Investigations for the Unstable Shoulder

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Abstract

The unstable shoulder has a wide spectrum of presentations from the obvious dislocations to the subtle chronic instabilities. It is the job of the clinician who is interpreting the imaging to correlate a clear history with the pathology that can be seen and to go searching for the pathology that may not be obvious but could drastically alter management. For most cases, imaging is used mainly to direct further management than to diagnose. Therefore, it is critical to have access to the appropriate imaging modality taken in the correct manner to maximize the possibility of picking up all lesions. This review looks at the possible lesions and imaging modalities needed to diagnose them and more importantly, direct their future management.

Keywords: Shoulder instability, Shoulder imaging, Unstable shoulder, Shoulder dislocation.

Introduction

INTRODUCTION

The shoulder has the greatest range of motion compared to any joint in the body, however, this mobility comes at the expense of stability. Unlike other "ball and socket" joints, the glenohumeral joint (GHJ) relies more on its soft tissue restraints rather than its bony congruity to achieve a balance between range of motion and stability. The glenoid is deepened by the fibrous labrum and the joint capsule has thickenings in the form of glenohumeral ligaments (GHLs) of which the inferior or inferior GHLs (IGHL) is the major ligamentous stabilizer. It has an anterior and posterior band with an axillary pouch situated between. It is the anterior band that is critical to passive joint stabilization. Injuries to these bony or soft tissue components can lead to instability. It runs from the anteroinferior labrum to form a sleeve of continuous tissues with the glenoid rim, capsule, and periosteum to the humeral metaphysis. Importantly for stability, but also for diagnosis, it becomes taught in the position of abduction and external rotation or ABER. When there is pathology of the labroligamentous complex in this area, the IGHL is incompetent and the shoulder becomes unstable [1,2].

There are a number of imaging investigations that can be used to diagnose abnormalities in these structures and in this review we look to highlight the most important investigations used in this assessment of the acute and chronic unstable shoulder.

Subluxation is a partial loss of contact between the joint surfaces and dislocation is a complete loss of contact. Subluxation and dislocation can be acute or chronic and while it is commonly caused by a trauma, it can be atraumatic as well. Instability of the GHJ describes a pathological state in which this excessive translation leads to pain and loss of function. Instability can be unidirectional (anterior, posterior, or inferior) or multidirectional.

Glenohumeral shoulder instability is most common in young male adults, with nearly half of all dislocations occurring in those between the ages of 15 and 30-year-old. Of all GHJ dislocations presenting to emergency departments, more than 2/3rd are male [3].The causative trauma is commonly sports related.

Importantly, the younger patients with an acute traumatic dislocation have higher recurrence rates for anteroinferior dislocations than older patients [4,5]. This needs to be considered when assessing the imaging for this age group, as they are more likely to need surgery. The younger patients are also more likely to dislocate from a higher-energy injury in a preciously normal shoulder causing damage to their joint cartilage and the labro-ligamentous complex. Older patients are more likely to dislocate from a low-energy fall in a shoulder with pre-existing degenerative change or rotator cuff pathology.

Imaging

Imaging investigations are the mainstay for diagnosing and planning management of an unstable shoulder. These include plain X-rays, fluoroscopy, ultrasound scans (USS), computed tomography (CT), and magnetic resonance imaging (MRI). Arthroscopy can also be used as a diagnostic investigation.

While imaging modalities have advanced over the years, especially with three-dimensional (3D) reconstructions of CT and MRI images, plain radiographs remain the first investigation and for good reason. They are cheap and easy to obtain and can provide significant information, especially in case of acute dislocation. The most relevant views when investigating instability are a standard anteroposterior (AP) of the shoulder, an AP of the GHJ, a lateral trans-scapular Y-view, axial views, and Stryker notch views. Pre-reduction images can pick up a subluxed or dislocated joint. Post reduction films are important to

