Recurrent Posterior Shoulder Instability

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Abstract

Recurrent posterior shoulder instability is an uncommon condition. It is often unrecognized, leading to incorrect diagnoses, delays in diagnosis, and even missed diagnoses. Posterior instability encompasses a wide spectrum of pathology, ranging from unidirectional posterior subluxation to multidirectional instability to locked posterior dislocations. Nonsurgical treatment of posterior shoulder instability is successful in most cases; however, surgical intervention is indicated when conservative treatment fails. For optimal results, the surgeon must accurately define the pattern of instability and address all soft-tissue and bony injuries present at the time of surgery. Arthroscopic treatment of posterior shoulder instability has increased application, and a variety of techniques has been described to manage posterior glenohumeral instability related to posterior capsulolabral injury.

Recurrent posterior shoulder instability is an uncommon condition that is often unrecognized, leading to incorrect diagnoses, delays in diagnosis, and even missed diagnoses.[1] Posterior instability encompasses a wide spectrum of pathoanatomy that may affect the labrum, capsule, rotator interval, and bony architecture of the shoulder. Recurrent posterior subluxation is the most common type of posterior instability.

Background and Epidemiology

Glenohumeral instability is common, affecting approximately 2% of the general population.[2] However, posterior instability occurs in only 2% to 5% of those with shoulder instability.[3] Trauma is thought to be the underlying cause in approximately half of patients with posterior instability.[3] Although posterior dislocation represents only 4% of all joint dislocations,[4] it is often easily missed on clinical examination. Specific imaging assessment is important. Recurrent posterior subluxation, which may present with instability symptoms or simply as pain, is more common, particularly in those who participate in high-risk athletic activities.

Relevant Anatomy and Biomechanics

The shoulder is the most mobile, but also the least stable, joint in the body because less than one third of the humeral head articulates with the glenoid. Stability is conferred by a series of static and dynamic soft-tissue restraints that maintain the articulation of the humeral head with the glenoid while simultaneously providing for a large range of motion.[5]

Static Restraints

Articular factors such as joint congruency, glenoid version, and humeral retrotorsion contribute to static joint stability. Bony abnormalities such as glenoid retroversion or posterior glenoid erosion can be predisposing causative factors for posterior shoulder instability.[1]

The glenoid labrum, a wedge-shaped fibrous structure consisting of densely packed collagen bundles, increases the depth and surface area of the glenoid. It serves as an anchor point for the capsuloligamentous structures, deepens the glenoid concavity, and reduces glenohumeral translation with arm motion.[6] Labral excision decreases the depth of the socket by 50% and reduces resistance to instability by 20%.[6]

The glenohumeral ligaments are thickened fibrous bands within the joint capsule; these ligaments act at the end ranges of motion and provide static stability. Their function is dependent on the position of the arm and the direction of the force applied.[7] For example, when the arm is adducted, the superior glenohumeral ligament (SGHL) and coracohumeral ligament (CHL) limit inferior translation and external rotation of the humeral head. Additionally, the SGHL and the CHL resist posterior translation of the humeral head when the shoulder is in flexion, adduction, and internal rotation. The inferior glenohumeral ligament (IGHL) complex is composed of discrete anterior and posterior bands with an interposed axillary pouch that acts like a hammock, undergoing reciprocal tightening and loosening depending on arm position. The posterior band of the IGHL complex is the main restraint to posterior translation of the humeral head when the arm is abducted.

The posterior capsule is defined as the area superior to the posterior band of the IGHL complex. The posterior capsule is the thinnest (≤1 mm) and perhaps weakest portion of the shoulder capsule. It may limit posterior translation when the arm is flexed, adducted, and internally rotated.

The rotator interval plays a role in static stability and is defined by the borders of the supraspinatus superiorly, the subscapularis inferiorly, the coracoid process medially, and the biceps and humerus laterally. The SGHL, medial glenohumeral ligament, and CHL provide variable reinforcement to the rotator interval. The rotator interval and its constituents provide stability against inferior and posterior translations, particularly when the arm is adducted and externally rotated.[8] Evidence suggests that deficiencies in the rotator interval can contribute to instability in patients with excessive inferior or posterior translation.[9] In some individuals, the rotator interval may be composed of loosely arranged collagen, whereas in others, it may be completely devoid of tissue. This represents a rotator interval "capsular defect" that may need to be addressed in the symptomatic shoulder, but it may also be considered a normal anatomic variant in the stable shoulder.

Dynamic Restraints

Dynamic stability is provided by the rotator cuff, the deltoid, and the biceps tendon through a concavity-compression effect on the humeral head within the glenoid socket.[10] Of the four muscles of the rotator cuff, the subscapularis provides the greatest resistance to posterior translation.[10,11] In addition, dynamic stability of the shoulder also is provided by the trapezius, serratus anterior, teres major, and latissimus dorsi muscles. Scapulothoracic motion must be properly coordinated with glenohumeral motion so that the glenoid can be appropriately positioned to provide a stable platform beneath the humeral head.

Definitions: Laxity and Instability

The term instability is reserved for symptomatic shoulders—specifically, the sensation of the humeral head translating in the glenoid, which is frequently associated with pain and discomfort.[12] Instability is defined as pathologic joint translation that causes symptoms, or as the inability to keep the humeral head centered within the glenoid cavity during active motion. Laxity is defined as a specific translation for a particular direction or rotation.[13] Individuals may have significant laxity and yet remain asymptomatic. Conversely, others with only minimal degrees of laxity may have significant symptoms of instability. The distinction is important. Frequently, patients with excessive shoulder laxity sustain a traumatic injury and subsequently develop symptoms of instability. Individuals with recurrent posterior subluxation generally have symptomatic pain yet may or may not have symptoms of instability.

Classification of Posterior Instability

Posterior shoulder instability can be classified by direction, degree, cause, and volition. Unidirectional posterior subluxation is the most frequent form of posterior instability. Posterior instability also can occur as bidirectional or multidirectional instability.[14]

The degree of posterior instability can range from mild subluxation to frank dislocation. Recurrent posterior subluxation is the most common form.

