

Review article

Advances in the Diagnosis and Management of Shoulder Instability: A Review

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ABSTRACT

Shoulder instability, particularly anterior dislocation, is a common issue in younger, active individuals. The goals of nonoperative care include restoring mobility, alleviating discomfort, and preventing recurrence. After a brief period of sling immobilisation, intravenous analgesics, and intra-articular injections, physical therapy focusing on the rotator cuff and periscapular muscles is usually administered. Although they need further study, new tactics like immobilisation in external rotation show promise. The goals of nonoperative care include restoring mobility, alleviating discomfort, and preventing recurrence. After a brief period of sling immobilisation, intravenous analgesics, and intra-articular injections, physical therapy focusing on the rotator cuff and periscapular muscles is usually administered. Although they need further study, novel methods like immobilisation in external rotation show promise. Recurrent instability, particularly in athletes, should be treated surgically. Good results are obtained with less invasive arthroscopic techniques as well as open operations like Bankart repair. Following surgery, rehabilitation is crucial to regaining function and averting further instability.

Introduction

The glenohumeral joint is a marvel of biomechanical design, offering the largest range of motion of any joint in the human body. Its distinctive ball-and-socket shape, in which the spherical humeral head is defined by the small glenoid cavity, gives it this extraordinary mobility. Though it allows for a great deal of movement in several dimensions, this anatomical configuration inevitably compromises stability. As a result, the glenohumeral joint is especially prone to dislocations, the most common of which is anterior instability of the shoulder. This disorder mainly affects those who participate in physically demanding activities, including contact sports or military service, where instability is frequently caused by repeated stress or trauma. Shoulder stability is determined by the complex interaction between static and dynamic stabilising mechanisms. Static stabilisers include the glenoid labra, the glenohumeral ligaments, the bony architecture, and negative intra-articular pressure. The fibrocartilaginous labra not only deepen the glenoid cavity by increasing its articular surface, but they also serve as a crucial attachment site for the glenohumeral ligaments, particularly the inferior glenohumeral ligament (IGHL) [1].

An important stabilising component, the IGHL, in particular its anterior band, prevents the humeral head from anteriorly translating during abduction of the shoulder and external rotation. In particular ranges of movement, other ligaments, such as the middle and superior glenohumeral ligaments, offer further support. Muscles, especially the rotator cuff and periscapular musculature, must be actively engaged to produce dynamic stability. Concavity compression is the term for the compressive forces produced by the rotator cuff muscles that centre the humeral head inside the glenoid during motion. By putting strain on the labrum and glenoid, the long head of the biceps tendon also helps. Dynamic stabilisation is further improved by neuromuscular control, which combines proprioception and coordinated muscle activity [2].

Traumatic anterior dislocations are frequent despite these strong stabilising mechanisms, frequently brought on by high-force events like falls into an extended arm. The capsuloligamentous complex is commonly injured because of these occurrences, especially the IGHL from avulsion. The most well-known injury, the Bankart lesion, severely impairs joint stability by causing the anteroinferior labrum to separate from the glenoid. These injuries frequently coexist with humeral avulsions of the IGHL (HAGL lesions) and Hill-Sachs lesions, which are compression fractures of the humeral head, resulting in a complicated clinical picture.

Because advanced imaging techniques like CT and MRI allow for thorough visualisation of soft tissue and osseous damage, they have enhanced the diagnosis of shoulder instability. For instance, the glenoid track model helps evaluate bipolar bone loss by offering important insights into the relationship between glenoid abnormalities and Hill-Sachs lesions. This knowledge has improved surgical therapy and decision-making methods [3]. The goal of surgical procedures like the Latarjet procedure and arthroscopic Bankart repair is to restore both anatomical and functional integrity. Particularly for severe glenoid bone loss, the Latarjet method works well because it uses its triple mechanism to increase stability. To avoid recurrence,

rehabilitation programs also place a strong emphasis on retraining dynamic stabilisers. New methods, such as computer modelling and bio-enhanced tissue healing, have the potential to improve treatment results even further. The anatomy and current developments in the diagnosis and treatment of shoulder instability are examined in this study, with a focus on the combination of biomechanical knowledge, cutting-edge imaging, and creative surgical and rehabilitation techniques. This review attempts to give a thorough framework for tackling the complex issues of shoulder instability in a variety of patient demographics by synthesising existing research [4].