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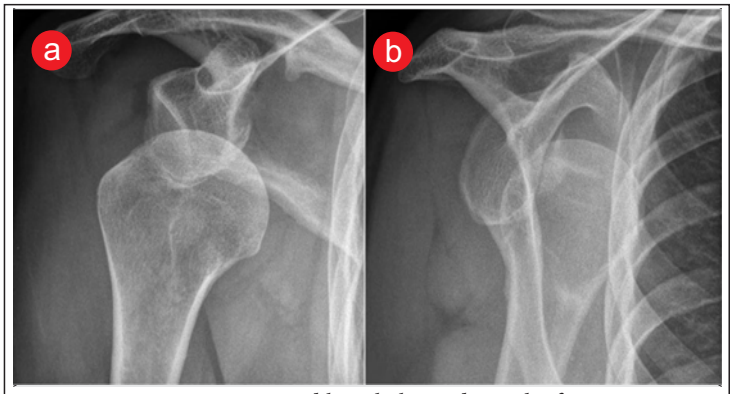

Figure 1: An anteroposterior and lateral plain radiograph of an acute anterior dislocation.

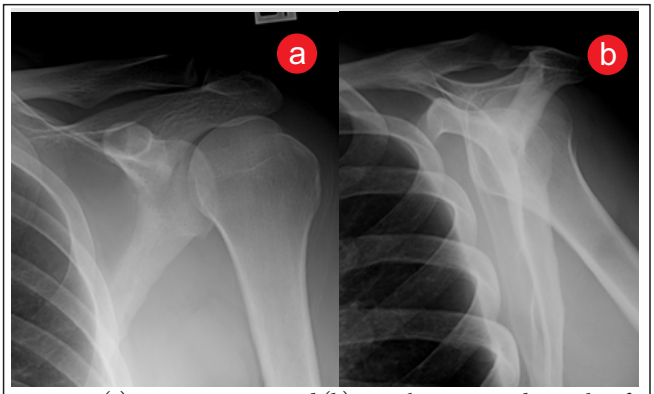

Figure 2: (a) Anteroposterior and (b) scapular Y view radiographs of a Hill–Sachs lesion.

characterize any residual subluxation or associated bony lesions such as a bony Bankart or a Hill–Sachs lesion. However, any suspicion of a bony lesion necessitates assessment with 3D imaging.

USS is more useful when detecting associated soft tissue lesions or lesions that have developed as part of a picture of chronic instability. These include rotator cuff tears; rupture, tendinosis and subluxation of the biceps tendon; joint effusions; paralabral cysts suggestive of a labral tear; suprascapular and axillary nerve pathology as well as pathology in the acromioclavicular (AC) or sternoclavicular joints. It has the advantage of being a dynamic investigation, which is non-invasive, relatively cheap, and easy to obtain. However, it has limited use in visualizing the GHJ.

CT is most useful for characterizing osseous lesions including fractures, bony Bankart lesions, Hill–Sachs lesions as well as glenoid remodeling. It can assess bone qualitatively, quantitatively and morphologically at a high resolution. If it is combined with intra-articular contrast medium, the resultant CT-arthrography can be used to assess the labrum, capsule articular cartilage and intra-articular loose bodies. It is relatively inexpensive but does involve ionizing radiation. It can be a useful alternative to MRI if a patient has contra-indications such as a pacemaker.

MRI and MR arthrography is the investigation of choice for detailed assessment of the soft tissues of the shoulder. MRI is particularly useful for assessing full thickness rotator cuff tears, rotator cuff muscle atrophy and biceps pathology. MR arthrography can add detail when assessing partial thickness randomised controlled trials, articular surfaces, intra-articular loose bodies, the capsule, and the labro-ligamentous complex. There is little use for MR arthrography in the acute setting due to the arthrographic effect of the effusion or hemarthrosis.

MR images should be obtained in several planes. The coronal oblique images are parallel to the supraspinatus tendon in either proton density (PD), PD with fat suppression (FS) or short T1 inversion recovery (STIR) sequences. This plane is most useful for assessing rotator cuff tears. Sagittal images are obtained in the plane perpendicular to the long axis of the supraspinatus tendon. They assess the rotator cuff in the short axis useful to look at muscle bulk.

Axial images are very useful for instability because in addition to evaluating arthropathy of the GHJ and AC joints and assessing the long head of the biceps in the bicipital groove, this plane is most useful for assessing labral pathology. The more common sequences are T2 weighted gradient echo and FS-PD.