Posterior instability may be traumatic (acquired) or atraumatic. The traumatic type is the more common form.[1] This can occur as a single traumatic event with the shoulder in an "at risk" position (ie, flexion, adduction, and internal rotation) or as a culmination of multiple, smaller traumatic episodes. For example, an electrical shock producing posterior dislocation is a classic example of a single traumatic event. An offensive lineman with the arms in the blocking position would typify a predisposition to recurrent posterior subluxation because of the repetitive loading. Posterior instability occurring secondary to overhead sports presents more insidiously because of the gradual capsular failure from repetitive microtrauma. Common provocative activities include the backhand stroke in racket sports, the pull-through phase of swimming, and the follow-through phases in a throwing activity or golf.

Posterior instability in the setting of an atraumatic history should alert the clinician to the possibility of an underlying collagen disease or bony abnormality (eg, glenoid hypoplasia, excessive glenoid retroversion). In such situations, surgical intervention should be approached cautiously.

Finally, posterior instability may be defined by its volitional component. Involuntary posterior instability typically results from a traumatic event (acute or repetitive) and most commonly manifests as mild subluxation. The symptoms do not occur willfully and usually are not controllable. Voluntary posterior instability occurs when a patient can willfully dislocate or subluxate the shoulder. Two different patterns have been described—voluntary muscular and voluntary positional posterior instability. In voluntary muscular (or habitual) posterior instability, an underlying muscular imbalance typically exists that allows voluntary subluxation/dislocation of the shoulder with the arm in adduction. Patients with habitual voluntary posterior instability are generally considered poor surgical candidates. However, patients with the second voluntary form, positional voluntary posterior instability, can respond well to surgery provided they do not have underlying psychiatric or secondary gain issues.[15] Typically, these individuals have instability when the arm is flexed and adducted. Although these individuals may be able to voluntarily reproduce their instability, they usually avoid the provocative maneuvers.[15]

Evaluation

History

Although posterior shoulder instability is uncommon, an awareness of the disorder, together with a thoughtful evaluation beginning with the clinical history, usually leads to the proper diagnosis. The first step is to inquire about a history of trauma. In the case of a single traumatic episode, the direction of the applied force and the position of the arm at the time of injury may provide insight into the diagnosis. Classically, posterior subluxation occurs with a traumatic event when the arm is in an at-risk position (eg, forward flexion, adduction, internal rotation).[16] A fall or blow to the arm while in an at-risk position can result in a posterior labral detachment (reverse Bankart lesion).[16] Repetitive stresses on the posterior capsule, either from sports or other activities, may lead to acquired posterior subluxation.

Patients with recurrent posterior subluxation most commonly report pain and feelings of weakness. Instability symptoms may or may not be present. With careful questioning, the direction, frequency, and severity of the patient's symptoms can be ascertained. Overhead athletes often describe insidious pain that may occur in the later phases of their sporting activities, when muscle fatigue and dynamic stability are compromised. Mechanical symptoms, such as giving way, slipping, popping, catching, or clicking, are less common than in anterior instability. Volitional components should be assessed.

Physical Examination

The physical findings of patients with posterior instability often are more subtle than those of patients with anterior instability. Active and passive ranges of motion usually are normal and symmetric. The posterior joint line may be tender to palpation. Crepitus is sometimes noted as the arm is internally rotated. Strength testing is usually symmetric, except in rare cases of posterior rotator cuff muscle deficiency or nerve injury with external rotation weakness. In these cases, atrophy of the posterior rotator cuff muscles may be apparent on inspection.

Patients should be assessed for generalized ligamentous laxity by evaluating the contralateral shoulder, elbows, and knees, and by testing the patient's ability to oppose the thumb to the forearm. In addition, sulcus testing should be performed. The sulcus can be quantified by the distance from the greater tuberosity to the acromion. A sulcus sign >2 cm is virtually pathognomonic for multidirectional instability, but pain and symptoms of inferior instability must also be present for this diagnosis. If the sulcus does not reduce as the arm is externally rotated, it should be considered pathologic, with a defect in the rotator interval that should be addressed at the time of surgery.

Scapulohumeral rhythm and scapulothoracic mechanics should be assessed to exclude the possibility of scapular winging, which is frequently confused with posterior instability.[17] In some instances, a compensatory scapular winging may occur. As the scapula wings, it effectively anteverts the glenoid and dynamically increases the bony stability.[17] In such instances, a thorough neurologic examination should be performed with appropriate neurologic testing, as indicated.

Specific Posterior Instability Tests

The posterior stress test (Figure 1)

is performed with the individual in the supine position; the arm is flexed to 90° and internally rotated. The examiner axially loads the humerus against the posterior glenoid by pushing the arm posteriorly with one hand while the other hand is applied to the back of the shoulder. The posterior stress test is positive when a subluxation of the humeral head over the glenoid rim is palpated or observed.

The jerk test (Figure 2) is performed with the patient sitting upright; the arm is flexed 90° and internally rotated, and the elbow is flexed to 90°. A posterior force is generated by applying an axial load to the humerus by pushing on the flexed elbow. In patients with significant laxity, this will cause a posterior dislocation or subluxation of the glenohumeral joint. The arm is then extended and, as this occurs, the glenohumeral joint will reduce with a jerk. If a painful relocation occurs, the jerk test is positive. Usually the reduction is observed as there is a sudden change in velocity as the humeral head reenters the glenoid fossa.

The load and shift test (Figure 3, A) is performed with the patient seated upright, arm at the side. The humeral head and proximal humerus are grasped and compressed into the glenoid socket, and anterior and posterior stress is applied with grading of the degree of translation. This test is used to determine the amount of glenohumeral translation, but it is difficult to accurately quantitate results. A 50% displacement of the humeral head is considered the upper limit of normal. It is not unusual to find symmetric posterior translation between the affected and unaffected shoulders.[5,14]

The modified load and shift test (Figure 3, B) is performed with the patient supine and the affected

