The Language of Fractures

Christopher V. Bensen, M.D.

A PA's Guide to the Musculoskeletal Galaxy
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Virtual

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Disclosures

- Partner, Keys Medical Group
  - Key West, Florida
- No corporate affiliation, interests, or royalties
- bensencv@gmail.com
- 828-773-9227

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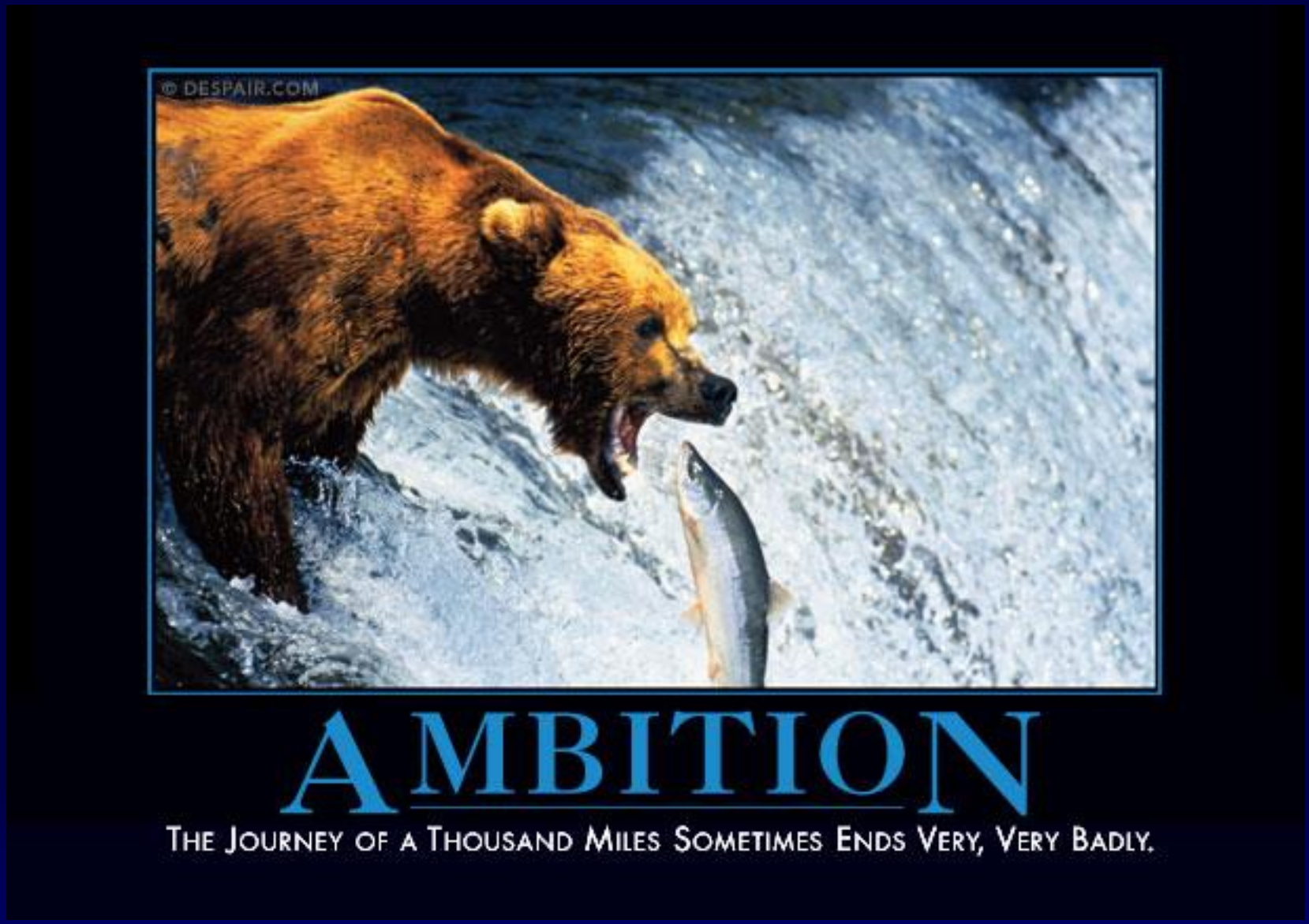

Goals

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

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Example

- PA working in ED: “I have a consult for you.”
- Me: “OK great whatcha got?”
- PA: “68 yo lady who fell and I’m pretty sure she broke her right leg but the radiologist hasn’t read the x-rays yet”
- Me: “OK well did you see them?”
- PA: “Yes but like I said they’re not read yet”
- Me: ☹☹☹

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“Do what you fear and fear disappears”

-David Joseph Schwartz

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Introduction

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

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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 or just fractured?”

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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!

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Fx Classification

- AO classification
- Bone-specific

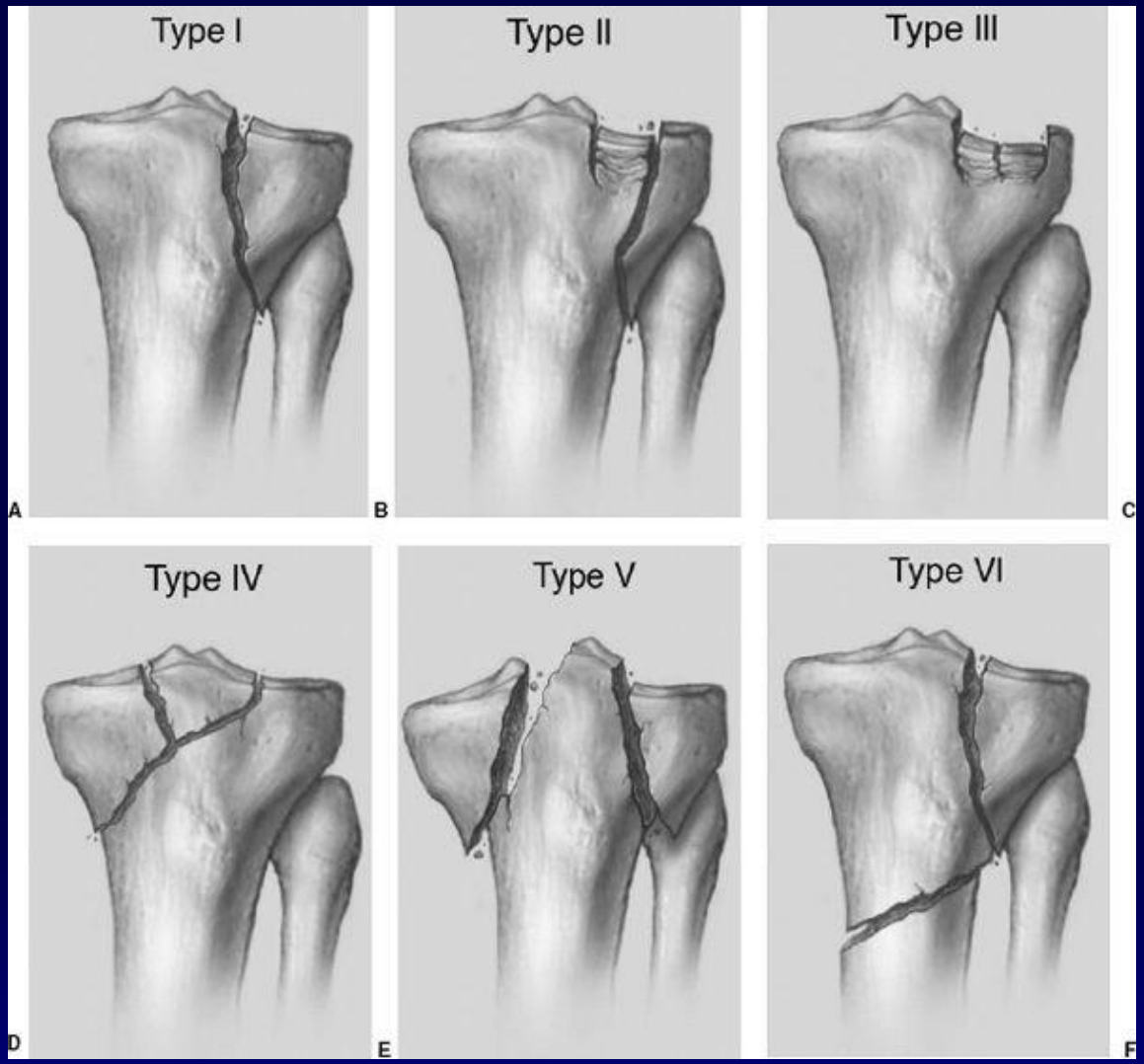
AO Classification

- Global fracture classification
  - Ascribes numbers to bones
  - Ascribes letters to subtypes
  - Helpful in research
  - Cumbersome (IMHO)
  - Not so helpful in clinical setting
  - “Hey Doc I’ve got a 42-B3 down here in the ED”

TRADITION

JUST BECAUSE YOU'VE ALWAYS DONE IT THAT WAY
DOESN'T MEAN IT'S NOT INCREDIBLY STUPID.

