MIS Techniques in Orthopedics

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This book is dedicated to our families,
who allow us to pursue our dreams and careers,
and to our colleagues, with whom we wish to share our ideas.

Preface

Minimally invasive surgery (MIS) is changing the way orthopedic surgery is practiced and is now considered state-of-the-art. There are rapid advances in the surgical techniques with the introduction of navigation and robotics, which assist the surgeon in performing the procedure with limited visualization. This edition of *MIS Techniques in Orthopedics* elaborates on current techniques for the hip and knee, and also introduces the most recent sections on the upper extremity and computer navigation. The contributing authors are experts in the field and share with the reader their experiences and surgical pearls. Keeping pace with new techniques and technologies in orthopedic surgery can be very demanding; our hope is that surgeons will find this text a useful reference as they embark upon minimally invasive surgery.

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Section I

The Shoulder and Elbow

1

Mini-Incision Bankart Repair for Shoulder Instability

Edward W. Lee and Evan L. Flatow

The tenuous balance between stability and motion of the glenohumeral joint often results in one of the most common problems encountered by the orthopedic surgeon. Historically, surgical treatment of glenohumeral instability was generally indicated only for recurrent anterior dislocations. The breadth of operative procedures to treat anterior shoulder instability has included staple capsulorraphy,[1] subscapularis transposition,[2] shortening of the subscapularis and anterior capsule,[3] transfer of the coracoid,[4] and osteotomies of the proximal humerus[5] or the glenoid neck.[6] In terms of measuring clinical success based on recurrence of dislocation, these various procedures were very effective. However, restricted external rotation and overhead motion sacrificed stability at the expense of function and led to the recognition of late glenohumeral osteoarthrosis following some of these repairs.[7–11] Furthermore, the traditional limited operative indications failed to account for the growing awareness of subluxations as a source of symptomatic instability.[12–15] Better understanding of glenohumeral joint biomechanics, the role of the capsuloligamentous structures, and their modes of failure has led to an emphasis on restoration of normal anatomic relationships.

Anatomy and Biomechanics

Multiple structures are involved in maintaining stability of the shoulder. The balance between stability and permitting a wide range of motion is provided by the interaction of dynamic and static factors. The static stabilizers include the glenoid, labrum, capsule, glenohumeral ligaments, and the rotator interval. The role of the biceps tendon as a static stabilizer is unclear but is also thought to contribute to glenohumeral joint stability.

The glenoid provides a small, shallow surface to articulate with the humeral head and provides little constraint for the glenohumeral joint. The fibrocartilaginous labrum attaches to the glenoid rim and increases its effective depth and surface area. Isolated labral deficiency has been shown not to allow glenohumeral dislocation without associated injury to the capsule, emphasizing the crucial role of the capsuloligamentous structures in maintaining stability.

The three major glenohumeral ligaments function as *check-reins* toward the extremes of motion while remaining relatively lax in the mid-range to allow normal joint translation. Turkel et al.[16] found that the contributions of these structures were position dependent. The superior glenohumeral ligament, coracohumeral ligament, and the rotator interval (between the leading edge of the supraspinatus and the superior edge of the subscapularis) restrain anterior humeral head translation in 0 degrees of abduction and external rotation. With increasing abduction to 45 degrees, the middle glenohumeral ligament provides the primary anterior restraint. Finally, the inferior glenohumeral ligament (IGHL) tightens and becomes the prime anterior stabilizer at 90 degrees of abduction and 90 degrees of external rotation. Biomechanical study of the IGHL demonstrated tensile failure at the glenoid insertion or in midsubstance. Significant deformation, however, was observed in midsubstance even if the ultimate site of failure occurred at the insertion.[17]

The rotator cuff and scapular stabilizers serve as dynamic restraints in normal shoulder biomechanics. A primary role of the rotator cuff is to resist translational forces on the joint through compression of the humeral head into the glenoid cavity. Scapular winging, an imbalance of the scapular stabilizing musculature, has been implicated in pain and instability of the glenohumeral joint. Operative intervention addressing scapulothoracic dysfunction may lead to elimination of symptoms in select cases.

Clinical Features

Patient History

Critical to the evaluation of glenohumeral instability is a careful history and physical examination. The nature of the injury surrounding the onset of symptoms should be determined and is particularly useful in identifying the type of instability. Position of the arm at the time of injury or circumstances that provoke symptoms often indicates the direction of instability. Reproduction of a patient's symptoms in a position of abduction, external rotation, and extension suggests anterior instability. Flexion, internal rotation, and adduction, in contrast, would more likely point to posterior instability.