Anatomy

Because of its distinct anatomical structure and low intrinsic bone stability, the glenohumeral joint has unmatched mobility. The combined action of the rotator cuff, periscapular muscles, and the tendon of the long head of the biceps brachii results in dynamic stabilisation. Concavity compression is a biomechanical phenomenon wherein the rotator cuff muscles and the middle deltoid produce compressive pressures that stabilise the humeral head against the glenoid. Furthermore, neuromuscular control, which combines proprioceptive information with quick, reactive muscle contractions to preserve joint congruency during motion, is crucial to dynamic stabilisation.

The scapula's dynamic adjustment to give the humerus a solid yet movable basis is a crucial component of shoulder mechanics. By maintaining the glenoid's ideal position in relation to the humeral head throughout movement, this scapulohumeral rhythm promotes stability and mobility. The complex interplay between the humeral muscles and the scapular stabilisers is similar to a precision system that strikes the perfect equilibrium between conflicting demands for stability and mobility [5].

The glenoid labra, capsuloligamentous structures, and intra-articular pressure dynamics all contribute to the glenohumeral joint's static stability. The alignment and resistance to translational pressures are increased by the labrum, a fibrocartilaginous ring that surrounds the glenoid and deepens the articular cavity by about 50%. Additionally, it acts as the anchor for the glenohumeral ligaments, which include the inferior glenohumeral ligament (IGHL), middle glenohumeral ligament (MGHL), superior glenohumeral ligament (SGHL), and coracohumeral ligament. These ligaments are specialised to withstand instability in certain places and are thickenings of the capsule. The MGHL restricts anterior displacement in mid-range abduction, the IGHL complex is the main barrier to anterior dislocation when the shoulder is abducted and externally rotated, and the SGHL restrains inferior and posterior translations when the arm is in a neutral posture.

Because it produces a vacuum-like effect that prevents the humeral head from translating, negative intra-articular pressure greatly enhances joint stability. In order to preserve articular congruence under varied loads, this pressure-dependent stabilisation depends on the sealing qualities of the intact capsule, which produce viscous and intermolecular forces. When any of the above factors are impaired, the glenohumeral joint becomes more susceptible to instability due to the biomechanical effectiveness of these stabilising mechanisms. The labrum and the IGHL are frequently disrupted by traumatic dislocations, which are usually caused by high-energy mechanisms such as a fall onto an extended arm in abduction and external rotation. The ensuing lesions weaken the anterior capsuloligamentous complex and make the joint more susceptible to recurrent instability. One example of this is the often-seen Bankart lesion. Dynamic stabilisers are essential for reducing instability, especially following an initial injury. In addition to their compressive function, the rotator cuff muscles work in concert with scapular stabilisers to adjust joint forces during intricate shoulder motions. Static deficiencies are harder to adjust for when these muscles are dysfunctional or when neuromuscular coordination is disrupted.

The interaction of these stabilising mechanisms emphasises the difficulties in regulating glenohumeral instability and the intricacy of shoulder mechanics. The understanding of how these systems contribute to both normal function and pathological disorders is being further refined by advanced imaging and biomechanical investigations. This knowledge informs therapy methods that are customised to meet the unique anatomical and functional needs of each patient [6].

Diagnosis of Shoulder Instability

Recurrent dislocations or subluxations are the hallmark of glenohumeral instability, which can be categorised according to its underlying aetiology, chronicity, and direction of instability. To properly diagnose the problem and direct treatment plans, a comprehensive history, physical examination, and imaging examinations are necessary.

