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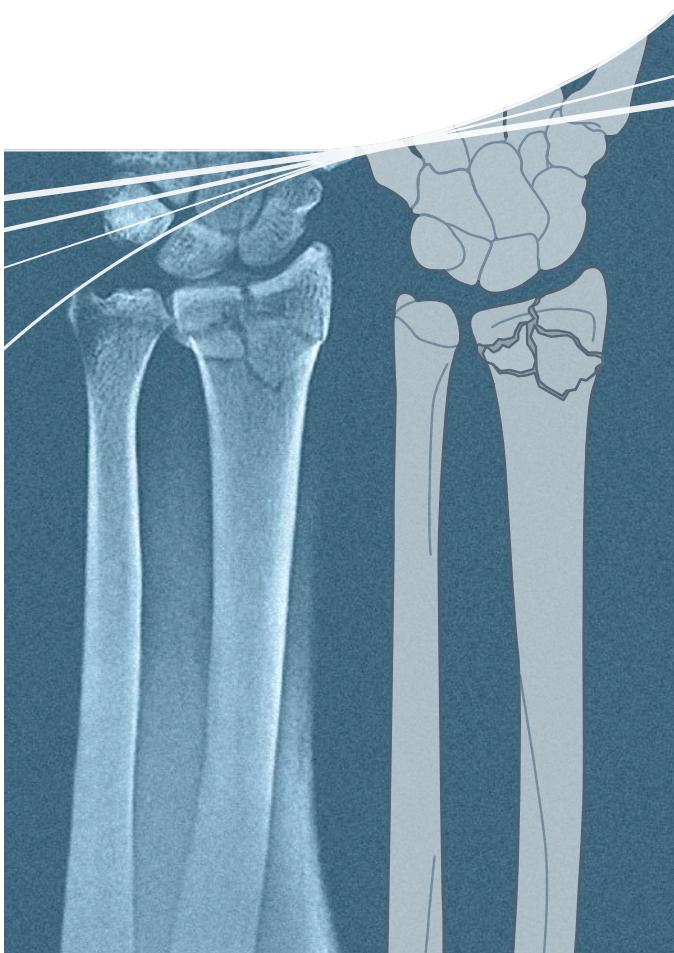
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AO/OTA Fracture and Dislocation Classification

Introduction to the classification of long-bone fractures



Humerus

11 Proximal end segment

11A Extraarticular, unifocal, 2-part

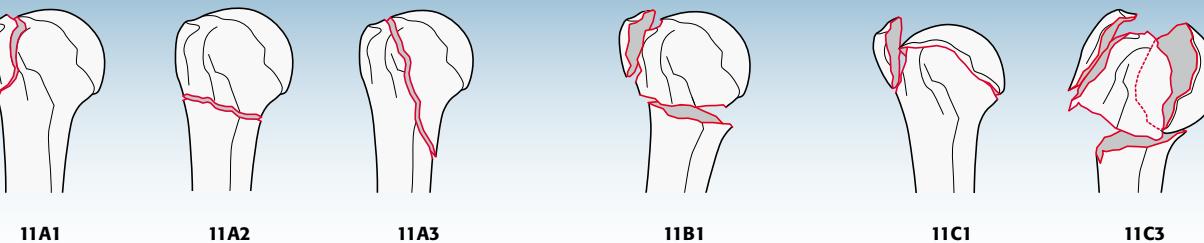
- 11A1 Tuberosity
- 11A2 Surgical neck
- 11A3 Vertical

11B Extraarticular, bifocal, 3-part

- 11B1 Surgical neck

11C Articular or 4-part

- 11C1 Anatomical neck
- 11C3 Anatomical neck associated with metaphyseal fracture



12 Diaphyseal segment

12A Simple

- 12A1* Spiral
- 12A2* Oblique ($\geq 30^\circ$)
- 12A3* Transverse ($< 30^\circ$)

12B Wedge

- 12B2* Intact wedge
- 12B3* Fragmentary wedge

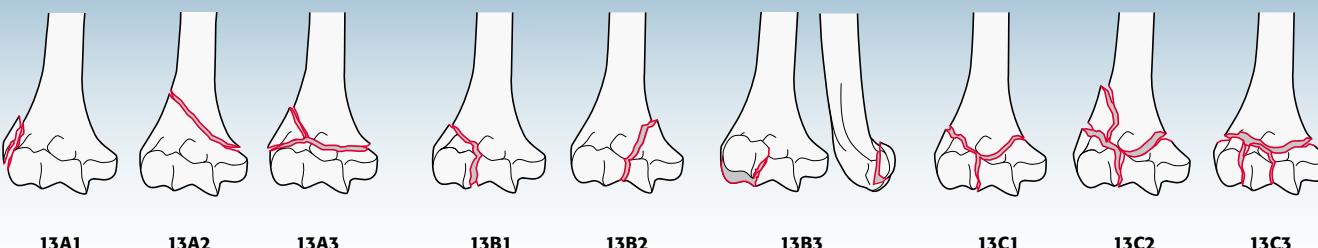
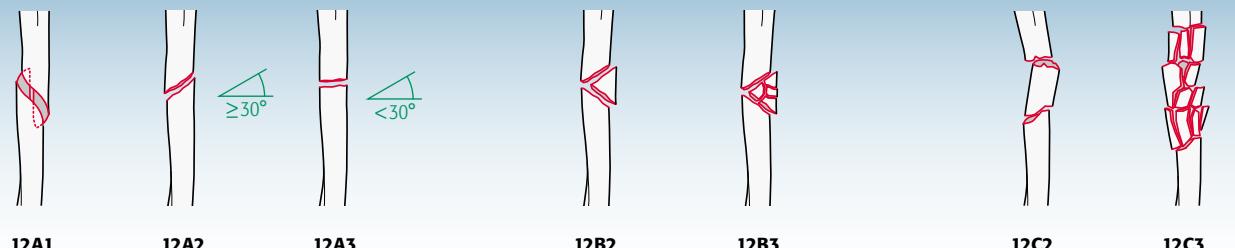
12C Multifragmentary