In determining the degree and etiology of instability, the history should ascertain whether the initial and any subsequent episodes of instability were elicited by high-energy trauma (such as violent twisting or fall), minimal repeated trauma (such as throwing a ball), or no trauma (such as reaching a high shelf). An initial dislocation resulting from a single traumatic episode frequently produces a Bankart lesion. In contrast, capsular laxity and absence of a Bankart lesion often is found in those patients who suffer an atraumatic dislocation, multijoint laxity, and several shoulder subluxations prior to a frank dislocation. The type of reduction required (i.e., was the shoulder self-reduced or did it require manipulation by another person?) may also provide additional information about the extent of joint laxity.

Acquired instability was described by Neer in which cumulative enlargement of the capsule results from repetitive stress.[18] Overhead athletes develop isolated shoulder laxity from overuse with no evidence of laxity in other joints. These patients may become symptomatic after years of microtrauma or only after a frank dislocation following a single traumatic event. This patient group demonstrates that multiple etiologies may contribute to instability and underscores the need for careful diagnosis and treatment to address coexisting pathologic entities.

Voluntary control of instability must be carefully sought as this may change the ultimate course of treatment. Patients with psychiatric disorders may use a concomitant ability to dislocate the shoulder for secondary gain. While operative intervention in this situation would likely fail, treatment options exist for other forms of voluntary subluxation. Surgery may benefit patients who can subluxate the shoulder by placing the arm in provocative positions. Biofeedback techniques, however, may help those patients who sublux through selective muscular activation.[19]

Detailed record of prior treatment should also be obtained, including the type and duration of immobilization, rehabilitative efforts, and previous surgeries. Knowledge of failed interventions helps guide future treatment in the recurrent dislocator.

Pain as an isolated symptom does not typically reveal much useful information. Anterior shoulder pain may indicate anterior instability as well as other common disorders including subacromial impingement. Similarly, posterior shoulder pain is nonspecific and may represent a range of pathology from instability to cervical spine disorders. Location of the pain in combination with provoking arm positions and activities, however, may aid in making a diagnosis of instability. Altered glenohumeral kinematics in throwers, for example, may result in posterior shoulder pain during late-cocking (internal impingement).[20]

Patients may also report other symptoms consistent with subtle shoulder instability. Rowe and Zarins[21] described a phenomenon termed the *dead-arm syndrome* in which paralyzing pain and loss of control of the extremity occurs with abduction and external rotation of the shoulder. A similar phenomenon may be seen in patients with inferior subluxation when they carry heavy loads in the affected arm.

Finally, determining the patient's functional demands and level of impairment is important prior to formulating a therapeutic plan. The different expectations of a sedentary patient with minimal functional loss versus the high-performance athlete with pain and apprehension may affect the type of prescribed treatment.

Physical Examination

A thorough physical examination is equally essential in making an accurate diagnosis and recommending the appropriate intervention. Both shoulders should be adequately exposed and examined for deformity, range of motion, strength, and laxity. Demonstration of scapular winging may accompany instability, particularly of the posterior-type, and should be considered a potential cause of symptoms. Generalized ligamentous laxity may also contribute to instability and can be elicited with the ability to touch the thumb to the forearm and hyperextend the

A

B

Figure 1.1. Tests for generalized ligamentous laxity. (A) Thumb-to-Forearm. (B) Index metacarpophalangeal joint hyperextension.

index metacarpophalangeal joint beyond 90 degrees (Figure 1.1). Operative reports and evidence of healed anterior or posterior scars from previous instability repairs will indicate what has been done and may provide a rationale for the patient's current symptoms.

Tenderness to palpation of the acromioclavicular joint should be sought and may represent the source of symptoms in a patient with an asymptomatic loose shoulder. Pain along the glenohumeral joint line can be associated with instability but is a nonspecific finding.

Typically, there is a full range of motion with the exception of guarding at the extremes as the shoulder approaches unstable positions. Clinical suspicion should be raised, however, in the patient older than 40 years of age who is unable to actively abduct the arm after a primary anterior dislocation. It has been shown that a high percentage of these patients will have a concurrent rupture of the rotator cuff with restoration of stability following repair.[22]

Various basic provocative tests can be used to reproduce the patient's symptoms and confirm the diagnosis. In order to minimize the effects of muscle guarding, these maneuvers should be performed first on the unaffected side and then in succession of increasing discomfort. The *sulcus test* evaluates inferior translation of the humeral head with the arm at the side and in abduction[23] (Figure 1.2). Significant findings would include an increased palpable gap between the acromion and humeral head compared to the opposite side as well as translation below the glenoid rim. Incompetence of the rotator interval will not reduce the gap with performance of the test in external rotation.

