Musculoskeletal trauma is one of the common reasons for attendance to Accident & Emergency and/or primary care. Appendicular radiographs, with the chest radiograph, constitute the commonest plain radiographic investigations the population undergo. Diagnosis is often straightforward, but certain patterns of injury may be more complex and elude detection. Reliance on a single investigation, and particularly a single view, at one time point without proper clinicoradiological correlation and follow-up can have detrimental consequences.

A fracture can be defined as a ‘break in the continuity of a bone’ and is included in the International Classification of Disease (ICD-10) under M84 as ‘Disorders of continuity of bone’.

The purpose of this paper is to review common fracture patterns of the upper limb. ‘Overlooks’ or ‘don’t miss’ cases that are detected by radiologists subsequently will be highlighted and discussed. Conventionally the upper limb is divided into ‘parts’ by the three major joints of wrist, elbow and shoulder and imaging should be tailored around clinical findings and appropriate application of this principle will also be discussed.

**THE WRIST AND HAND**

Many fracture complexes are described in this region. The patient’s age as well as the mechanism of injury are important considerations in the fracture pattern. Children’s bones are soft and may not have ossified, so incomplete fractures (where only one cortex breaks) are common. Fig 1 demonstrates one type of incomplete fracture (the other type being a greenstick fracture) and illustrates an important radiological principle: always image in two planes. Typically, the two planes are at right angles to each other and are known as ‘orthogonal’ planes.

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to the bone’s distal blood supply. With an appropriate clinical history, a standard 3 or 4 view radiograph series should be performed to ensure full visualisation of the carpal bones (Fig 4). This however may not reveal an undisplaced scaphoid fracture initially \(^3\).

Non-scaphoid carpal fractures are seen less frequently than scaphoid fractures and form only 10-30% of carpal fractures \(^4,8\). It is important to consider an occult fracture (up to 16% \(^3,4\)), dislocation and/or ligamentous disruption when clinical signs or symptoms are present but there is no visible bony injury on radiographs (clinical-radiological disassociation).

In the hand, a common fracture is the Boxer’s fracture

![Fig 4. Proximal pole scaphoid fracture (←) & concurrent triquetral fracture (*).](image1)

Common practice in suspected scaphoid injury is to immobilise in cast and perform repeat radiographs after 10 to 14 days \(^6\). This approach is however debated and it is becoming more common to perform secondary investigations such as Magnetic Resonance Imaging (MRI), Isotope Bone Scan or Computed Tomography (CT), each with their own benefits, limitations and sensitivities \(^5,6\).

### Table 1

<table>
<thead>
<tr>
<th>Eponymous Name</th>
<th>Fracture of Distal Radius</th>
<th>Intra-articular</th>
<th>Angulation</th>
<th>Displacement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colles Fracture (Fig 2)</td>
<td>Transverse</td>
<td>No</td>
<td>Dorsal</td>
<td>Dorsal</td>
</tr>
<tr>
<td>Smith Fracture (Fig 3a)</td>
<td>Transverse</td>
<td>No</td>
<td>Palmar</td>
<td>Palmar</td>
</tr>
<tr>
<td>Barton Fracture (Fig 3b)</td>
<td>Dorsal</td>
<td>Yes</td>
<td>N/A</td>
<td>+/- Dorsal</td>
</tr>
<tr>
<td>Chauffeur Fracture</td>
<td>Lateral (Radial Styloid)</td>
<td>Yes</td>
<td>N/A</td>
<td>+/- Lateral</td>
</tr>
</tbody>
</table>

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![Fig 3. Other Eponymous Wrist Fractures.](image2)

(a) Smith (‘reverse Colles’) with palmar angulation (line).
(b) Barton (dorsal oblique intra-articular) fracture of the distal radius (←) \(^9\).

![Fig 5. Hand Injuries.](image3)

(a) A Boxer’s fracture in the 5th metacarpal.
(b) A Bennett fracture which is an intra-articular fracture-dislocation at the base of the metacarpal of the thumb (1*).

The dashed line represents the site of MCP-UCL of the thumb involved in Skier’s thumb (not present).

