



Arthroscopic soft tissue stabilization: single anterior portal technique

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Abstract: Arthroscopic anterior labral repair for anterior shoulder instability has become increasingly popular in recent decades. While open repair has long been considered the gold standard, the advent of suture anchors as well as improved arthroscopic techniques have allowed outcomes following arthroscopic repair to parallel those of open techniques. Arthroscopic procedures have several benefits, including improved cosmesis and post-operative pain control. Appropriate patient selection is critical to outcomes following arthroscopic Bankart repair. The following review highlights key components of the pathoanatomy and patient presentation essential to the success of arthroscopic repair. Surgical technique utilizing a single anterior portal is described, and important technical pearls and pitfalls are summarized.

Keywords: Shoulder instability; arthroscopic Bankart repair; single anterior portal

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Introduction

Open Bankart repair has long been considered the gold standard in treatment of anterior shoulder instability; however, over the past decade, arthroscopic stabilization for anterior instability has gained popularity and is now the favoured technique in many centers. The objectives of an arthroscopic repair mirror those of open methods: the anatomy of the anterior capsulolabral complex is restored and the inferior glenohumeral ligament is re-tensioned. The rise in popularity of arthroscopic management is secondary to advancements in surgical equipment and technique as well as an improved understanding of the underlying pathoanatomy responsible for shoulder instability. The advent of suture anchors over earlier techniques such as transglenoid sutures has resulted in marked improvements in the success of arthroscopic management and allows for multiple points of fixation (1-5). These advancements, along with appropriate patient selection, have yielded

similar outcomes between open and arthroscopic methods, with some authors claiming that appropriately addressing underlying pathology as opposed to the surgical approach itself is more important to outcomes (6).

Several soft tissue lesions are associated with anterior glenohumeral instability. The classic lesion, termed Bankart lesion, is a detachment of the anterior inferior portion of the labrum (2,7). This is thought to be the “essential lesion” in anterior shoulder instability and is typically associated with some degree of capsular stretch (2,7,8). Other associated lesions include an anterior labroligamentous periosteal sleeve avulsion (ALPSA) lesion which is characterized by the avulsed labrum healing in a medialized position along the glenoid neck, a humeral avulsion of the glenohumeral ligament (HAGL) lesion where detachment of the glenohumeral ligament occurs off the humerus, and a Hill-Sachs lesion which is an impaction fracture of the posterior humeral articular surface (1,2,7). Further,

Table 1 Advantages and disadvantages of arthroscopic anterior stabilization

Advantages
Decreased post-operative pain
Less soft tissue dissection
Improved cosmesis
Improved visualization
Appropriate IGHL tensioning
Multiple stitch configuration
Disadvantages
Inability to address bone loss
Cost
Proficiency in arthroscopic surgery

IGHL, inferior glenohumeral ligament.

glenoid bone loss may also accompany anterior instability. This can occur as an acute fracture or, more commonly, secondary to erosion from repeated instability episodes (1). While some of these associated lesions can be addressed arthroscopically if appropriately recognized, bony defects often warrant open approaches. Failing to recognize certain pathoanatomic variables and patient factors will adversely affect results of arthroscopic techniques. Several authors have shown that the most common reason for failure following arthroscopic Bankart repair is significant glenoid bone loss (2,6,9). Generally, glenoid bone loss greater than 20% of the glenoid surface warrants an open procedure (1,2,6). More recent biomechanical and clinical studies out of Korea have shown that perhaps 15-16% bone loss may be a more accurate clinical threshold for failure (10,11). Further, patients with engaging Hill-Sachs lesions are more likely to fail arthroscopic Bankart repair alone (1,8,12). Identification of this lesion requires a dynamic evaluation prior to performing a Bankart repair (1). Appropriate recognition of bony lesions precluding arthroscopic soft tissue repair is essential to patient selection.