MR arthrography is more sensitive for assessing labral pathology than conventional MRI but 3T MRI has been shown to improve the assessment of these lesions without the need for contrast medium. The MR images are either T1-weighted with fat saturation for gadolinium contrast or PD/T2-weighted if saline is used. The MRI should be performed as soon as possible after injection to take advantage of maximal joint distension. Indirect MR arthrography can be used when an intravenous injection of gadolinium is given and a scan performed after 15-20 minutes of gentle exercise. There is no joint distension but can be useful if an arthrogram cannot be performed.

If the patient has already had surgery then the resultant scarring, altered anatomy and implant artefacts can pose a challenge. While non-metallic or titanium fixation can help, using STIR or fast spin echo can help reduce the susceptibility of FS sequences to

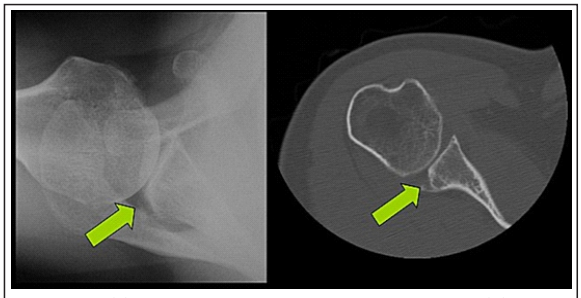

Figure 3: (a) X-ray of reverse bony Bankart lesion,(b) lesion seen on computed tomography.

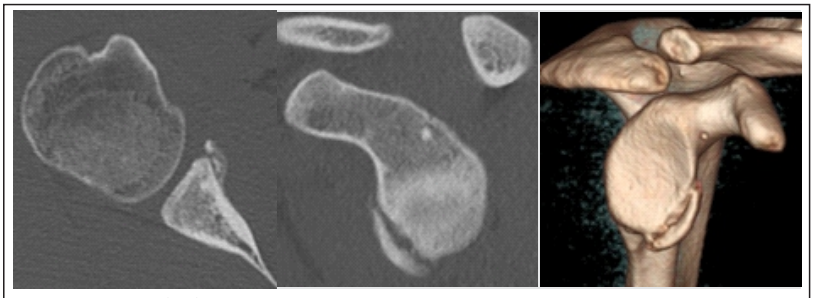

Figure 4: (a-c) Bony Bankart lesion seen on computed tomography images.

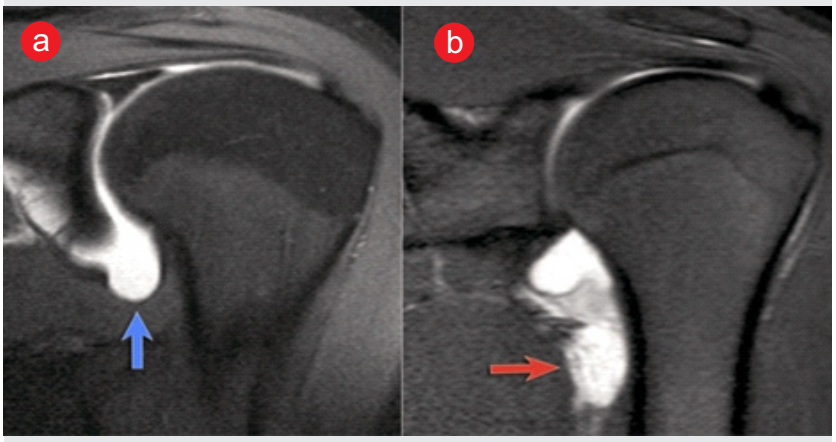

Figure 5:(a) Normal sagittal T2 magnetic resonance,(b) humeral avulsion of glenohumeral ligament with effusion.

Figure 6:Anterior labral periosteal sleeve avulsion.

artefact.

Other investigations for an unstable shoulder may include vascular or electroneurological studies if there is a clinical suspicion for neurovascular pathology, but these won't be covered in this review.

As clinicians, we will be presented with a clinical picture either from our own assessment or from the request form that has been submitted to radiology. Therefore, a logical approach to describing the investigations is to discuss what each offers in the most common clinical scenarios that tend to be present.

Acute first time dislocations

Acute shoulder dislocation is a clinical diagnosis based on history and examination. The immediate and long-term management should be based on the results of suitable radiological investigations. The first-line radiological investigation is plain film radiography, which has the major advantage of being quick and easily accessible in the vast majority of emergency departments.