Tibial Plateau - Schatzker



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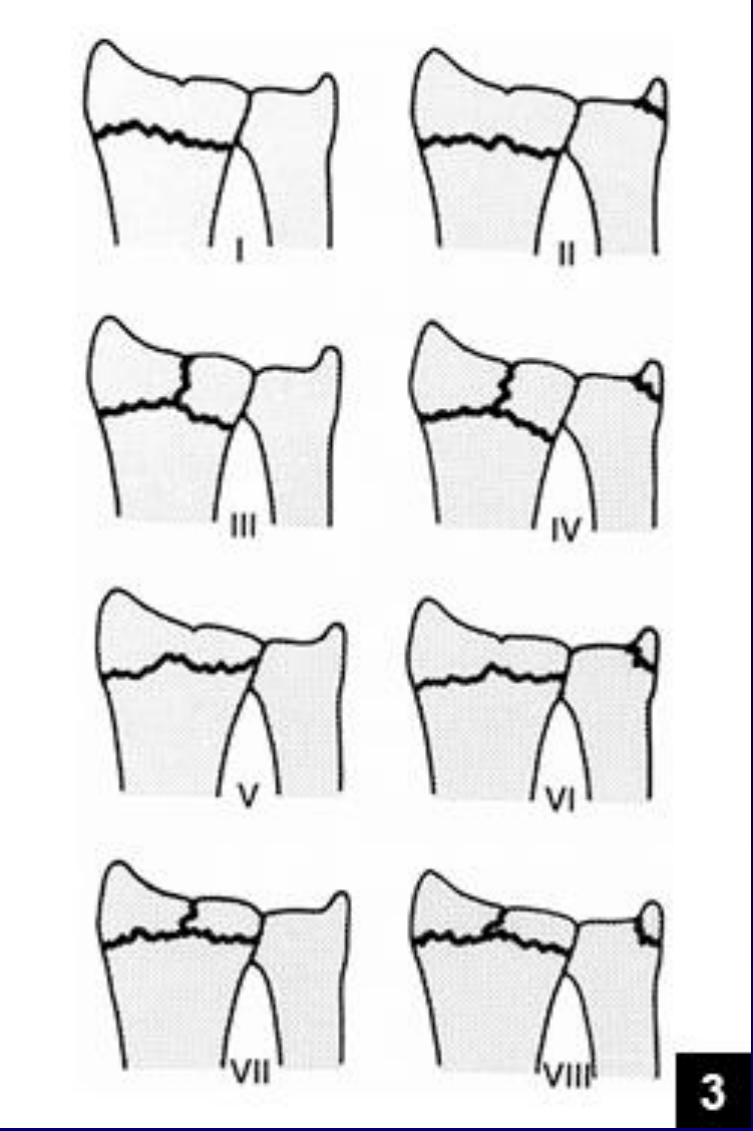
Distal Radius - Frykman



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!

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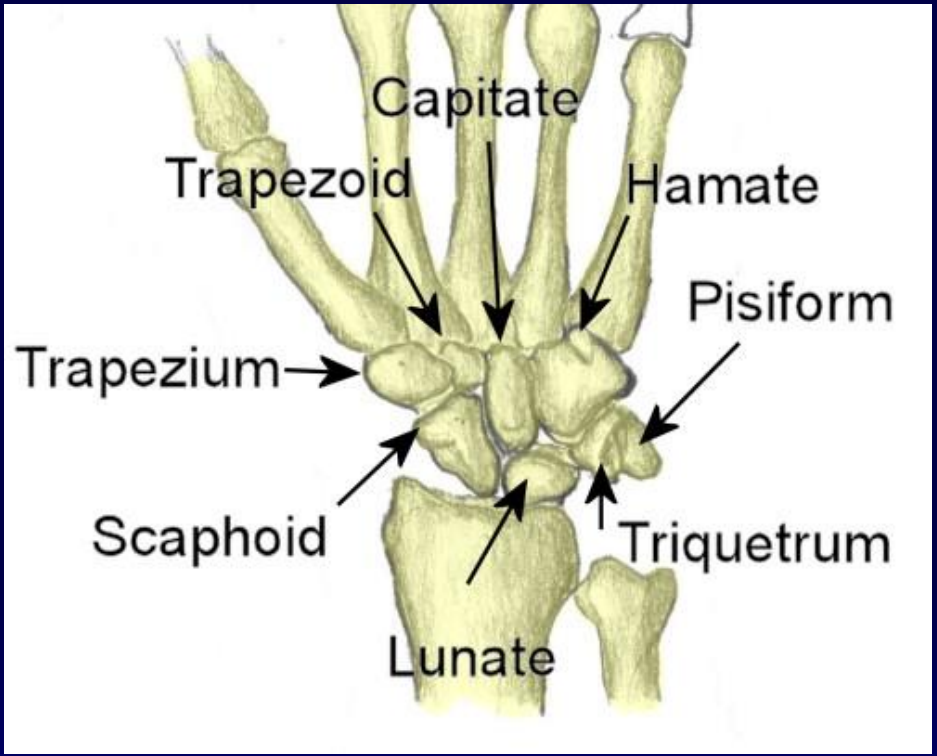
Questions

- 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 bone is broken?

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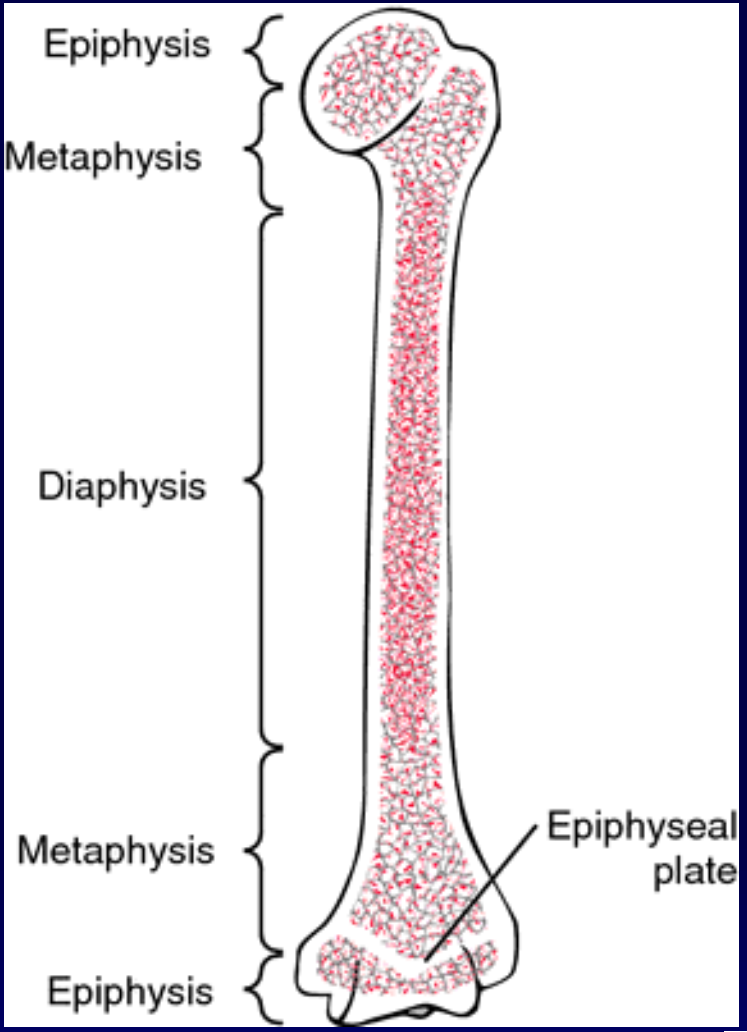
Which part is broken?