Several authors have cited the advantages of arthroscopic stabilization over open procedures (1,6,13). The advantages and disadvantages of arthroscopic Bankart repair are summarized in *Table 1*. Arthroscopic procedures are less invasive when compared to their open counterpart, resulting in decreased post-operative pain as well as improved cosmesis (1,13,14). Arthroscopic techniques allow

for direct intra-articular visualization from various angles with less soft tissue dissection, facilitating the identification of associated lesions as well as a dynamic assessment of the Hill-Sachs lesion (1). Further, appropriate re-tensioning of the inferior glenohumeral ligament can be directly visualized (1). Despite these advantages, no functional advantage to arthroscopic stabilization over open repair has been identified (4). Careful patient selection and appropriate management of underlying pathology has resulted in arthroscopic techniques yielding similar functional outcomes compared to open techniques. Consequently, many surgeons now consider arthroscopic techniques the new gold standard for Bankart repair (1).

Patient selection and workup

Key features on history and physical examination are useful in understanding the type of instability a patient is experiencing and may ultimately help determine if an arthroscopic stabilization procedure is an appropriate option. The most important features to obtain in a thorough history are: (I) the direction of instability (anterior or posterior); (II) the degree of dislocation (subluxation or dislocation); (III) the immediate treatment (self-reduction or assisted reduction); (IV) the predominant symptoms (looseness, apprehension, or pain); (V) age of onset; (VI) number of recurrent dislocations; and (VII) activity level (2,6). It is useful to understand the degree of trauma required to elicit an instability event as well as the arm position when this occurs. Dislocations that occur in the absence of trauma should be evaluated for a volitional component (2). Cases of recurrent dislocation that occur with increasing ease should raise concerns for bone loss (1,2). A complete examination of the shoulder should be obtained in all patients. It is important to assess the neurologic status of the extremity as well as range of motion, scapular motion, and rotator cuff strength which, if abnormal, indicate associated injuries (1,2). Examination findings specific to anterior shoulder instability include the apprehension test, relocation test, and anterior release test (15). Further, patients should be evaluated for generalized laxity with tools such as the Beighton score and tests such as the sulcus sign (2,6).

Standard radiographs should include a true glenohumeral anteroposterior view, axillary lateral view, and a scapular-Y view. Further radiographs may be useful in diagnosing associated bony lesions. The West point view

Table 2 Indications and contraindications of arthroscopic anterior stabilization

Indications
Anterior instability in active patients <30 years old
Recurrent anterior instability
Contraindications
Glenoid bone erosion >20%
Engaging Hill-Sachs lesion
Habitual dislocation
Degenerative joint changes
Active infection
Relative
ISIS >6
Severe capsular deficiency

ISIS, Injury Severity Index Score.

is useful in identifying glenoid bone loss and glenoid rim fractures (2). The Stryker Notch view and anteroposterior view in internal rotation are most useful in identifying Hill-Sachs lesions (2). Bony lesions are best evaluated with a CT scan with 3D reconstruction and humeral head digital subtraction (2). This allows for an accurate assessment of the surface area of bone loss using the best-fit circle method described by Huysmans and colleagues (2,16). Magnetic resonance arthrography (MRA) is the gold standard for evaluating soft tissue lesions prior to arthroscopic evaluation and management (1).

Information gleaned from the history, physical examination, and imaging are useful in determining the success of arthroscopic stabilization. Indications and contraindications for arthroscopic management are summarized in *Table 2*. As previously discussed, significant bone loss on either the glenoid or humeral side represent contraindications to successful arthroscopic management (1,2,6,17-21). Balg and Boileau used key features from history, physical examination, and imaging to estimate the success of arthroscopic repair in a 10-point Injury Severity Index Score (ISIS) (9). This takes into account age, level of sport, type of sport, laxity, Hill-Sachs lesions, and glenoid bone loss (22). Patients with scores of 3 or less were found to have low (5%) rates of recurrence following arthroscopic Bankart repair and those with scores greater than 6 were found to have high (70%) rates of recurrence (1,22,23).

Surgical technique

Patient positioning

With the patient in the supine position, general anaesthesia is administered. After securing the airway, both shoulders are assessed for range of motion, laxity and instability. The patient is then placed in the lateral decubitus position with the operative shoulder positioned superiorly. Tilting the beanbag back slightly keeps the glenoid face parallel to the floor. All bony prominences are padded and an axillary roll is positioned. Ten pounds of traction is applied to the shoulder and it is placed in 40° of abduction and 20° of forward flexion. While either the lateral decubitus position or the modified beach chair position may be used and is a matter of surgeon preference, the authors prefer the lateral decubitus position as it provides improved access to the axillary pouch and posterior recess. Further, it allows for traction to be applied to the shoulder improving visualization (20). Once the patient is appropriately positioned, the arm is sterilely prepped and draped and a surgical pause is carried out.