- 12C2* Intact segmental
- 12C3* Fragmentary segmental

* Qualifications:

12A and 12B: a Proximal 1/3, b Middle 1/3, c Distal 1/3

12C: i Proximal diaphyseal-metaphyseal, j Pure diaphyseal, k Distal diaphyseal-metaphyseal



13 Distal end segment

13A Extraarticular

- 13A1 Avulsion
- 13A2 Simple
- 13A3 Wedge or multifragmentary

13B Partial articular

- 13B1 Lateral sagittal
- 13B2 Medial sagittal
- 13B3 Frontal/coronal plane

13C Complete articular

- 13C1 Simple articular, simple metaphyseal
- 13C2 Simple articular, wedge or multifragmentary metaphyseal
- 13C3 Multifragmentary articular, wedge or multifragmentary metaphyseal

Radius

2R1 Proximal end segment

2R1A Extraarticular

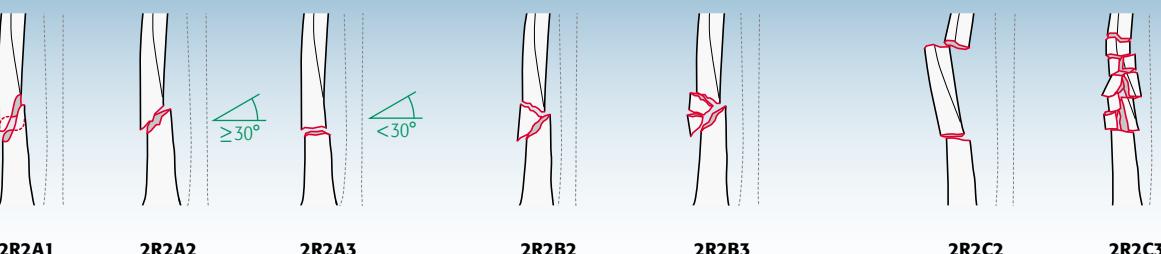
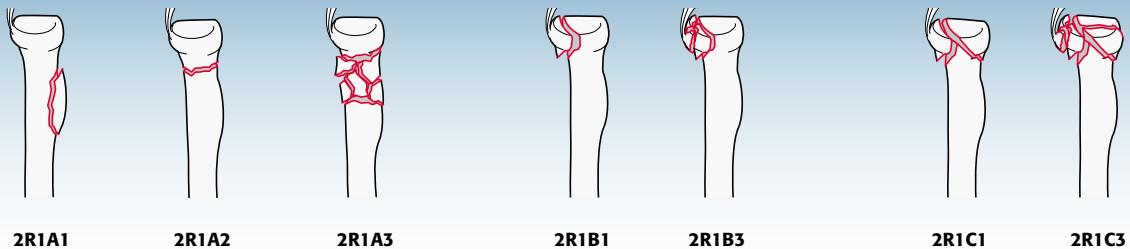
- 2R1A1 Avulsion of bicipital tuberosity
- 2R1A2 Neck, simple
- 2R1A3 Neck, multifragmentary

2R1B Partial articular

- 2R1B1 Simple
- 2R1B3 Fragmentary

2R1C Complete articular

- 2R1C1 Simple
- 2R1C3 Multifragmentary



2R2 Diaphyseal segment

2R2A Simple

- 2R2A1* Spiral
- 2R2A2* Oblique ($\geq 30^\circ$)
- 2R2A3* Transverse ($< 30^\circ$)

2R2B Wedge

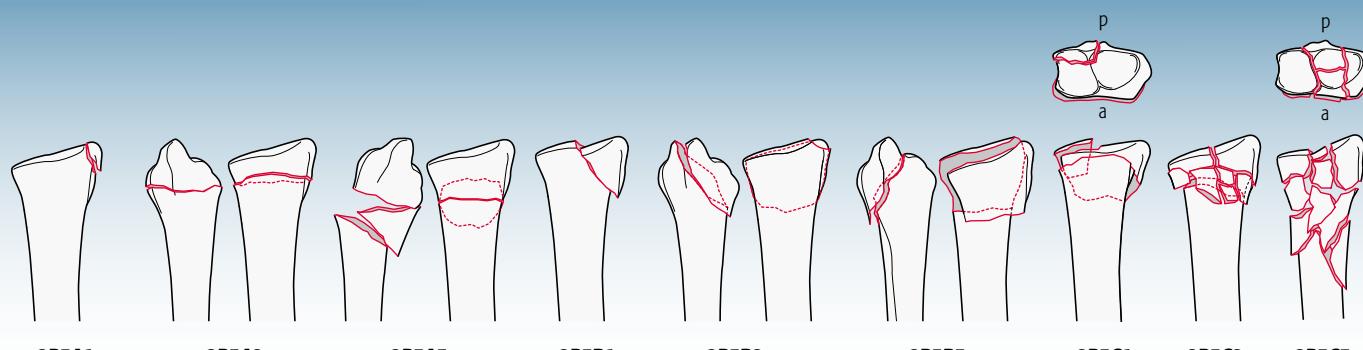
- 2R2B2* Intact wedge
- 2R2B3* Fragmentary wedge