- 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?



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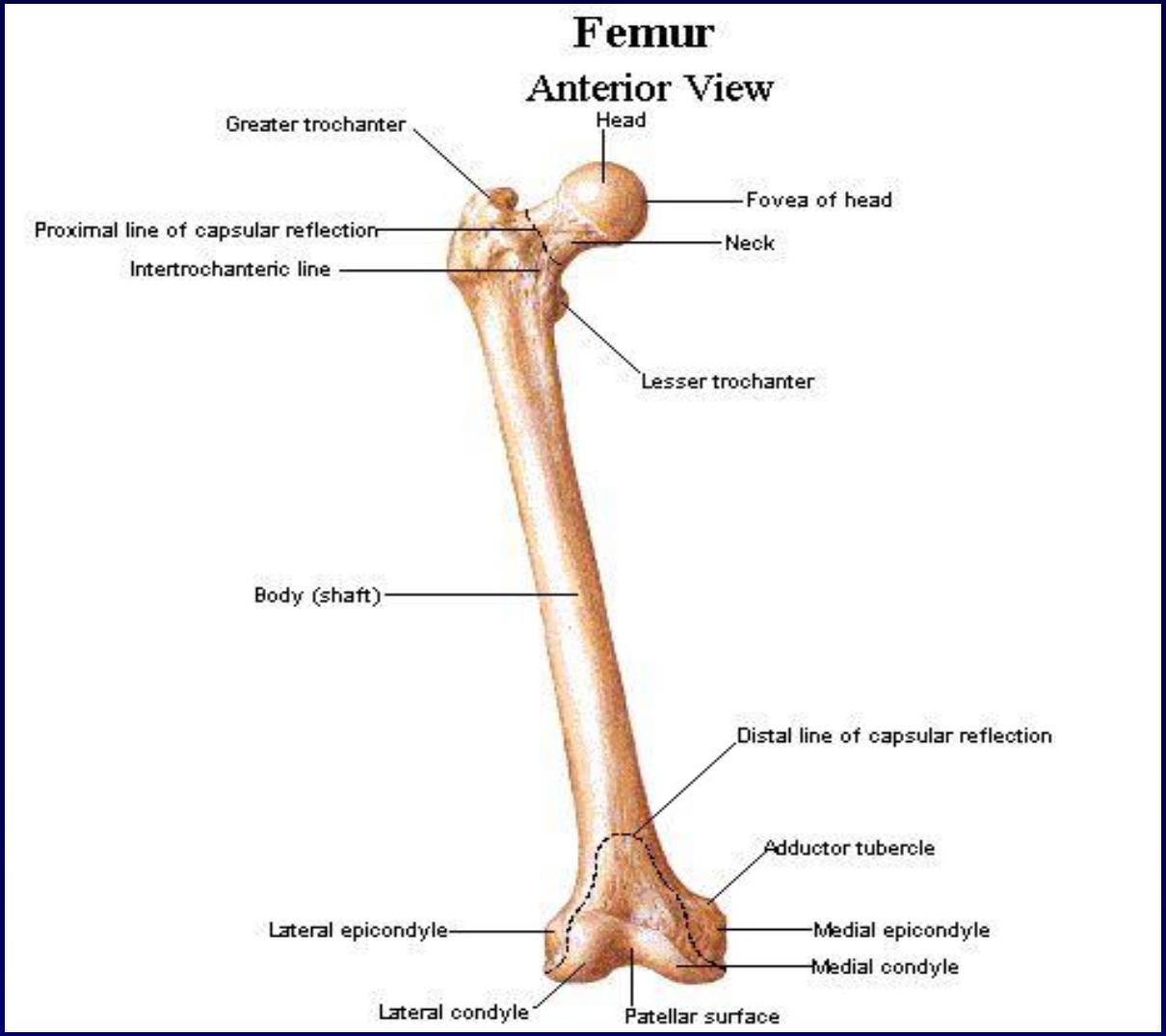
Which part is broken?

- 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?



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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

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Comminuted Fracture

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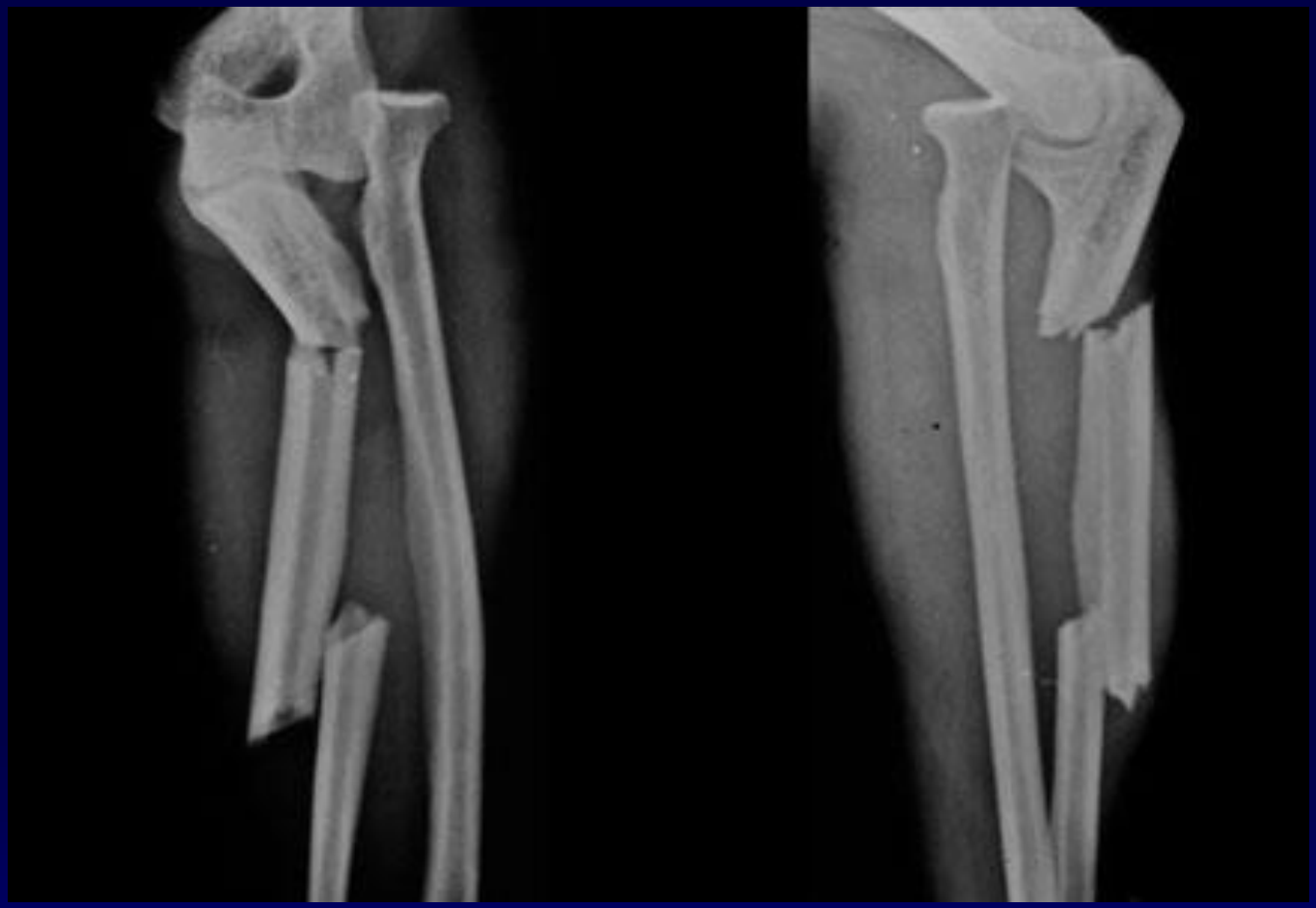
Segmental Fracture