Portal placement and diagnostic arthroscopy

The posterior viewing portal is established first. This is placed in the “soft spot” just lateral to the glenoid and 1cm inferior to the posterior edge of the acromion (20,24). This portal should be placed so that the camera angle replicates the angle of the glenoid face. A drive-through sign, which is the ability to sweep the arthroscope easily from the superior aspect of the glenohumeral joint to the inferior aspect of the glenohumeral joint and into the axillary pouch, may be noted (20,21,25). This sign is indicative of capsular laxity and injury (25). To establish the anterior working portal, a spinal needle is used for localization. The needle is inserted through the rotator interval and is navigated through the joint to ensure that the instruments used for suture shuttling as well as anchor placement can reach the zone of pathology, most importantly the anterior inferior labrum (*Figure 1*). The ideal angle of approach to the anterior glenoid is 45 degrees particularly for suture anchor drilling (21). Typically, this portal is just superior to the subscapularis tendon and off the anterior corner of the acromion (24). Once the satisfactory position has been selected, the anterior portal is established in line with the spinal needle using an outside-in technique (24).

Traditionally, several authors utilize three standard

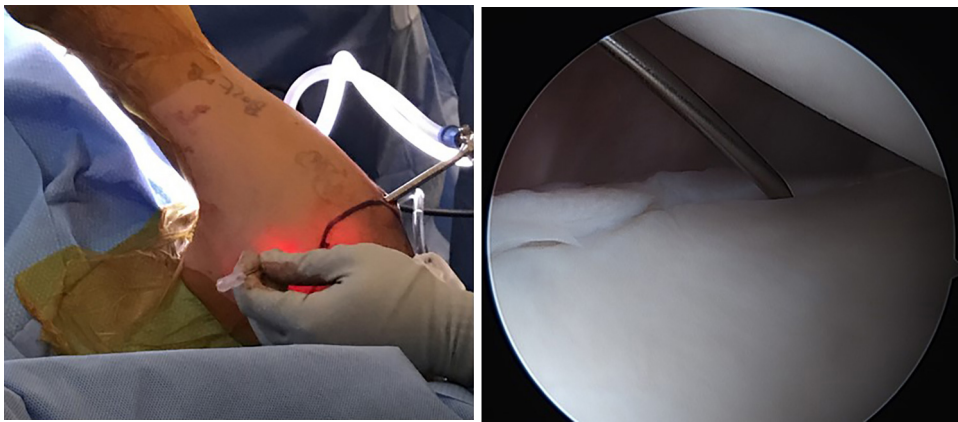


Figure 1 The patient is placed in the lateral decubitus position. Viewing from a standard posterior portal, a spinal needle is used to landmark the location of the anterior portal under direct visualization.

portals when performing anterior labral repairs (2,20). In addition to the two aforementioned portals, an anterior midglenoid portal can be established (2). Recent literature suggests that use of a single anterior portal yields the same outcomes and avoids portal crowding anteriorly (24). The use of a single anterior portal is our preferred technique. In cases where a single anterior portal is insufficient to place the most inferior suture anchor, this anchor may be placed through a separate stab incision without the use of a cannula (21).

A thorough diagnostic evaluation of the glenohumeral joint is then performed. The labrum is visualized from both the anterior as well as the posterior portal and 70° arthroscope is used as necessary, which allows for identification of a possible ALPSA lesion (2,20,21). The biceps tendon and superior labrum are probed to look for concomitant tears. The rotator cuff is then assessed including the subscapularis, which can be torn in settings of anterior instability. It is important to look for a HAGL lesion, which can occur with or without an associated anterior labral lesion (20,21,26). If present, capsular splits may be repaired in a side-to-side manner (20). When avulsed off the humerus, it is difficult to achieve the correct angle of approach for repair through the anterior portal (20). A second anterior portal or open approach may be required to adequately repair the lesion. Failure to address a HAGL lesion when present results in a significantly higher rate of recurrence following repair (1,2,20,21,26).

