diameter)
- Appropriately sized dilators are often necessary for cannula insertion over Wissinger rods, especially if penetrating the intra-articular fibers of the subscapularis
- Knotless suture anchors (2.9 mm) with broad, low-profile suture (1.5 mm) to avoid suture abrasion on the humeral articular cartilage and to preserve load to failure characteristicss[8]
- Alternatively, single- or double-loaded suture anchor (2.4 or 3) can be used if knot fixation is preferred

Positioning and Portals

The authors' preference is to perform all arthroscopic stabilization procedures in the lateral decubitus position with arm-weighted suspension. Other surgeons may prefer a beach chair position for the advantages of anatomic orientation. The authors' experience has been that lateral decubitus position consistently provides adequate arthroscopic visualization regardless of patient body habitus and allows the surgical assistant to assist with the surgical procedure instead of constantly modifying the arm position. Care should be taken to limit duration of weighted suspension to avoid neurologic injury. The authors' preference is to use 10 lbs to suspend the arm in 35 to 40 degrees of abduction and 10 to 20 degrees of forward flexion (FF).

Precise portal positioning is paramount to a successful revision arthroscopic shoulder stabilization procedure. To perform a revision stabilization with augmentation, the authors' preference is to use 4 portals, including a standard posterior viewing portal, a rotator interval portal with an 8.25-mm cannula, a posteroinferior 7 o'clock portal with an 8.25- or 9-mm cannula, and often a percutaneous trans-subscapularis 5 o'clock portal (Figure 4-3).

Step-by-Step Description of the Procedure

Step 1: Diagnostic Arthroscopy

While in the lateral decubitus position, a load and shift test can be performed before weighted suspension is applied. To begin, a standard posterior viewing portal is created slightly more

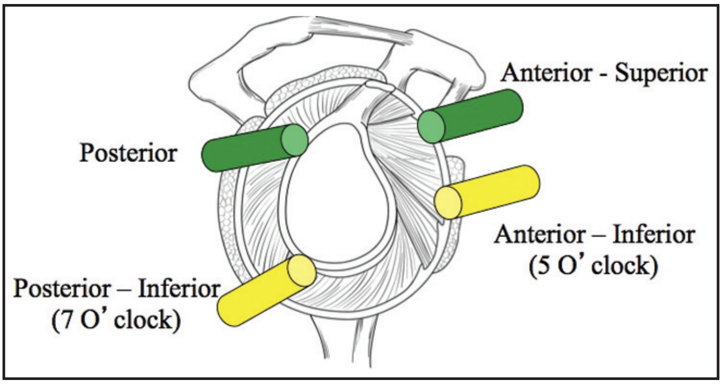

Figure 4-3. Portal placement for revision arthroscopic stabilization. Standard posterior viewing port, rotator interval anterosuperior portal, trans-rotator cuff 5 o'clock portal, and posteroinferior 7 o'clock portal.

lateral than in a beach chair position. Subsequently, an anterior portal is established in the rotator interval directly above the rolled border of the subscapularis following localization with a spinal needle in an outside-in fashion lateral to the coracoid process. An 8.25-mm cannula is introduced. Diagnostic arthroscopy is now performed with a probe through the posterior and anterior cannulas to evaluate the rotator cuff, bicep tendon, superior labrum, and presence of retained hardware. The capsule is assessed for overall tissue quality and for the presence of an HAGL lesion. The amount of anteroinferior glenoid bone loss is then evaluated by the technique described by Burkhart and colleagues.[9] The articular cartilage is then evaluated for the presence of a glenolabral articular disruption lesion for prognostic purposes. The humeral head is inspected for the presence and size of a Hill-Sachs defect. If concern exists for a possible engaging Hill-Sachs lesion, the arm can be taken out of weighted suspension and brought into abduction and ER under arthroscopic visualization. In the rare situation where an engaging Hill-Sachs lesion is present without associated significant glenoid bone loss, then an arthroscopic remplissage procedure is typically performed in addition to anterior Bankart repair. If concern exists for a posterior capsulolabral injury, the arthroscope can be placed through the anterior cannula, and a probe introduced through the posterior portal can palpate the posterior labrum. Once the diagnostic arthroscopy is complete and the diagnosis is confirmed to be an isolated failed Bankart repair with minimal glenoid bone loss and adequate capsular tissue integrity, the surgeon may proceed with the revision arthroscopic Bankart repair with a posteroinferior capsulolabral plication augmentation.