2R2C Multifragmentary

- 2R2C2* Intact segmental
- 2R2C3* Fragmentary segmental

* Qualifications:

2R2A and 2R2B: a Proximal 1/3, b Middle 1/3, c Distal 1/3
2R2C: i Proximal diaphyseal-metaphyseal, j Pure diaphyseal, k Distal diaphyseal-metaphyseal



2R3 Distal end segment

2R3A Extraarticular

- 2R3A1 Radial styloid avulsion
- 2R3A2 Simple
- 2R3A3 Wedge or multifragmentary

2R3B Partial articular

- 2R3B1 Sagittal
- 2R3B2 Dorsal rim (Barton's)
- 2R3B3 Volar rim (reverse Barton's, Goyrand-Smith's II)

2R3C Complete articular

- 2R3C1 Simple articular and metaphyseal
- 2R3C2 Multifragmentary metaphyseal
- 2R3C3 Multifragmentary articular, simple or multifragmentary metaphyseal

Ulna

2U1 Proximal end segment

2U1A Extraarticular

- 2U1A1 Avulsion of triceps insertion
- 2U1A2 Simple metaphyseal
- 2U1A3 Multifragmentary metaphyseal

2U1B Partial articular

- 2U1B1* Olecranon
- 2U1B2* Coronoid

2U1C Complete articular

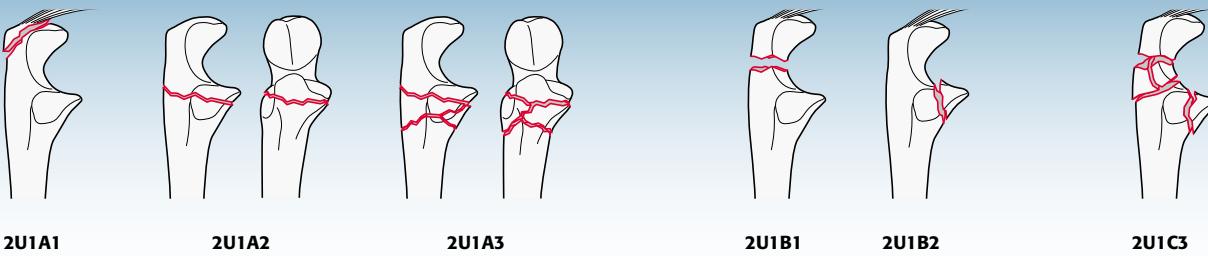
- 2U1C3* Olecranon and coronoid

* Qualifications:

B1: d Simple, e Multifragmentary

B2: n Involving sublime facet, o Tip (avulsion), p <50%, q ≥50%

C3: d Simple, r Multifragmentary olecranon, s Multifragmentary involving coronoid process



2U2 Diaphyseal segment

2U2A Simple

- 2U2A1* Spiral
- 2U2A2* Oblique (≥30°)
- 2U2A3* Transverse (<30°)

2U2B Wedge

- 2U2B1* Intact wedge
- 2U2B2* Fragmentary wedge

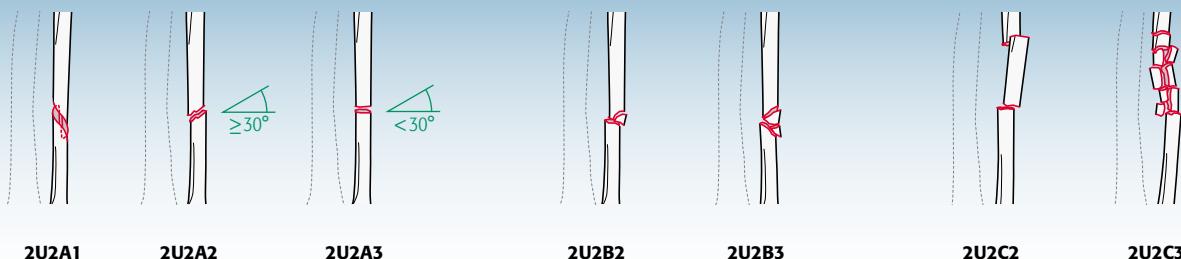
2U2C Multifragmentary

- 2U2C1* Intact segmental
- 2U2C2* Fragmentary segmental

* Qualifications:

2U2A and 2U2B: a Proximal 1/3, b Middle 1/3, c Distal 1/3

2U2C: i Proximal diaphyseal-metaphyseal, j Pure diaphyseal, k Distal diaphyseal-metaphyseal