A thorough evaluation for articular surface lesions is then carried out. While pre-operative CT imaging is used to estimate glenoid bone loss, this should be reassessed and

confirmed at the time of arthroscopy. Following glenoid assessment, the humeral head should be assessed for a bipolar Hill-Sachs lesion. Hill-Sachs lesions are commonly present in anterior instability; however, the majority are not significant (2,8). A Hill-Sachs lesion is best viewed from the standard posterior portal (21). A dynamic assessment is then carried out to determine if the lesion is engaging. A lesion is considered to be engaging if the lesion engages the anterior glenoid rim when the arm is brought into a position of abduction and external rotation (2,8,12). Lesions are more likely to engage if glenoid bone loss is concomitantly present (2,21). Significant Hill-Sachs lesions are those that are engaging or “off-track” lesions, and when present should not be managed with arthroscopic anterior labral repair alone (2,20,21,27). In these instances, a remplissage augmentation should be considered (12,20,21).

Preparing the glenoid

Using an arthroscopic elevator, the labrum and ligamentous complex are thoroughly elevated off the glenoid neck as a single unit (*Figure 2A*). A grasper is used to assess the mobility of the tissue. The release is adequate once the muscle fibers of the subscapularis are visible and the labrum “floats up” to the level of the glenoid rim (2,20). There is typically a capsular stretch injury with inferior capsular redundancy, requiring the capsulolabral complex to be shifted in an inferior-to-superior direction in order to re-establish physiologic tension (2,20). In cases of patients with ligamentous laxity, a more than physiologic shift may be opted to address concerns of capsular redundancy. The

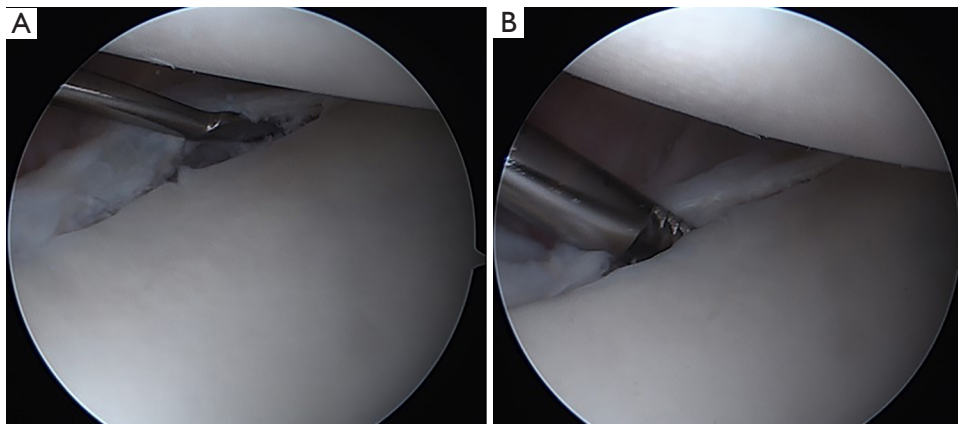


Figure 2 View of glenohumeral joint from posterior portal. (A) An elevator is used to mobilize the anteroinferior labrum from the glenoid neck; (B) a shaver is used to create a bleeding bone bed for healing along the anteroinferior glenoid rim in the area of labral repair.

glenoid rim is then gently decorticated using a combination of a burr, shaver or a rasp (*Figure 2B*). The goal is to create a bleeding bone bed for healing without causing iatrogenic glenoid bone loss (2,20). A small curette may be used to remove 1–2 mm strip of articular cartilage from the anterior glenoid rim to prevent the capsule from healing in a medialized position following repair (20,21).