Laxity can be further evaluated by anterior and posterior drawer or load-and-shift tests.[24] The proximal humerus is shifted in each direction while grasped between the thumb and index fingers. Alternatively, with the patient supine, the scapula is stabilized while the humeral head is axially loaded and translated anteriorly and posteriorly. Translation greater than the opposite shoulder or translation over the glenoid rim indicates

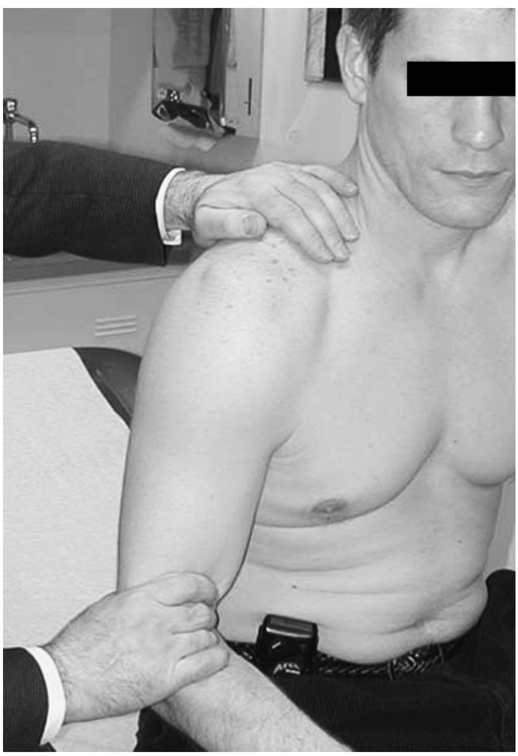


Figure 1.2. Sulcus sign. Downward traction of the arm will create a gap between the acromion and the humeral head.

A

B

Figure 1.3. (A) Anterior/posterior drawer: translation of the humeral head held between the thumb and index finger and stabilization of the scapula with the other hand. (B) Load-and-shift: simultaneous axial loading and translation of the humeral head.

significant laxity. Only translations which reproduce the patient's symptoms are considered as demonstrating instability (Figure 1.3).

The anterior apprehension test is performed by externally rotating, abducting, and extending the affected shoulder while stabilizing the scapula or providing an anteriorly directed force to the humeral head with the other hand. Significant findings would include a sense of impending subluxation or dislocation, or guarding and resistance to further rotation secondary to apprehension.[25] Pain as an isolated finding is nonspecific and may indicate other pathology such as rotator cuff disease. *Jobe's relocation test* is done in the supine position, usually accompanying the apprehension test. As symptoms are elicited with progressive external rotation, the examiner applies a posteriorly directed force to the humeral head. A positive test is signified by alleviation of symptoms[26] (Figure 1.4).

A

B

Figure 1.4. (A) Apprehension test: abduction and external rotation will produce sense of impending subluxation/dislocation with anterior glenohumeral instability. (B) Relocation test: posterior-directed force on the humeral head will alleviate symptoms.

Posterior instability can be elicited with the *posterior stress test*. As one hand stabilizes the scapula, a posteriorly directed axial force is applied to the arm with the shoulder in 90 degrees of flexion, abduction and internal rotation. Unlike the anterior apprehension test, the posterior stress test usually produces pain rather than true apprehension.[27]

Radiographic Features

Though the history and physical examination are the key elements in patient evaluation, a series of radiographic studies may be helpful in confirming the diagnosis and defining associated pathology. Anteroposterior (AP) radiographs in internal and external rotation, a lateral view in the scapular plane (scapular-Y view), and a lateral of the glenohumeral joint (i.e., a standard supine axillary or Velpeau axillary view) should be obtained in the initial evaluation. A Hill-Sachs lesion (posterolateral impression fracture) of the humeral head is best seen on the AP radiograph in internal rotation (Figure 1.5) or on specialized views such as the Stryker Notch.[28] Fractures or erosions of the glenoid rim can be detected on an axillary or apical oblique view (Garth).[29]

Other more specialized imaging studies are not routinely obtained in the initial evaluation of instability but may be useful in a preoperative workup. Computed tomography can assist in further assessment of fractures and glenoid erosions or altered glenoid version as well as detect subtle subluxation of the humeral head.[30,31] MRI and MR arthrography can identify associated pathology of the labrum, glenohumeral ligaments, and the rotator cuff.[32–34] The addition of abduction and external rotation has been shown to increase the sensitivity of MR arthrography in delineating tears of the anterior labrum.[35,36] More

