Interpretation of the shoulder radiograph

Introduction

Shoulder injuries are a common presentation to emergency departments. The patient's history is important in determining the mechanism of injury and most fractures or dislocations will be apparent on clinical examination. Conventional (X-ray) radiography provides the mainstay of traumatic shoulder imaging and it is important to request the appropriate views to avoid misinterpretation. Computed tomography (CT) may be used as a second-line investigation in complex fractures that require surgical intervention. It is important to remember that musculotendinous and cartilaginous injuries may not be apparent on plain radiographs and that ultrasound and magnetic resonance imaging (MRI) may be used to image these structures in selected cases.

Anatomy

The shoulder girdle consists of the clavicle, scapula and humerus. The synovial sternoclavicular joint articulates with the manubrium and the first costal cartilage. It permits limited rotatory movement of the clavicle. Its fibrous capsule is further reinforced by the costoclavicular and sternoclavicular ligaments. The clavicle acts as a strut between the upper limb and the trunk, and provides attachments for the deltoid, trapezius and pectoralis major muscles. Between the clavicle and the first rib pass the subclavian vessels and the brachial plexus.

The acromioclavicular joint is a plane synovial joint which articulates with the acromion process of the scapula. Its weak fibrous capsule is strengthened by the acromioclavicular ligament, with the coracoclavicular ligaments providing vertical stability.

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The triangular scapula lies over the posterior costal surfaces. It has three bony eminences – the spine and acromion, the coracoid process and the glenoid. It articulates with the clavicle and the humerus. The shallow glenoid fossa is deepened by a fibrocartilaginous labrum which accepts part of the humeral head to form the ball-and-socket glenohumeral joint. The superior portion of the labrum blends with the tendon of the long head of the biceps brachii muscle. The surrounding capsule is loose to allow a full range of movement. The joint is strengthened by the glenohumeral, coracohumeral, transverse humeral and coracoacromial ligaments. Dynamic stability is provided by the rotator cuff complex which passes from the scapular surfaces to insert on to the lesser and greater tubercles of the humerus.

The anatomical neck of the humerus separates the head from the tubercles and is where the joint capsule is attached. Just below this level is the surgical neck which is prone to fracturing.

Radiographic views

The anteroposterior (AP) view is the primary projection for evaluating the shoulder (*Figure 1*). The humeral head is asymmetrical and typically has an appearance similar to the head of a walking stick. The articular surfaces of the humeral head and the glenoid fossa should be parallel to each other. The fused humeral growth plate may appear as two wavy lines passing between the tubercles and should not be mistaken for fractures. The unfused ossification centres of the acromion and coracoid have a typical location and an intact cortex. The undersurface of the acromion and the distal clavicle should form a straight line and the joint space should not exceed 10 mm.

Figure 1. Normal anteroposterior shoulder radiograph.

Figure 2. Normal axial shoulder radiograph.

In order to assess the alignment of the glenohumeral joint an axial view is performed with the patient abducting his/her arm (*Figure 2*). The humeral head should be seen to articulate with the glenoid fossa. The acromion process and coracoid are directed anteriorly on this projection. If the patient's movements are limited by pain then a lateral scapular or Y-view may be performed (*Figure 3*). In this view the

Figure 3. Normal lateral scapular or Y-view.

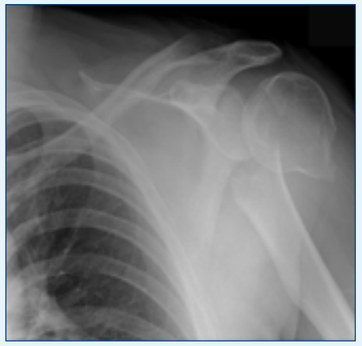


Figure 4. A displaced fracture of the surgical neck of the humerus.

humeral head is projected over the glenoid and the acromion and coracoid lie on either side forming a Y-shape.

Proximal humeral fractures

Fractures of the proximal humerus usually involve the surgical neck. They are considered displaced if the fragments are separated by more than 10 mm or the angulation exceeds 45° (*Figure 4*). More complex fractures involve the humeral head, and the lesser and greater tubercles (*Figure 5*), and may be associated with avascular necrosis. These injuries are often seen in the elderly following a fall and may be associated with shoulder dislocation and injuries to the wrist and hip.