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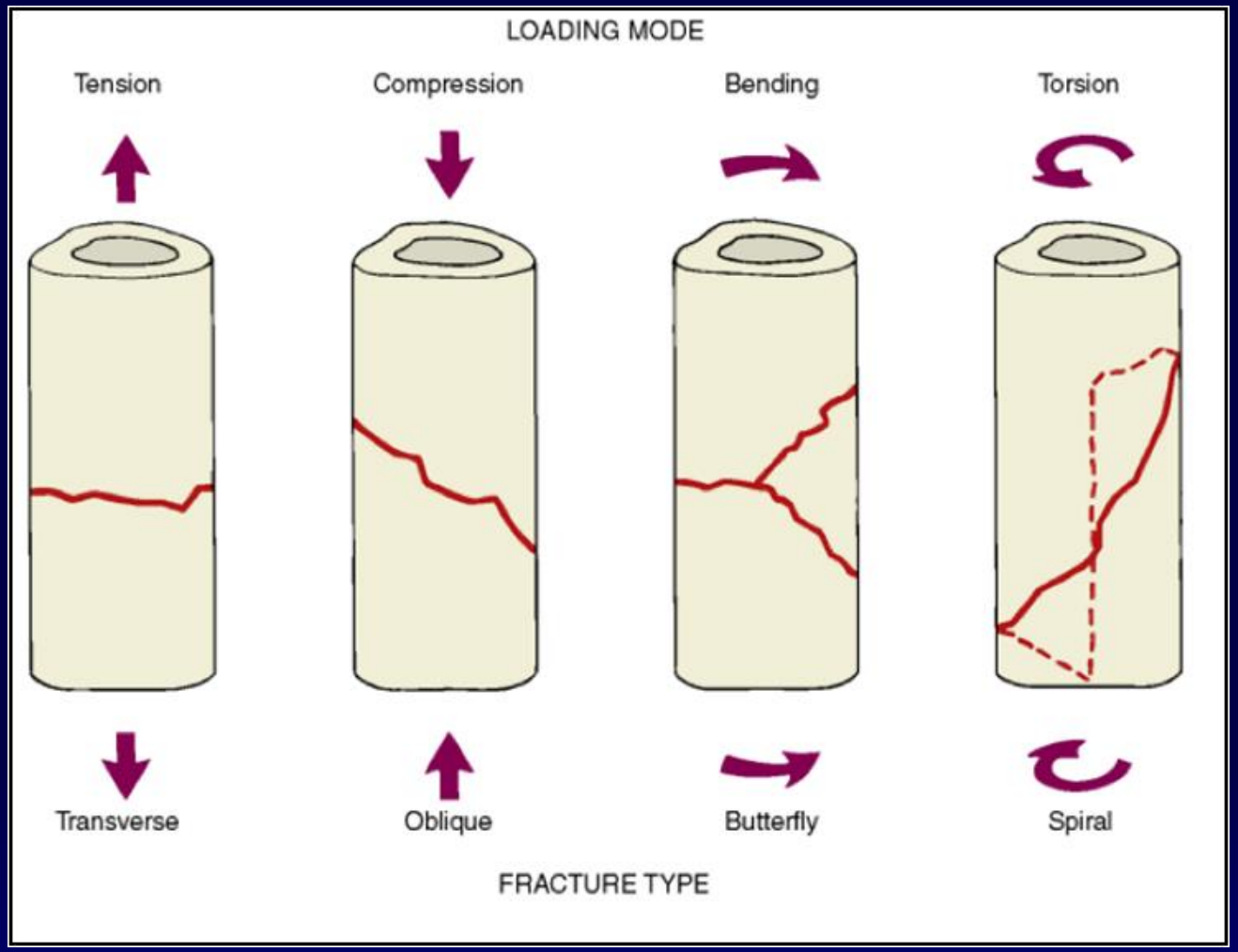
What is the Fracture Pattern?

- 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 (non-long) bones
  - Describe direction if indicated
    - Distal relative to proximal

Nondisplaced Fracture

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50% Displaced Fracture

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100% Displaced Fracture

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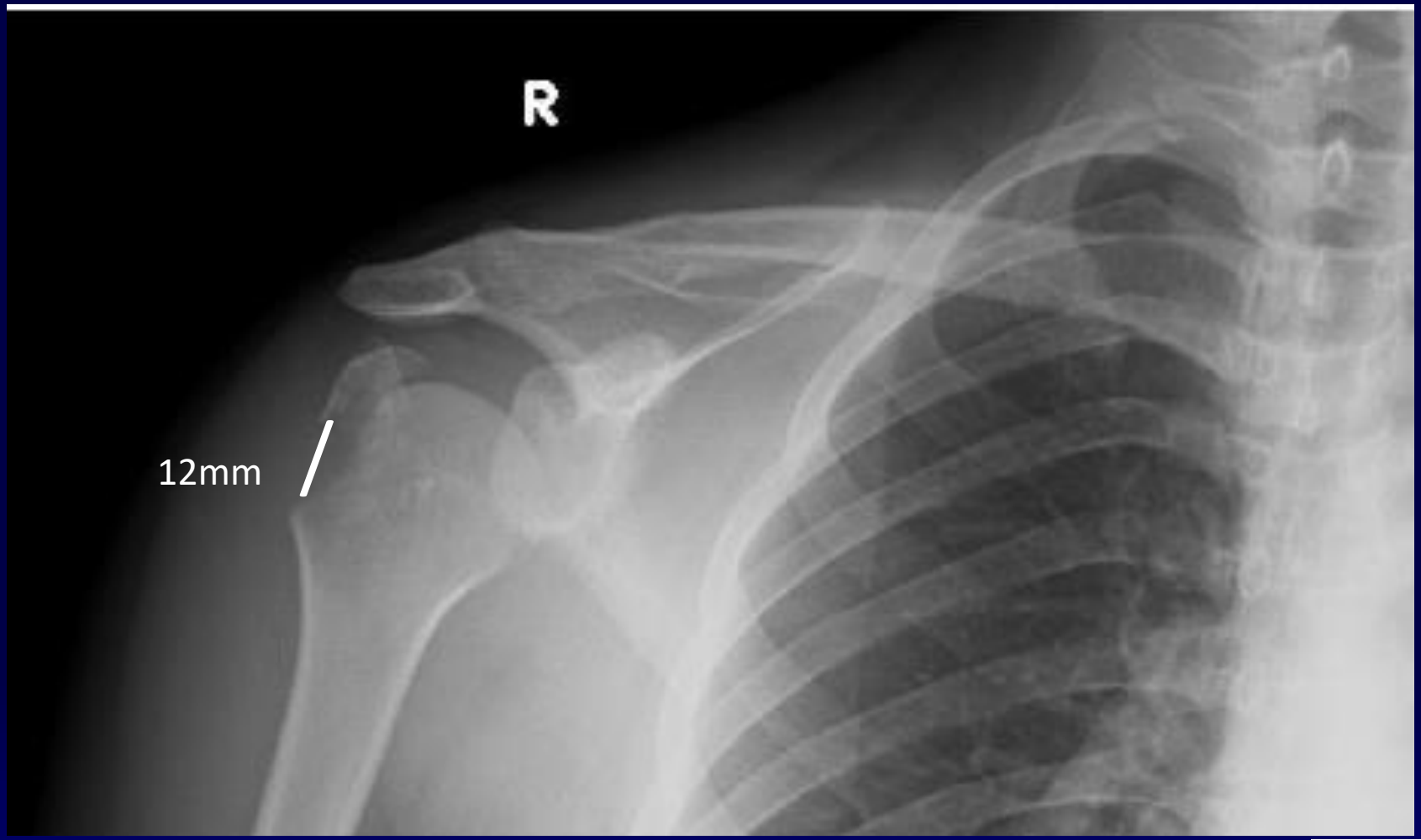
Measured Displacement



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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?

