Chapter 2
Shoulder and Upper Limb

Clavicle

Craig Classification

Group I: Fracture of the middle third
Group II: Fracture of the distal third. Subclassified according to the location of coracoclavicular ligaments relative to the fracture as follows:
   Type I: Minimal displacement—interligamentous fracture between conoid and trapezoid or between the coracoclavicular and acromioclavicular ligaments
   Type II: Displaced secondary to a fracture medial to the coracoclavicular ligaments—higher incidence of non-union
      IIA: Conoid and trapezoid attached to the distal segment (Fig. 2.1)
      IIB: Conoid torn, trapezoid attached to the distal segment (Fig. 2.2)
   Type III: Fracture of the articular surface of the acromioclavicular joint with no ligamentous injury—may be confused with first-degree acromioclavicular joint separation

Group III: Fracture of the proximal third
   Type I: Minimal displacement
   Type II: Significant displaced (ligamentous rupture)
   Type III: Intraarticular
   Type IV: Epiphyseal separation
   Type V: Comminuted
Acromioclavicular Joint

Rockwood Classification (Fig. 2.3)

Type I:  
Sprain of the AC ligament  
AC joint tenderness, minimal pain with arm motion, no pain in coracoclavicular interspaces.  
No abnormality on radiographs.

Type II:  
AC ligament tear with joint disruption, coracoclavicular ligaments sprained. Distal clavicle is slightly superior to
acromion and mobile to palpation; tenderness is found in the coracoclavicular space. Radiographs demonstrate slight elevation of the distal end of the clavicle and AC joint widening. Stress films show the coracoclavicular ligaments are sprained but integrity is maintained.

**Type III:** AC and coracoclavicular ligaments torn with AC joint dislocation; deltoid and trapezius muscles usually detached from the distal clavicle.

**Figure 2.3** Types I–VI of the Rockwood classification for acromioclavicular joints [2]
The upper extremity and distal fragment are depressed, and the distal end of the proximal fragment may tent the skin. The AC joint is tender, coracoclavicular widening is evident. Radiographs demonstrate the distal clavicle superior to the medial border of the acromion; stress views reveal a widened coracoclavicular interspace 25–100 % greater than the normal side.

Type IV: Type III with the distal clavicle displaced posteriorly into or through the trapezius. Clinically, more pain exists than in type III; the distal clavicle is displaced posteriorly away from the clavicle. Axillary radiograph or computed tomography demonstrates posterior displacement of the distal clavicle.

Type V: Type III with the distal clavicle grossly and severely displaced superiorly. This type is typically associated with tenting of the skin. Radiographs demonstrate the coracoclavicular interspace to be 100–300 % greater than the normal side.

Type VI: AC dislocated, with the clavicle displaced inferior to the acromion or the coracoid; the coracoclavicular interspace is decreased compared with normal. The deltoid and trapezius muscles are detached from the distal clavicle. The mechanism of injury is usually a severe direct force onto the superior surface of the distal clavicle, with abduction of the arm and scapula retraction. Clinically, the shoulder has a flat appearance with a prominent acromion; associated clavicle and upper rib fractures and brachial plexus injuries are due to high-energy trauma. Radiographs demonstrate one of two types of inferior dislocation: subacromial or subcoracoid.

Sternoclavicular Joint

Anatomic Classification

Anterior dislocation—more common
Posterior dislocation
Etiologic Classification

Sprain or subluxation
- Mild: joint stable, ligamentous integrity maintained
- Moderate: subluxation, with partial ligamentous disruption
- Severe: unstable joint, with complete ligamentous compromise

Scapula

Zdravkovic and Damholt Classification

Type I: Scapula body
Type II: Apophyseal fractures, including the acromion and coracoid
Type III: Fractures of the superolateral angle, including the scapular neck and glenoid

Coracoid Fractures

Eyres and Brooks Classification (Fig. 2.4)