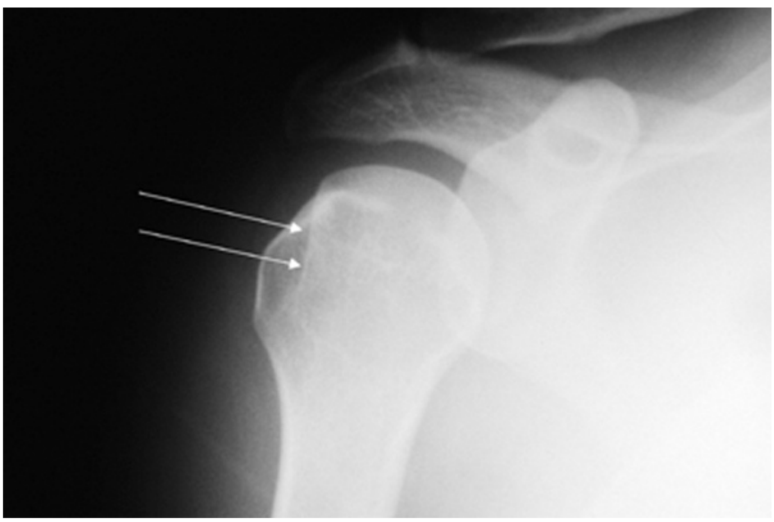


Figure 1.5. Hill-Sachs lesion. An impaction fracture of the posterolateral humeral head associated with an anterior glenohumeral dislocation is depicted by the small white arrows on this internally rotated anteroposterior radiograph.

recent radiographic modalities such as dynamic MR imaging currently have no defined indications but may become a useful adjunct in evaluating glenohumeral instability.[37]

Treatment

Nonoperative Treatment

Although the results vary with age and associated bone and soft-tissue injury, nonoperative treatment consisting of a period of immobilization followed by rehabilitation is typically successful in managing the majority of patients with glenohumeral instability. Early studies of young (less than 20 years old), athletic patients, however, found a recurrence rate as high as 90% after a primary dislocation.[38,39] While subsequent studies have reported lower numbers,[40,41] clearly the risk for subsequent dislocations is higher with earlier onset of instability.

The length and type of immobilization remains a matter of debate. Several published series have advocated immobilization for a few days to several weeks. However, studies by Hovelius[41] and Simonet and Cofield[40] have found no difference in outcome from either the type or length of immobilization. In general, younger patients (less than 30 years of age) sustaining a primary dislocation are preferably immobilized for approximately 3 to 4 weeks. Older patients, who have a smaller risk of recurrent instability but a higher susceptibility to stiffness, may be immobilized for shorter periods.

Rehabilitation efforts are aimed at strengthening the dynamic stabilizers and regaining motion. Progressive resistive exercises of the rotator cuff, deltoid, and scapular stabilizers are recommended. Stress on the static restraints (i.e., capsuloligamentous structures) should be prevented in the immediate postinjury period by avoidance of vigorous stretching and provocative arm positions.

Operative Treatment

Failure of conservative management for glenohumeral instability is an indication for proceeding with operative intervention. Open procedures are currently the gold standard for repair of the disrupted soft-tissue shoulder stabilizers.

Modern techniques emphasize anatomic restoration of the soft-tissue structures. Based on the work of Perthes in 1906,[42] Bankart,[43] in 1923, popularized repair of the capsule to the anterior glenoid without shortening of the overlying subscapularis. After modifications to his original description, reconstruction of the avulsed capsule and labrum to the glenoid lip is commonly referred to today as the *Bankart repair*. Several capsulorraphy procedures have also been described to address capsular laxity and the increase in joint volume. These procedures allow tightening of the anterior capsule in combination with reattachment of a capsulolabral avulsion.