Acromioclavicular joint injuries

Injury to the acromioclavicular joint is usually as a result of direct trauma. In severe injuries the fibrous capsule and coracoclavicular ligaments are disrupted causing joint instability. The distal end of the clavicle is superiorly subluxed and its undersurface forms a step where it meets the acromion process (*Figure 6*). Less severe sprains may not be apparent unless the joint is put under stress by holding a weight in the hand while the radiograph is taken. Comparison views with the asymptomatic side may be useful as there is a range of normal appearances. Non-traumatic pathology, such as rheumatoid arthritis or hyperparathyroidism, may cause erosion of the distal end of the clavicle and give the appearance of a widened acromioclavicular joint space.

Figure 5. A fracture of the greater tubercle of the humerus (arrow).

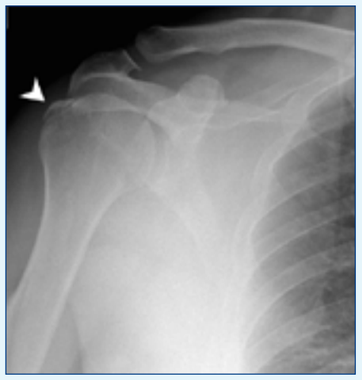
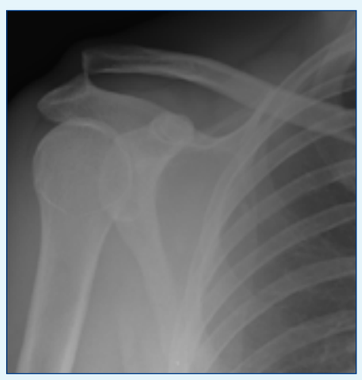


Figure 6. Subluxation of the acromioclavicular joint.



Glenohumeral joint

The shoulder joint has a wide range of movement but is relatively unstable and prone to dislocation. The vast majority of dislocations are anterior as a result of external rotation and abduction. As a consequence the humeral head comes to lie in a subcoracoid location. During the process of dislocation a compression fracture of the posterolateral humeral head may occur (Hill–Sachs deformity), or the anterior bony glenoid or its fibrocartilaginous labrum may be fractured (Bankart lesion).

In 10% of anterior dislocations there is an associated fracture of the greater tubercle. Anterior dislocations are usually readily apparent with the humeral head lying below the coracoid process on the AP view (*Figure 7*), and anterior to the glenoid on the axial or Y-views (*Figure 8*). It is important to obtain post-reduction radiographs to document the joint alignment and to scrutinize the film for associated fractures.

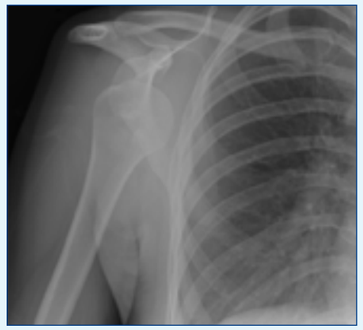


Figure 7. Anterior dislocation of the humeral head (anteroposterior view). The humerus lies in a subcoracoid position.

Posterior dislocations are much rarer and are less easy to appreciate both clinically and radiographically. They are usually associated with seizures or electrocutions, but may result from severe trauma. Forced posterior movement and internal rotation cause the humeral head to rest under the acromion process. On the AP view the internal rotation of the humeral head may give it a characteristic 'light bulb' appearance (*Figure 9*). The glenohumeral joint space also appears widened and there may be decreased overlap of the humeral head and glenoid. The axial or Y-views (*Figure 10*) confirm that the humeral head lies posterior to the glenoid. Other forms of

Figure 8. Anterior dislocation of the humeral head (lateral scapular or Y-view). The humeral head is displaced anteriorly revealing the glenoid fossa.