History and Examination

It's critical to comprehend the patient's age, dominant hand, degree of activity, and involvement in sports because these variables affect the type and danger of instability. It is important to investigate traumatic experiences that cause instability, paying particular attention to the arm's posture and the force used.

Instead, patients who are unable to remember these specifics could describe the arm postures that cause their symptoms. For diagnosis, it is essential to distinguish between dislocation (total separation) and subluxation (partial displacement). Along with the patient's neurological disorders, mental health, and any hereditary or systemic variables that can affect recovery, previous therapies such as physical therapy, surgery, or immobilisation should be recorded.

One important prognostic factor is age. Research indicates that those under the age of 20 who have their first dislocation have a 90% chance of recurrence, but those over 40 have a 10% chance and are at a greater risk of rotator cuff problems. Manual employment and high-contact sports can raise the likelihood of recurrence if they are not treated surgically. Furthermore, because it is associated with worse results, deliberate dislocation—which is frequently connected to behavioural or mental health issues—needs particular attention [7].

Types of Instability

Trauma that affects stabilising components such as the labrum, glenoid rim, or humeral head is usually linked to unidirectional instability. While posterior instability happens during posterior loading with the arm flexed, adducted, and internally rotated, anterior instability frequently arises from a hyperabducted, externally rotated arm that is subjected to an anterior force. In these situations, surgical treatment is usually required to restore stability and stop recurrence of structural damage, such as labral tears or fractures.

Multidirectional instability (MDI), on the other hand, manifests as symptoms in several directions and frequently lacks a traumatic incident. It's critical to distinguish between joint laxity and actual instability since the former refers to greater mobility without symptoms, whilst the latter contains aberrant laxity that results in discomfort or dysfunction. Excessive capsular redundancy, which can be inherited or developed by repetitive strain, as in the case of sportsmen or labourers, is frequently the cause of MDI. It might coexist with osseous abnormalities or structural damage, such as labral tears [8].

Associated Anatomical Lesions

Secondary anatomical alterations are often the result of recurrent instability. Bankart lesions and other labral tears impair the stability of the shoulder by interfering with the deepening action of the glenoid. The humeral head is less securely held in place by the capsule in MDI due to capsular redundancy, and the joint is further destabilised by osseous abnormalities such as glenoid bone loss and Hill-Sachs lesions.

Diagnostic Tools

Shoulder instability is defined by the joint's inability to maintain its natural position, leading to recurrent dislocations or subluxations. Diagnosis requires a comprehensive approach, beginning with a detailed physical examination and supplemented by diagnostic imaging to identify the direction of instability, underlying structural damage, and associated injuries.

Clinical Examination

The physical examination is a systematic process to assess the shoulder's structure and function.

Inspection and Palpation: The initial step involves a visual inspection for signs like scapular winging (suggesting nerve injury) or muscular atrophy (indicating chronic instability or nerve involvement). Palpation is then used to identify tender areas that may point to specific injuries in the labrum, joint capsule, or rotator cuff tendons.

Range of Motion (ROM) and Strength Testing: Assessing ROM helps identify limitations due to pain or instability. Strength testing is crucial, especially in patients over 40, to detect rotator cuff injuries often associated with dislocation. Examiners must avoid forcing the joint beyond the patient's comfort zone to prevent iatrogenic dislocation.

Specific Instability Tests

A battery of tests is used to pinpoint the direction of instability and suggest the underlying pathology.

Anterior Instability

Apprehension Test: The arm is placed in 90° of abduction and external rotation. A positive test is indicated by patient apprehension or fear of dislocation (Sensitivity: 65.6%, Specificity: 95.4%).

Relocation Test: Following a positive apprehension test, a posteriorly directed force on the humeral head relieves the apprehension (Sensitivity: 64.6%, Specificity: 90.2%). When combined, these two tests have a sensitivity of 81% and a specificity of 98%.