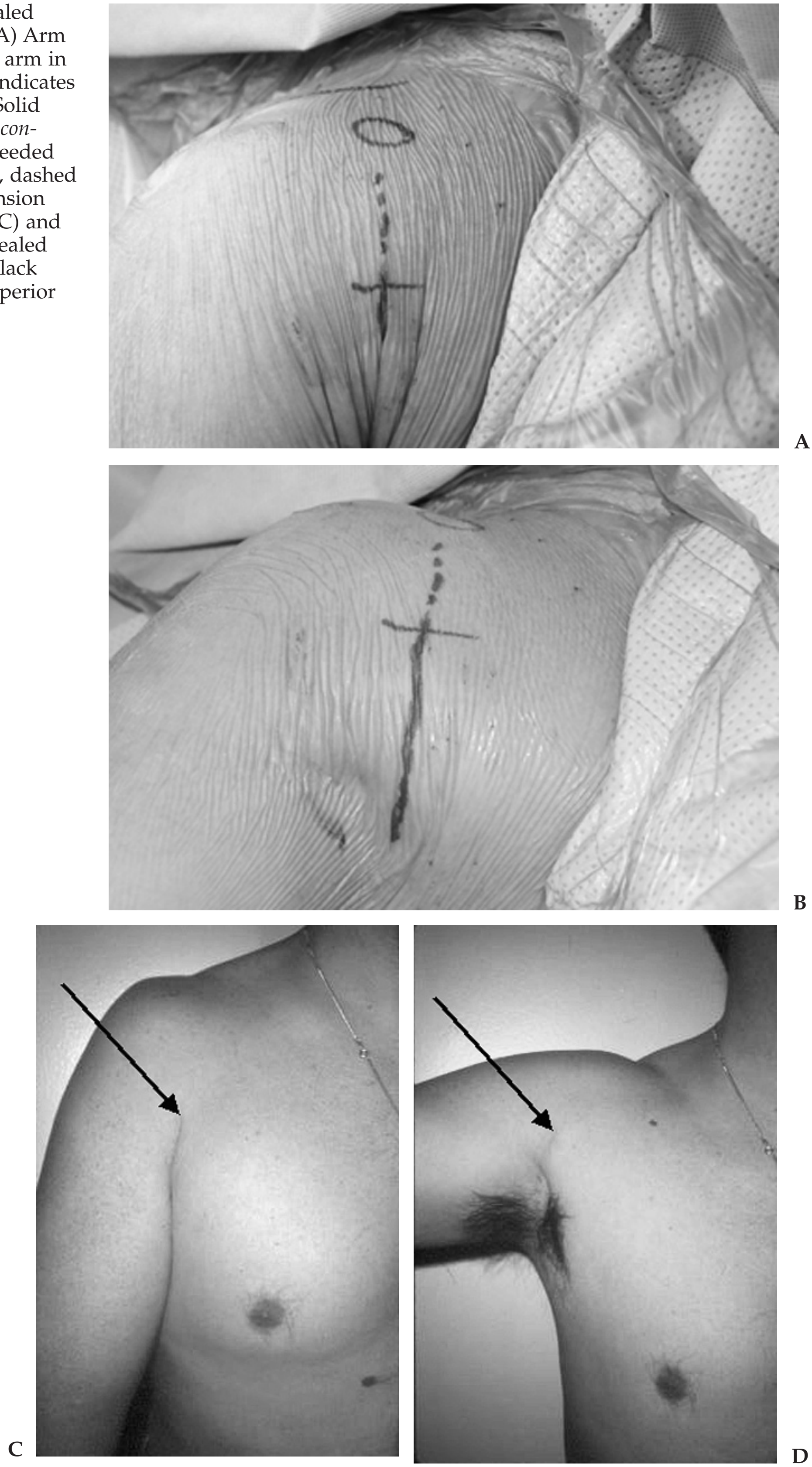
The inferior capsular shift was first introduced by Neer and Foster for multidirectional instability.[44] This procedure can reduce capsular volume through overlap of capsular tissue on the side of greatest instability and reducing tissue redundancy by tensioning the inferior capsule and opposite side. For anterior inferior instability, we prefer to use a modified inferior capsular shift procedure, in essence, a laterally based T capsulorraphy, which allows us to adapt the repair to each individual.[45,46]

The rationale behind this universal approach to instability is predicated on several factors. First, the capsule is shaped like a funnel with a broader circumferential insertion on the humeral side. Implementing a laterally based incision allows the tissue to be shifted a greater distance and reattached to the broader lateral insertion, thus allowing more capsular overlap. Second, following intraoperative assessment of the inferior pouch and capsular redundancy, the inferior shift procedure permits variable degrees of capsular mobilization around the humeral neck to treat different grades of tissue laxity. Third, use of a T capsulorraphy permits independent tensioning of the capsule in the medial-lateral and superior-inferior directions. Medial-lateral tensioning is usually a secondary concern, and if overdone, may result in loss of external rotation. Fourth, a lateral capsular incision affords some protection to the axillary nerve, particularly during an inferior dissection as the nerve traverses under the inferior capsule. Finally, capsular tears/avulsions from the humeral insertion, although rare, are more readily identified and repaired with a laterally based incision.