There are a number of views that can be obtained but the aim is to obtain a minimum of 2 orthogonal views of the GHJ to determine the direction of the dislocation and visualize any associated bony injuries. These are typically the Hill–Sachs lesion [6] which is present in 84% of acute anterior dislocations [7] and the bony Bankart lesion [8]. However, it is not uncommon to take a series of between 3 and 5 views as each view offers a specific advantage to evaluate a portion of the joint but not the joint in its entirety (Fig. 1).

The minimum radiographic series for an episode of acute instability is an AP view and a lateral view.

The ideal lateral is an axillary lateral view as it gives a view of the lesser tuberosity, the anterior and posterior glenoid rims and any anterior or posterior translation of the humeral head on the glenoid. It may not be possible to obtain in trauma as it involves abduction of the arm, ideally to 90°. The plate is placed on the superior aspect of the shoulder and the beam is passed from between the arm and the chest in a superior direction.

There is a trauma axillary view that does not require arm abduction as the X-ray plate is placed directly under the shoulder with the patient leaning back and the beam is positioned directly above. The lateral or scapular "Y" view gives a clear indication of the position of dislocation but offers limited information on associated bon injuries, especially bony Bankart lesions. The image is obtained by placing the anterior aspect of the shoulder against the X-ray plate, then placing the X-ray tube posteriorly, along the scapular spine (Fig. 2).

Other views include the Stryker notch view, which assesses for a Hill–Sachs lesion and the West point axillary view, which is useful in assessing anterior glenoid abnormalities [9].

In addition to immediate diagnosis, plain films are used to assess the joint post-reduction and assess the need for immediate additional intervention. The disadvantage of plain film radiography is that it does not assess the degree of soft-tissue damage. If soft tissue trauma is left undiagnosed and untreated then patients are likely to encounter laxity and thus further chronic instability, especially in the younger age group and those in a high-risk sporting or working situations. Further imaging is therefore an essential part of the radiological work-up for patients presenting with acute shoulder instability.

If plain films do not clearly show or quantify a suspected lesion, 3D imaging with CT is often necessary. CT can be used for assessment of acute shoulder instability,

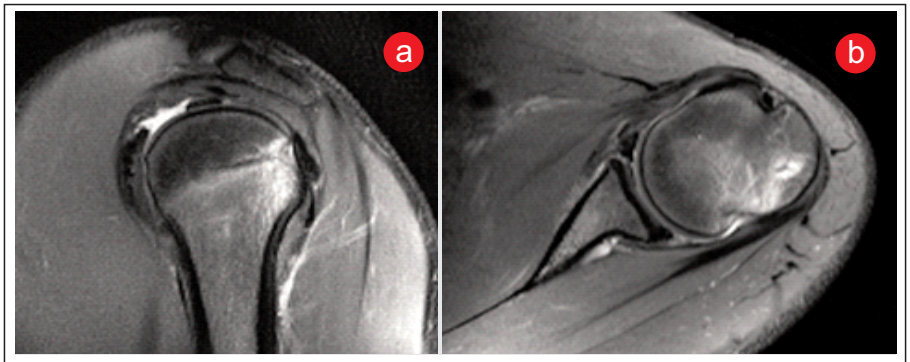

Figure 3: (a & b) Magnetic resonance images of Hill–Sachs lesion.

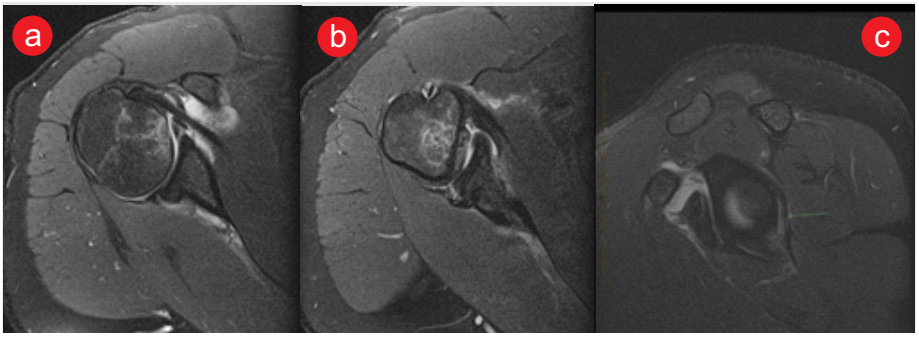

Figure 5:(a) Normal sagittal T2 magnetic resonance,(b) humeral avulsion of glenohumeral ligament with effusion.

