

The Language of Fractures

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A PA's Guide to the Musculoskeletal Galaxy
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Disclosures

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 - ❖ Key West, Florida
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Goals

- Be able to discuss basic fracture terminology and nomenclature
- Recognize common fracture patterns, morphology, and classification
- Communicate accurate description of fractures between colleagues



Introduction

- Relevance
- Bone Anatomy
- Imaging
- Nomenclature
- Fracture Description
- Special Fracture Types
- Cases



Introduction

- Importance of Accurate Fracture Description
 - ❖ Effective communication among providers
 - ❖ Documentation
 - ❖ Anticipate associated conditions
 - ❖ Formulate treatment plan
 - ❖ Predict outcomes and complications
 - ❖ Advise patients on expectations



“Hey Doc, is it broke?”

- Prerequisites to determine the answer
 - ❖ Knowledge Base
 - Anatomy
 - Fracture morphology
 - Communication
 - ❖ Appropriate Imaging studies
 - Correct patient?
 - Adequate views?
 - When were they obtained?



Appropriate Imaging

- You cannot describe what you can't see
- "One view is no view"
- Assess entire bone
- Assess joints above and below fractures
- Don't be afraid to get additional images
- Ask for help!
- The most commonly missed fracture is the second one!







Fx Classification

- AO classification
- Bone-specific

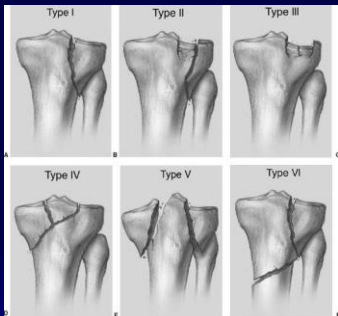


AO Classification

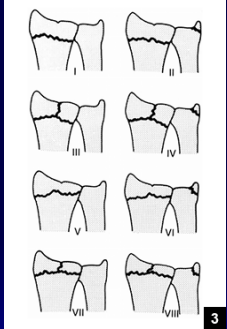
- Global fracture classification
 - ❖ Ascribes numbers to bones
 - ❖ Ascribes letters to subtypes
 - ❖ Helpful in research
 - ❖ Cumbersome
 - ❖ Not so helpful in clinical setting



Tibial Plateau - Schatzker



Distal Radius - Frykman



3



Eponyms

- Colles
- Smith
- Barton
- Bennett
- Rolando
- Boxer's
- Galeazzi
- Monteggia
- Hill-Sachs
- Bankart
- Maisonneuve
- Pellegrini-Steida
- Tilleaux
- Triplane
- Segond
- Lisfranc



Mnemonic: OLD ACID

- O: Open or Closed?
- L: Location of Fracture
- D: Degree (Complete vs. Incomplete)
- A: Articular Extension?
- C: Comminution/ Fracture Pattern
- I: Intrinsic Bone Quality
- D: Displacement/Angulation



Mnemonic: BLT LARD

- B: Bone
- L: Location of Fracture
- T: Fracture Type?

- L: Change in Length
- A: Angulation
- R: Rotational Deformity
- D: Degree of Displacement



Just Ask Yourself a Few Simple Questions!



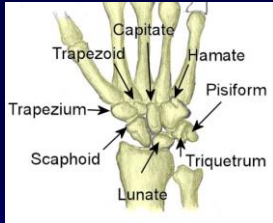
Questions

- Which bone(s) is(are) broken?
- Which part of the bone is broken?
- How many fragments are there?
- What is the fracture pattern?
- Are the ends close to each-other?
- Are the fragments anatomically aligned?
- Does the fracture involve a joint surface?
- Is the skin intact?



Which bone is broken?

- Knowledge of basic skeletal anatomy is tantamount.
- Most are easy
- Hand Fractures
- Foot Fractures
- Mnemonics
- Practice



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Which part is broken?

- Use skeletally immature nomenclature
 - ❖ Epiphysis
 - ❖ Metaphysis
 - ❖ Diaphysis
- Divide long bones into thirds
 - ❖ Proximal/Middle/Distal
- Use anatomic landmarks
 - ❖ Head, neck, base, shaft, condyle



Which part is broken?

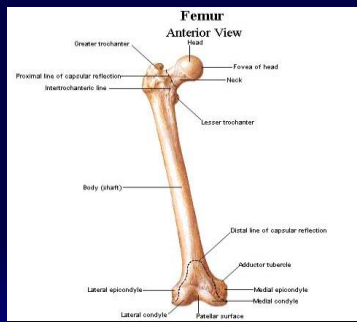


Which part is broken?