Step 2: Establish a Posteroinferior 7 o'clock Portal

In a revision situation, it is the authors' preference to perform an inferior and posteroinferior capsulolabral plication as an augmentation to the anteroinferior Bankart repair. For a right shoulder, a posteroinferior 7 o'clock portal provides excellent access to the 6 and 7 o'clock position on the glenoid. The 7 o'clock portal location is typically 2 fingerbreadths distal and 2 fingerbreadths lateral to the standard posterior viewing portal, or roughly 4 cm distal to the posterolateral edge of the acromion. A spinal needle is introduced under direct visualization. The spinal needle should hug the humeral head as it enters the joint at a steep trajectory while aiming at the 6 o'clock glenoid position. This steep trajectory will be helpful for eventual anchor insertion at the 6 and 7 o'clock glenoid position. Once the spinal needle position and trajectory are satisfactory, a Wissinger rod replaces the spinal needle. Care is taken to aim toward the axillary pouch when piercing the capsule with the rod to avoid iatrogenic glenoid articular damage. An 8.25- or 9-mm cannula is inserted over the Wissinger rod after dilating with sequential dilators.

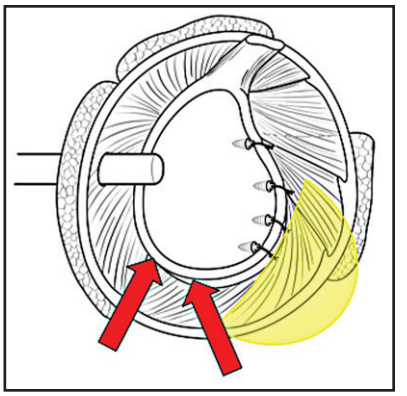

Figure 4-4. Revision arthroscopic Bankart repair requires an inferior and posteroinferior capsulolabral augmentation. Suture anchors are typically placed at the red arrows to help reduce the IGHL capsular laxity and create an internal sling.

Step #3: Capsule and Bone Preparation

While viewing from the standard posterior viewing portal, a rasp is introduced through the anterior cannula to gently prepare the anterior and inferior capsule surfaces. The rasp is then inserted into the 7 o'clock portal to prepare the inferior and posteroinferior capsule. Retained hardware and suture from prior surgery is removed by tightly wrapping the free suture ends around a suture grasper in an "alligator roll" fashion. Next, an arthroscopic periosteal elevator is introduced through the anterior cannula and the anterior and anteroinferior labrum is elevated off the glenoid sharply to create one large sleeve. This step is particularly important in the presence of an anterior labrum periosteal sleeve avulsion or a labrum that was previously "fixed" inferior to the glenoid rim. A grasper placed through the 7 o'clock portal can attempt a trial reduction of the elevated labrum onto the rim of the glenoid to confirm adequate elevation. As the capsulolabral injury often continues posteroinferiorly, the elevator can be used through the 7 o'clock portal to elevate this portion of the labrum as well. To confirm adequate elevation of the anterior capsulolabral sleeve, some surgeons prefer to view from the anterior portal or an anterosuperior portal to see the subscapularis fibers, but in the authors' experience, this has often not been necessary. Using a 70-degree arthroscope through the posterior portal may also be utilized to view the anterior capsule and subscapularis. Once the injured capsulolabral tissue is adequately elevated, the glenoid bone must be gently decorticated to promote healing. It is important to avoid injury to the adjacent labrum and capsule by using a hooded burr while carefully limiting the amount of bone resection.

Step #4: The 6 o'clock Anchor Placement—The Inferior Capsular Sling Augmentation

To begin the revision repair with inferior capsular augmentation, it is the authors' preference to first create the inferior and posteroinferior capsulolabral plication augmentation. To do this, an anchor is placed at the 6 o'clock or 6:30 position (Figure 4-4). A 90-degree curved suture-passing device is introduced through the 7 o'clock portal and used to shuttle the PDS suture under the capsule and labrum at the 6 o'clock position. Care is taken to avoid the axillary nerve by staying superficial once the tip of the suturing device passes through the capsule. The PDS suture is retrieved through the anterior cannula with a suture retriever. One end of a broad suture (LabralTape 1.5 mm [Arthrex]) is then attached to the PDS suture outside of the cannula and retrograded under the labrum and out the 7 o'clock portal. A suture retriever is then introduced in the 7 o'clock portal to retrieve the other end of the labral tape so that both ends are out of the 7 o'clock portal in a simple suture fashion. Next, a drill sleeve is introduced into the 7 o'clock portal and placed at the 6 o'clock or 6:30 glenoid position. Care is taken to place the drill sleeve up onto the articular surface in front of the labrum and as perpendicular to the articular surface as possible