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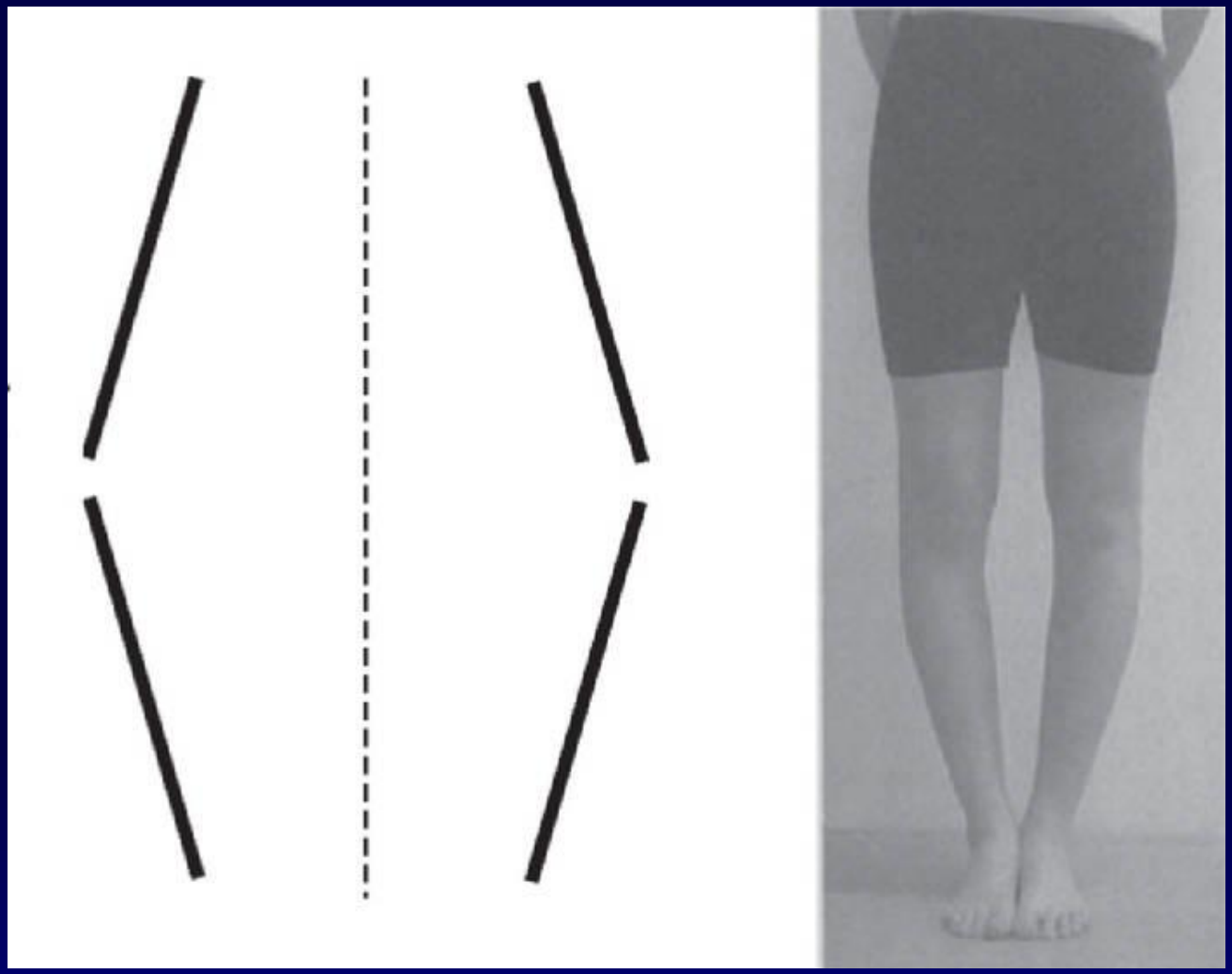
Varus Alignment



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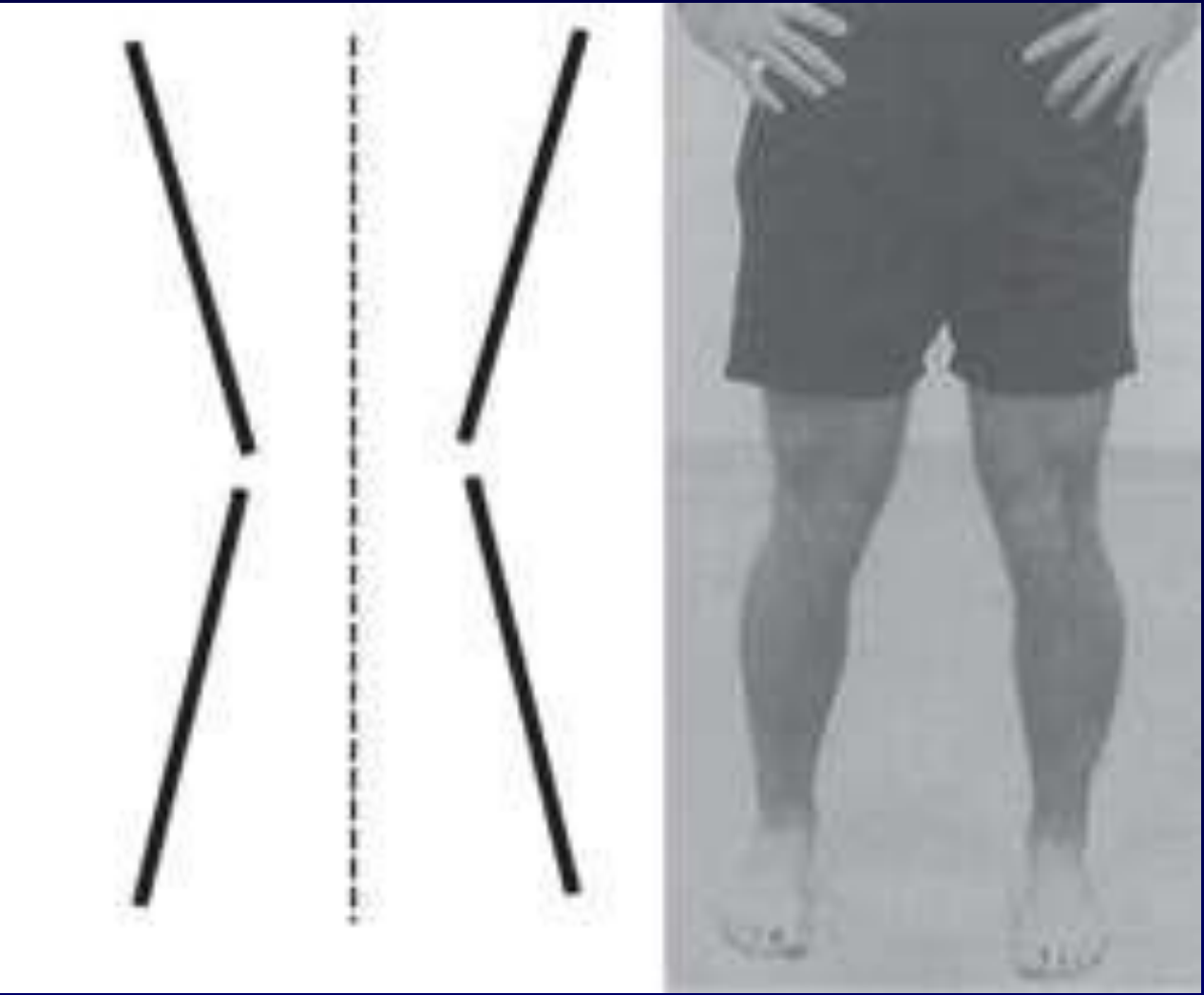
Valgus Alignment



Are the fragments aligned?