Type I: Coracoid tip or epiphyseal fracture
Type II: Mid process
Type III: Basal fracture
Type IV: Involvement of superior body of scapula
Type V: Extension into the glenoid fossa

The suffix of A or B can be used to record the presence of absence of damage to the clavicle or its ligamentous connection to the scapula.
**Intraarticular Glenoid Fractures**

Ideberg Classification (Fig. 2.5)

- **Type I:** Avulsion fracture of the anterior margin
- **Type IIA:** Transverse fracture through the glenoid fossa exiting inferiorly
- **Type IIB:** Oblique fracture through the glenoid fossa exiting inferiorly
- **Type III:** Oblique fracture through the glenoid exiting superiorly; often associated with an acromioclavicular joint injury
- **Type IV:** Transverse fracture exiting through the medial border of the scapula
- **Type V:** Combination of a type II and type IV pattern
- **Type VI:** Sever continuation of glenoid surface (GOSS)

**Anterior Glenohumeral Dislocation**

Classification

- Degree of instability
- Dislocation/subluxation
- Chronology/type
  - Congenital
  - Acute versus chronic
  - Locked (fixed)
  - Recurrent
- Force
  - Atraumatic
  - Traumatic
- Patient contribution
  - Voluntary/involuntary
- Direction
  - Subcoracoid
  - Subglenoid
  - Intrathoracic
Figure 2.5 Ideberg classification of intraarticular glenoid fractures [4]
Posterior Glenohumeral Dislocation

Anatomic Classification

Subacromial (98%). Articular surface directed posteriorly; the lesser tuberosity typically occupies the glenoid fossa; often associated with an impaction fracture on the anterior humeral head.

Subglenoid (very rare). Humeral head posterior and inferior to the glenoid.

Subspinous (very rare). Humeral head medial to the acromion and inferior to the spine of the Scapula.

Inferior Glenohumeral Dislocation (Luxatio Erecta)

Superior Glenohumeral Dislocation

Proximal Humerus

Neer Classification (Fig. 2.6)

- The four parts are the greater and lesser tuberosities, the shaft, and the humeral head.
- A part is displaced if >1 cm of displacement or >45° of angulation is seen.
- At least two views of the proximal humerus (anteroposterior and scapular Y views) must be obtained; additionally, the axillary view is very helpful for ruling out dislocation.

Humeral Shaft

Descriptive Classification

Open/closed
Location: proximal third, middle third, distal third
Degree: incomplete, complete
Direction and character: transverse, oblique, spiral, segmental, comminuted
Intrinsic condition of the bone
Articular extension
Figure 2.6  Neer classification of fractures to the proximal humerus [5]

<table>
<thead>
<tr>
<th>I</th>
<th>Minimal displacement</th>
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<tbody>
<tr>
<td>II</td>
<td>Anatomical neck</td>
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<tr>
<td>III</td>
<td>Surgical neck</td>
</tr>
<tr>
<td>IV</td>
<td>Greater tuberosity</td>
</tr>
<tr>
<td>V</td>
<td>Lesser tuberosity</td>
</tr>
<tr>
<td>VI</td>
<td>Fracture-dislocation</td>
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<tr>
<td></td>
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<tr>
<td></td>
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<table>
<thead>
<tr>
<th>Displaced fractures</th>
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</thead>
<tbody>
<tr>
<td>2 part</td>
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<tr>
<td>3 part</td>
</tr>
<tr>
<td>4 part</td>
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</tbody>
</table>

Articular surface
AO Classification of Humeral Diaphyseal Fractures (Fig. 2.7)

Type A: Simple fracture  
   A1: Spiral  
   A2: Oblique (>30°)  
   A3: Transverse (<30°)  

Type B: Wedge fracture  
   B1: Spiral wedge  
   B2: Bending wedge  
   B3: Fragmented wedge  

Type C: Complex fracture  
   C1: Spiral  
   C2: Segmented  
   C3: Irregular (significant comminution)

Distal Humerus

Descriptive

Supracondylar Fractures
   Extension Type
   Flexion Type

Transcondylar Fractures
   Fracture passes through both condyles and is within the joint capsule.

