Diagnosis and management of shoulder instability

The shoulder is the most commonly dislocated joint, with an annual incidence of 10–20 dislocations per 100 000 people (Krøner et al, 1989). Most dislocations result from trauma and 97% are anterior (Krøner et al, 1989). Approximately half occur in people aged 15–29 years, with men being 2.5 times more at risk than women (Zacchilli and Owens, 2010).

Instability is defined as excessive movement of the humeral head on the glenoid. Normal shoulder anatomy is shown in *Figure 1*. The shoulder has static and dynamic stabilizers. Static stabilizers include the articular surface configuration, the glenohumeral ligaments and the glenoid labrum. Dynamic stabilizers include the rotator cuff, scapular rotators and the long head of biceps. Abnormalities in any of these components can cause instability.

Shoulder instability is often classified using the Stanmore classification (Jaggi and Lambert, 2010) (*Figure 2*). This recognizes the contributions of trauma, structural abnormalities and abnormal muscle patterning. This triangle concept is important because it emphasizes that an individual patient may have more than one contributory factor. Trauma, structure and muscle patterning are not mutually exclusive, nor are they binary – each of these three factors forms a continuum, ranging from a minor contribution through to a major contribution. A single patient can fall anywhere along the spectrum, with contributions from one, two or all three factors.

Traumatic anterior dislocation often occurs when a patient falls forwards and puts his/her arm up to protect him-/herself. The mechanism of injury is an external rotation force, applied to an abducted arm, which levers the humeral head out of the socket. With anterior dislocation, there is squaring of the shoulder contour. In anterior instability, anterior displacement of the humeral head occurs as the arm is abducted and externally rotated. Traumatic posterior dislocation can occur in epileptics and following electric shocks. With posterior dislocation, the patient is unable to externally rotate his/her shoulder and the coracoid appears prominent. In posterior instability, posterior displacement of the humeral head occurs as the arm is elevated. When the arm descends there is often an audible clunk as the shoulder relocates. Muscle patterning instability is usually posterior (Jaggi and Lambert, 2010). Multidirectional instability involves inferior instability, combined with anterior, posterior, or both anterior and posterior instability. It is usually atraumatic and often occurs in people with generalized hypermobility. The risk of recurrent instability is inversely proportional to age. For example, men <19 years of age have a 75% chance of redislocation, with most recurrences occurring within 2 years (Robinson et al, 2006).

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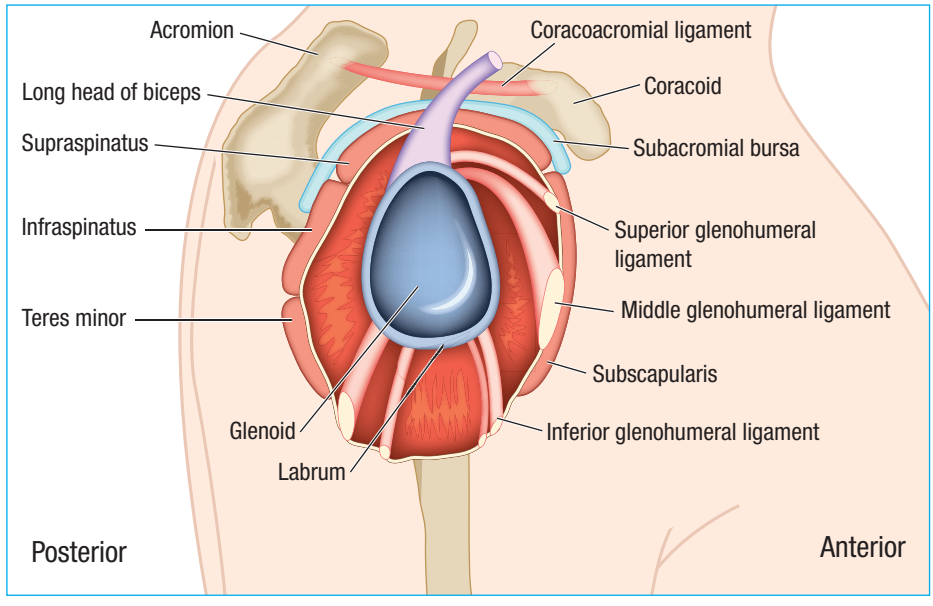

Figure 1. Normal shoulder anatomy.