however, it is not as commonly used as MRI. It is particularly useful in patients who have contraindications for MRI and those who have metal implants in or around the shoulder that would cause MR artefact. CT is good for characterizing the size and location of osseous defects prior to surgical intervention and 3D reconstructions are useful to calculate and plan [10]. With modern MRI sequences, CT and MR have now been shown to have comparable results in terms of quantifying the degree of osseous defects [11]. Conventional CT has a much more limited role in assessing degree of soft tissue involvement. CT arthrography, which involves imaging the joint following intra-articular injection of a contrast agent can be used to investigate for cartilaginous defects when MRI is not available but with poorer resolution and increased ionizing radiation, its use is limited (Fig. 3) [12].

The majority of cases of acute instability will need further imaging using MRI. MRI can be used with or without an intra-articular injection of a contrast agent, typically gadolinium. This MR arthrography isn't necessary in the acute setting as the effusion or hemarthrosis distends the joint and acts as a natural contrast to highlight lesions of the labro-ligamentous complex. In the more chronic setting, the intra-articular contrast agent performs this job.

The use of appropriate fat suppressed or STIR sequences, highlights fluid in the soft tissues allowing delineation of acute injury by demonstrating joint effusions, bleeding, soft tissue, and bony edema. The quantity and quality of the information necessary for planning future management is maximal within the first 7-10 days of the injury. As will be seen in those patients with chronic instability, scar tissue and tissues remodeling can reduce the sensitivity of MRI to picking up soft tissue injury when the scan is distant to the traumatic event [13].

Lesions

The most common soft tissue injuries in acute instability are the Bankart lesion, Perthes lesion, glenolabral articular disruption (GLAD) lesion, humeral avulsion of glenohumeral ligament (HAGL) lesion, and anterior labral periosteal sleeve avulsion (ALPSA). All these lesions have characteristic findings on MRI [14].

Bankart lesions, which are avulsion injuries of the glenoid labrum are best identified on T2-weighted imaging. The lesions appear as linear increased signal in the normally low-signal antero-inferior labrum. The Bankart lesion is present in 73% of acute anterior dislocations [7]. If associated with an avulsion fracture of the labrum off the glenoid rim the lesion can be seen on X-ray and CT images (Fig. 4).

Perthes lesions are similar to the Bankart lesion, in that the labrum is separated from the glenoid articular cartilage; however, the periosteal sleeve is not ruptured. On conventional MRI in a neutral arm position, it may be difficult to identify the lesion as the labrum may be only minimally displaced. For this reason, they are often left undiagnosed and only discovered during surgery, however, studies have shown that MRI in ABER can yield significantly higher detection rates over MR in neutral position [13].

The GLAD lesion is an anteroinferior labral tear that is associated with an injury to the glenoid articular cartilage.

The IGHL is the most important soft tissue stabilizer of the shoulder, hence a disruption at the humeral insertion is highly likely to lead to chronic anterior instability and is critical to identify on MRI. This is known as a HAGL lesion. It is uncommon for the HAGL to be associated with a bony avulsion (Fig. 5).

The ALPSA is a Bankart lesion where the labro-ligamentous complex has rolled up and displaced medially leaving a bare glenoid rim. It has a high association with chronic instability (Fig. 6).

In the days and weeks following dislocation bone edema may be seen on the imaging [10] which may aid in the identification of small Hill–Sachs and other osseous lesions. The identification of a typical pattern of bone edema is especially useful if the history is unclear for an instability episode (Fig. 7).

The Hill–Sachs defect is the most common bony lesion following anterior dislocation but a glenoid rim fracture is more concerning. While a displaced rim fragment may block reduction in the acute setting, the rim fracture has a higher prognostic significance for recurrent dislocation than a Hill–Sachs lesion. The risk increases with an increase in size of the fragment [15, 16, 17].