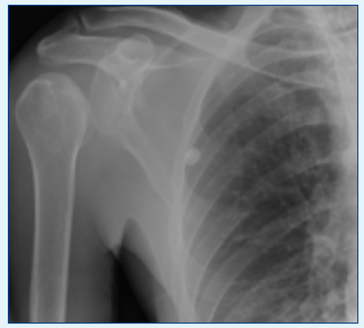


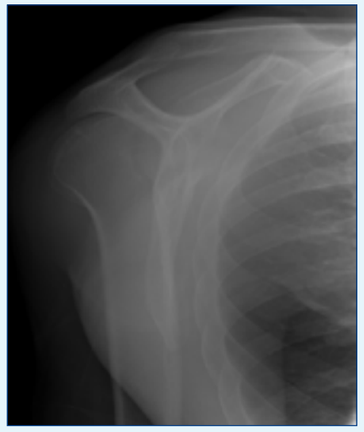
Figure 9. Posterior dislocation of the humeral head (anteroposterior view). The humeral head has a 'light bulb' appearance as a result of internal rotation of the shoulder. The glenohumeral joint space is widened.

dislocation are very rare and often associated with severe trauma and neurovascular compromise.

Clavicular fractures

Fractures of the clavicle are frequently encountered, especially in children, and may be complicated by non-union if not immobilized. The middle third is involved in 80% of cases with the pull of sternocleidomastoid usually displacing the fragments (*Figure 11*). However, not all fractures are easy to detect on an AP view and a projection with 45° angulation may be of use if there is a high clinical suspicion. Fractures involving the distal third are less common, and may be complicated by ligamentous injury. Proximal clavicular fractures are rare.

Figure 10. Posterior dislocation of the humeral head (lateral scapular or Y-view). The humeral head is displaced posteriorly below the acromion process.

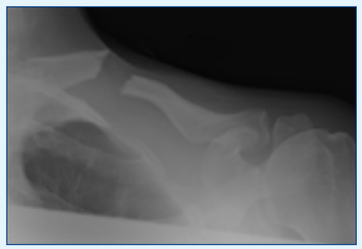


Scapular fractures

Fractures of the scapula are uncommon and usually occur in the setting of severe blunt trauma such as a fall or a road accident. They are frequently associated with other injuries such as rib and humeral fractures as well as pulmonary trauma. The combination of scapular and clavicular fractures gives rise to a 'floating shoulder'. Most fractures will be demonstrated on the conventional AP and lateral scapular views.

The majority of fractures involve the body, spine or neck of the scapula and are usually extra-articular. Extension to the glenoid may require surgical fixation. Fractures of the coracoid are usually the result of an avulsion injury from the coracoclavicular ligament or the short head of biceps. Acromial fractures typically arise from direct blunt trauma (*Figure 12*). Scapulothoracic dissociation is a rare and severe complication of high-impact trauma which is associated with bony, ligamentous and neurovascular damage to the upper limb.

Figure 11. A fracture of the middle third of the clavicle.



Sternoclavicular joint injury

Fracture dislocations of the sternoclavicular joint are often the result of direct trauma. The joint may dislocate anteriorly and treatment is generally conservative. However, posterior dislocations may damage the underlying neurovascular structures and operative repair may be necessary. The appearances of these injuries may be subtle on plain radiographs and CT may be necessary to assess the extent of mediastinal injury.

Conclusions

Injuries to the shoulder are common and are generally straightforward to recognize on plain radiographs. It is important to make a systematic assessment of each bone and joint on at least two radiographic views. Post-reduction radiographs should always be obtained and associated fractures not overlooked. BJHM

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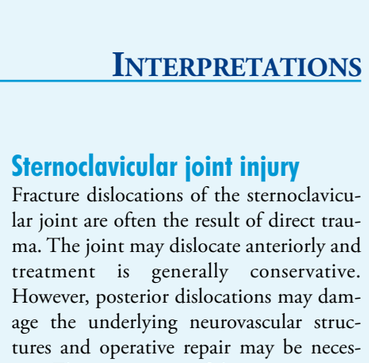
Figure 12. A fracture through the acromion process (arrow). The fourth rib is also fractured.



KEY POINTS

- Shoulder injuries are frequent and may lead to disability if not recognized.
- Most injuries are apparent on the anteroposterior view.
- An axial or Y-view should be obtained if a dislocation is suspected.
- Carefully evaluate possible posterior dislocations.
- Clavicular fractures are common and may be overlooked.
- Acromioclavicular strains may require stress radiographs for diagnosis.
- Proximal humeral fractures may be associated with wrist and hip fractures in the elderly.