AO/OTA Fracture and Dislocation Classification

This leaflet is designed to provide an introduction to the classification of long-bone fractures.
Humerus

11 proximal (types according to topography and extent of bone lesion)

11-A extraarticular unifocal fracture
- 11-A1 tuberosity
- 11-A2 impacted metaphyseal
- 11-A3 nonimpacted metaphyseal

11-B extraarticular bifocal fracture
- 11-B1 with metaphyseal impaction
- 11-B2 without metaphyseal impaction
- 11-B3 with glenohumeral dislocation

11-C articular fracture
- 11-C1 with slight displacement
- 11-C2 impacted with marked displacement
- 11-C3 dislocated

12 diaphyseal

12-A simple fracture
- 12-A1 spiral
- 12-A2 oblique (≥ 30°)
- 12-A3 transverse (< 30°)

12-B wedge fracture
- 12-B1 spiral wedge
- 12-B2 bending wedge
- 12-B3 fragmented wedge

12-C complex fracture
- 12-C1 spiral
- 12-C2 segmental
- 12-C3 irregular

13 distal

13-A extraarticular fracture
- 13-A1 apophyseal avulsion
- 13-A2 metaphyseal simple
- 13-A3 metaphyseal multifragmentary

13-B partial articular fracture
- 13-B1 sagittal lateral condyle
- 13-B2 sagittal medial condyle
- 13-B3 coronal

13-C complete articular fracture
- 13-C1 articular simple, metaphyseal simple
- 13-C2 articular simple, metaphyseal multifragmentary
- 13-C3 articular multifragmentary
31 proximal (defined by a line passing transversely through the lower end of the lesser trochanter)

31-A extraarticular fracture, trochanteric area
  31-A1 pertrochanteric simple
  31-A2 pertrochanteric multifragmentary
  31-A3 intertrochanteric

31-B extraarticular fracture, neck
  31-B1 subcapital, with slight displacement
  31-B2 transcervical
  31-B3 subcapital, displaced, nonimpacted

31-C articular fracture, head
  31-C1 split (Pipkin)
  31-C2 with depression
  31-C3 with neck fracture

32 diaphyseal

32-A simple fracture
  32-A1 spiral
  32-A2 oblique (> 30°)
  32-A3 transverse (< 30°)
  32-A(1–3).1 = subtrochanteric fracture

32-B wedge fracture
  32-B1 spiral wedge
  32-B2 bending wedge
  32-B3 fragmented wedge
  32-B(1–3).1 = subtrochanteric fracture

32-C complex fracture
  32-C1 spiral
  32-C2 segmental
  32-C3 irregular
  32-C(1–3).1 = subtrochanteric fracture

33 distal

33-A extraarticular fracture
  33-A1 simple
  33-A2 metaphyseal wedge and/or fragmented wedge
  33-A3 metaphyseal complex

33-B partial articular fracture
  33-B1 lateral condyle, sagittal
  33-B2 medial condyle, sagittal
  33-B3 coronal

33-C complete articular fracture
  33-C1 articular simple, metaphyseal simple
  33-C2 articular simple, metaphyseal multifragmentary
  33-C3 articular multifragmentary
41 proximal

41-A extraarticular fracture
41-A1 avulsion
41-A2 metaphyseal simple
41-A3 metaphyseal multifragmentary

41-B partial articular fracture
41-B1 pure split
41-B2 pure depression
41-B3 split-depression

41-C complete articular fracture
41-C1 articular simple, metaphyseal simple
41-C2 articular simple, metaphyseal multifragmentary
41-C3 articular multifragmentary

42 diaphyseal

42-A simple fracture
42-A1 spiral
42-A2 oblique ($\geq 30^\circ$)
42-A3 transverse ($< 30^\circ$)

42-B wedge fracture
42-B1 spiral wedge
42-B2 bending wedge
42-B3 fragmented wedge

42-C complex fracture
42-C1 spiral
42-C2 segmental
42-C3 irregular

43 distal

43-A extraarticular fracture
43-A1 simple
43-A2 wedge
43-A3 complex

43-B partial articular fracture
43-B1 pure split
43-B2 split-depression
43-B3 multifragmentary depression

43-C complete articular fracture
43-C1 articular simple, metaphyseal simple
43-C2 articular simple, metaphyseal multifragmentary
43-C3 articular multifragmentary
**44 malleolar**

**44-A infrasyndesmotic lesion**
- 44-A1 isolated
- 44-A2 with fractured medial malleolus
- 44-A3 with posteromedial fracture

**44-B transsyndesmotic fibular fracture**
- 44-B1 isolated
- 44-B2 with medial lesion
- 44-B3 with medial lesion and Volkmann's fracture

**44-C suprasyndesmotic lesion**
- 44-C1 fibular diaphyseal fracture, simple
- 44-C2 fibular diaphyseal fracture, multifragmentary
- 44-C3 proximal fibular lesion
AO/OTA system for numbering the anatomical location of a fracture in three bone segments (proximal = 1, diaphyseal = 2, distal = 3)

Anatomical location of the fracture. Anatomical location is designated by two numbers: one for the bone and one for its segment (ulna and radius as well as tibia and fibula are regarded as one bone). The malleolar segment (44-) is an exception. The proximal and distal segments of long bones are defined by a square the sides of which have the same length as the widest part of the epiphysis (exceptions 31- and 44-).
## Definitions of fracture types for long-bone fractures in adults