When the shoulder dislocates posteriorly, it is reverse Hill–Sachs and reverse Bankart lesions that predominate. In this case, a 29-year-old man was tackled playing rugby and fell awkwardly. He heard a crack and was unable to move his shoulder. It was reduced in the field. When assessed a week later, the post reduction imaging demonstrated a posterior labral tear (reverse Bankart) and a reverse Hill–Sachs lesion indicative of a posterior dislocation (Fig. 8).

Effusions and hemarthroses are often beneficial in identifying shoulder pathology following acute dislocation. The high-signal fluid causes distension of the joint capsule, filling defects and allowing structures to separate, therefore acting as a "natural contrast" [12]. Bankart lesions are more easily identifiable whilst an effusion is present, as the fluid clearly fills the defect between the avulsed labrum and the glenoid. Chondral defects are more easily detectable in GLAD lesions [18] and injury to the GHL, as seen with HAGL lesions, can be localized by the associated periarticular edema and hemorrhage in the axillary pouch, quadrilateral space, and proximal humerus around the lesser tuberosity [19].

Further evidence for HAGL lesions may be

the "J" sign, which is increased signal from edema and hemorrhage around the torn stump of the IGHL [20].

For injuries with less effusion, or when imaging is obtained after the effusion has subsided, then MR arthrography is an option. The contrast agent works in much the same manner as an effusion, stretching the capsule and contrasting with the structures inside the capsule. This allows quality imaging to be obtained much later after the initial complaint of instability. The drawback to arthrography is the invasive nature of contrast administration [12]. It requires fluoroscopic guidance of intra-articular administration of the contrast solution, which can be time-consuming and carry the risks associated with any joint injection: infection, bleeding and pain. Although these drawbacks exist, MR arthrography is generally very well tolerated and the benefit of making an accurate diagnosis and initiating the correct treatment far outweighs the risks of the procedure. With the advent of 3T MRI, the increased resolution has allowed improved visualization of many soft tissue lesions without the need for arthrography, but this technology is not widely available outside of the major centers.

Acute shoulder instability can be investigated with a diagnostic arthroscopy. This allows visualization of the contents of the shoulder capsule and is the standard that many studies into accuracy of imaging modalities compare their results against. It also allows for an examination under anesthesia, which can allow for clinical findings not possible in an apprehensive, awake patient.

However, compared to imaging, it is an expensive, invasive procedure with associated risks of anesthesia and surgery and hence is not recommended for diagnostic purposes unless imaging modalities are not available or have yielded no satisfactory results [21]. The cost of diagnostic arthroscopy far outweighs that of MR imaging: US$480 (+US$132 for 45 min of anesthesia) versus US$67 (all prices based on US Healthcare in 2014) [22]. For these reasons, arthroscopy tends to be limited to therapeutic purposes.

It is important to note that all these lesions have been described as they relate to anterior instability and dislocation. In cases of posterior dislocation, the common lesions are the reverse Bankart and reverse Hill–Sachs. They are located opposite to their namesakes in the AP plane.

Chronic instability with repeated dislocations

Similarly to acute instability, chronic instability can be caused by a traumatic event or arise without any antecedent trauma. The latter tends to be in patients with generalized hypermobility. These hypermobile patients may show minimal MRI findings.

In the chronically unstable patients, as with the acute dislocation, imaging is necessary to make surgical plans as well as just for diagnosis. In fact, in post-traumatic patients who continue to endure repeated GHJ instability episodes, the clinical diagnosis is clear. The role of imaging in this situation becomes the need to characterize the associated pathology and plan future surgery to address lesions. The surgical planning will be based on the need to reconstruct any osseous lesions of the glenoid or humeral head, soft tissue lesions of the labro-ligamentous complex or both. When assessing the inferior capsulolabral soft tissues in a chronic dislocator, both the investigations used and the lesions that are found are similar to those of an acute patient.

It is less common to encounter hemarthroses, HAGL and other capsular injuries. It is more common to find capsular laxity, a Bankart lesion, an ALPSA, a Hill–Sachs lesion, glenoid rim deficiency or a fracture of the greater tuberosity in chronic repeated dislocators [23,24]. Glenoid rim fractures and rotator cuff tears occur in roughly the same proportions in patients with acute and chronic instability but more frequent in patients with repeat dislocations.

The prevalence of a Hill–Sachs lesion increases from 25% in 1st time dislocators to between 40% and 90% in recurrent dislocators [24,25]. The character of the lesion can change over time with an increase in size seen in individuals with repeated episodes and the development of a signature hatchet morphology over time [26].