Associated abnormalities

Dislocations can be associated with other pathologies. Most commonly, a Bankart lesion occurs: an avulsion injury where the labrum separates from the glenoid. This lesion is sometimes referred to as a 'simple'

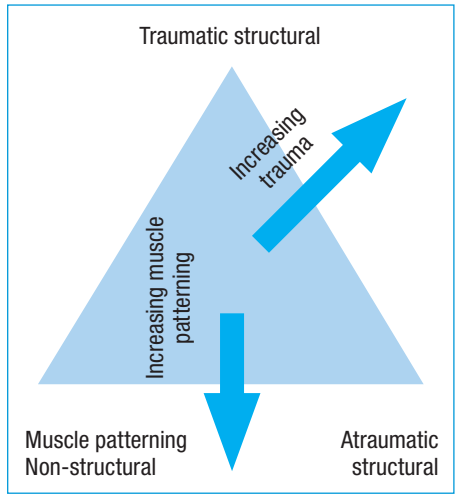

Figure 2. The Stanmore classification of shoulder instability. An individual patient can lie anywhere within the triangle because his/her instability may have contributions from trauma, structural abnormalities and muscle patterning. From Jaggi and Lambert (2010).

Bankart lesion because only soft tissue is involved. Conversely, in a 'bony' Bankart lesion, there is an associated fracture of the anteroinferior glenoid. Bony Bankart lesions are more common in those who suffer recurrent dislocations.

A Hill–Sachs lesion may also occur: a compression fracture of the posterosuperior humeral head which results from impaction of the soft humeral head on the hard glenoid during dislocation. Around 16% of anterior dislocations also sustain greater tuberosity fractures, which often reduce following shoulder relocation (Robinson et al, 2012). Clinically apparent nerve injuries occur in 13.5% of dislocations, with the axillary nerve at greatest risk (Robinson et al, 2012).

Older patients are more likely to suffer nerve injuries. Approximately 10% of patients suffer new onset weakness as a result of associated rotator cuff tears (Robinson et al, 2012). The British Elbow and Shoulder Society advocates considering cuff tears in people aged >40 years, with the aim of quickly identifying affected individuals, allowing early surgical repair to achieve optimum outcomes (Brownson et al, 2015).

Diagnosis

An accurate diagnosis of instability requires history taking, examination skills and appropriate investigations.

History

Following an acute shoulder dislocation, essential components of history taking include the mechanism of injury, whether the shoulder was reduced at the scene of injury, the length of time the shoulder was dislocated, associated injuries, neurovascular symptoms and whether the patient is fasted. In the context of chronic instability, patients often report pain, subluxation, dislocation, or a feeling that the shoulder might come out of the joint. Overhead activities can be particularly difficult.

History of a specific traumatic injury indicates the possibility of structural contributions to instability, whereas a history of insidious onset without trauma suggests non-structural causes. Ascertaining the success or failure of previous treatment is important for informing prognosis and subsequent treatment recommendations. The British Elbow and Shoulder Society (Brownson et al, 2015) recommends that history taking should include:

- Patient expectations
- Hand dominance
- Occupation
- Level of activity or sports
- Age at first dislocation
- Sex of patient
- Symptoms of ongoing instability
- Number of dislocations
- Comorbidities.

'Red flags' requiring same-day urgent referral to an orthopaedic surgeon include severe acute pain and unreduced dislocation. Unreduced dislocation should be considered with a history of trauma, an epileptic fit or electric shock, loss of rotation and an abnormal shoulder shape. Patients with suspected acute rotator cuff tears resulting from dislocation do not need same-day urgent orthopaedic review. However, they should be referred to orthopaedics for review in the next available specialist shoulder clinic (Brownson et al, 2015).