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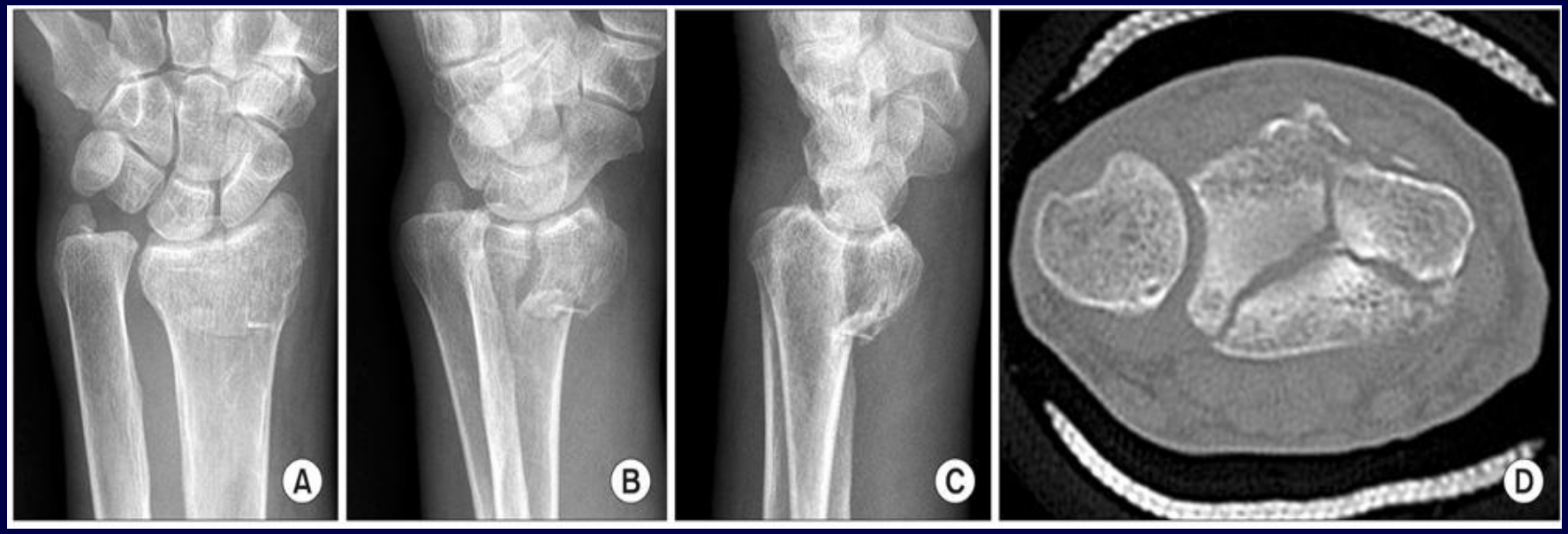
Is a Joint Surface Involved?

- 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



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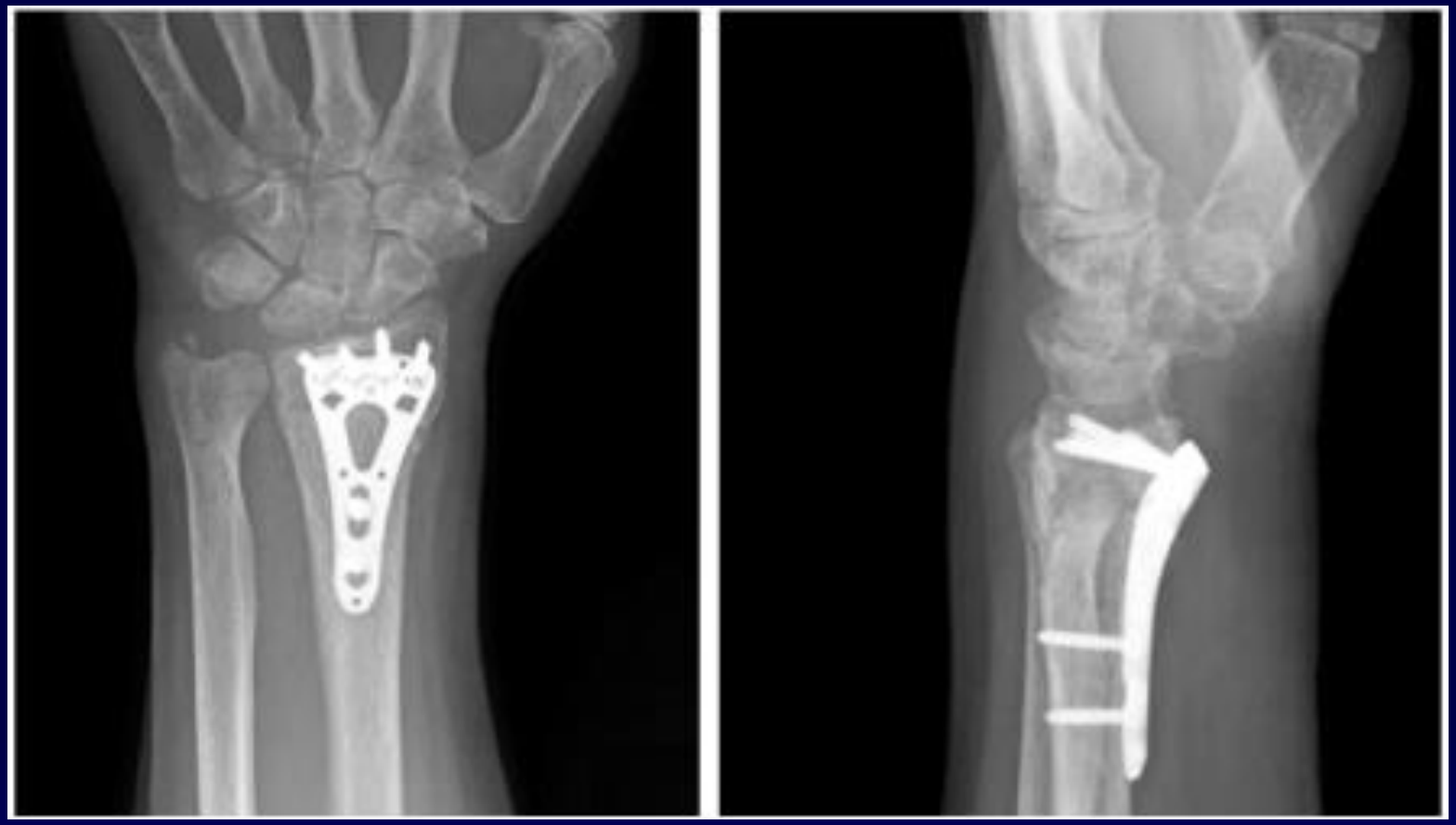
Intra-articular Fractures



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Intra-articular Fractures

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Intra-articular Fractures

Is the Skin Intact?

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

Open Fractures

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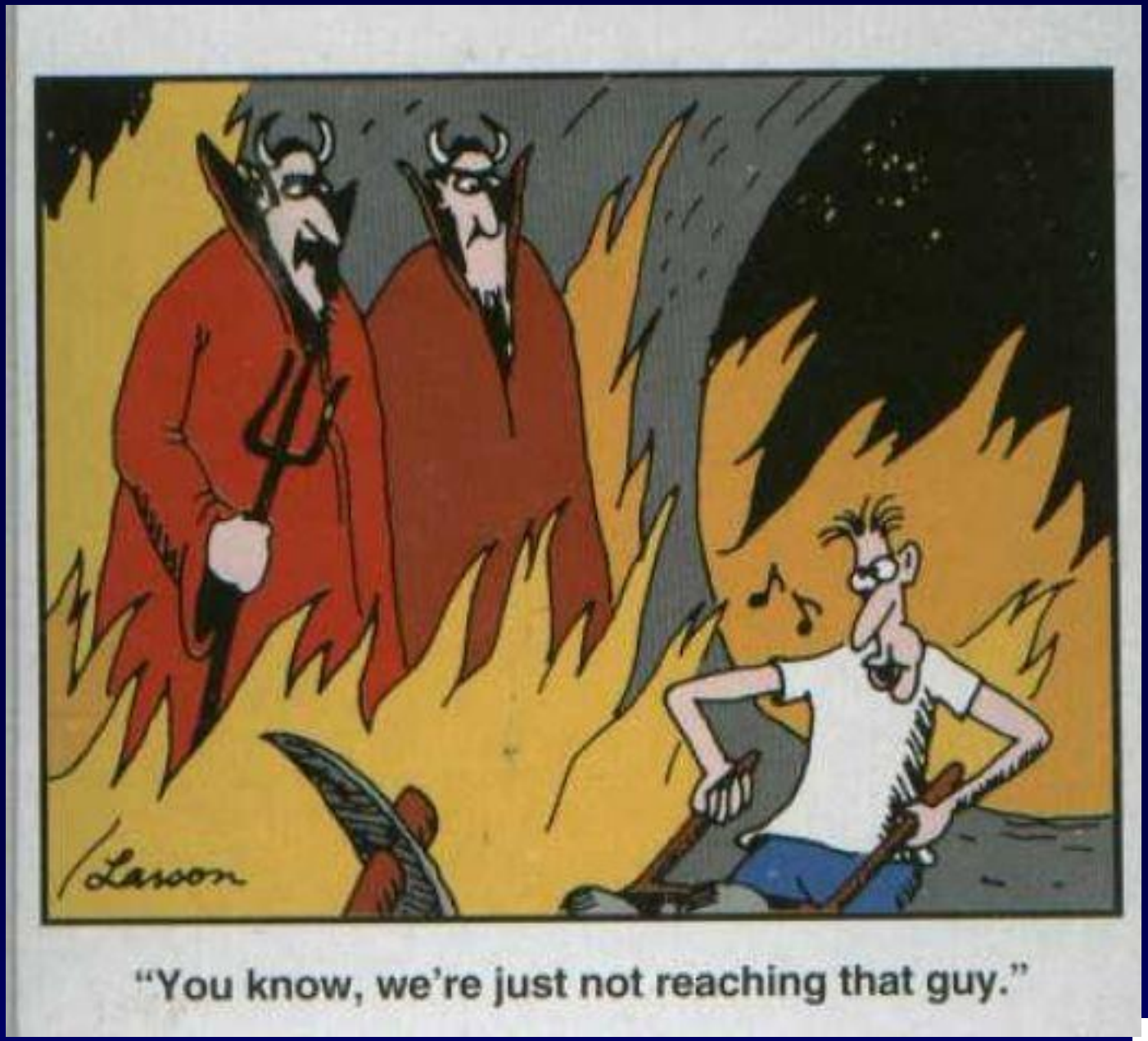
Gustilo Classification