![Fig 6. Finger Injuries.](image4)

(a) A common example is the volar plate avulsion injury at the base of the middle phalanx.
(b,c) In the absence of bony injury one must consider the less common ligamentous rupture. Always check for joint subluxation or dislocation: less obvious on the DP but clear on lateral projection.
(Fig 5a). This angulated fracture of the distal metacarpal commonly occurs at the metacarpal of the little finger but can occur in any. The base of the thumb is at increased risk of bony-ligamentous injury due to its exposed position and complex articulation. Examples include a Skier’s thumb (rupture of the medial/ulnar collateral ligament of the metacarpal-phalangeal joint (MCP-UCL) of the thumb +/- bony avulsion) or Bennett fracture (Fig 5b).

The digits themselves, particularly the distal phalanges, are especially vulnerable to direct trauma. Each bone and joint, visible on the radiograph, must be carefully evaluated for any penetrating, crush or avulsion associated injury (Fig 6).

**THE FOREARM AND ELBOW**

Proximal to the wrist the bony elbow structures require careful assessment not just for cortical integrity (Fig 7) but anatomical alignment (Fig 8) and secondary ‘soft tissue’ signs. Specifically the presence of an effusion on true lateral (Fig 8) is often critical in the detection algorithm of bony injury.

In children developing ossification centres can provide additional challenges for the radiologist. The centres ossify in a predicable order with age and the ‘C.R.I.T.O.L.’ mnemonic may be utilised to correlate the sequence of ossification with radiographic findings (ie first Capitellum < Radius < Internal epicondyle < Trochlea < Olecranon < Lateral epicondyle last).

Injury to any long bone in apparent isolation should prompt clinical assessment of both proximal and distal joints with radiographs undertaken, in two planes to include these joints. Examples of such joint involvement would include the Monteggia and Galeazzi fracture-dislocation patterns (Fig 9).

**HUMERUS AND SHOULDER**

The diaphysis of the humerus is less commonly injured than its peri-articular portions except in severe trauma. A fracture in the absence of a history of a suitable energy mechanism should raise the possibility of an insufficiency or pathological fracture. Examples of said underlying processes are osteoporosis or metastasis respectively (Fig 10a). This
also highlights the importance of reviewing each radiograph for findings outside the ‘bony field of view’, (Fig 10b).

After the clavicle, the ‘surgical’ neck of the humerus, just distal to its ‘anatomical’ head, is the commonest site of fracture in the shoulder region (Fig11) and the third commonest fracture of the extremities8. Fractures of the ‘anatomical’ neck, the articular segment between the tuberosities, in isolation are less common but may be seen in complex multi-component injuries8,10.

When interpreting shoulder radiographs, glenohumeral dislocation should also be considered and excluded. The position of the humeral head in relation to the glenoid is assessed on dedicated axial or ‘Y’ views: an extension of the principle of always reviewing at least two orthogonal views. Anterior-inferior dislocation of the shoulder joint (Fig 12) occurs more frequently than posterior dislocation (Fig 13), each condition presenting with different clinical findings and radiographic appearances8.

Stabilising soft tissue structures such as the rotator cuff...
Muscles, tendons and ligaments are often injured in combination and need to be considered as they influence management in the short and long term. One must also look for subtle but important injuries especially in the presence of dislocation (or subsequent reduction) such as a Bankart lesion or Hill-Sachs Deformity (Fig 14).

A checklist review of review areas such as scapula and ribs should form part of the diagnostic algorithm to ensure subtle or uncommon injuries are not overlooked (Fig 15).

**CONCLUSION**

Radiographic interpretation is an essential skill for many clinicians but radiologists are there to help and experienced radiographers can often assist. Remember:

1. Image appropriately and provide maximal clinical information.
2. Consider the history, examination and patient age to maximise/optimise clinical-radiological correlation.
3. Always review at least two orthogonal views e.g. AP and Lateral. Review systematically and in its entirety the region imaged.
4. Consider subtle findings such as the presence of acute angles in cortical surfaces; periosteal reaction and sclerosis.
5. Check your review areas.
6. ‘Think outside the bone.’ Review the soft tissues and consider what other injury may have occurred.
7. Older images are your friend and if no fracture is identified, on the initial view, consider re-imaging after an appropriate interval or undertaking further investigations if symptoms persist (e.g. CT, MRI or Nuclear Medicine studies).

Radiographs are an adjunct to, not a replacement for, clinical assessment and may not always provide a definitive answer.

While I have provided an overview of upper limb radiographic interpretation the principles described above can be applied, generally to the lower limb and to radiographs of the body and axial skeleton.

The authors have no conflict of interest

**REFERENCES**