Examination

A dislocated shoulder may be apparent because of squaring of the shoulder contour. In a slim patient, the humeral head may also be palpable in its dislocated position. In the acute phase following a dislocation, the shoulder is often painful and assessment can be difficult; movement may be restricted. However, once the initial pain has settled, most patients can achieve full movement. Documentation of examination findings is important, both clinically and for medicolegal reasons.

Useful tests for chronic instability are described in *Table 1* and include anterior apprehension, posterior apprehension, load and shift, rotation, sulcus sign, Beighton's score, other signs of hyperlaxity, rotator cuff assessment and neurological examination. Neurovascular examination of the affected arm is essential, particularly in the case of an acutely dislocated shoulder. *Table 2* shows how to perform a quick, targeted neurological examination.

Investigations

X-ray in two views demonstrates the dislocation. An anteroposterior X-ray is essential. The second view should ideally be axial. However, if this is impossible because of pain, a modified axial or lateral scapular view are acceptable. In an X-ray demonstrating anterior dislocation (*Figure 3a*), the humeral head sits medial and inferior to the glenoid. In *Figure 3b* the shoulder has dislocated posteriorly. This type of dislocation is often missed. However, close inspection of the X-ray reveals that the humeral head is rotated internally, giving the appearance of a light bulb. The humeral head and glenoid overlap. X-rays may also reveal a bony Bankart or Hill–Sachs lesion. A bony Bankart appears as a fracture of the anteroinferior glenoid rim. A Hill–Sachs lesion (*Figure 3c*) is demonstrated by a posterolateral indentation of the humeral head which occurs at or above the level of the coracoid.

Magnetic resonance arthrogram is the best investigation for labral abnormalities, such as Bankart lesions. Furthermore, up to 40% of patients aged 40–60 years have associated rotator cuff tears. These tears can be identified by either magnetic resonance imaging or ultrasound. Bony abnormalities are best assessed with computed tomography. Associated greater tuberosity fractures can also be identified on X-ray, although computed tomography provides more accurate assessment of the amount of displacement.

Electromyography is recommended for nerve injuries sustained during shoulder dislocation when there is no recovery after 6 weeks. If electromyography does not show evidence of recovery, referral to a nerve injury centre is required for consideration of surgical neurolysis, nerve repair or nerve grafting (Brownson et al, 2015).

Management

Figure 4 shows an algorithm summarizing management. The treatment for an acutely dislocated shoulder is emergent reduction. There are many techniques for reducing shoulder dislocations. The British Elbow and Shoulder Society (Brownson et al, 2015) describes the principles of safe reduction:

- Analgesia and/or general anaesthetic for muscular individuals
- In-line traction rather than rotation
- Documentation of pre- and post-reduction neurovascular findings
- Post-reduction X-rays in two planes to confirm reduction.

After reduction, patients are immobilized in a sling. The British Elbow and Shoulder Society does not recommend external rotation slings because of equivocal evidence, increased cost and poor compliance (Brownson et al, 2015). Prolonged immobilization beyond 1 week does not reduce redislocation (Paterson et al, 2010).

Table 1. Recommended components of a physical examination for patients with shoulder instability