Figure 1

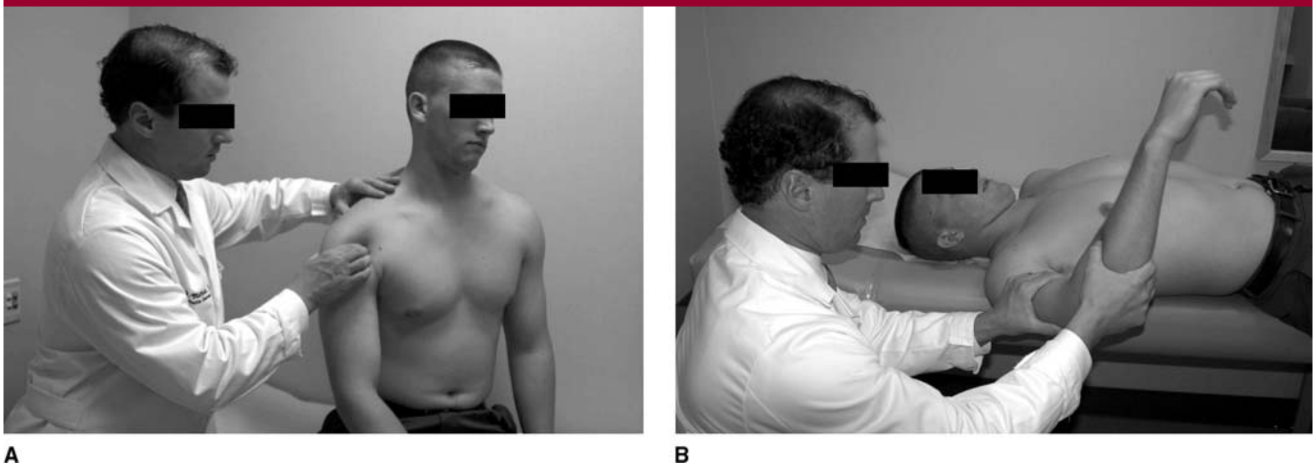
Posterior stress test. A posterior force is applied through the humerus. The test is positive if there is palpable crepitus or subluxation. Often pain is elicited, but this is not as specific a finding.

Figure 2

A B

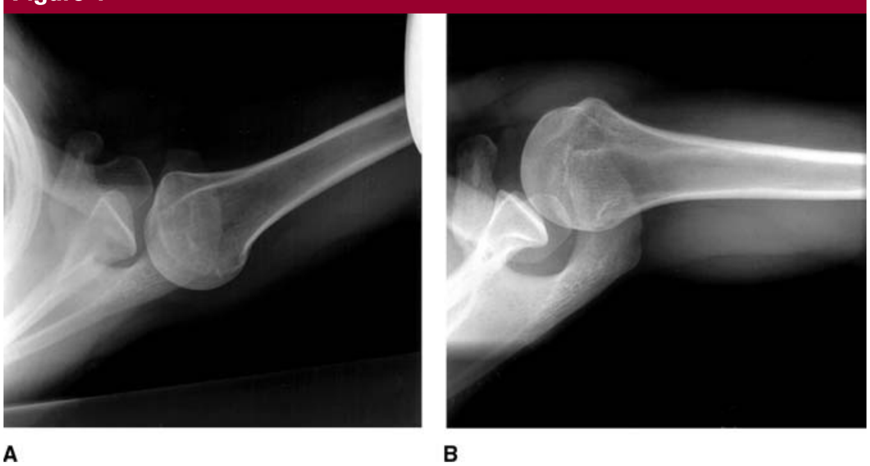
Jerk test. **A,** A posterior force is applied along the axis of the humerus with the arm in forward flexion and internal rotation. This will cause the humeral head to subluxate posteriorly out of the glenoid socket. **B,** As the arm is brought into extension, a clunk will be felt as the humerus reduces into the glenoid cavity.

Figure 3



A, Load and shift test. The patient is seated upright. A compressive force is applied through the humeral head to center the humeral head within the glenoid cavity. Posterior or anterior forces can then be applied to assess the amount of joint translation. This can be compared with the contralateral shoulder. **B,** Modified load and shift. The patient is supine. A compressive force is applied along the long axis of the humerus to center the humeral head in the glenoid cavity. A posterior force can then be applied to assess the degree of translation of the humeral head.

Figure 4



Axillary radiographs of an individual with voluntary posterior instability showing the humeral head dislocated **(A)** and reduced **(B)**.

shoulder at the edge of the examining table. The shoulder is positioned in the scapular plane and in neutral rotation. Manual force is placed at the ipsilateral elbow to concentrically reduce the humeral head. Anterior and posterior forces are then applied to the proximal humerus in varying degrees of rotation and elevation with grading of the amount of translation.[14] The load and shift and modified load and shift tests are typically graded as follows: grade 0, minimal translation; grade 1, humeral head translates to the glenoid rim; grade 2, humeral head translates over the glenoid rim but spontaneously reduces; and grade 3, humeral head dislocates and does not spontaneously reduce.

Imaging

Radiographs

Plain radiographs of the shoulder should include true anteroposterior views in neutral, internal, and external rotation; a transscapular view or Y view; and an axillary view. These views are needed to ensure that the joint is located, to evaluate the posterior glenoid rim, and to look for impaction fractures of the humeral head. In addition to humeral head position, these studies demonstrate glenoid rim morphology (hypoplasia, excessive retroversion, and/or fracture of the posterior glenoid rim). However, most individuals with recurrent posterior instability do not have bony abnormalities. For those with a volitional component, dynamic radiographs can confirm the diagnosis (Figure 4).

Multiplanar Imaging

Computed tomography (CT) or magnetic resonance imaging (MRI) is essential to assess the version and morphology of the glenoid. These tests also help detect subtle anterior

Table 1

Surgical Decision Making for Posterior Instability According to Pathoanatomy

Pathologic Lesion	Procedure of Choice
Posterior Bankart lesion	Arthroscopic or open posterior Bankart repair
Excessive capsulolabral laxity	Arthroscopic or open posterior capsular shift ± rotator interval closure
Glenoid erosion	Posterior glenoid bone grafting
Increased glenoid retroversion	Posterior opening wedge glenoid osteotomy

Figure 5

Arthroscopic photograph of a posterior capsulolabral disruption (posterior or reverse Bankart lesion). The probe is in the defect.

humeral head defects and glenoid fractures. Contrast can enhance the ability to evaluate the posterior labrum and capsule, particularly with injuries such as capsulolabral disruptions or lateral capsular injuries.[18] Contrast also enhances assessment of the superior labrum. For surgical candidates, it is critically important to identify the pathoanatomy so that the appropriate surgical approach can be chosen. For example, an individual with significant retroversion of the glenoid will have an unacceptably high failure rate if a soft-tissue capsulorrhaphy is performed and the bony abnormality is not addressed. Preoperative diagnosis helps in surgical planning, particularly as arthroscopic treatment becomes more popular. Depending on the surgeon's skill level, some injuries (eg, glenoid erosion, posterior humeral avulsion of the glenohumeral ligaments, capsular rupture) are more appropriately addressed through an open surgical approach.