Anterior & Posterior Instability

Load and Shift Test: The humeral head is loaded into the glenoid and shifted anteriorly or posteriorly, graded from 0 (minimal) to 3 (dislocated). Sensitivity varies widely (8.0–71.7%), while specificity is high (89.9–100%).

Anterior/Posterior Drawer Test: The humeral head is translated anteriorly or posteriorly to assess the degree of movement (Sensitivity: 53.0–58.3%, Specificity: 85.0–92.7%).

Posterior Instability

Jerk Test: With the arm in 90° of abduction and internal rotation, an axial load is applied. A painful clunk or subluxation indicates a positive test (Sensitivity: 73%, Specificity: 98%).

Kim Test: Performed similarly to the jerk test but with an adduction force, it specifically detects posteroinferior labral tears (Sensitivity: 80%, Specificity: 94%).

Inferior Instability

Sulcus Sign: A downward force on the arm causes inferior subluxation, creating a sulcus. A positive sign suggests rotator interval or superior glenohumeral ligament insufficiency (Sensitivity: 28%, Specificity: 97%).

Gagey Test: Passive abduction beyond 105° suggests laxity of the inferior glenohumeral ligament (IGHL) (Sensitivity: 66.7%, Specificity: 90%).

Hyperextension Internal Rotation Test: Measures inferior capsular and IGHL tension by comparing hyperextension angles between shoulders.

Generalized Laxity

Beighton Score: This systemic score assesses hypermobility in joints like the elbows, knees, and thumbs. A high score indicates generalized ligamentous laxity, a risk factor for multidirectional shoulder instability.

Diagnostic Imaging

Imaging is a crucial supplement to the physical exam to confirm structural injuries.

Magnetic Resonance Imaging (MRI): The gold standard for evaluating soft tissues, MRI provides detailed images of labral tears, rotator cuff injuries, and capsular damage.

Computed Tomography (CT): Excellent for visualizing bony anatomy, CT scans identify fractures, glenoid bone loss, and humeral head defects (Hill-Sachs lesions). CT arthrography can also reveal soft tissue injuries.

Classification

Several systems have been developed to categorize shoulder instability based on its cause, direction, and associated structural damage, which guides treatment decisions.

TUBS vs. AMBRI

This classic dichotomy separates instability into two main types:

TUBS: Stands for Traumatic, Unidirectional, Bankart lesion, often requiring Surgery. This describes instability resulting from a single traumatic event, typically leading to anterior dislocation with a Bankart tear (labral detachment). Treatment is often arthroscopic Bankart repair.

AMBRI: Stands for Atraumatic, Multidirectional, Bilateral, Rehabilitation as first-line treatment, and Inferior capsular shift if surgery is needed. This describes instability without significant trauma, often due to inherent ligamentous laxity, affecting multiple directions. Treatment focuses on rehabilitation, with surgery (e.g., arthroscopic capsular plication) reserved for failures.

Stanmore Triangle Classification

This system introduces a third, dynamic component to instability:

Polar Type I (Traumatic Structural): Aligns with TUBS, caused by a major injury leading to structural damage.

Polar Type II (Atraumatic Structural): Aligns with AMBRI, involving structural laxity without trauma.

Polar Type III (Non-Structural): Instability is driven by abnormal muscle patterning and neuromuscular control, rather than structural damage. Patients may move between these poles over time.

Bone Loss Classification

The amount of bone loss from the glenoid rim or humeral head is a critical prognostic factor.

Glenoid Bone Loss: Significant loss (historically >25%, but now considered as low as 13.5%) or an "inverted pear" glenoid shape dramatically increases recurrence rates after soft-tissue repair alone.

Humeral Bone Loss: Large Hill-Sachs lesions can engage with the glenoid rim, causing recurrent instability.

Glenoid Track Concept: This concept evaluates the interaction between humeral and glenoid bone loss. An "off-track" Hill-Sachs lesion, which falls outside the safe contact area of the glenoid (the "track"), has a high risk of engagement and recurrence, often requiring bone-block procedures like the Latarjet.