Exception to this are fractures of the proximal humerus (11-), proximal femur (31-), malleoli (44-), subtrochanteric fractures (32-)

<table>
<thead>
<tr>
<th>Segment</th>
<th>Type</th>
<th>Extraarticular</th>
<th>Partial articular</th>
<th>Complete articular</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Proximal</td>
<td>A</td>
<td>Extraarticular</td>
<td>Partial articular</td>
<td>Complete articular</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No involvement of displaced fractures that extend into the articular surface</td>
<td>Part of the articular component is involved, leaving the other part attached to the meta-/diaphysis</td>
<td>Articular surface involved, metaphyseal fracture completely separates the articular component from the diaphysis</td>
</tr>
<tr>
<td>2 Diaphyseal</td>
<td>B</td>
<td>Simple</td>
<td>Wedge</td>
<td>Complex</td>
</tr>
<tr>
<td></td>
<td></td>
<td>One fracture line, cortical contact between fragments exceeds 90% after reduction</td>
<td>Three or more fragments, main fragments have contact after reduction</td>
<td>Three or more fragments, main fragments have no contact after reduction</td>
</tr>
<tr>
<td>3 Distal</td>
<td>C</td>
<td>Extraarticular</td>
<td>Partial articular</td>
<td>Complete articular</td>
</tr>
<tr>
<td></td>
<td></td>
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<td>Articular surface involved, metaphyseal fracture completely separates the articular component from the diaphysis</td>
</tr>
</tbody>
</table>
### Steps in identifying diaphyseal fractures

<table>
<thead>
<tr>
<th>Step</th>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Which bone?</td>
<td>Specific bone (X)</td>
</tr>
<tr>
<td>2</td>
<td>Is the fracture at the end or in the middle segment of the bone?</td>
<td>Middle segment (X2)</td>
</tr>
<tr>
<td>3</td>
<td>Type: Is the fracture a simple or multifragmentary one (does it have &gt;2 parts)?</td>
<td>Simple (X2-A)</td>
</tr>
<tr>
<td>3a</td>
<td>Is there contact between both fracture ends or not?</td>
<td>If there is contact, it is a wedge (X2-B)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If there is no contact, it is complex (X2-C)</td>
</tr>
<tr>
<td>4</td>
<td>Group: Is the fracture pattern caused by a twisting (spiral) or bending force?</td>
<td>Spiral or twisting forces will result in a simple spiral (X2-A1), a spiral wedge (X2-B1), or a spiral fragmented complex fracture (X2-C1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Bending forces produce simple oblique (X2-A2), simple transverse (X2-A3), bending wedge (X2-B2), fragmented wedge (X2-B3), or complex (X2-C3) fractures</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C2 fractures are segmental by definition</td>
</tr>
</tbody>
</table>

### Classification of fractures of the diaphysis into the three fracture groups

<table>
<thead>
<tr>
<th>Type</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>A</td>
<td>Simple</td>
</tr>
<tr>
<td>Spiral</td>
<td>Oblique</td>
</tr>
<tr>
<td>B</td>
<td>Wedge</td>
</tr>
<tr>
<td>Spiral</td>
<td>Bending</td>
</tr>
<tr>
<td>C</td>
<td>Complex</td>
</tr>
<tr>
<td>Spiral</td>
<td>Segmental</td>
</tr>
</tbody>
</table>
### Steps in identifying end segment fractures

<table>
<thead>
<tr>
<th>Step</th>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Which bone?</td>
<td>Specific bone (X)</td>
</tr>
<tr>
<td>2</td>
<td>Is the fracture at the end or in the middle segment of the bone?</td>
<td>End segment</td>
</tr>
<tr>
<td>3</td>
<td>Is the fracture through the proximal or distal end segment?</td>
<td>Proximal (X1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Distal (X3)</td>
</tr>
<tr>
<td>4a</td>
<td>Type: Does the fracture enter the articular surface?</td>
<td>If it does not enter, it is extraarticular (XX-A), go to step 6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If it enters, it is articular, go to step 4b</td>
</tr>
<tr>
<td>4b</td>
<td>Type: Is it partial or total articular?</td>
<td>If part of the joint is still attached to the meta-/diaphysis, it is partial articular (XX-B)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If it is not attached to the diaphysis, it is complete articular (XX-C)</td>
</tr>
<tr>
<td>5</td>
<td>Group: How many fracture lines cross the joint surface?</td>
<td>If there is one line, it is simple</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If there are &gt;2 lines, it is multifragmentary</td>
</tr>
<tr>
<td>6</td>
<td>Group: How is the metaphysis fractured?</td>
<td>Simple: extraarticular (XX-A1), or simple articular (XX-C1)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wedge: extraarticular (XX-A2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Complex: extraarticular (XX-A3), or simple articular (XX-C2), or complex articular (XX-C3)</td>
</tr>
</tbody>
</table>

### Classification of fractures of the end segment into the three fracture groups

<table>
<thead>
<tr>
<th>Type</th>
<th>Group</th>
<th>Step 1</th>
<th>Step 2</th>
<th>Step 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A</strong> Extraarticular</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Simple</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wedge</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complex</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>B</strong> Partial articular</td>
<td></td>
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</tr>
<tr>
<td>Split</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Depression</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Split-depression</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>C</strong> Articular</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Simple articular, simple metaphyseal</td>
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</tr>
<tr>
<td>Simple articular, complex metaphyseal</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complex articular, complex metaphyseal</td>
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