2U3 Distal end segment

2U3A Extraarticular

- 2U3A1 Styloid process
- 2U3A2 Simple
- 2U3A3 Multifragmentary

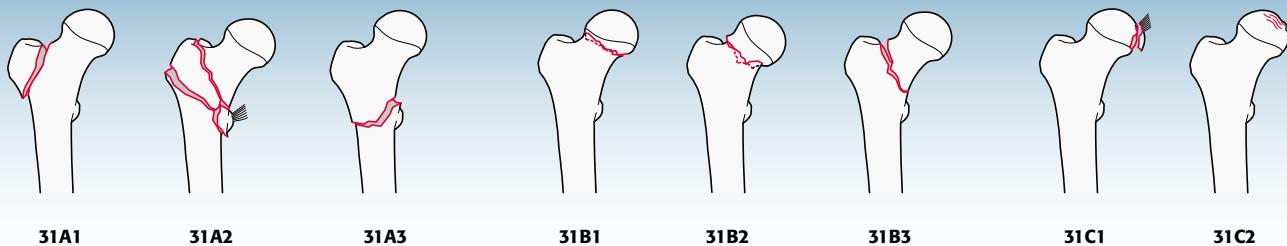
2U3B Partial articular

2U3C Complete articular

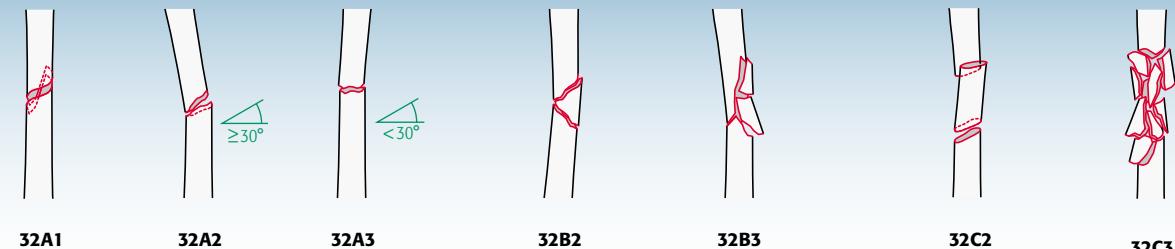


Femur

31 Proximal end segment

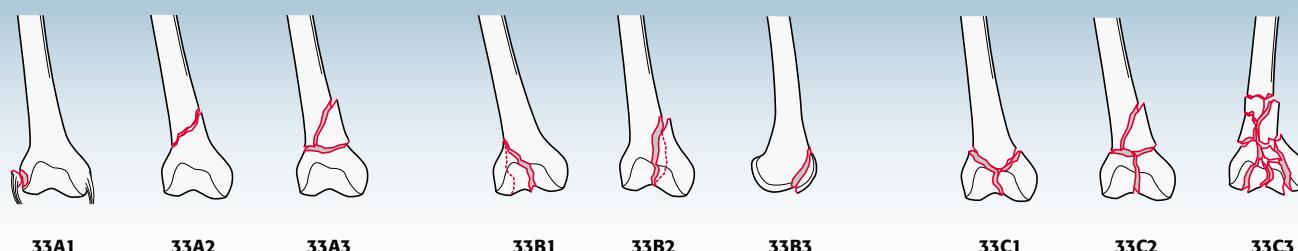


32 Diaphyseal segment

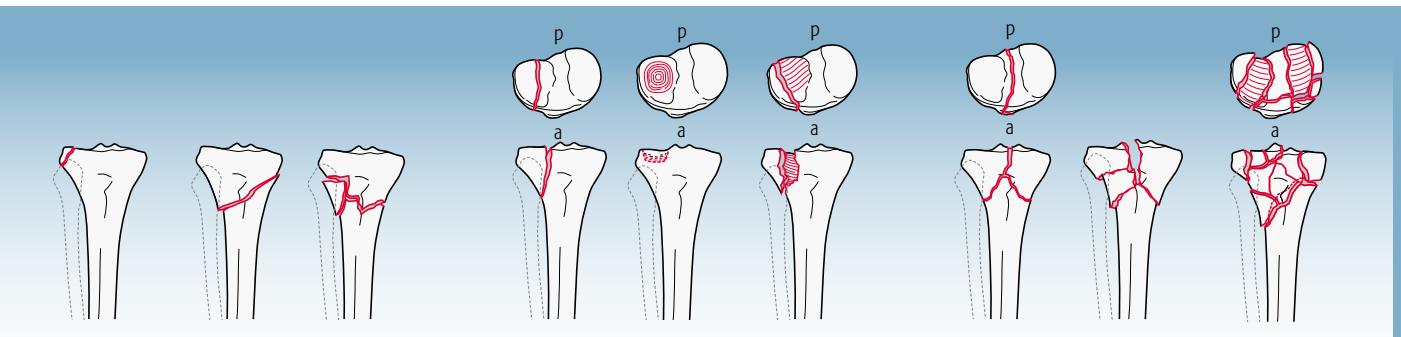


* Qualifications:
 32A and 32B: a Proximal 1/3, b Middle 1/3, c Distal 1/3
 32C: i Proximal diaphyseal-metaphyseal, j Pure diaphyseal, k Distal diaphyseal-metaphyseal