Risk Stratification:

Instability Severity Index Score (ISIS)

The ISIS is a preoperative score that predicts recurrence risk after arthroscopic Bankart repair. It factors in: Patient age, Level of sports participation, Degree of glenoid and humeral bone loss, and Shoulder hyperlaxity. Patients with an ISIS > 6 have a high recurrence rate (~70%) and may be better candidates for alternative procedures like the Latarjet.

Management

In clinical practice, shoulder instability is a regular occurrence. According to research by Lennart Hovelius of Gävle Hospital in Sweden, shoulder dislocations affect 1.7% of people, with a higher frequency seen in men. Shoulder dislocations occur at a rate of 17 per 100,000 person-years, with the highest incidence occurring in males aged 21 to 30 and females aged 61 to 80, according to research conducted in Denmark by Krøner and colleagues. According to research by Zacchilli and Owens, the incidence of shoulder dislocations in the US was 23.9 per 100,000 person-years, with young adult men being the most likely to experience them.

There is still disagreement about how to treat shoulder dislocations that occur for the first time. There is a significant risk of redislocation with nonoperative therapy, which is frequently advised initially, especially in younger people or those engaged in high-risk activities. For example, recurrence rates can reach 94% in those under the age of 20. Redislocation rates are also high in historical data; Rowe (1956) reported a redislocation rate of 38% in 313 patients after a 4.8-year follow-up period. Similarly, after five years, Hovelius found that 256 patients had a redislocation rate of 44%. Following a first-time dislocation, participants were randomised in research by Kirkley and her colleagues at the Fowler Kennedy Sport Medicine Clinic in Canada. Either early arthroscopic stabilisation within 4 weeks of the dislocation or 3 weeks of immobilisation followed by rehabilitation was administered to the patients. A prevalent problem in both athletes and the general population is shoulder impairment, especially in relation to glenohumeral instability. To restore functioning and lower the chance of recurrence, this issue must be properly managed. Both nonoperative and surgical therapy are available for shoulder instability, and each strategy is customised to the patient's specific requirements, considering factors including age, activity level, and aspirations for the future [15,16]

Non-surgical Management of Shoulder Dislocation

Nonoperative methods are frequently used as the first line of treatment for a severely dislocated shoulder. Over time, a number of reduction procedures have been developed to realign the shoulder joint, including the Cunningham, Milch, and Stimson manoeuvres. Usually, the reduction is carried out using intra-articular lidocaine (IAL) injections or intravenous analgesia with or without sedation (IVAS). It is well established that IVAS and IAL offer comparable degrees of pain alleviation and patient satisfaction throughout the process. However, according to a Cochrane analysis, IAL is linked to fewer problems and a quicker recovery than IVAS.

Following shoulder reduction, the patient is put in a sling and advised to rest for a brief length of time, usually one to three weeks. Restoring range of motion (ROM) and managing discomfort are the main priorities during this period. Avoid stimulating positions like external rotation and abduction, which can cause instability to repeat too soon, and instead maintain the arm in a neutral position. To accomplish these aims, physical therapy is frequently started early and progresses to rotator cuff and periscapular strengthening activities. This maximises the shoulder's dynamic stabilisation.

The conventional method of immobilisation involves internal rotation and adduction of the arm. Studies have revealed that immobilisation for longer than a week does not significantly reduce the risk of recurrence. Recently, researchers have proposed that after a dislocation, the shoulder should be somewhat externally rotated. By squeezing the subscapularis tendon against the anterior glenoid neck, Itoi et al.'s approach reduces joint effusion and prevents labral separation, which in turn lowers the recurrence rate. Despite encouraging first results, the data is still unclear since later research has not been able to reliably repeat these outcomes. Once an athlete has recovered normal strength and reached a pain-free range of motion, they are usually permitted to resume their sport. Shoulder harnesses may be used to reduce the chance of further dislocations during athletic activities. The designs of these devices differ; neoprene harnesses are more suited for athletes who need a wider range of motion, such as overhead athletes or swimmers, while stiff braces are best for contact sports like football.