Anterior apprehension test	The examiner stands behind the patient with the palm of one hand stabilizing the scapula. The examiner's other hand holds the patient's forearm and abducts the shoulder to 90°. The examiner then externally rotates the shoulder. A positive test occurs when the patient involuntarily contracts the pectoralis major, or if the patient stops the test for fear of dislocating the shoulder. If this test is normal at 90°, it can be repeated at 120° and 150°
Posterior apprehension test	The examiner internally rotates the shoulder and forward flexes the patient's arm to 90°. Then the examiner pushes the patient's elbow to achieve posterior movement at the shoulder. A positive test occurs when the patient reports a feeling of instability
Load and shift test	This is also sometimes known as the anterior and posterior drawer test. One of the examiner's hands stabilizes the scapula, while the other hand centres the humeral head and moves it anteriorly, and then posteriorly. The distance moved by the humeral head is graded: I mild, movement of <1 cm; II moderate, humeral head moves >1 cm or to the edge of the glenoid; III severe, humeral head moves beyond the edge of the glenoid resulting in dislocation
Rotation	Increased external rotation combined with reduced internal rotation indicates glenohumeral internal rotation deficit. An internal rotation deficit of >25°, compared to the contralateral shoulder, exacerbates the condition by altering humeral head centring and worsening anterior capsule laxity. Glenohumeral internal rotation deficit is common in overhead athletes and is caused by repetitive overuse
Sulcus sign	The patient is asked to relax while the examiner holds the patient's arm above the elbow and applies inferior traction. A positive test occurs when an indentation sulcus appears just distal to the lateral edge of the acromion
Beighton's score	The threshold for joint laxity in a young person is 4–6 out of 9. Consequently, a score of 6 or more indicates hypermobility. 1 point is scored for each of the following findings: right thumb passive dorsiflexion to forearm, left thumb passive dorsiflexion to forearm, right little finger extension >90°, left little finger extension >90°, right elbow hyperextension >10°, left elbow hyperextension >10°, right knee hyperextension >10°, left knee hyperextension >10°, ability to place both palms flat on the floor bending forwards with both knees fully extended
Generalized hyperlaxity	Patients with generalized hyperlaxity often have a positive sulcus test, a raised Beighton's score, poor posture, poor single leg balance and poor scapular control. Poor scapular control can manifest as winging or as scapular dyskinesia during repetitive shoulder abduction movements. Sometimes patients voluntarily dislocate their shoulder as a 'party trick'
Rotator cuff	A careful examination of rotator cuff strength is essential. Any doubt of cuff integrity necessitates an orthopaedic referral. Both shoulders should always be compared. Supraspinatus is tested with the 'empty cans' test. The patient elevates the arm to 90° in the plane of the scapula with the thumb pointing downwards, as if emptying a can of beer onto the floor. The examiner pushes downwards on the patient's forearm while the patient resists. Infraspinatus and teres minor are tested by examining external rotation strength. Subscapularis is tested with Gerber's lift off test where the patient stands with the arm internally rotated behind the back. The examiner places a hand on the patient's palm and the patient pushes his/her hand away from his/her back and towards the examiner. If this test is impossible because of pain, then the 'bear hug' test can be used. The patient places the palm of the hand on the front of the opposite shoulder and resists the examiner who tries to pull the patient's hand away from the shoulder. Weakness of both infraspinatus and supraspinatus could indicate a large acute cuff tear
Neurological examination	A basic neurological examination should, as a minimum, include an assessment of the terminal nerve branches of the brachial plexus: musculocutaneous, axillary, radial, median and ulnar

Age is important. The British Elbow and Shoulder Society recommend that those aged <25 years should be assessed by a shoulder surgeon within 6 weeks of dislocation as they may require early surgery because of their high risk of redislocation (Brownson et al, 2015). Those aged 25–40 years should be assessed for instability 3–6 months after dislocation – if they remain symptomatic surgery could be considered (Brownson et al, 2015).

Shared decision making is vital (Francis, 2013; General Medical Council, 2013). Most patients want detailed information about their condition and available treatments (Gigerenzer and Muir Gray, 2011). Although professional knowledge is required, the patient's perspective on what matters is often of equal or greater importance. For example, two patients with identical chronic instability symptoms and imaging may choose different treatments: a patient who accepts avoiding sport for 6 months might choose surgery, whereas a sportsman wishing to continue competing this season might choose physiotherapy.