Although the gadolinium-enhanced magnetic resonance arthrogram provides excellent soft-tissue detail, we think that a CT scan with intra-articular contrast provides the best information with regard to bony anatomy and articular orientation. CT is superior in its ability to determine the glenoid morphology as well as the degree of glenoid retroversion. Glenoid retroversion is best measured on axial CT scan images through the mid-glenoid; this corresponds with the first inferior image, on which the tip of the coracoid process is no longer visible.[19] At this level, glenoid retroversion between –2° and –8° is considered normal.[19]

Initial Treatment

Nonsurgical treatment is successful for the great majority of patients with recurrent posterior subluxation. The aim of physical therapy is to strengthen the dynamic muscular stabilizers to compensate for the damaged or deficient static stabilizers.[20] The focus should be on exercises that strengthen the posterior deltoid, the external rotators, and the periscapular muscles. These exercises are typically used in conjunction with activity modification and biofeedback. Nonsurgical treatment of posterior instability is successful in approximately 65% to 80% of cases.[20,21]

Surgical Treatment

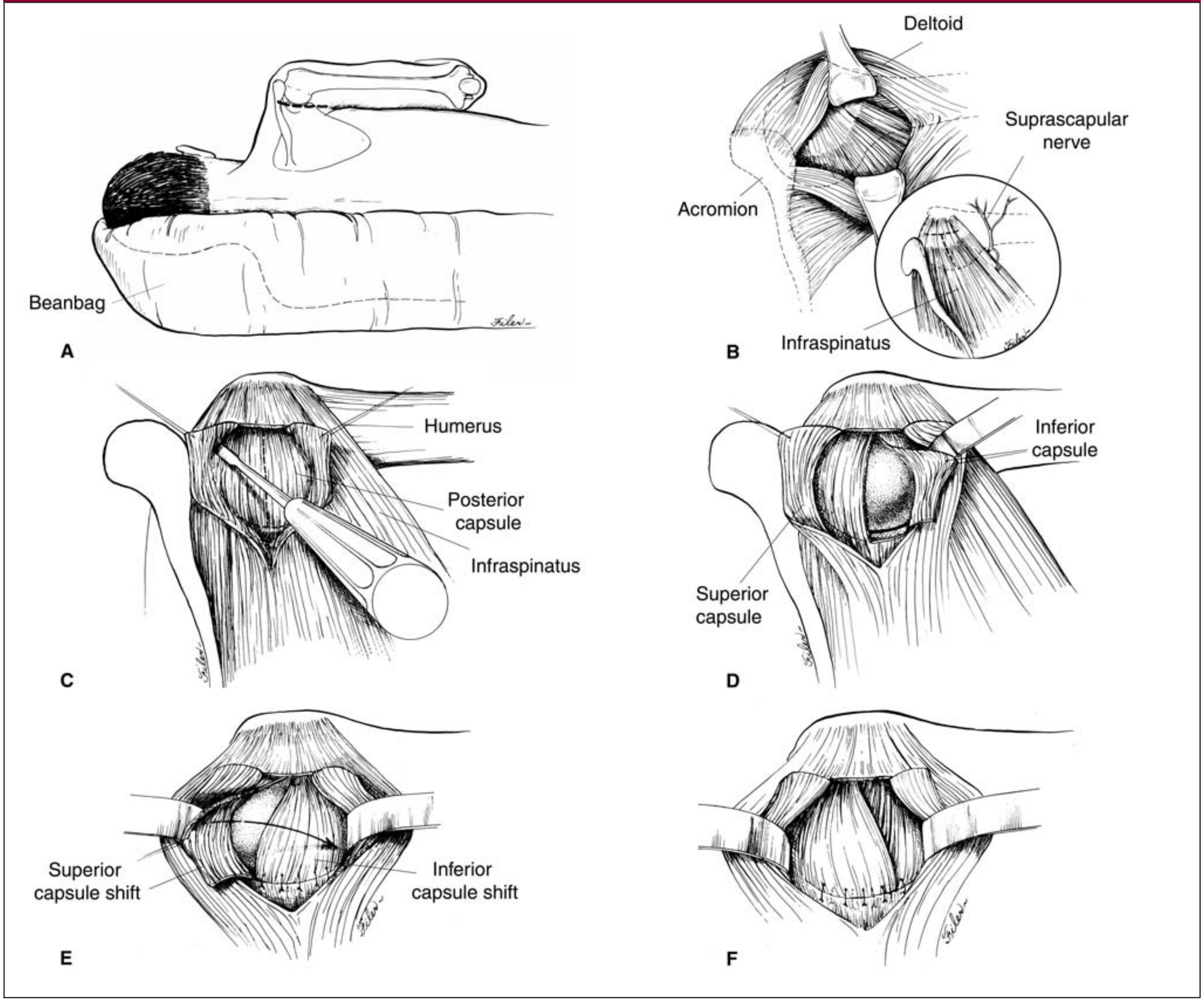
Open procedures have been the mainstay of treatment when nonsurgical treatment fails and have led to good results when implemented appropriately[1,15,22] During the past decade, the arthroscopic treatment of posterior shoulder instability has attracted increasing interest as a means to restore stability without the morbidity of open surgery. A variety of arthroscopic techniques have been described to manage posterior glenohumeral instability in relation to posterior capsulolabral injury and redundancy.[23-26] The perceived advantages of the arthroscopic approach include less morbidity, shorter surgery time, improved cosmesis, and less postoperative pain.[27,28]

Prerequisites

Because of the multifactorial nature of posterior instability, as well as the lack of a single consistent "essential pathologic lesion," the surgeon must consider all potential contributing factors and correct the relevant pathoanatomy encountered in that individual case (Table 1). The best surgical candidates are those with recurrent, posttraumatic, unidirectional subluxation. These patients are also the ideal candidates for arthroscopic stabilization, either by suture anchors or simple posterior capsular plication with sutures (Figure 5). The procedures used to address posterior instability may be subdivided into soft-tissue and bony procedures.