Surgical Management of Shoulder Dislocation

Surgery is frequently recommended in situations of recurrent glenohumeral instability, especially in young, energetic people or those participating in high-demand sports. The patient's age, degree of activity, and risk of recurrent instability are some of the variables that influence the choice to continue with surgery. When conservative care is unsuccessful, surgery may be required, particularly in patients under the age of 25, since recurrence rates can range from 60% to 90%. There are two types of surgical treatment options: open and arthroscopic. By treating any structural injury to the labrum, joint capsule, or surrounding ligaments, the objective is to stabilise the shoulder.

Open Anterior Capsulolabral Reconstruction (Bankart Repair)

In the past, individuals with severe or persistent shoulder instability were often treated with surgical operations. Using a deltopectoral technique, the surgeon splits or releases the subscapularis tendon to reveal the joint capsule during an open Bankart repair. Next, suture anchors are used to heal the labral rip. Although this method works well, it may cause a loss of external rotation, which might harm athletes who need a lot of range of motion, such as swimmers or overhead sports.

Arthroscopic Bankart Repair

Since they are less intrusive and produce results that are equivalent to open surgery, arthroscopic treatments have grown in popularity in recent years. Suture anchors are used to restore the torn labrum to the anterior glenoid during the arthroscopic Bankart repair, which is carried out through tiny incisions. To confirm the diagnosis and evaluate any further joint injury, such as rotator cuff tears or Hill-Sachs lesions, a diagnostic arthroscopy is initially conducted. Suture anchors are then used to repair the labrum and joint capsule, re-establishing the glenohumeral joint's static stabilisers. There is no discernible difference between open and arthroscopic procedures in terms of patient satisfaction or recurrence rates. Open repairs, however, can cause some external rotation to be lost, which could impair performance in several sports. For sportsmen who depend on high levels of external rotation, such as tennis players or baseball pitchers, arthroscopic stabilisation is recommended [17].

Addressing Glenoid Bone Loss

Glenoid bone loss is a major obstacle in treating recurrent shoulder instability because it might reduce the effectiveness of soft tissue repairs. 3D CT scans and other preoperative imaging are essential for determining the degree of bone loss. Generally speaking, arthroscopic Bankart repair is contraindicated in cases where the glenoid has lost more than 20–25% of its bone. Open procedures like the Bristow or Latarjet procedures could be recommended in these situations. By repositioning the coracoid process and its tendons to the anterior glenoid rim, these procedures offer soft tissue support in addition to bone augmentation. Low recurrence rates and increased patient satisfaction are linked to the Bristow and Latarjet treatments, especially when there has been substantial bone loss.

Postoperative Care

After shoulder instability surgery, postoperative rehabilitation is crucial to a full recovery. After three to four weeks of immobilisation in a sling, the rehabilitation phase usually consists of progressive mobilisation exercises to regain range of motion. After a complete range of motion is restored, strengthening activities are started, and 16–20 weeks after surgery, sport-specific training begins. Depending on the operation type and the athlete's recovery, contact sports can usually be resumed in 20–24 weeks [18,19].

Conclusion

A specific strategy is needed to treat shoulder impairment, depending on the patient's age, degree of activity, and the degree of instability. Many patients find that nonoperative therapies, including pain management and temporary immobilisation, are beneficial in halting further dislocations. However, in order to restore shoulder function and avoid long-term problems, young, energetic people who have recurring instability frequently need surgery. Although both open and arthroscopic procedures provide consistent results, the choice between them is based on the patient's particular requirements, such as the necessity for mobility following surgery or the existence of coexisting ailments. For the best results after surgery, rehabilitation is essential, with an emphasis on regaining strength, range of motion, and functioning unique to a certain sport. The prognosis for people with shoulder instability is getting better because of advancements in surgical methods and aftercare, which may allow patients to resume their regular activities and sports.

Conflict of interest. Nil

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