Table 2. Components of a targeted neurological examination for patients with shoulder instability

Nerve	Nerve roots	Test for motor function	Test for sensation
Musculocutaneous	C5, C6, C7	Elbow flexion	Radial forearm
Axillary	C5, C6	Shoulder abduction	'Sergeant stripes' upper lateral arm
Radial	C5, C6, C7, C8, T1	Elbow extension	Hand first dorsal web space
Median	C6, C7, C8, T1	Make fist	Tip index finger
Ulnar	C8, T1	Spread fingers wide	Tip little finger

Physiotherapy

Physiotherapy is the mainstay of treatment for atraumatic instability (Jaggi and Lambert, 2010; Brownson et al, 2015). Older patients with traumatic structural abnormalities may

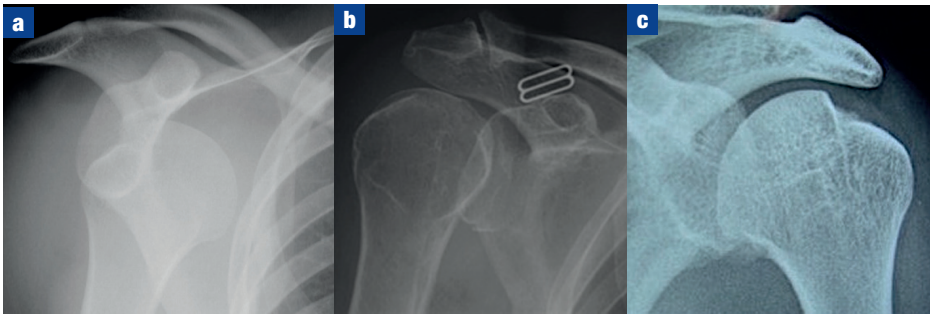

Figure 3. Anteroposterior X-rays of the shoulder. **a.** An anterior dislocation; the humeral head sits medial and inferior to the glenoid. **b.** Posterior dislocation; the humeral head is rotated internally, causing a light bulb appearance. **c.** A Hill–Sachs lesion; a posterolateral indentation occurs on the humeral head at or above the level of the coracoid.

also be treated primarily with physiotherapy because their risk of redislocation is lower than that of their younger counterparts. Physiotherapy usually lasts between 4 and 12 weeks, depending on the patient's individual progress (Brownson et al, 2015). Exercises often include proprioception, postural exercises, core stability, scapular rotator exercises and rotator cuff strengthening (Jaggi and Lambert, 2010). Patients with nerve injuries also require physiotherapy to minimize loss of movement (Brownson et al, 2015).

Surgery

Surgery is usually reserved for patients with traumatic instability and structural abnormalities such as Bankart lesions. Patients without structural lesions who remain symptomatic despite completing a full course of physiotherapy may also progress to surgery. Surgery aims to increase shoulder stability and reduce the risk of dislocation. Anatomical repair is preferred over non-anatomical repair because it reduces pain, reduces recurrent dislocation and reduces shoulder osteoarthritis (Brownson et al, 2015). Surgical stabilization can be arthroscopic (keyhole) or open. Most patients are now treated arthroscopically (Owens et al, 2011; Brownson et al, 2015). Traditionally, arthroscopic and open surgery reported equal redislocation rates, ~8% at 2–4 years follow up (Harris et al, 2013). However, more recent work suggests a trend towards improved outcomes with arthroscopic surgery (Petrera et al, 2010; Brownson et al, 2015).

Arthroscopic stabilization

Arthroscopic stabilization is performed through two or three small 0.5–1 cm incisions. Anchors are the most reliable way of reattaching the torn labrum to the glenoid (Brownson et al, 2015). This technique aims to re-tension the capsule. It also helps recreate the natural bumper at the glenoid edge (*Figure 5*). Most surgeons use three anchors. Reported risk factors for recurrent instability after arthroscopic stabilization include being male, age <22 years, contact sports, overhead activities, and waiting >6 months between first dislocation and surgical stabilization (Brownson et al, 2015).