The patient is placed in a beach-chair position although slightly more recumbent than when performing a rotator cuff repair. We prefer interscalene regional block anesthesia at our institution because of its safety and ability to provide adequate muscle relaxation. Examination under anesthesia should be performed prior to breaching the soft tissues to confirm the predominant components of instability. The key to a mini-open Bankart procedure is the use of a concealed anterior axillary incision starting approximately 3 cm below the tip of the coracoid and extending inferiorly for 7 cm to 8 cm into the axillary recess (Figure 1.6). Local anesthetic is injected into the inferior aspect of the wound where thoracic cross-innervation prevents a complete block in this area. Full-thickness subcutaneous flaps are mobilized until the inferior aspect of the clavicle is palpated. The deltopectoral interval is then developed taking the cephalic vein laterally with the deltoid. If needed, the upper 1 cm to 2 cm of the pectoralis major insertion may be released to gain further exposure. The clavipectoral fascia is then gently incised lateral to the strap muscles, which are gently retracted medially. Osteotomy of the coracoid should not be necessary and may endanger the medial neurovascular structures. A small, medially based wedge of the anterior fascicle of the coracoacromial ligament may be excised to increase visualization of the superior border of the subscapularis muscle, rotator interval, and anterior aspect of the subacromial space.

The upper and lower borders of the subscapularis are identified. The anterior humeral circumflex vessels are carefully isolated and ligated. Preservation of the inferior border of the subscapularis to provide protection to the axillary nerve has been suggested.[47] This may be a reasonable option in true unidirectional instability cases; however, inadequate exposure of the inferior capsule may compromise the

Figure 1.6. Concealed axillary incision. (A) Arm at the side and (B) arm in abduction. Circle indicates coracoid process. Solid line indicates true *concealed* incision; if needed for more exposure, dashed line indicates extension toward coracoid. (C) and (D) demonstrate healed axillary incision. Black arrows indicate superior extent of incision.



ability to correct any coexisting inferior laxity component. Another approach splits the subscapularis longitudinally in line with its fibers making visualization of the glenoid rim more difficult but motion is less restricted postoperatively. This approach may be useful in athletes who throw, in whom any restriction in external rotation postoperatively should be avoided.[48] We prefer to detach the tendon 1 cm to 2 cm from its insertion onto the lesser tuberosity, careful not to stray too medial into the muscle fibers and compromise the subscapularis repair. Blunt elevation of the muscle belly from the capsule medially may permit easier identification of the plane between the two structures.

Examination of the rotator interval is essential during dissection of the capsule and subscapularis. As one of the primary static stabilizers of the glenohumeral joint, the rotator interval can be an important component of recurrent anterior instability. We repair it when it is widened, aware that overly tightening the gap will limit external rotation.

The capsule is then incised laterally leaving a 1-cm cuff of tissue for repair while placing traction sutures in the free edge. Placing the arm in adduction and external rotation maximizes the distance between the incision and axillary nerve which should be palpated and protected throughout the procedure.

The extent of capsular dissection and mobilization depends on the components of instability. Unidirectional anterior instability will only require dissection of the anterior capsule. Bi-directional anterior-inferior instability requires the addition of inferior capsular mobilization to eliminate the enlarged capsule. In these cases, the shoulder is gradually flexed and externally rotated to facilitate sharp dissection of the anterior and inferior capsule off the humeral neck. A finger can be placed in the inferior recess to assess the amount of redundant capsule and the adequacy of the shift. As more capsule is mobilized and upward traction is placed on the sutures, the volume of the pouch will reduce and push the finger out indicating an adequate shift.

The inferior component in unidirectional instability is minimal, and thus, an inferior shift and the horizontal incision may be unnecessary. With a significant inferior capsular redundancy, the horizontal limb of the T in the capsule is made between the inferior and middle glenohumeral ligaments. A Fukuda retractor is then placed to visualize the glenoid (Figure 1.7). If the capsule is thin and redundant medially, a *barrel* stitch can be used to tension it as well as imbricate the capsule at the glenoid rim to serve as an additional bumper to augment a deficient labrum[49] (Figure 1.8).

Effectiveness of a shift requires anchoring of the capsule to the glenoid. When the glenohumeral ligaments and labrum are avulsed from the bone medially, they must be reattached to the glenoid rim (Figure 1.9). The Bankart lesion must be anchored to the rim before performing the capsulorraphy because the capsule must be secured to the glenoid for the shift to be effective. This can be accomplished inside out, anchoring the labrum with sutures through bone tunnels. After the glenoid rim is roughened with a curette or high-speed burr, two to three sets of holes are made adjacent to the articular surface and through the glenoid rim. Curved awls, angled curettes, and heavy towel clips may