Anterior capsulolabral repair

The inferior most anchor is placed first. Through the anterior portal, a drill hole is placed on the inferior glenoid at a position 2 mm onto the articular face. This is typically at the 5:00 o'clock or 5:30 o'clock position and placing this first anchor inferior enough to appropriately address the pathology present is critical to the outcome of the repair (28). A suture anchor (Bio-SutureTak, Arthrex; Naples, FL) is impacted into position using a mallet at angle 45 degrees to the glenoid face (2,20). Using the same anterior portal with the sutures from the anchors parked at the side, a tissue penetrator preloaded with a monofilament wire loop is pierced through the capsule and under the torn labrum at the articular margin along the most anteroinferior point (at the 5:00–5:30 o'clock position) on the glenoid (*Figure 3A*). Tissue is typically grabbed more inferior than the location of the suture anchor in order to perform an inferior to superior capsular shift in addition to a lateral to medial shift. The axillary nerve lies closest to the 6:00 o'clock position and care should be used to avoid this area (2). It is our preference to take a shallower

amount of capsular tissue in this area to avoid iatrogenic injury. After passing through the soft tissue, the wire loop is deployed and the penetrator is retracted out of the capsule and removed from the shoulder. It is important to continue feeding the wire while removing the tissue penetrator to avoid de-threading the capsule. With the free ends of the wire parked on the side of the anterior portal, a suture retriever is then introduced through the same anterior portal to bring the looped end of the wire with one limb of the suture anchor simultaneously out of the shoulder to avoid tangling (*Figure 3B*). Careful suture management is critical when using a single anterior portal technique. Next, the retrieved single limb of suture from the anchor is loaded onto the loop wire which is then shuttled through the capsule and labral complex (*Figure 3C*). Standard arthroscopic knot-tying technique is then utilized to secure the fixation.

After the lowest anchor, and especially above the equator, we prefer to use knotless anchors (PushLock, Arthrex; Naples, FL), as shown in *Figure 4*. Knotless anchors avoid potential irritation to the articular cartilage from a prominent suture knot while providing the same degree of fixation to the glenoid (29,30). Each suture is secured and cut before the next anchor is placed in order to simplify suture management (20). The shoulder should be held in neutral to 45 degrees of external rotation when tying sutures to avoid over tensioning (24). These steps are repeated for each anchor used, moving sequentially more superior. An ideal repair has three or more anchors placed inferior to the 3:00 o'clock position, spaced 5–7 mm apart (2,13,20,24).



Figure 3 Steps in repairing the labrum viewed from posterior portal. (A) The tissue penetrator is passed through the capsule and beneath the torn labrum at the 5:30 o'clock position; (B) a grasper is used to retrieve the wire loop from the anterior portal; (C) labrum is repaired back onto the glenoid.