Before any surgical procedure, an examination under anesthesia is performed. The amount of humeral head translation on the glenoid surface is graded as follows: 0, stable or trace laxity; 1, up to 50% translation; 2, dislocatable with spontaneous reduction; and 3, dislocates and does not spontaneously reduce. Sul-

Figure 6



Open posteroinferior capsular shift. **A,** The patient is positioned in the lateral decubitus position in a beanbag. A posterior axillary incision is used (broken line). **B,** The deltoid is split in line with its fibers to expose the underlying infraspinatus and teres minor. Inset, Split in the infraspinatus and the location of the T-plasty in capsule. **C,** The infraspinatus is split and a T-shaped capsulotomy is performed. The capsule is opened just lateral to the labrum. **D,** The capsulotomy is performed at the glenoid side. Labral detachments are repaired. **E,** The inferior capsule is shifted superiorly. **F,** This is reinforced with the superior limb of the capsule.

cus testing and passive range of motion are compared with the opposite shoulder.

Soft-Tissue Procedures

Open Posteroinferior Capsular Shift

The open posteroinferior capsular shift procedure is best for patients with recurrent posttraumatic subluxation and those with involuntary, recurrent, atraumatic subluxation. The procedure also may be indicated in those with recurrent voluntary positional posterior subluxation.[15]

Positioning

The procedure may be performed under general anesthesia, regional anesthesia alone, or general anesthesia combined with a regional anesthetic. The patient is positioned on a full-length beanbag, in the lateral decubitus position (Figure 6, A). A mechanical arm holder from the opposite side of the operating table can be helpful to support the arm in internal or external rotation.

Incision

The shoulder is approached posteriorly; we prefer the incision in the posterior axillary fold. The deltoid can then be split in line with its fibers, detached from its origin on the scapular spine, or abducted and elevated to reach the infraspinatus over the joint line (Figure 6, B). The infraspinatus is then split at the level of the equator of the glenoid to expose the underlying posterior glenohumeral joint capsule. Care is taken not to divide the muscle more than 1.5 cm medial to the glenoid in order to avoid damage to the branches of the suprascapular nerve to the infraspinatus.

Capsular Shift

The capsule is then divided horizontally from medial to lateral at the equator of the glenoid. Although both medial and lateral capsular shifts have been described,[29,30] we prefer a medially based shift with a T-plasty of the capsule performed at the level of the glenoid. The posterior capsule is often quite thin and the medial capsule is of better quality than the lateral capsule. We open the capsule just lateral to the labrum (Figure 6, C). The remaining capsulolabral sleeve is then elevated from the glenoid rim inferiorly to the six o'clock position. The joint is inspected and any posterior labral injury is repaired with two or three bioabsorbable suture anchors (Figure 6, D). The suture anchors are placed at intervals along the posterior glenoid rim, just at the articular margin. The capsulolabral lesion is then repaired anatomically, although the labrum is often quite small.

During capsular repair, the patient's arm is positioned in 20° of abduction and in neutral rotation. The inferior flap of capsule is shifted from inferior to superior to remove redundancy (Figure 6, E). The superior flap is then shifted inferiorly over the inferior flap to reinforce the posterior capsule (Figure 6, F). In the setting of capsular rupture or insufficiency, the posterior capsule may be augmented with the infraspinatus tendon. Nonabsorbable transosseous sutures or suture anchors are used to repair the infraspinatus.[31] The deltoid is closed in a side-to-side fashion with braided, nonabsorbable sutures.

Arthroscopic Posterior Stabilization

The indications for the arthroscopic approach are identical to those for the open posteroinferior capsular shift. Ideal candidates are those with a posterior Bankart lesion. Relative contraindications to arthroscopic treatment of recurrent posterior instability include failed prior arthroscopic stabilization procedures, humeral avulsions of the glenohumeral ligaments, or gross symptomatic bi- or multidirectional instability from excessive generalized laxity, such as with Ehlers-Danlos syndrome. A distinction must be made, however, between these patients and those who have multidirectional laxity but remain symptomatic only in the posterior direction. This latter group makes up a large number of patients with recurrent posterior instability, and they respond well to arthroscopic stabilization. Absolute contraindications to arthroscopic stabilization are the rare individuals with either glenoid erosion (acquired or developmental) or excessive glenoid retroversion. In these settings, bony procedures are required to reconstruct or reorient the glenoid.

Patient Positioning

The procedure can be performed in either the lateral decubitus or beach chair position. For the lateral decubitus position, the arm is placed in a traction device (Arthrex Star Sleeve; Arthrex, Naples, FL) with 20° of abduction and 20° of extension. Direct lateral traction also can be applied to the proximal humerus.

Arthroscopic Portals

Three or four portal techniques can be used, with one or two posterior portals and two anterior portals. The posterior portal must be placed slightly lateral to allow access to the posterior glenoid rim and the posteroinferior capsule. If the posterior portal position is not ideal, a second posterior portal can be used. Both an anterosuperior portal and a midanterior portal are created in the rotator interval region. The former is used for viewing, and the latter for instrumentation and suture passage (Figure 7, A).

Arthroscopic Shift

A significant capsulolabral injury (posterior Bankart lesion) can be repaired with suture anchors; otherwise the capsular redundancy, which is more typically encountered, can be reduced with a posterior capsular shift. The shift begins at the 6 o'clock position. Using a shuttling-type angled instrument, the capsule is grasped 10 to 15 mm lateral to the glenoid rim and is shifted to the labrum with three to five sutures (Figure 7, B through D), depending on the size of the shoulder, the laxity present, and the degree of shift desired. For patients with significant inferior laxity, a rotator interval closure is performed to provide additional stability against inferior translation.[8] We perform the rotator interval closure as a capsular closure, plicating the middle glenohumeral ligament to the superior glenohumeral ligament.