- Proximal end of the ulna = olecranon
- Proximal end of radius = head
- Distal end of metacarpal/tarsal = head
- Proximal end of metacarpal/tarsal = base
- Proximal end of humerus/femur =
 - ❖ Head
 - ❖ Neck
 - ❖ Greater and lesser tuberosities/trochanters



Which part is broken?



How many fragments are there?

- Two fragments = simple
- Multiple fragments = comminuted
- Two or more fractures in the same bone = segmental
- Provides information on degree of energy



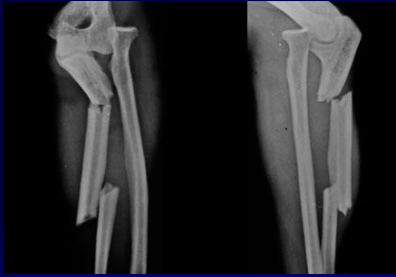
Simple Fracture



Comminuted Fracture



Segmental Fracture

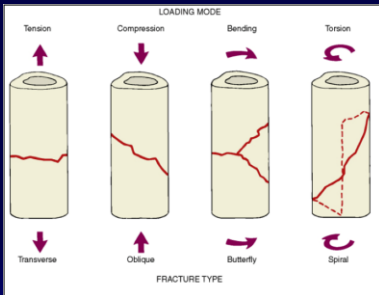


What is the Fracture Pattern?

- Transverse
- Oblique
- Spiral
- Comminuted
- Torus (Buckle)
- Avulsion
- Impacted



What is the Fracture Pattern?



Are the ends close to each-other?

- Displacement
 - ❖ Use percent of long bone width to define
 - 0% = Nondisplaced
 - 100% = Completely displaced
 - ❖ Use absolute measurements
 - Especially for intra-articular fractures
 - Other bones
 - ❖ Describe direction if indicated
 - Distal relative to proximal



Nondisplaced Fracture



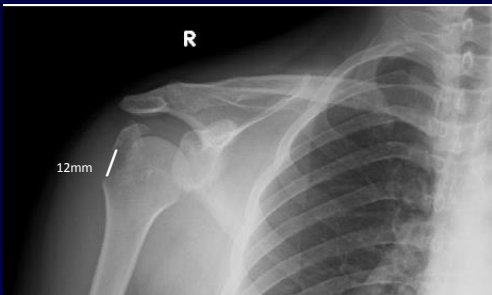
50% Displaced Fracture



100% Displaced Fracture



Measured Displacement



Are the fragments aligned?

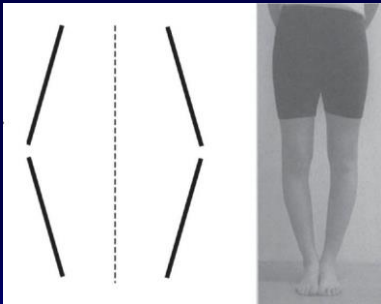
- Angulation
 - ❖ Describe in degrees relative to long axis
 - ❖ Generally 0-90°
 - ❖ Define Apex
 - Medial/Lateral/Anterior/Posterior
 - Varus/Valgus



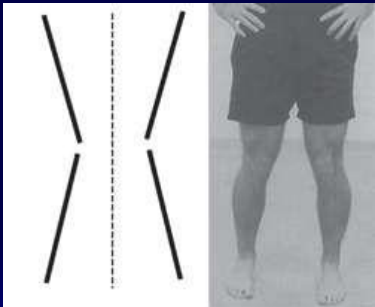
Are the fragments aligned?



Varus Alignment



Valgus Alignment



Are the fragments aligned?



Is a Joint Surface Involved?

- Intra-articular Fractures
 - ❖ Cross into a joint
 - ❖ Involve Articular Cartilage
 - ❖ More likely to require surgical management
 - ❖ Higher risk of post-traumatic arthritis
 - ❖ Generally more guarded prognosis



Intra-articular Fractures



Intra-articular Fractures



Intra-articular Fractures



Intra-articular Fractures



Is the Skin Intact?