33 Distal end segment



Tibia



41 Proximal end segment

41A Extraarticular

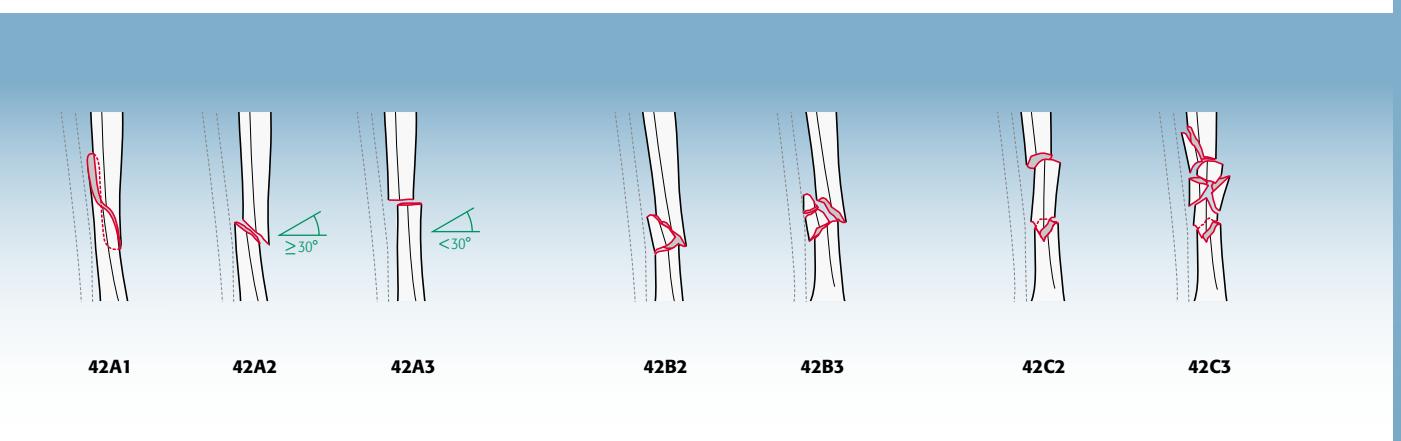
- 41A1 Avulsion
- 41A2 Simple
- 41A3 Wedge or multifragmentary

41B Partial articular

- 41B1 Split
- 41B2 Depression
- 41B3 Split depression

41C Complete articular

- 41C1 Simple articular, simple metaphyseal
- 41C2 Simple articular, wedge or multifragmentary metaphyseal
- 41C3 Fragmentary or multifragmentary metaphyseal



42 Diaphyseal segment

42A Simple

- 42A1* Spiral
- 42A2* Oblique ($\geq 30^\circ$)
- 42A3* Transverse ($< 30^\circ$)

42B Wedge

- 42B1* Intact wedge
- 42B3* Fragmentary wedge

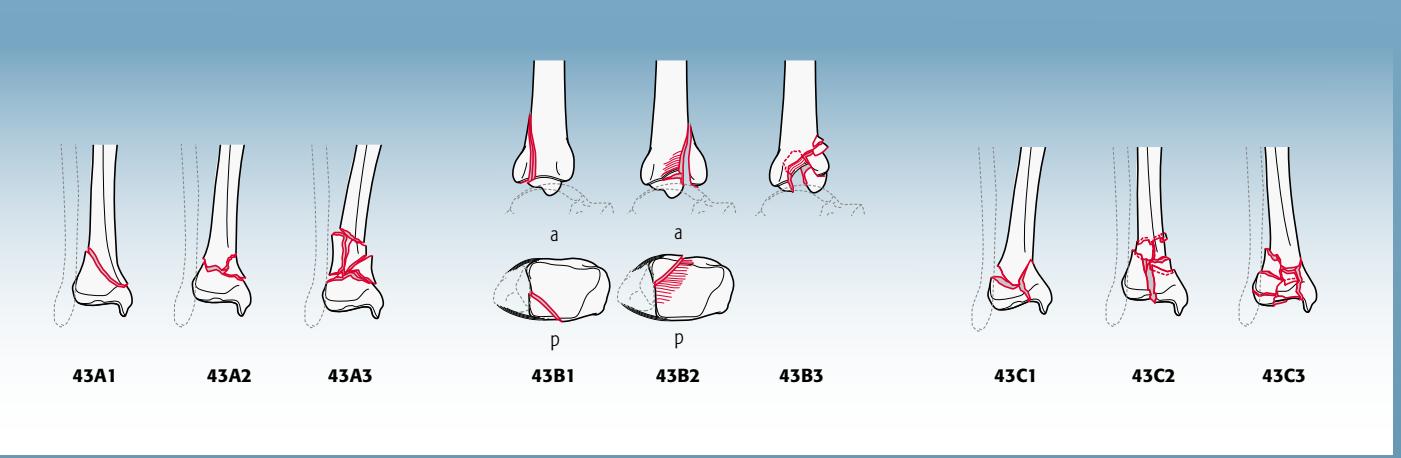
42C Multifragmentary

- 42C2 Intact segmental
- 42C3* Fragmentary segmental

* Qualifications:

42A and 42B: a Proximal 1/3, b Middle 1/3, c Distal 1/3

42C: i Proximal diaphyseal-metaphyseal, j Pure diaphyseal, k Distal diaphyseal-metaphyseal