- 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
  - Often require tissue transfers/flaps
- Grade 3C
  - Vascular injury



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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

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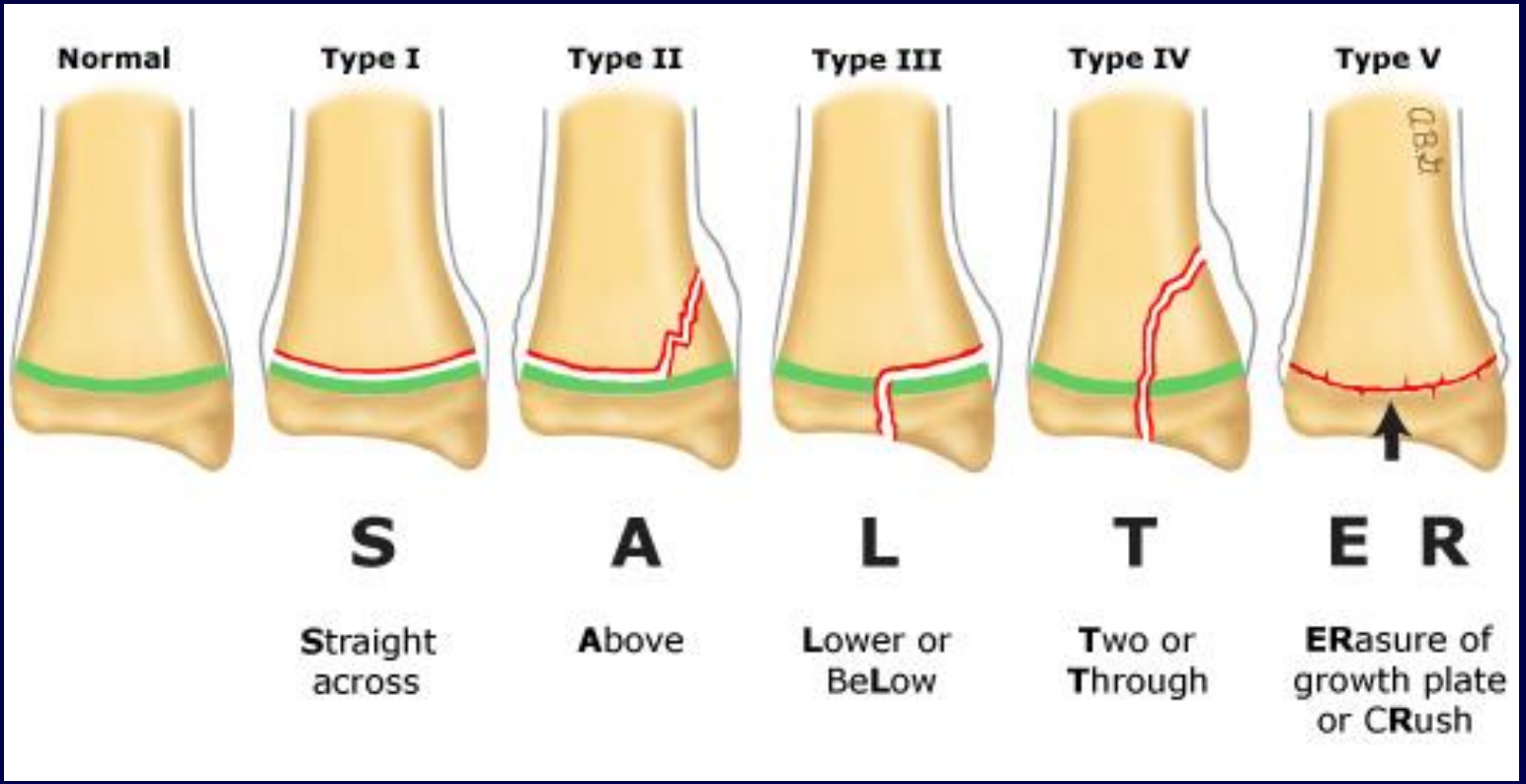
Pediatric Fractures

- Immature bone is not fully mineralized
- More flexible
- Capable of plastic deformity
- “Greenstick fracture”
- 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



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Salter-Harris Classification

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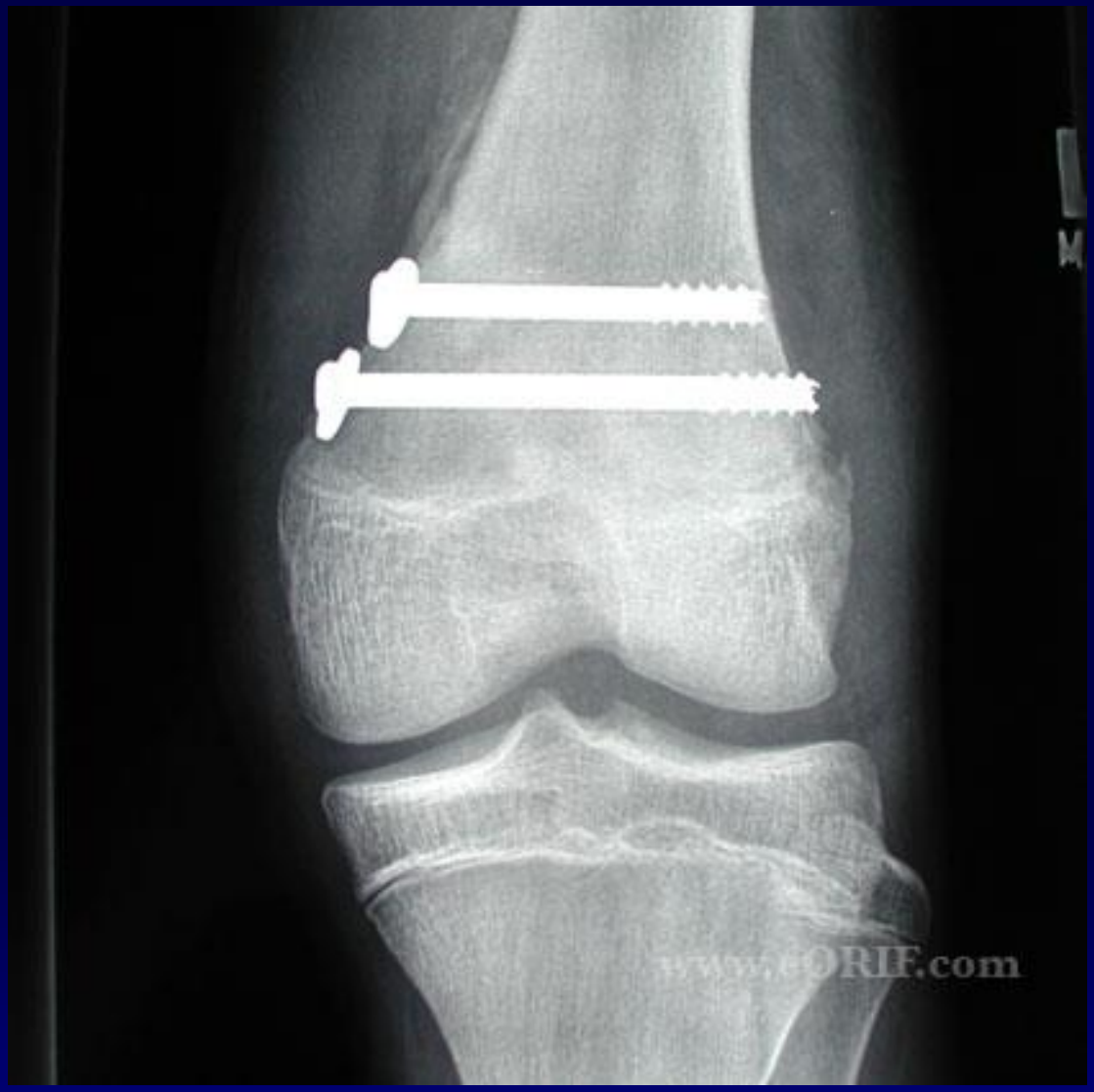
Salter-Harris Classification