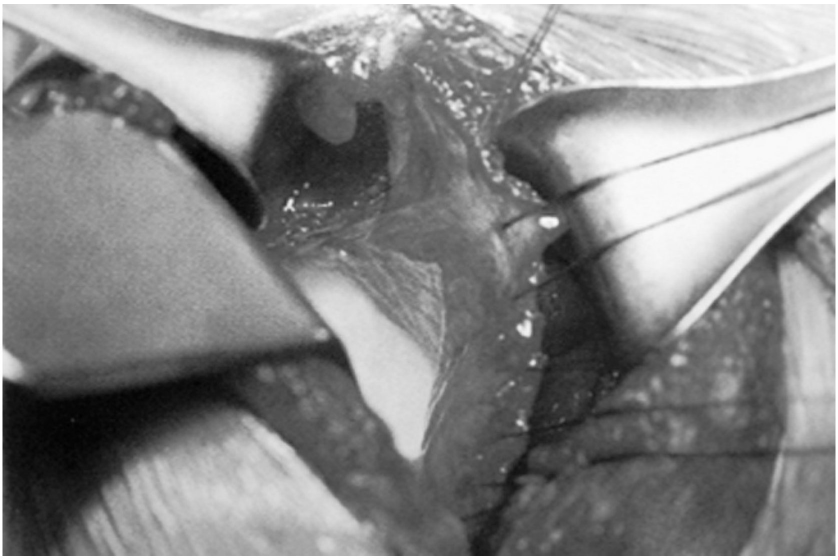


Figure 1.7. Mobilization of the capsule and placement of traction sutures in the free edge. A Fukuda retractor is placed allowing inspection of the glenoid.

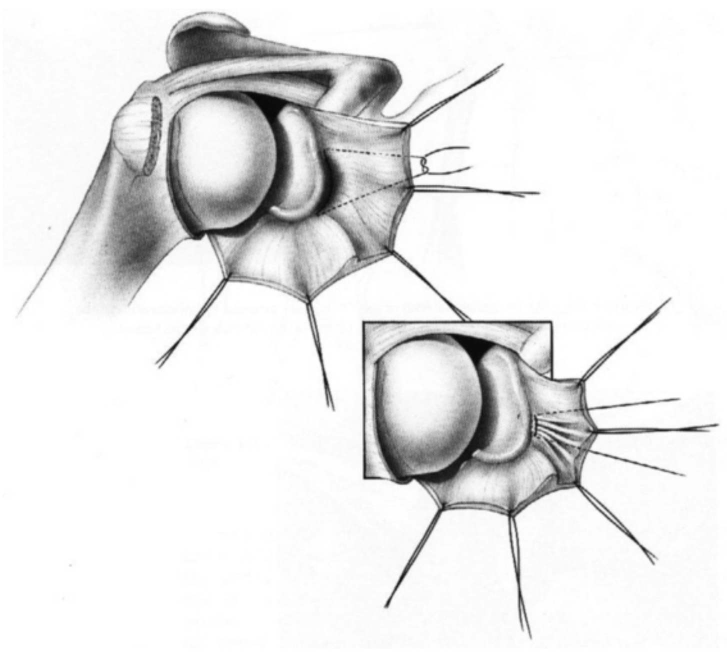


Figure 1.8. A *barrel* stitch may be used medially to bunch up tissue at the glenoid rim to compensate for a deficient labrum. (From Post M, Bigliani L, Flatow E, Pollock R. The Shoulder: Operative Technique. Lippincott Williams & Wilkins, New York. 1998. p. 184.)

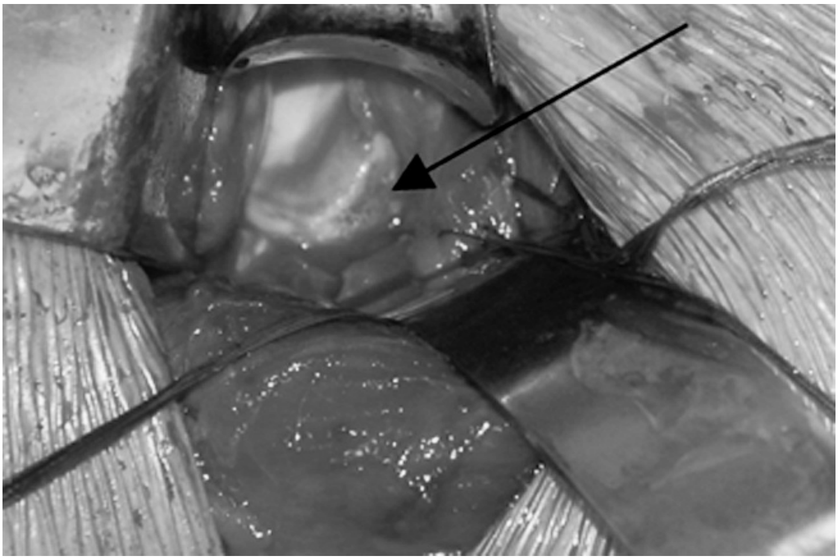


Figure 1.9. Avulsion of the glenohumeral ligaments and labrum from the glenoid rim. Solid black arrow indicates bare anterior glenoid rim.

be used to fashion the tunnels. A small CurvTek (Arthrotek, Warsaw, IN) may also be helpful in making the holes. Number 0 nonabsorbable braided sutures (e.g., Ethibond; Ethicon/Johnson & Johnson, Somerville, NJ) are passed through the tunnels. Both limbs are then brought inside out through the labrum and tied on the outside of the capsule. Alternatively, suture anchors can be used, placing them adjacent to the articular margin and careful not to insert them medially to avoid a step-off between the rim and the labrum.