43 Distal end segment

43A Extraarticular

- 43A1 Simple
- 43A2 Wedge
- 43A3 Multifragmentary

43B Partial articular

- 43B1 Split
- 43B2 Split depression
- 43B3 Depression

43C Complete articular

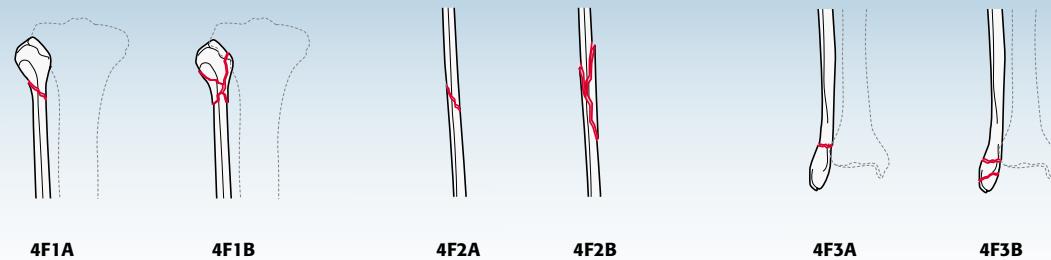
- 43C1 Simple articular, simple metaphyseal
- 43C2 Simple articular, multifragmentary metaphyseal
- 43C3 Multifragmentary articular and multifragmentary metaphyseal

Fibula

4F1 Proximal end segment

4F1A* Simple

4F1B* Multifragmentary



4F2 Diaphyseal segment

4F2A* Simple

4F2B* Wedge or multifragmentary

4F3 Distal end segment

4F3A Simple

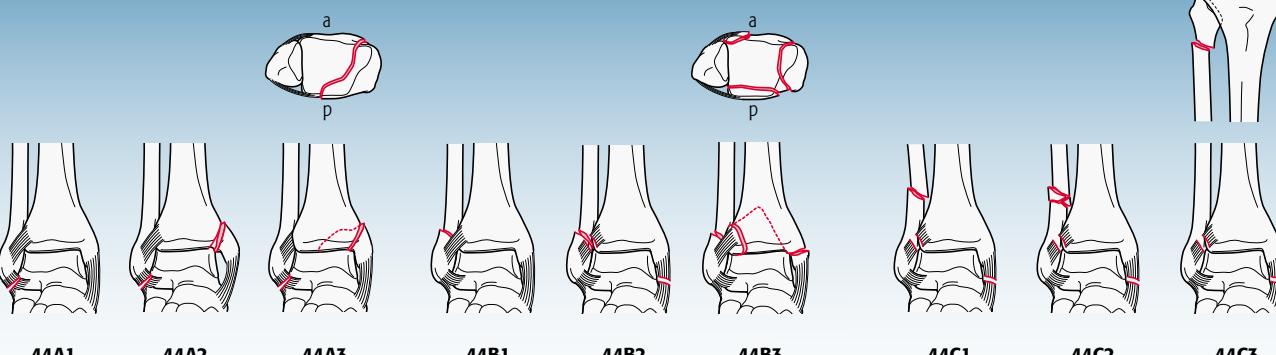
4F3B Wedge or multifragmentary

* Qualifications:

4F1: n Extraarticular, o Intraarticular

4F2: a Proximal 1/3, b Middle 1/3, c Distal 1/3

Malleolar segment



44A Infrasyndesmotic fibula injury

44A1 Isolated fibula injury

44A2 With medial malleolar fracture

44A3 With posteromedial fracture

44B Transsyndesmotic fibula fracture

44B1 Simple fibula fracture

44B2 With medial injury

44B3 With medial injury and fracture of the posterolateral rim
(Volkmann's fragment)