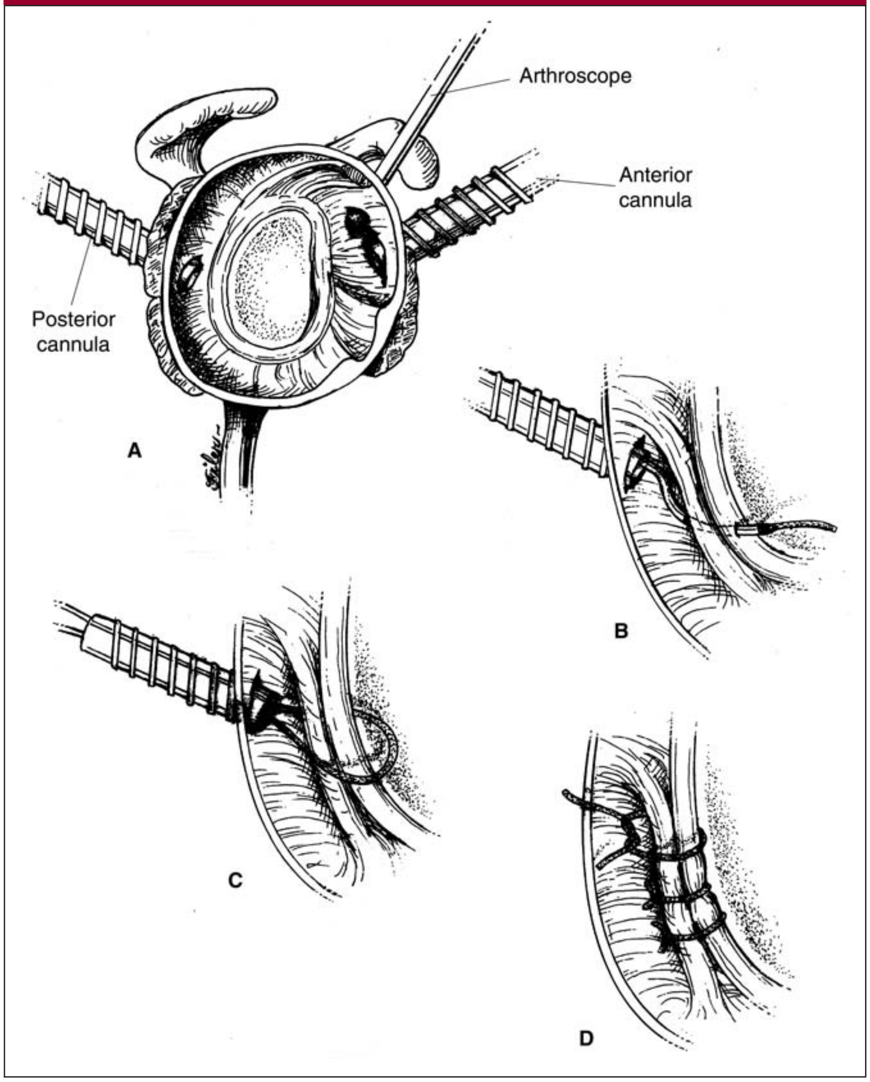
Bony Procedures

In the setting of severe glenoid dysplasia or retroversion, defined as retroversion >20° (Figure 8, A), an opening wedge posterior glenoid osteotomy is indicated. For patients with significant focal posterior glenoid defects, a bone block or bony glenoid reconstruction is indicated. Although corrective humeral rotational osteotomies have been described in several European series, they are not widely used in North America.

Opening Wedge Glenoid Osteotomy

Patients are positioned in the lateral decubitus position, and expo-

Figure 7



Arthroscopic posterior stabilization technique. **A,** Portal placement using a three-portal technique. The arthroscope is initially introduced into the posterior portal but is then switched to the anterosuperior portal to visualize the posterior capsule. The posterior capsule is addressed as viewed arthroscopically from the anterosuperior portal. The superior aspect of the glenoid is oriented to the bottom of the page and the inferior aspect oriented to the top. **B,** The capsule is being shifted to the labrum using a shuttling-type suture passer, which is gentle on the tissues. **C,** Both limbs of a permanent suture are retrieved through the posterior cannula and tied. **D,** The steps are repeated from inferior to superior, with three to five sutures typically being used.

sure is similar to that described for the open capsular shift. The posteromedial neck of the glenoid is exposed. An autologous tricortical bone graft is used. The width of the graft is variable depending on the degree of correction (10 to 25 mm) and should be contoured in a wedge fashion (Figure 8, B). The osteotomy should be incomplete, leaving the anterior glenoid cortex intact to maintain stability. When the desired correction has been obtained, the tricortical bone graft is inserted to correct the retroversion. The graft may be press-fit (our preference) or secured by screws (Figure 8, D). Residual capsular redundancy may then be treated, as described. This is a technically challenging procedure; numerous complications have been reported, including intra-articular fracture, nerve injury, loss of reduction, and hardware problems.

Posterior Bone Graft

For patients with acquired focal glenoid defects, the glenoid can be reconstructed with an anatomic intra-articular bone graft to restore the glenoid arc, or with an extra-articular bone graft that serves as a buttress for the humeral head (Figure 9). We prefer the extra-articular approach, advancing the capsule anterior and medial to the graft to serve as a soft-tissue interposition. Care must be taken to avoid either medial placement with ineffective buttressing or excessive lateral placement with impingement on the humeral head.[32] The preferred graft source is the inner table of the iliac crest.

Postoperative Rehabilitation

Postoperative management requires the use of an orthosis to maintain abduction, neutral rotation, and extension of the shoulder. The elbow should be positioned posterior to the plane of the body to decrease tension on the repair. Immobilization is maintained for 4 to 6 weeks, depending on the degree of instability, the quality of the tissue, and the security of the repair. At 6 weeks, active assisted range-of-motion exercises are started. Strengthening is delayed until the third postoperative month. Collision sports should be avoided for the first 6 months.