Open surgery

Open surgery is usually performed through a modified deltopectoral approach, which is approximately 3 inches in length. Although anatomical Bankart repairs are sometimes performed as open surgery, the majority of open surgeries are stabilizations involving bone blocks. Bone block procedures are used when >20% of the glenoid surface area is lost or for patients who have failed arthroscopic stabilization (Brownson et al, 2015).

The Latarjet operation is the most common bone block procedure. It involves transfer of the coracoid process, through a split in the subscapularis, to the

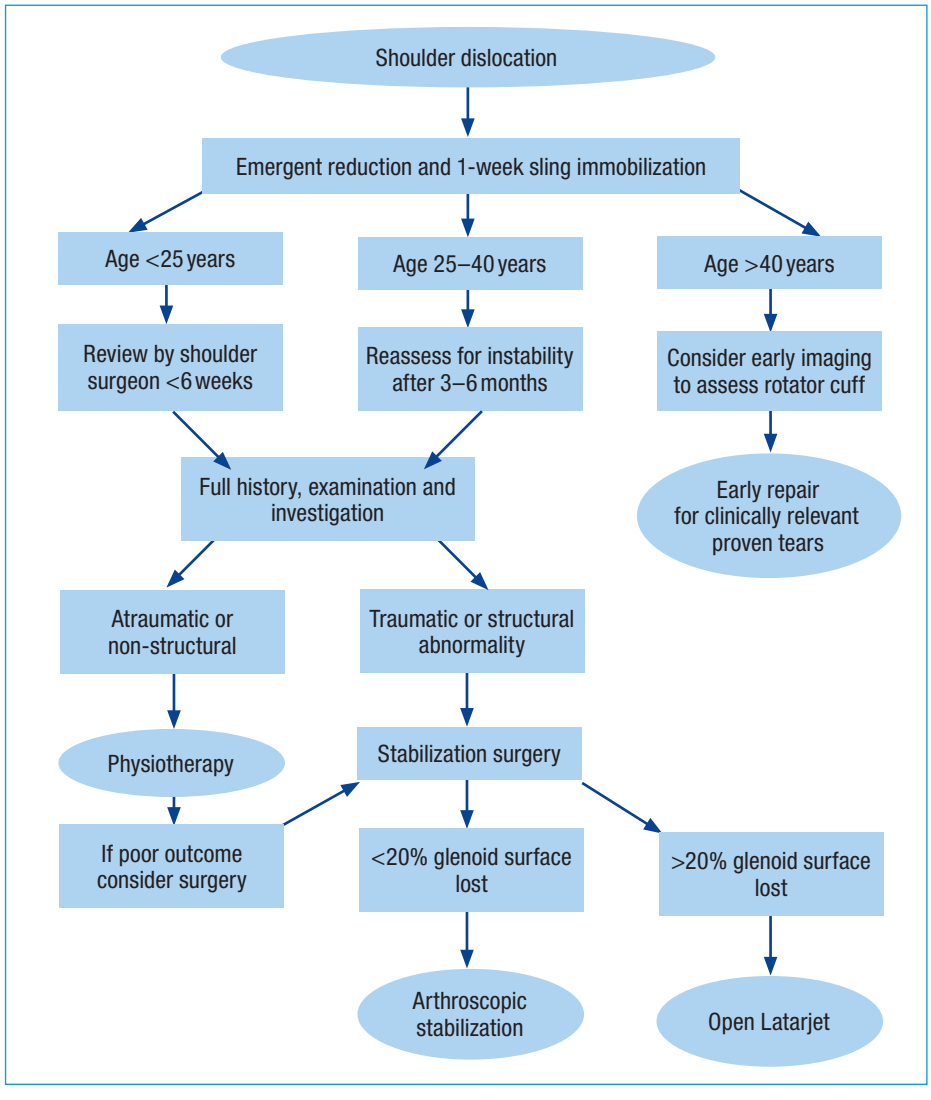

Figure 4. Algorithm summarizing the management of shoulder instability.