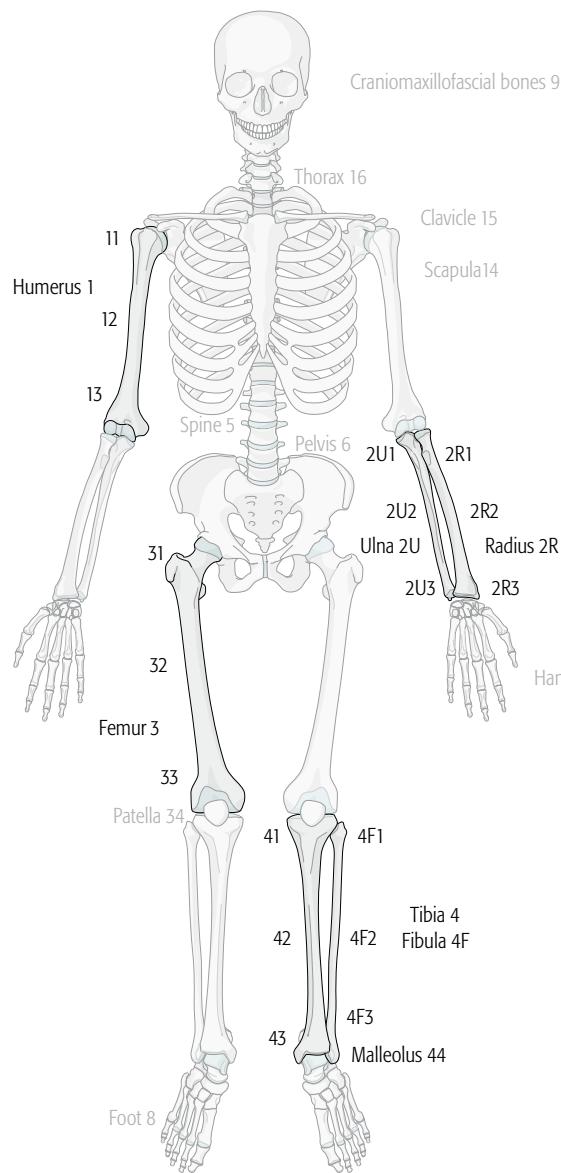
44C Suprasyndesmotic fibula fracture

44C1 Simple diaphyseal fibula fracture

44C2 Wedge or multifragmentary diaphyseal fibula fracture

44C3 Proximal fibula injury

Coding—bone and location



Alphanumeric structure of the AO/OTA classification

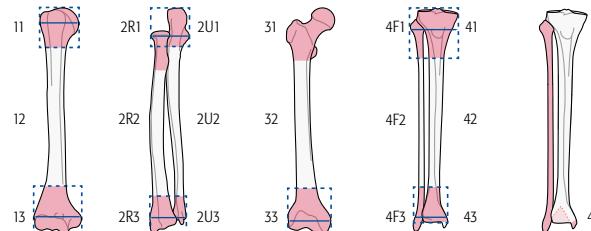
Diagnosis

X-rays, CT scan, MRI as required, operative findings

Localization Morphology

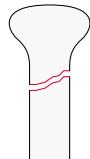
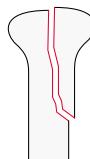
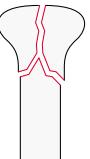
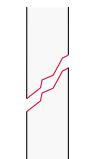
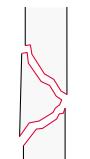
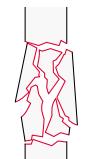
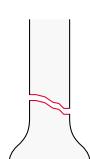
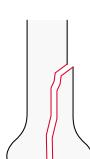
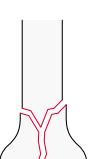
Bone Location Type Group Subgroup (Qualifications) [Universal modifiers]

For further information about refined coding of the morphology of the fracture to subgroup level and applying universal modifiers and qualifications, please consult the *Journal of Orthopaedic Trauma*, 2018 Supplement 1, available online.



The anatomical location of the fracture is designated by two numbers: one for the bone and one for its segment. The tibia is an exception with the malleoli representing a fourth segment (44). The proximal and the distal segments of long bones are defined by a square whose sides have the same length as the widest part of the epiphysis (exception: 31).

Definitions of fracture types for long-bone fractures in adults

Segment	Type	A	B	C	
Proximal					
1					
	Extraarticular	Partial articular	Complete articular		
Diaphyseal					
2					
	Simple	Wedge	Multifragmentary		
Distal					
3					
	Extraarticular	Partial articular	Complete articular		

Extraarticular—type A, when the fracture does not involve the joint surface.

Partial articular—type B, when the fracture involves one part of the articular surface while the remainder of the joint remains attached to the metaphysis and diaphysis.

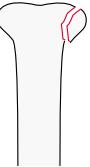
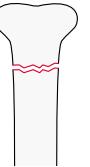
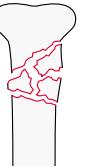
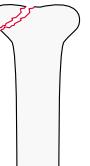
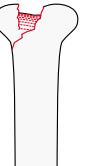
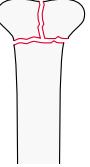
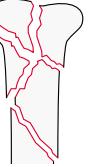
Complete articular—type C, when the fracture has disrupted the joint surface, which is completely separated from the diaphysis.

Simple—type A, fracture with a single circumferential fracture.

Wedge—type B, fracture with one or more intermediate fragments. After reduction there is some cortical contact between the main proximal and distal fragments.

Multifragmentary—type C, with one or more intermediate fragments. After reduction there is no contact between the main proximal and distal fragments.

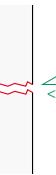
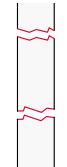
Describing the fracture morphology—types of end-segment fractures

Type	Group			Steps in identifying end-segment fractures
	1	2	3	
Extraarticular A				
	Avulsion	Simple	Multifragmentary	
Partial articular B				
	Simple	Split depression	Fragmentary	
Complete articular C				
	Simple articular, simple metaphyseal	Split depression, multifragmentary metaphyseal	Multifragmentary articular, multifragmentary metaphyseal	

Step	Question	Answer
1	What is the bone?	Specific bone number, see skeleton
2	At which end is the fracture located?	Proximal (1) Distal (3)
3	Type: Does the fracture enter the joint surface?	No—extraarticular (A), go to step 5 Yes—articular (B or C), go to step 4
4a	Type: If articular, is it partial (part of joint attached to metaphysis)?	Yes (type B), go to step 6
4b	Type: If articular, is it complete (no part of joint attached to metaphysis)?	Yes (type C), go to step 7
5	Group: If extraarticular (A), what is the fracture pattern?	Avulsion (1) Simple (2) Wedge or multifragmentary (3)
6	Group: If partial articular (B), what is the fracture pattern?	Simple (1) Split and/or depression (2) Fragmentary (3)
7	Group: If complete articular (C), what is the articular fracture pattern?	Simple (1) Multifragmentary (2 and 3)
8	Add qualifications and/or universal modifiers	