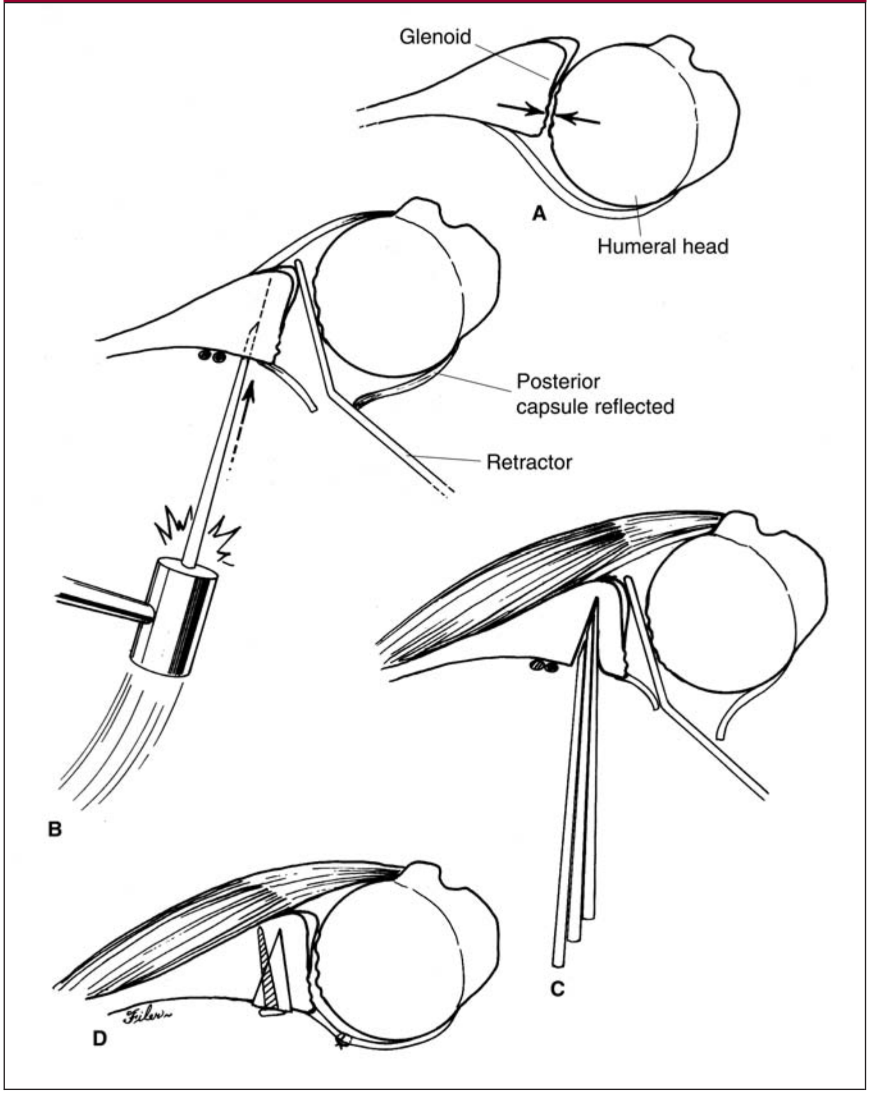
Results

Published results are summarized in Table 2. Although initial surgical results were so poor that some authors concluded that recurrent posterior instability should not be treated surgically,[1] most of the early failures and recurrences resulted from a lack of knowledge of the pathoanatomy and the relevant biomechanics. Improved patient selection and surgical techniques have led to better outcomes.

Fronek et al[30] and Hurley et al[21] reported a 63% to 91% success rate with nonsurgical treatment, with no limitations in activities of daily living and only moderate disability in sports activities. Many of these patients had positive examination findings for posterior instability but did not require any further treatment. Fronek et al[30] also reported good results with open posterior capsulorrhaphy. Hawkins et al[1] advocated the use of the infraspinatus tendon to reinforce the capsule and reported an 85% success rate at average follow-up of 7 years (range, 2 to 15 years). Pollock and Bigliani[32] reported an overall satisfactory rate of 80% with this procedure at average follow-up of 5 years. When revision cases were excluded, the success rate improved to 96%, highlighting the importance of meticulous soft-tissue repair at the first surgery.

Over the last decade, advances in arthroscopy have made this approach quite attractive. Although a variety of techniques has been described, the key features include restoring the labrum and eliminating capsular redundancy. In 1998, Wolf and Eakin[25] reported success in 16 of 17 patients who underwent an arthroscopic posterior capsular plication for unidirectional posterior instability. Eleven returned to their preinjury level of function, and there were no reported complications. Antoniou et al[16] reported on 41 patients with posterior instability treated with an arthroscopic posteroinferior capsulolabral augmentation procedure. Thirty-five patients noted improvement, although 28 actually reported a perception of shoulder stiffness. Williams et al[23] reported on 27 shoulders (26 patients) with traumatic posterior Bankart lesions surgically treated with arthroscopic repair using bioabsorbable tack fixation; 55% of patients (11 patients) were American football players. Symptoms of pain and instability were eliminated in 24 patients (92%). Two patients required additional surgery.

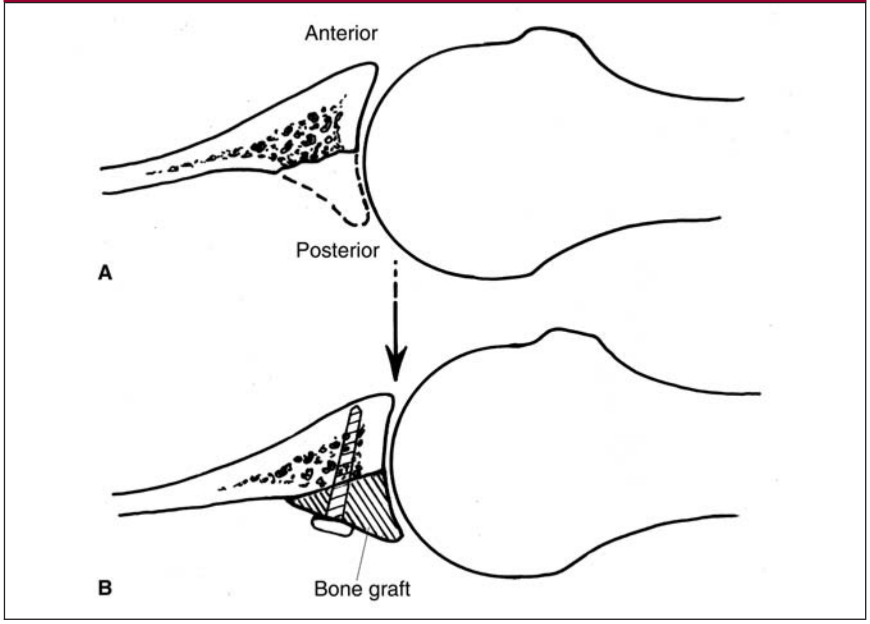
Figure 8



Posterior opening wedge osteotomy. Significant retroversion (>20°) of the glenoid, as shown here **(A),** is best addressed with this procedure. The opening wedge osteotomy should be performed using a standard posterior approach. The osteotomy **(B)** should begin approximately 10 mm medial to and parallel to the articular surface. Stacking multiple broad flat osteotomes **(C)** helps achieve distraction posteriorly while the anterior cortex is preserved. Care should be taken to avoid an intra-articular fracture. The tricortical graft from the iliac crest may be press-fit (our preference) or carefully secured with small fragment screws **(D)**.