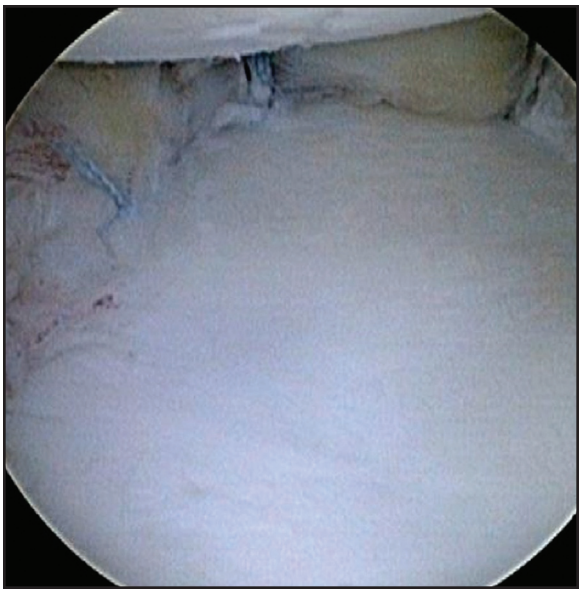

Figure 4-5. Right shoulder lateral position posterior viewing portal. Revision Bankart repair with posterior and posteroinferior augmentation with knotless suture anchors.

to avoid skiving with the drill. While the surgeon holds the drill sleeve and the arthroscope, the assistant drills the glenoid through the drill sleeve. The drill sleeve is removed from the cannula while the arthroscopic view remains fixed on the glenoid drill site to maintain visualization of the anchor insertion site. Next, the assistant passes the 2 ends of the labral tape through the knotless anchor (2.9 mm) islet. The assistant then holds the camera and maintains an arthroscopic view of the glenoid insertion site while the surgeon inserts the anchor into the drilled site. A mallet is used to fully seat the anchor to avoid articular damage from prominent hardware. A suture cutter is used to cut the labral tape flush with the glenoid surface to avoid prominent suture (Figure 4-5).

Depending on surgeon preference, the inferior capsulolabral plication augmentation can be extended posteriorly with an additional anchor at the 7 o'clock or 7:30 position. This would be performed in the same manner as the 6 o'clock anchor described previously. Of note, after this step, when clinically indicated, an arthroscopic remplissage procedure can be performed to address an engaging Hill-Sachs lesion. In a setting with minimal anteroinferior bone deficiency (ie, less than 15%) with a suitable Hill-Sachs lesion, remplissage remains an additional option to reduce the incidence of recurrence. Typically, the bony bed of the lesion is prepared and 1 or 2 double-loaded suture anchors are placed transtendinously through a percutaneous technique. The anchors are placed along the top margin of the defect and a tissue penetrator placed percutaneously is used through the cuff into the joint to retrieve a single suture limb of each suture. The sutures are tied while visualizing through the subacromial space to avoid inadvertent capture of the subdeltoid fascia.

Step 5: Anteroinferior Anchor Insertion Through a Trans-Subscapularis (5 o'clock) Portal

It is the authors' opinion that the low anteroinferior capsulolabral repair is vital to successful revision Bankart repair. Attempting to place this anteroinferior anchor from the anterior cannula in the rotator interval often leads to skiving of the drill or inadequate bony fixation of the anchor, complications that are increasingly likely in a revision setting with compromised bony anatomy. In order to obtain optimal anchor insertion trajectory, it is often necessary to place the anchor through a trans-subscapularis portal (5 o'clock portal for right shoulder). The axillary nerve is below the inferior border of the subscapularis and should be safely 2 to 3 cm away from the

5 o'clock portal site if placed in the middle of the subscapularis fibers.[10] A spinal needle is used first to optimize the portal location and trajectory. To avoid injury to the subscapularis, this anchor can be placed either percutaneously or through a narrow 4-mm metal cannula. A large cannula is not routinely placed through the subscapularis. Once the anchor is introduced through the trans-subscapularis 5 o'clock portal, suturing and knot tying can be performed through the standard anterior rotator-interval cannula.