Condylar Fracture
   Medial
   Lateral
Figure 2.7  AO classification of humeral diaphyseal fractures
Intercondylar Fractures

Riseborough and Radin Classification (Fig. 2.8)

Type I: Nondisplaced
Type II: Slight displacement with no rotation between the condylar fragments in the frontal plane
Type III: Displacement with rotation
Type IV: Severe comminution of the articular surface

Condylar Fractures

Milch Classification (Fig. 2.9)

Two types for medial and lateral; the key is the lateral trochlear ridge.

Type I: Lateral trochlear ridge is left intact
Type II: Lateral trochlear ridge is part of the condylar fragment (medial or lateral)
Figure 2.9 Milch classification of condylar fractures [7]
Capitellum Fractures

Classification (Fig. 2.10)

Type I: Hahn-Steinthal fragment. Large osseous component of capitellum, sometimes with trochlear involvement
Type II: Kocher-Lorenz fragment. Articular cartilage with minimal subchondral bone attached: “uncapping of the condyle”
Type III: Markedly comminuted

Figure 2.10 Types I and II classification of capitellum fractures [2, 8–11]
Coronoid Process Fracture

Regan and Morrey Classification (Fig. 2.11)

Type I: Fracture avulsion just the tip of the coronoid
Type II: Those that involve less than 50 % of coronoid either as single fracture or multiple fragments
Type III: Those involve >50 % of coronoid
Subdivision into A: Without elbow dislocation  
B: With elbow dislocation

Figure 2.11 Regan and Morrey classification of coronoid process fractures [12]
Olecranon

The Mayo Classification of Olecranon Fractures (Fig. 2.12)

Type I: Nondisplaced or minimally displaced
   IA: Noncomminuted
   IB: Comminuted

Type II: Displacement of proximal fragment without elbow instability
   IIA: Noncomminuted
   IIB: Comminuted

Type III: Displaced fracture of proximal fragment with elbow instability
   IIIA: Noncomminuted
   IIIB: Comminuted
Figure 2.12 Mayo Classification

Type I Undisplaced

Type II Displaced – stable

Type III Unstable
Figure 2.13 Mason classification of radial head fractures [14]

Radial Head

Mason Classification (Fig. 2.13)

Type I: Nondisplaced marginal fractures
Type II: Marginal fractures with displacement (impaction, depression, angulation)
Type III: Comminuted fractures involving the entire head
Type IV: Associated with dislocation of the elbow (Johnston)
Elbow Dislocation

Classification (Fig. 2.14)

Chronology: Acute, chronic (unreduced), recurrent

Descriptive: Based on relationship of radius/ulna to the distal humerus, as follows:

- **Posterior**
  - Posterolateral: >90 % dislocations
  - Posteromedial
- **Anterior**
- **Lateral**
- **Medial**
- **Divergent** (rare)

Anterior-posterior type (ulna posterior, radial head anterior).
Mediolateral (transverse) type (distal humerus wedged between radius lateral and ulna medial).
Forearm

Descriptive Classification

- Closed versus open
- Location
- Comminuted, segmental, or multifragmented
- Displacement
- Angulation
- Rotational alignment

**Monteggia Fractures (Fig. 2.15)**

Fracture of the shaft of the ulna with associated dislocation of the radial head.