It is intuitive that the location and orientation of the lesion depends on position of humeral head during dislocation and the magnitude of the compressive force during the trauma [26].The location and magnitude is important to direct the need for surgical management and what surgical option will be employed. The Hill–Sachs lesion can cause symptoms of catching, clicking and popping [27].

If large enough, the lesion can engage the glenoid rim in the position of instability. Engaging is caused when the lesion extends in size to include part of the articular surface and so in abducted and externally rotated position, the glenoid rim falls into this lesion. Symptoms range from apprehension and subluxation in mild cases to locking and dislocation in severe cases.

Surgical management includes remplissage, bone graft with allograft, space fillers, a Laterjet procedure, resurfacing arthroplasty or even a hemiarthroplasty. The choice of surgical management is driven by the position and size of the lesion but also the patient's symptoms. While imaging is used to quantify the lesion preoperatively, whether a lesion is engaging or not is judged clinically.

Instability arising from glenoid pathology can be from a lack of bone or from insufficiency of anteroinferior labro-ligamentous complex. If there is significant loss of bone, there can be an articular incongruency which leads to a mechanical mismatch. The glenoid rim can be pathologically flat or deficient post fracture or bony remodeling or both [28].

Imaging is used to quantify the size of lesion and qualify rim contour. The risk factors for instability from glenoid pathology are as follows:

- AP width of defect measures 21% or more of total glenoid length
- Total articular surface decreases by 20-30% [16,17]
- Inverted pear shape.

Surgical management is dictated by the degree of change:

- If loss<15% of width or 10% of area – Soft tissue repairs
- 15-30% or 10-25% of surface – Bone augmentation in physically active
- >30% width or >25% area – Glenoid

reconstruction, latarjet procedure.

The use of CT scans has traditionally been the imaging modality of choice using both two-dimensional and 3D reconstructions to quantify the area and width of bone losses. The use of CT arthrography improves soft tissue evaluation but limits cortical bone evaluation as the iodinated contrast material can have same attenuation as cortical bone. Therefore, MRI is still needed to evaluate soft tissues appropriately. Now that MRI is yielding similar levels of information of the cortical bone, CT is being used less frequently.

It is worth noting that many chronically unstable patients experience acute events on a background of chronic instability and their imaging should be evaluated with this in mind. An MRI of an acute dislocation on a background of chronic instability may still demonstrate a hemarthrosis and bone marrow edema overlying chronic findings. It is essential to have access to a detailed history when assessing the imaging of an instability episode to ensure that acute changes do not mask the sometimes more subtle chronic lesions.

Many of the labral-ligamentous lesions seen with glenohumeral instability occur at the time of the acute dislocation as discussed earlier in the chapter. However, many also evolve over time, after the acute first time dislocation. The severity of these chronic soft tissue lesions depends on the initial energy of the first trauma, the associated lesions incurred at the time and the subsequent level of activity of the patient and the number of subsequent dislocations they have suffered.

The Bankart lesion can occur with the first dislocation or after multiple events. It can change morphology from being non-displaced to being displaced. This is evident on MRI, as the glenoid rim becomes bare or deficient anteroinferiorly.

GLAD lesions develop with subsequent dislocation as chondral flaps increase in size and detach from the glenoid fossa leading to focal cartilage loss and loose bodies. This can lead to degenerative changes and osteoarthritis with its classic subchondral sclerosis as well as bony remodeling of the glenoid.

An ALPSA lesion can arise from a Perthes lesion (see acute instability) and is common in recurrent dislocators. If the periosteum remains attached to labrum, traction is transmitted along the IGHL and the periosteum is stripped from the medial glenoid neck. Over time, the labral-ligamentous complex then retracts medially with periosteum, over time. This rolled-up soft-tissue then scars down becoming immobile.

This can mean it is obscured from view at arthroscopy by a smooth synovialized surface that is created as it heals. There is a characteristic pattern of findings on MRI, which shows a deficient or bare glenoid rim on the axial and oblique coronal images. If the labrum is absent, it may be found medially as a focal soft tissue thickening 5-15mm medial to glenoid rim [29,30]. If the IGHL is identified, it can be followed to a thickened periosteal sleeve. This is made easier using an MR arthrogram, with or without ABER positioning.