KEY POINTS

- Following dislocation, patients should not be immobilized in a sling for more than 1 week.
- Men <20 years of age have the highest risk of recurrent instability.
- Patients aged >40 years must be carefully examined for associated fractures, rotator cuff tears and nerve injuries. If found, the patient needs review in the next available specialist shoulder clinic.
- Severe pain after reduction of dislocation or unreduced dislocation requires same-day urgent orthopaedic referral.
- Shared decision making, incorporating the patient's personal preferences, is essential.
- Physiotherapy is the recommended treatment for atraumatic instability.
- Surgery is usually reserved for symptomatic patients with traumatic instability, structural abnormalities, or atraumatic patients who have failed physiotherapy.

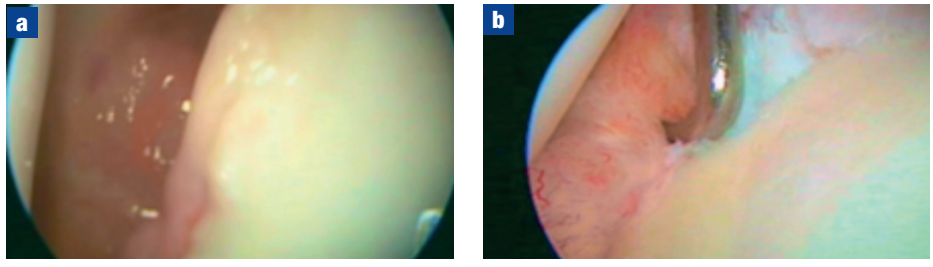

Figure 5. **a.** An arthroscopic view showing that the edge of the glenoid is bare because there is a Bankart lesion where the labrum has detached from the glenoid. **b.** Arthroscopic suture anchor fixation allows reattachment of the labrum to the glenoid, thereby reconstructing the normal soft tissue bumper at the edge of the glenoid.

anteroinferior glenoid. In the UK, Latarjets are usually performed as open surgeries, although arthroscopic Latarjets are popular in France. Currently, there are no long-term data supporting arthroscopic over open Latarjet (Brownson et al, 2015). Latarjet is not recommended as a first-line treatment for instability because complication rates are high, with up to 30% of patients suffering complications such as non-union (failure to heal), nerve injury, recurrent dislocation and infection (Brownson et al, 2015).

Non-Latarjet bone block options for restoring glenoid bone stock include iliac crest graft and allograft. Again, these procedures can be performed both arthroscopically and as open surgeries. However, evidence for these grafts is poor, with most reported studies being case series (Brownson et al, 2015).

Associated injuries may also require surgery. Hill–Sachs defects comprising >40% of the humeral head are likely to require surgery. Management is controversial because there is no high quality evidence to support the use of one technique over another. Currently, a Latarjet, or arthroscopic stabilization with additional remplissage, appears most promising (Brownson et al, 2015). In remplissage, the posterior capsule and infraspinatus tendon are used to fill the Hill–Sachs defect. The British Elbow and Shoulder Society recommends that dislocations associated with minimally displaced greater tuberosity fractures are treated non-operatively with sling immobilization for 3 weeks, followed by physiotherapy. Fractures with >5 mm of displacement have better outcomes when treated surgically; open reduction and internal fixation could provide better functional results than closed reduction with percutanous pinning (Brownson et al, 2015). Symptomatic acute cuff tears sustained during dislocation should also be managed surgically. Surgery reduces pain, improves function and improves patient satisfaction (Gomberawalla and Sekiya, 2014). Early surgical repair is better than delayed repair (Hantes et al, 2011).

After both arthroscopic and open stabilization, patients are immobilized in a sling for 6 weeks. They must avoid contact sports, such as rugby and martial arts, for 6 months. Patients will also need to engage in a physiotherapy programme, practising exercises every day. Failure to comply with these postoperative restrictions increases the risk of redislocation. Consequently, patients should be carefully counselled preoperatively to ensure that they are willing to undertake not only the surgery itself, but also the postoperative rehabilitation. **BJHM**

Conflict of interest: none.

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