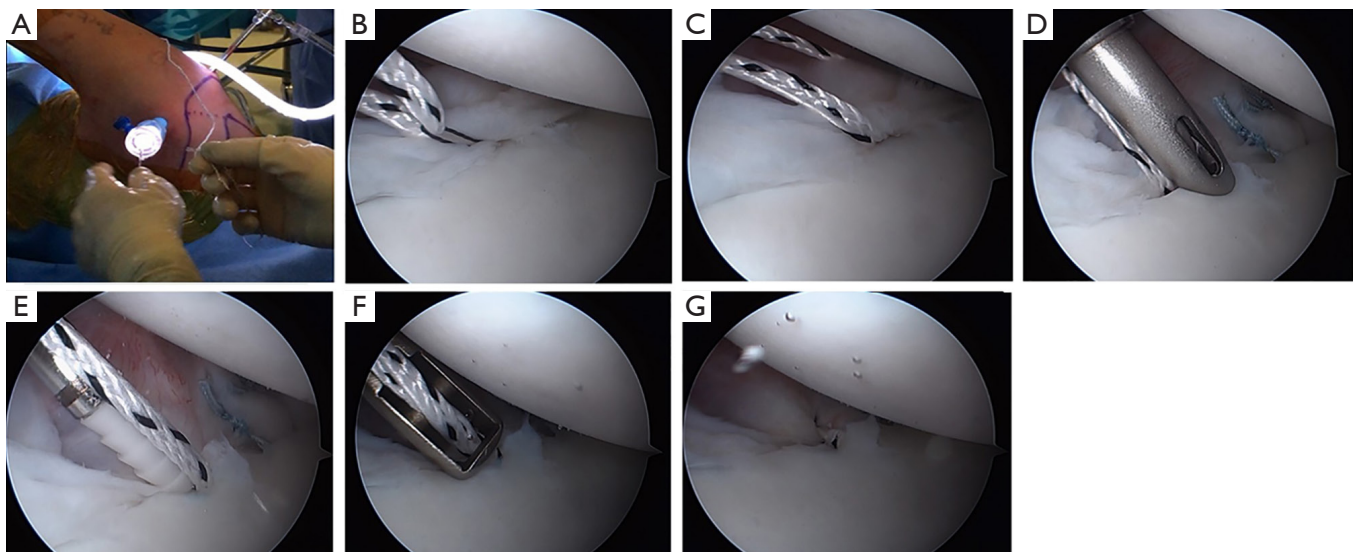


Figure 4 Steps demonstrating anterior labrum repair using single anterior working portal. (A) The fiber loop is retrieved from the anterior portal and used to shuttle a low-profile polyethylene suture (LabralTape, Arthrex; Naples, FL); (B) the polyethylene suture is loaded and the opposite end of the wire is pulled; (C) this shuttles the suture through the tissue. The polyethylene suture is then threaded into a knotless anchor; (D) a hole is drilled on the glenoid in the desired position; (E) the hole is then filled with the knotless anchor, thus fixing the lesion; (F) the tails of the polyethylene sutures are cut flush against the tissue; (G) the repair is visualized to ensure appropriate tension and recreation of the anterior labrum.

Once completed, the repaired labrum is assessed for stability using a probe. When viewed from the anterior portal, the humeral head should be well centered on the glenoid, indicating balanced soft tissue tensioning (20). Secondary to reduced capsular volume, the arthroscope will now be difficult to maneuver inside the joint and the drive-

through sign will be abated (24).

Post-operative management

After the wounds are closed, the arm is taken out of traction and placed in an abduction sling. To facilitate the

Table 3 Postoperative rehabilitation protocol

Weeks	Protocol
0–4 weeks	Sling immobilization Ice/cryocuff Hand/wrist/elbow ROM exercises
4–6 weeks	Pendulum exercises Begin passive ROM with external rotation limit to 30 for the first 6 weeks and forward elevation in scapular plane
6–12 weeks	Passive ROM to progress to full after 6 weeks Active assisted and active ROM (FE to 180°, ER to 60°) at 8 weeks Isometric exercises Scapular strengthening and postural exercises Stretching exercises for deficiency in motion
12–24 weeks	Progressive resistance exercises Isotonic and isokinetic exercises are advanced Strengthening with restrictions to avoid rotator cuff tendonitis Light gym activities at 4 months Sports-specific exercises—once full motion, normal strength at 5 months
>24 weeks	Full, unrestricted activities

ROM, range of motion.

biologic repair process, the shoulder is immobilized in neutral rotation for 4–6 weeks. Return to full, unrestricted activities and sports is at 6 months, postoperatively. The postoperative rehabilitation protocol is shown in *Table 3*. Modifications in the rehabilitation protocol may be made based on integrity of the tissue at the time of repair and concomitantly performed procedures (2).

Outcomes

With modern anchors and techniques, the results following arthroscopic anterior stabilization procedures are similar to those of their open counterparts (1). Outcomes are most commonly quantified based on redislocation following repair, but some authors include return to sport, patient reported outcome measures, and the sensation of instability in outcome assessment. In a study by Armangil and colleagues, the single anterior portal technique was

specifically investigated (24). They found that with this technique redislocation rates were 5.6% (24). This is in keeping with redislocation rates reported in the literature following arthroscopic repair, which range from 5–18% (1,3,31,32). The most common cause of failure following arthroscopic stabilization is due to glenoid and/or humeral bone deficiencies (2,8,9,33). Other reasons for failure are related to subsequent trauma, age, gender, technical factors, initial causes of instability, and time from instability to surgery (6,19). Many of the causes of failure can be avoided by careful patient selection.

Discussion

The most efficacious management of anterior shoulder instability has been widely investigated in the literature. Surgical management for recurrent instability has long been the standard, with mounting evidence supporting the effectiveness of surgical management following first time dislocation in high risk young individuals (3). Both open and arthroscopic management of anterior shoulder instability yield favorable results (4). In recent decades, arthroscopic procedures have increased dramatically. With this, our understanding of factors predictive of failure as well as overall outcomes following arthroscopic repair have also risen.