Glenoid deficiency from a fracture of the rim or from repeated wear from chronic instability may contribute to the pathologic process. Defects representing less than 25% of the articular surface area may be repaired by reattaching the labrum and capsule back to the remaining glenoid rim. If a fragment of bone remains attached to the soft tissues, this can be mobilized and repaired back to the glenoid with sutures. Larger fragments can be reattached with a cannulated screw, countersinking the head of the screw within the bone. Defects larger than 25% without a reparable fragment, leaving an inverted-pear glenoid, in which the normally pear-shaped glenoid had lost enough anterior-inferior bone to assume the shape of an inverted pear,[50] should be augmented with bone. Femoral head allograft can be fashioned to reconstitute the rim. Another alternative to deepening the socket is to perform a Bristow-Laserjet procedure, transferring the coracoid tip with the attached coracobrachialis and short head of the biceps into the defect, close to the articular margin and behind the repaired capsule.[4] A cannulated screw, carefully engaging the posterior cortex of the glenoid, and a washer are used to secure the coracoid to the glenoid.

An engaging Hill-Sachs lesion may be another source of recurrent instability requiring attention for a successful repair. Preventing the head defect from engaging the glenoid rim can be accomplished in one of three ways. First, the capsular shift can be performed to tighten the anterior structures enough to restrict external rotation. This should be done with caution as previously mentioned, given the unwanted result in overhead athletes and the risk of late glenohumeral arthrosis. Second, a size-matched humeral osteoarticular allograft or a cortico-cancellous iliac graft can be utilized to fill the defect. Finally, an internal rotation proximal humeral osteotomy can be performed, albeit with significant technical difficulty and potential morbidity, shifting the defect out of the arc of motion.

The arm is positioned in at least 20 degrees of external rotation and 30 degrees of abduction and 10 degrees of flexion while securing the tissues for the capsular shift. In overhead athletes, approximately 10 degrees more abduction and external rotation may be used. Once any adherent soft tissues impeding excursion of the capsule are dissected from the capsule, the inferior flap should be shifted superiorly first, followed by the superior flap to a more inferior position. A suture may be placed medially to reinforce overlap of the two flaps. The subscapularis is then repaired as previously described followed by a layered closure and a subcuticular skin closure.

Postoperative Care

The challenge following an instability procedure is to find the delicate balance between early gradual motion and maintenance of stability. In general, patients are protected in a sling for 6 weeks with immediate active hand, wrist, and elbow motion and isometric shoulder exercises started at approximately 10 days. From 10 days to 2 weeks, gentle assisted motion is permitted with external rotation with a stick to 10 degrees and elevation to 90 degrees. From 2 to 4 weeks, motion is progressed to 30 degrees of external rotation and 140 degrees of elevation. From 4 to 6 weeks, external rotation to 40 degrees and elevation to 160 degrees are initiated in addition to light resistive exercises. Terminal elevation stretching and external rotation to 60 degrees are permitted after 6 weeks. After 3 months, when the soft tissues have adequately healed, terminal external rotation stretches are allowed. Patients can expect a return to sport at 9 to 12 months postoperatively. These are broad guidelines that should be adapted to each individual case based on intraoperative findings and frequent postoperative exams. Poor tissue quality, durability of the repair, patient reliability, and future demands on the shoulder should dictate the progression of the rehabilitation program.

Results

Good results have been achieved with most open capsulorraphy techniques to treat anterior/anterior-inferior glenohumeral instability. Thomas and Matsen[51] reported 97% good or excellent results in 63 shoulders with repair of the Bankart lesion and incising both the subscapularis and capsule. Pollock et al.[52] reported 90% successful results with an anterior-inferior capsular shift in 151 shoulders with a 5% rate of recurrent instability. Bigliani et al.[46] studied 68 shoulders in athletes who underwent an anterior-inferior capsular shift with 94% of patients with good or excellent results. Fifty-eight patients (92%) of patients returned to the major sports and 47 (75%) at the same competitive level.

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