- Closed Fracture
 - ❖ Intact skin overlying fracture
- Open Fracture
 - ❖ Loss of skin continuity
 - ❖ Protruding bone
 - ❖ Not necessarily directly over fracture
 - ❖ Small "inside-out" injury
 - ❖ Extensive soft tissue damage



Open Fractures



Gustilo Classification

- Grade 1
 - ❖ Less than 1 cm wound
 - ❖ Minimal contamination
- Grade 2
 - ❖ 1+ cm wound
 - ❖ Moderate contamination
- Grade 3
 - ❖ 10+ cm wound
 - ❖ Heavy contamination



Gustilo Classification

- Grade 3A
 - ❖ Moderate soft tissue injury
- Grade 3B
 - ❖ Significant soft tissue injury
 - ❖ Requiring tissue transfers/flap
- Grade 3C
 - ❖ Vascular injury



Special Cases

- Incomplete Fractures
- Pediatric Fractures
- Stress Fractures
- Pathologic Fractures
- Avulsion Fractures



Incomplete Fractures

- Partial loss of continuity of bone
- Possible to fracture one cortex
- Low Energy



Pediatric Fractures

- Immature bone is not fully mineralized
- More flexible
- Capable of "Plastic deformity"
- Must recognize growth plates and if they are involved

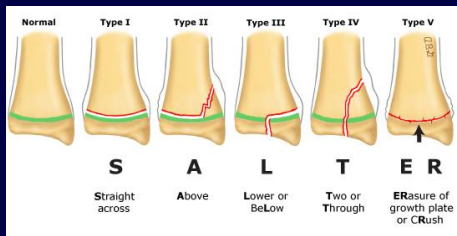


Salter-Harris Classification

- Based on which part of bone is fractured and extension of fracture line
 - ❖ Metaphysis
 - ❖ Epiphysis
 - ❖ Both



Salter-Harris Classification



Salter-Harris Classification



Salter-Harris Classification



Diagnosis?



Nonaccidental Trauma



Nonaccidental Trauma

- Orthopaedic providers often the first to evaluate child abuse victims
- Must be vigilant
- 50% will have a fracture
- 85% < 3yo; 70% < 1yo
- Beware of inconsistent history/findings
- Fractures in multiple stages of healing
- “Rare” or unusual fractures



Nonaccidental Trauma

Table 2. Specificities Of Radiologic Findings For Physical Abuse

High Specificity	Moderate Specificity	Low Specificity
Classic metaphyseal lesions	Multiple fractures, especially bilateral	Subperiosteal new bone formation
Rib fractures, especially posterior	Fractures of different ages	Clavicle fractures
Scapular fractures	Epiphyseal separations	Long bone shaft fractures
Sternal fractures	Vertebral body fractures and subluxations	Linear skull fractures
Spinous process fractures	Digital fractures	
	Complex skull fractures	

Adapted from Kleinman.⁴⁶



Stress Fractures

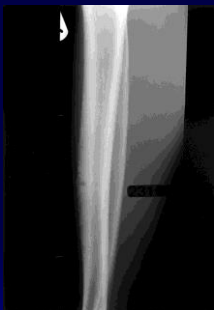
- Bone is constantly in state of turnover
- Repetitive stress can result in failure
- “March Fracture”
- Patients often unaware
- “Dreaded Black Line”
- Treatment depends on location and severity



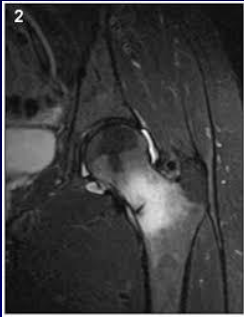
Stress Fractures



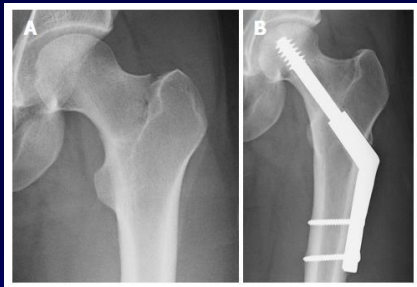
Stress Fractures



Stress Fractures



Stress Fractures



Pathologic Fractures

- Abnormal bone is more prone to failure
- Neoplastic
 - ❖ Most often metastatic (100:1)
- Metabolic



Pathologic Fractures



Pathologic Fractures



Avulsion Fractures

- Fracture at insertion of tendon or ligament
- Fragment displaced by force of soft tissue
- Degree of displacement often determines need for operative management



Avulsion Fractures



Other Signs of Fractures

- Callus
- Periosteal reaction
- Soft tissue swelling
- Periarticular fluid (lucency)
 - ❖ "Sail sign"



Periosteal Reaction



"Sail" Sign



Putting it All Together

- Don't worry about special names
- Don't worry about classifications
- Just describe what you see
- Use descriptive terms
- Be succinct