Several studies have assessed long-term outcomes following arthroscopic stabilization. A study by Aboalata and colleagues assessed 104 patients who underwent arthroscopic Bankart repair with a minimum of 10-year follow-up (31). They found that the overall patient satisfaction rate was 92.3% and return to pre-injury activity level was 49.5%. Redislocation rates were 18%, influenced significantly by patient age, history of recurrent dislocations, and duration of post-operative rehabilitation (31). Moderate to severe degenerative changes occurred in 12% of patients and was related to the number of dislocation events as well as the number of anchors used (31). These findings are in keeping with a review by Harris and colleagues, which found an 11% redislocation rate and a 26% rate of degenerative changes following arthroscopic stabilization at a mean of 11 years (32). These authors compared outcomes for arthroscopic and open procedures and concluded that the results were similar between the two methods (32).

Factors predictive of inferior outcomes as well as intra-operative and post-operative complications have also been well documented. Appropriately selected patients are imperative to favourable results. Significant glenoid and/

or humeral head bone loss is the most common reason for failure following arthroscopic anterior stabilization procedures, but unidentified HAGL lesions and rotator cuff tears also play a significant role (14,34). Further, Bankart repairs performed for patients misdiagnosed as having anterior instability or those who habitually or can voluntarily dislocate their shoulders can result in decreased range of motion, degenerative changes, and poor results with early failure (34). Intra-operative complications include injury to the axillary or musculocutaneous nerves, hardware failure, and insufficient soft-tissue tension related to improperly placed anchors (34). Bioabsorbable tacks are available for glenoid fixation, however, their use has been associated with recurrent effusions, stiffness, and synovitis and therefore their use is not recommended (34). Post-operatively, patients may be affected by stiffness, pain, infection, or chondrolysis (34). Careful attention to patient selection and intra-operative details can minimize these complications and improve results. In cases where recurrence or unsatisfactory results occur, both arthroscopic and open procedures can yield satisfactory results when applied to appropriately selected patients (18).

Pearls and pitfalls

- (I) Appropriate patient selection is critical to the success of arthroscopic procedure. Failure to appreciate significant bone loss will result in a higher rate of recurrent instability. The risk factors outlined by the ISIS are utilized to determine patient suitability for arthroscopic repair. In appropriately selected patients, outcomes following arthroscopic repair approach those of open management.
- (II) When performing labral surgery, our preference is to utilize the lateral decubitus positioning. In our experience, this position gives us improved exposure of the entire glenoid.
- (III) The diagnostic arthroscopy should include an estimation of glenoid bone loss and a dynamic assessment of the Hills-Sachs lesion. Pathology should be viewed from the anterior and posterior portal utilizing combination of both 30° and 70° arthroscope. Associated findings, such as ALPSA and HAGL lesions, should be looked for specifically.
- (IV) To successfully utilize the single anterior portal technique, the position is first localized using a spinal needle. The portal must be placed such that instruments can reach all pathologic areas on

the anterior glenoid with an appropriate angle of approach. The most difficult area to reach is the inferior pouch, and careful attention should be paid to this area when establishing the anterior portal.

- (V) Careful suture management is critical for a single anterior portal technique to avoid suture tangling.
- (VI) If there is difficulty obtaining the appropriate trajectory for drilling or insertion of the inferior anchor using the anterior portal, rather than compromising fixation, a stab incision is made for percutaneous trans-subscapularis anchor placement.
- (VII) Overly aggressive passage of the tissue penetrator in the inferior capsule puts the axillary nerve at risk. By taking shallower capsular penetration in this region, the risk of iatrogenic injury is minimized.
- (VIII) The repair is carried out in an inferior to superior direction, shifting capsulolabral tissue superiorly as each fixation point is secured. Bites taken inferior to the suture anchor can ensure an inferior to superior shift. At least three anchors should be placed, with adequate fixation below the equator on the glenoid.
- (IX) At the completion of the repair the anterior labral bumper should be re-established and the humeral head should be centered within the glenoid.

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aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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