The HAGL and capsular lesions are more likely to be identified if the MRI images are taken soon after the traumatic event. During the healing process, the IGHL can scar down to humerus and appear to have a normal contour at arthroscopy.

If it does not scar down, the resultant mechanical insufficiency can cause chronic instability. The capsular defect at the humeral attachment can lead to the development of a pseudo-pouch, which is adjacent to the normal axillary pouch. It is difficult to identify on a non-arthrographic MRI unless the shoulder joint is distended by an effusion. When seen on MR arthrogram, it gives the appearance of two pouches. In the months and years following trauma, a pseudo pouch suggests the diagnosis of a HAGL lesion [19].

There is a bony HAGL variant which represents a cortical fracture from the periosteal avulsion. This may be visualized more clearly on a CT scan.

Chronic instability without repeated dislocations

This group of patients presents a great challenge to clinicians. The symptoms occur due to repeated subluxation and micro-motion. There are a number of synonyms used to describe their clinical picture including relative instability, functional instability, micro-instability, and occult recurrent subluxation. These should all be borne in mind if evaluating imaging is requested using these clinical terms. The request may also be querying other pathology such as a rotator cuff tear, impingement or a superior labrum AP tear. It is, therefore, critical to consider GHJ instability in the evaluation of imaging for all young adult shoulders.

The patients may not present with obvious instability but may have an overuse activity, generalized capsular laxity or have suffered a remote trauma meaning it has been forgotten about or it was a dislocation that relocated immediately and now seen as not important.

The most common sports involved are swimmers, baseball pitchers, weight lifters, and tennis players. They only complain of pain but this is due to a functional instability. There is a gradual failure of both their passive and dynamic shoulder stabilizers. The IGHL stretches out along with the joint capsule leading to tearing of the anteroinferior labrum, delamination of articular cartilage over antero-inferior glenoid fossa.

The symptomatic athlete may have capsular stretching that isn't apparent on MRI but micro-instability has caused them to develop secondary rotator cuff tears, labral tears, and lesions of the long head of biceps.

The asymptomatic overhead athlete may have an anteroinferior labral tear on the MRI but with no loss of function. In fact, pitchers may develop anteroinferior labral tear as an adaptive change to improve their performance, allowing greater ABER during late cocking and early acceleration.

Patients with generalized capsular laxity are also categorized with the pneumonic atraumatic, multidirectional, bilateral, rehabilitation, and inferior capsular shift. They have capsular laxity and glenohumeral hypermobility which is exacerbated by repetitive overstretching, proprioceptive imbalance and connective tissue deficiency. Their functional imitation is due to involuntary GH instability. They have no history of trauma and arthroscopic findings are often limited to capsular redundancy in axillary pouch. Labral tears and osseous lesions are typically absent. Arthrography may also suggest capsular redundancy, but there are no reliable diagnostic criteria. The treatment is rehabilitation with

physiotherapy rather than surgery unless absolutely necessary. The results of surgery are disappointing mainly due to the inherently lax tissues which stretch out over time.

In patients who are unaware of their trauma, MRI imaging may be delayed for weeks or months from the time of injury. They have the same risks of labral-ligamentous complex lesions as first time dislocators but any bone marrow edema is likely to have resolved. Capsular defects may have healed and even remodeled and non-displaced labral fragments can scar to the glenoid rim. Labral-ligamentous lesions such as Bankart or Perthes lesions can easily be overlooked in absence of any evidence of a previous dislocation such as the edema associated with a Hill–Sachs lesion. As with acute lesions, MR arthrogram can improve diagnostic accuracy as contrast can fill the labral defects in non-displaced lesions and outline abnormal contours. The ABER position transmits tension from IGHL to labrum, increasing diagnostic confidence as the position can displace an occult lesion from the glenoid rim.

Conclusions

Glenohumeral instability can present with a broad range of symptoms and clinical scenarios. The diagnosis is obvious in some situations but most unstable shoulders have never dislocated. Imaging investigations can be used to diagnose in those for whom the clinical history isn't clear-cut. However, instability is a clinical diagnosis - A Hill–Sachs lesion is a marker of dislocation but not instability. Imaging diagnosis depends on clinical scenario therefore choice of imaging modality also does.

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