Kim et al[24] reported on 27 shoulders (27 patients) with traumatic unidirectional recurrent posterior subluxation treated with arthroscopic labral repair and posterior capsular shift using suture anchors. In all cases, symptoms were preceded by a traumatic event. Symptoms of pain and instability were eliminated in

Figure 9



A, A posterior glenoid bone graft can be used for erosions and osseous defects to restore concavity to the glenoid. **B,** Care must be taken to position the graft appropriately to effectively lengthen the articular arc while avoiding abutment of the graft on the humeral head.

all patients except one, who had recurrent instability. Postoperatively, all patients had improved shoulder scores. Twenty-six of 27 were able to return to their prior sports with little or no limitation.[24]

Thermal shrinkage of the capsular tissues also has been advocated to shrink the patulous posterior capsule.[33] Reported results for this technique vary from failure rates as low as 4%[33] to as high as 60%,[34] with capsular insufficiency present in up to 33%.[35] There have been alarming reports of capsular necrosis and capsular rupture.[35] We have found the visual response of capsular shrinkage at the time of arthroscopy to be variable and the clinical results of thermal capsulorrhaphy to be unpredictable, with unacceptably high failure rates. For these reasons, this technique is not recommended.

The surgical treatment of voluntary posterior instability remains controversial. Recurrence after soft-

Table 2

Results and Complications Reported After Posterior Instability Surgery

Study	Procedure (No. of Patients)	Recurrence	Complications (Other Than Recurrence)
Neer and Foster[29]	Open posterior inferior capsular shift	0% (0/15)	DJD 1 patient
Hawkins et al[1]	Glenoid osteotomy (17), reverse Putti-Platt (6), biceps transfer (3)	50% (13/26)	DJD with glenoid osteotomy 35 patients
Hurley et al[21]	Reverse Putti-Platt without bone block	73% (16/22)	DJD 2 patients
Fronek et al[30]	Open medial-based posterior shift (6) and with bone block (5)	9% (1/11)	1 superficial infection
McIntyre et al[26]	Arthroscopic posterior shift with sutures tied over clavicle or scapular spine	25% (5/20)	Recurrence only
Wolf and Eakin[25]	Arthroscopic posterior shift with and without suture anchors	7% (1/14)	Recurrence only
Antoniou et al[16]	Arthroscopic posterior shift with and without suture anchors	15% (6/41)	28 subjective stiffness with normal range of motion
Fuchs et al[15]	Open lateral-based posterior inferior shift with and without bone grafting (1) or osteotomy (3)	23% (6/26)	8 discomfort, 1 anterior subcoracoid impingement
Williams et al[23]	Arthroscopic posterior Bankart repair with bioabsorbable tack fixation	7% (2/27)	Recurrence only
Kim et al[24]	Arthroscopic posterior Bankart repair and posterior shift with suture anchors	4% (1/27)	Recurrence only

DJD = degenerative joint disease

tissue procedures has been reported to vary from 0% (0/15 patients)[29] to 72% (18/25 patients).[21] A conservative nonsurgical approach is advocated in these patients. Fuchs et al[15] reported good to excellent results in 24 of 26 shoulders (92%) with voluntary posterior instability treated with open surgery.

Complications and Pitfalls

The complications of surgery are included in Table 2 and are procedure-specific and technique-dependent. Recurrence is the most frequently reported complication.[1,30] Recurrence may result from a new injury or from a failure of the initial procedure. Individuals with traumatic recurrence of the instability usually have better results after revision surgery than do patients with atraumatic recurrence of the posterior instability.

Stiffness after surgery for posterior instability presents as loss of internal rotation. It is infrequently reported in the literature, and its incidence may be underestimated.[30] In certain circumstances, stiffness may be acceptable to maintain stability, but it is likely to be patient-specific. For example, internal rotation losses of 10° may have few functional consequences for most individuals, but they may be devastating for certain populations, such as professional baseball pitchers, tennis players, or swimmers who, respectively, need to throw a ball, hit a serve, or pull a stroke at high speed. The phenomenon of subcoracoid impingement also may occur when excessive posterior capsular tightness creates an obligate anterior shift of the humeral head and causes the subscapularis and anterior soft tissues to impinge on the coracoid.[36]

Excessive tightness can have major consequences on joint kinematics and joint reactive forces, creating shearing forces on the glenoid rim that result in cartilage erosion and early osteoarthrosis.[37] This has been called capsulorrhaphy arthropathy. Osteoarthrosis is also a complication that has been reported after posterior glenoid osteotomy and posterior glenoid bone grafting. This complication is usually the result of an intra-articular fracture or impingement of the humeral head on the glenoid rim or the bone block.

Both the axillary[38] and suprascapular nerves[39] are at risk during open surgery for posterior instability. Injuries may occur during sharp dissection, tissue retraction, and suture placement.

Summary

The diagnosis and management of posterior shoulder instability remain challenging. Posterior instability is uncommon, and the diagnosis may be subtle. The most common presenting complaint is pain. Thorough evaluation and appropriate imaging will demonstrate the pathoanatomy, which can be variable and may involve soft-tissue and/or bony elements. Careful classification of the instability will yield insight into the natural history and help guide treatment. In the great majority of individuals, nonsurgical treatment is the preferred initial management. In those who fail conservative measures, surgery may be indicated. Careful preoperative planning, surgery targeted at the specific pathology, and thoughtful aftercare can maximize the chance for success and minimize the risk of complications. Individuals with voluntary instability, multidirectional instability, or bony defects will require a more careful assessment of the cause of the instability. If an extended rehabilitation program is unsuccessful, combined soft-tissue and bony procedures may be needed to restore stability.

References

Evidence-based Medicine: Level II prospective comparative studies are references 23 and 34. The remaining references are level III and IV case-control series or level V (references 3, 12, and 19) expert opinion. There are no prospective, blinded, randomized studies reported.

Citation numbers printed in **bold type** indicate references published within the past 5 years.

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