Describing the fracture morphology—types of diaphyseal fractures

Type

	Group		
	1	2	3
Simple			
A			
	Spiral	Oblique	Transverse
Wedge			
B			
	Intact	Fragmentary	
Multifragmentary			
C			
	Intact segmental	Fragmentary segmental	

Steps in identifying diaphyseal fractures

Step	Question	Answer
1	What is the bone?	Specific bone number, see skeleton
2	Is the fracture at the end or middle segment?	Middle-diaphyseal segment (2)
3	What is the type?	Simple (A) Wedge (B) Multifragmentary (C)
4a	Group: If simple (A), what is the fracture pattern?	Spiral (1) Oblique (2) Transverse (3)
4b	Group: If wedge (B), what is the fracture pattern?	Intact (2) Fragmentary (3)
4c	Group: If multifragmentary (C), what is the fracture pattern?	Intact segmental (2) Fragmentary segmental (3)
5	Add qualifications and/or universal modifiers	

Universal modifiers

The universal modifiers are descriptive terms of fracture morphology, displacement, associated injury, or location that are generalizable to most fractures. They provide details that are optional for users.

- Universal modifiers may be added to the end of the fracture code within square brackets, eg, [1].
- Multiple universal modifiers may be contained within the same set of square brackets and separated by a comma.

Example

A proximal humeral fracture dislocation with displacement, anterior dislocation, cartilage injury, and osteopenia:
11A1.2[2,5a,8e,9]



List of universal modifiers

1	Nondisplaced
2	Displaced
3	Impaction 3a Articular 3b Metaphyseal
4	No impaction
5	Dislocation 5a Anterior (volar, palmar, plantar) 5b Posterior (dorsal) 5c Medial (ulnar) 5d Lateral (radial) 5e Inferior (with hip is also obturator) 5f Multidirectional
6	Subluxation/ligamentous instability 6a Anterior (volar, palmar, plantar) 6b Posterior (dorsal) 6c Medial (ulnar) 6d Lateral (radial) 6e Inferior (with hip is also obturator) 6f Multidirectional
7	Diaphyseal extension
8	Articular cartilage injury* 8a ICRS Grade 0 Normal 8b ICRS Grade 1 Superficial indentation (A) and/or superficial fissures and cracks (B) 8c ICRS Grade 2 Abnormal lesions extending down to 50% of cartilage depth 8d ICRS Grade 3 Severely abnormal with defects extending down >50% of cartilage depth (A); down to calcified layer (B); down to subchondral bone but not through (C); blisters included (D) 8e ICRS Grade 4 Severely abnormal cartilage loss through subchondral bone
9	Poor bone quality
10	Replantation
11	Amputation associated with a fracture
12	Associated with a nonarthroplasty implant
13	Spiral type fracture
14	Bending type fracture

*This grading system is used with the permission of the International Cartilage Repair Society (ICRS).

Qualifications are descriptive terms of fracture morphology or location that are specific to each fracture.

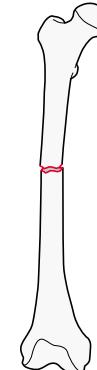
- Qualifications are represented with lower-case letters to differentiate them from the fracture type (which is always an upper-case letter).
- They are optional and applied to the fracture code where the asterisk is located as a lower-case letter within rounded brackets. More than one qualification can be applied, separated by a comma.
- The majority of qualifications are applied at subtype level.

Example

Femur, diaphyseal segment,
simple, transverse fracture (< 30°)

32A3(b)

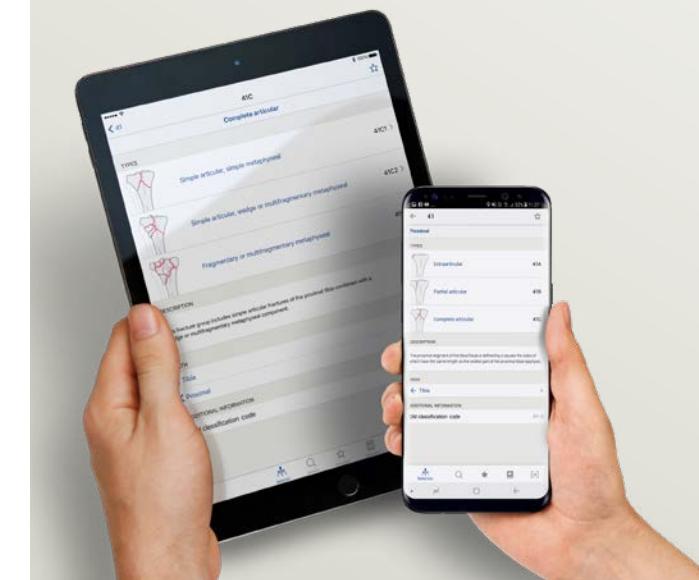
- * Qualifications
- a Proximal 1/3
- b Middle 1/3**
- c Distal



Meinberg E, Agel J, Roberts C, et al. Fracture and Dislocation Classification Compendium—2018. *J Orthopaed Trauma*. 2018 Jan;32(Suppl 1).

The revised AO/OTA Classification app

now available for iOS and Android mobile devices



For further educational material about the classification and access to the complete Fracture and Dislocation Classification Compendium, please use the QR code.