The presence of anteroinferior glenoid bone loss or residual suture anchors may make insertion of new suture anchors challenging. In the revision setting, it is common that the anteroinferior glenoid has inadequate "real estate" for insertion of multiple suture anchors. In this situation, the authors' preference is to place one double-loaded anchor at the 5 o'clock position with knot fixation (2.4 or 3 double-loaded). When using knot fixation, the first step is to position the drill sleeve onto the anteroinferior glenoid using a sharp trochar introduced through a percutaneous trans-subscapularis 5 o'clock portal without the need for a cannula. When piercing through the subscapularis with the pointed trochar and drill sleeve, it is safer to aim toward the axillary pouch to avoid iatrogenic injury to the glenoid articular surface. Once through the subscapularis, the sharp trochar is removed and the drill is used through the drill sleeve placed onto the desired 5 o'clock glenoid position. After the glenoid is drilled, the double-loaded anchor is placed through the drill sleeve and the mallet is used to fully seat the anchor into position. The suture tails from the anchor are left in their percutaneous position. The 90-degree curved suture passer is introduced through the anterior rotator interval cannula and passed under the capsule and labrum inferior to the anchor at the 5:30 position so that knot tying will shift and reduce the inferiorly displaced labrum up to the 5 o'clock anchor position. The PDS is retrieved out of the 7 o'clock portal. One limb of one of the sutures is retrieved out of the 7 o'clock portal, where it is tied to the PDS. The PDS is then retrograded through the anterior cannula, passing the suture under the labrum. The other end of the same suture is retrieved through the anterior cannula, creating a simple suture pattern. An arthroscopic knot is tied using a knot pusher, choosing the limb that passed through the labrum as the post to prevent the knot from abrading the articular surface. This knot is then cut with the suture-cutting device. The second suture is typically passed at the 4:30 position, just superior to the anchor and tied in a similar fashion. It is important to pass and tie the inferior (5:30) suture before the superior (4:30) suture in order to adequately reduce the inferiorly displaced Bankart lesion to the glenoid.

Step 6: Additional Anterior Anchor Placement

In a revision setting, it is important to use at least 3 anchors for the Bankart repair. Once the anteroinferior anchors have been placed, the surgeon can progress up the glenoid face toward the 3 o'clock position, depending on the extent of the Bankart lesion. Typically, the most superior anchor is at the 3 o'clock position, but about 5% to 10% of Bankart lesions can extend superiorly to involve the superior labrum and bicep insertion. The surgeon must be aware of anatomic variations of the anterosuperior labrum such as a sublabral foramen or Buford complex, which should not be "repaired." The authors' preference is for knotless fixation at the 3 o'clock position. The curved suture passer is introduced through the anterior cannula and the PDS suture is passed under the labrum at the 3:30 or 4 o'clock position and retrieved out of the 7 o'clock portal. The broad low-profile suture is tied to the PDS and pulled back under the labrum and out the anterior cannula. A suture retriever is used to pull the other limb of the labral tape out of the anterior cannula, creating a simple suture pattern. The drill sleeve is inserted up onto the glenoid articular cartilage at the 3 o'clock position by the surgeon while the assistant drills through the drill sleeve. The labral tape is passed through the suture anchor (2.9 mm) islet and the anchor is seated into the drilled glenoid site with a mallet. The labral tape ends are cut flush with the glenoid articular surface. This process is repeated if further superior labral stabilization is needed. At the end of the procedure, a load and shift test can be repeated and documented. The complete revision Bankart repair with augmentation can be seen in Figure 4-5.

Postoperative Protocol

- Weeks 1 through 4: Sling for 4 weeks, with motion restricted to 90 degrees of FF, 40 degrees of ER at side, internal rotation to stomach, and 45 degrees of abduction. Passive ROM exercises are started first, followed by active-assist ROM and, ultimately, active ROM as tolerated.
- Weeks 4 through 8: Discontinue sling at 4 weeks. Increase active ROM to 140 degrees of FF, 40 degrees of ER at side, internal rotation to posterior belt, and 60 degrees of abduction. Strengthening begins during this phase, including isometrics, light bands, and scapular stabilizers.
- Weeks 8 through 12: If ROM is lacking, increase to full with gentle passive stretching at end ranges. Advance strengthening as tolerated. Isometrics are first, bands second, and light weights third.
- Months 3 through 12: Strengthening continues 3 times per week, as well as closed chain exercises. Sports-specific rehab begins at 3 months. Return to throwing begins at 4.5 months and throw from mound at 6 months. Full recovery is expected by 1 year.

Potential Complications

Recurrent instability is the most common complication following revision arthroscopic shoulder stabilization. A systematic review of 16 articles and 349 patients undergoing revision arthroscopic Bankart repair found an overall recurrence rate of 12.7%.[11] Other complications may include loss of motion, deep infection, or neurologic injury.

Top Technical Pearls for the Procedure

1. Elevate all of the labrum and capsule as one large sleeve until it can be adequately reduced up onto the glenoid surface.
2. Augment the revision Bankart repair with an inferior and posteroinferior capsulolabral plication through a 7 o'clock portal.
3. Using a trans-subscapularis 5 o'clock portal is helpful to place the anteroinferior anchor in an optimal trajectory, especially in revision cases in which the glenoid may be compromised.
4. Use a double-loaded anchor in the anteroinferior position when bone loss and previous anchors prohibit placement of multiple anchors.
5. Pass the suture under the labrum inferior to the anchor position so the suture will shift and reduce the displaced labrum superiorly to the anchor.

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