Bado Classification

- **Type I:** Anterior dislocation of the radial head with fracture of the ulnar diaphysis at any level with anterior angulation
- **Type II:** Posterior/posterolateral dislocation of the radial head with fracture of the ulnar diaphysis with posterior angulation
- **Type III:** Lateral/anterolateral dislocation of the radial head with fracture of the ulnar metaphysis
- **Type IV:** Anterior dislocation of the radial head with fractures of both the radius and ulna within proximal third at the same level
Figure 2.15 Monteggia fractures [15]
Table 2.1 Frykman classification of distal radius

<table>
<thead>
<tr>
<th>Fracture</th>
<th>Distal ulnar fracture</th>
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<tbody>
<tr>
<td>Extraarticular</td>
<td>Absent II</td>
</tr>
<tr>
<td>Intraarticular involving radiocarpal joint</td>
<td>III IV</td>
</tr>
<tr>
<td>Intraarticular involving distal radioulnar joint</td>
<td>V VI</td>
</tr>
<tr>
<td>Intraarticular involving radiocarpal and distal radioulnar joint</td>
<td>VII VIII</td>
</tr>
</tbody>
</table>

Distal Radius (Table 2.1 and Fig. 2.16)

Descriptive Classification

- Open/closed
- Displacement
- Angulation
- Comminution
- Loss of radial length
- Intraarticular involvement

Figure 2.16 Fractures of the distal radius [21]
Smith Fracture

Modified Thomas’ Classification (Fig. 2.17)

Type I: Extraarticular  
Type II: Fracture line crosses into the dorsal articular surface  
Type III: Fracture line enters the carpal joint (Volar Barton)
Scaphoid Fractures

Russe Classification

1. Horizontal oblique
   - Distal third
   - Middle third (waist)
   - Proximal third
2. Transverse fracture line
3. Vertical oblique fracture line

Herbert and Fisher Classification (Fig. 2.18)

Type A: Acute stable fractures
   - A1: Fracture of tubercle
   - A2: Undisplaced “crack” fracture of the waist

Type B: Acute unstable fractures
   - B1: Oblique fractures of distal third
   - B2: Displaced or mobile fracture of the waist
   - B3: Proximal pole fractures
   - B4: Fracture dislocation of carpus
   - B5: Comminuted fractures

Type C: Delayed union

Type D: Established nonunion
   - D1: Fibrous nonunion
   - D2: Sclerotic nonunion (Pseudoarthrosis)

Note that stable indicates nondisplaced fractures with no stepoff in any plane; unstable indicates displacement with 1 mm or more step-off with scapholunate angulation >60° or lunatocapitate angulation >15°.
Figure 2.18 Herbert and Fisher classification [17]
Lunate Fractures

Teisen and Hjarkbaek Classification (Fig. 2.19)

Group I: Fracture volar pole, possibly affecting the volar nutrient artery
Group II: Chip fracture which does not affect the main blood supply
Group III: Fracture of dorsal pole of the Lunate possibly affecting the blood supply
Group IV: Sagittal fracture through the body of lunate
Group V: Transverse fractures through the body of the lunate
Intraarticular Fractures (Fig. 2.20)

Type I: Bennett fracture—fracture line separates major part of metacarpal from volar lip fragment, producing a disruption of the first carpometacarpal joint; first metacarpal is pulled proximally by the abductor pollicis longus.

Type II: Rolando fracture—requires greater force than a Bennett fracture; presently used to describe a comminuted Bennett fracture, a “Y” or “T” fracture, or a fracture with dorsal and palmar fragments.

Extraarticular Fractures

Type IIIA: Transverse fracture
Type IIIB: Oblique fracture
Type IV: Epiphyseal injuries seen in children
Distal Phalanx Fractures

Kaplan Classification

Type I: Longitudinal split
Type II: Comminuted tuft
Type III: Transverse fracture

Mallet Fracture

Wehbe and Schnider Classification (Fig. 2.21)

Type I: Mallet fractures including bone injuries of varying extend without subluxation of distal interphalangyal joint
Type II: Fractures are associated with subluxation distal interphalangyal joint
Type III: Epiphyseal and physeal injuries
   Each type then divided into three subtypes:
   A: Fracture fragment involving less than 1/3 of articular surface of distal phalanx
   B: Fracture fragment involving 1/3–2/3 of articular surface
   C: Fragment that involves more than 2/3 of articular surface
Figure 2.21 Wehbe and Schneider classification [20]
References