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Diagnosis?

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Nonaccidental Trauma

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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.[8]

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Stress Fractures

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

Stress Fractures

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Stress Fractures

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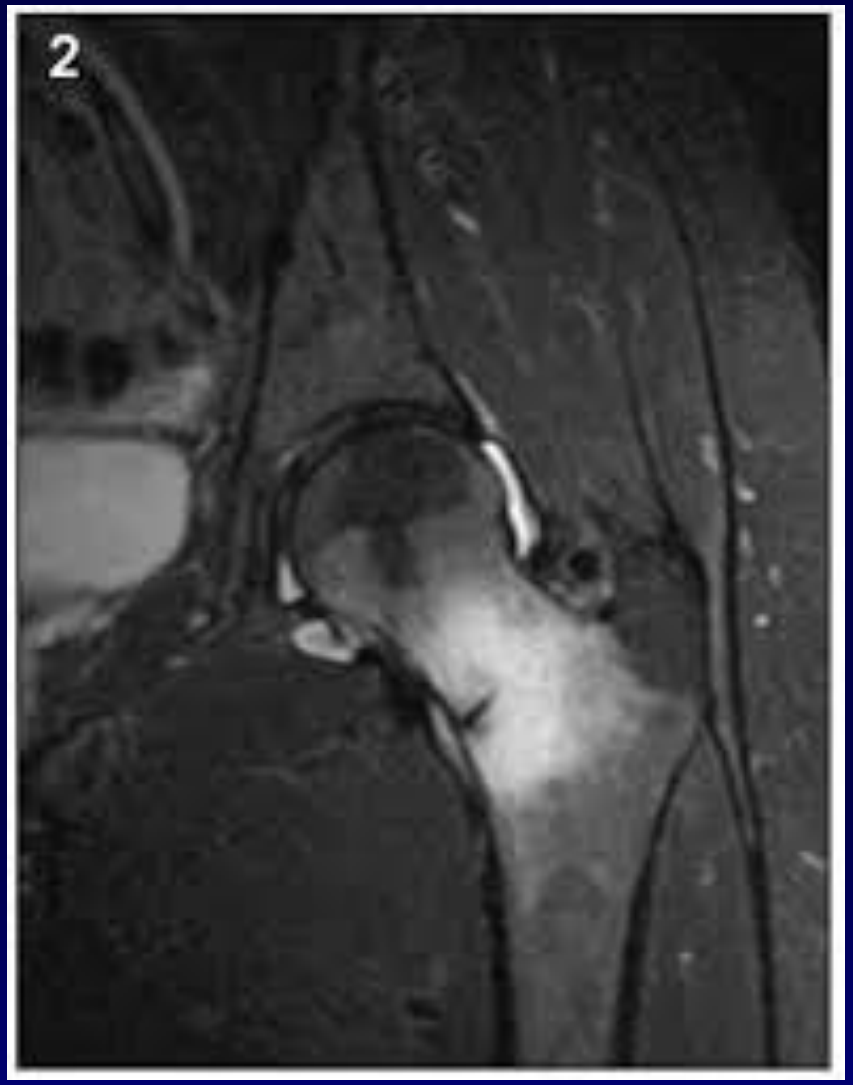
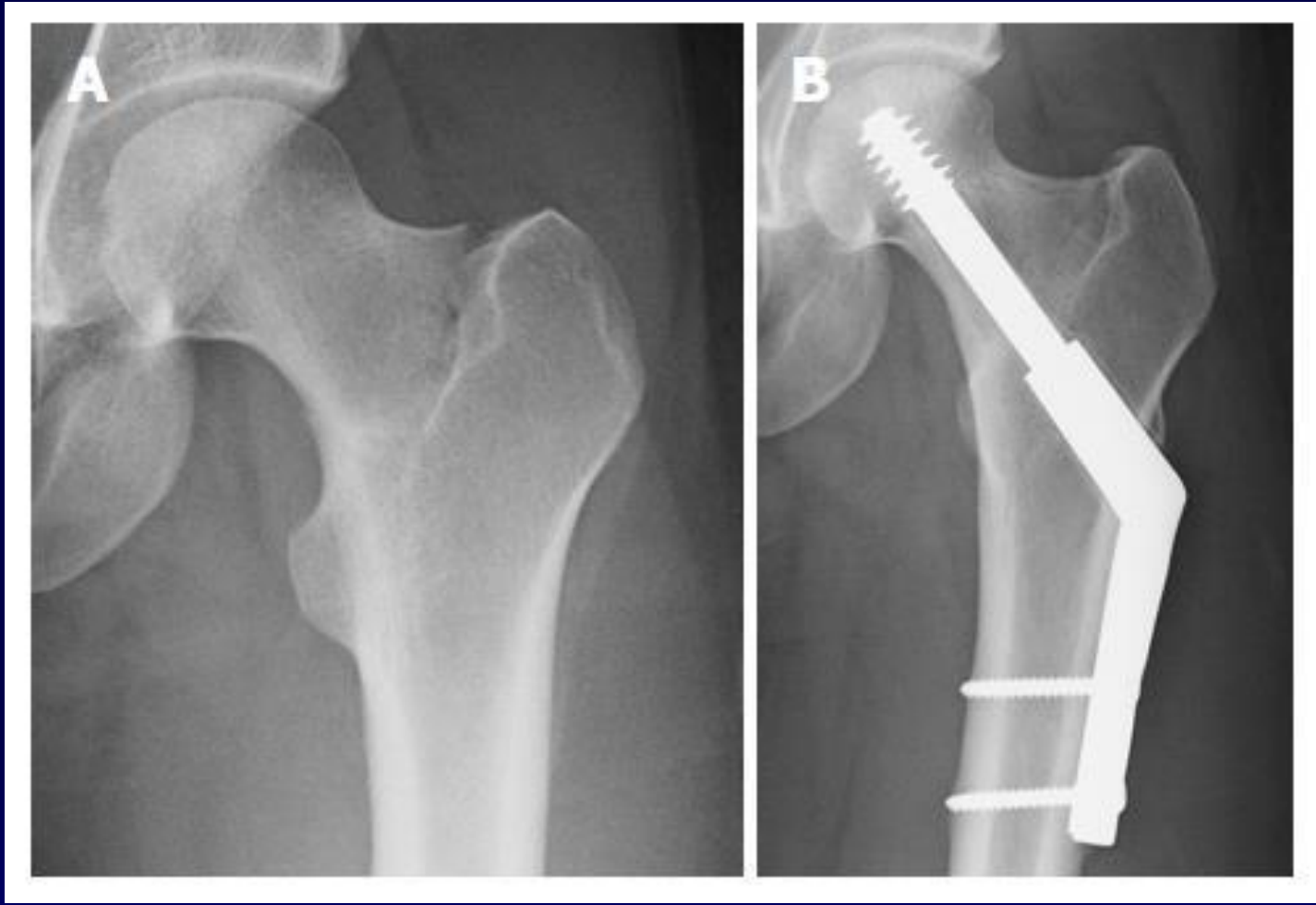
Stress Fractures



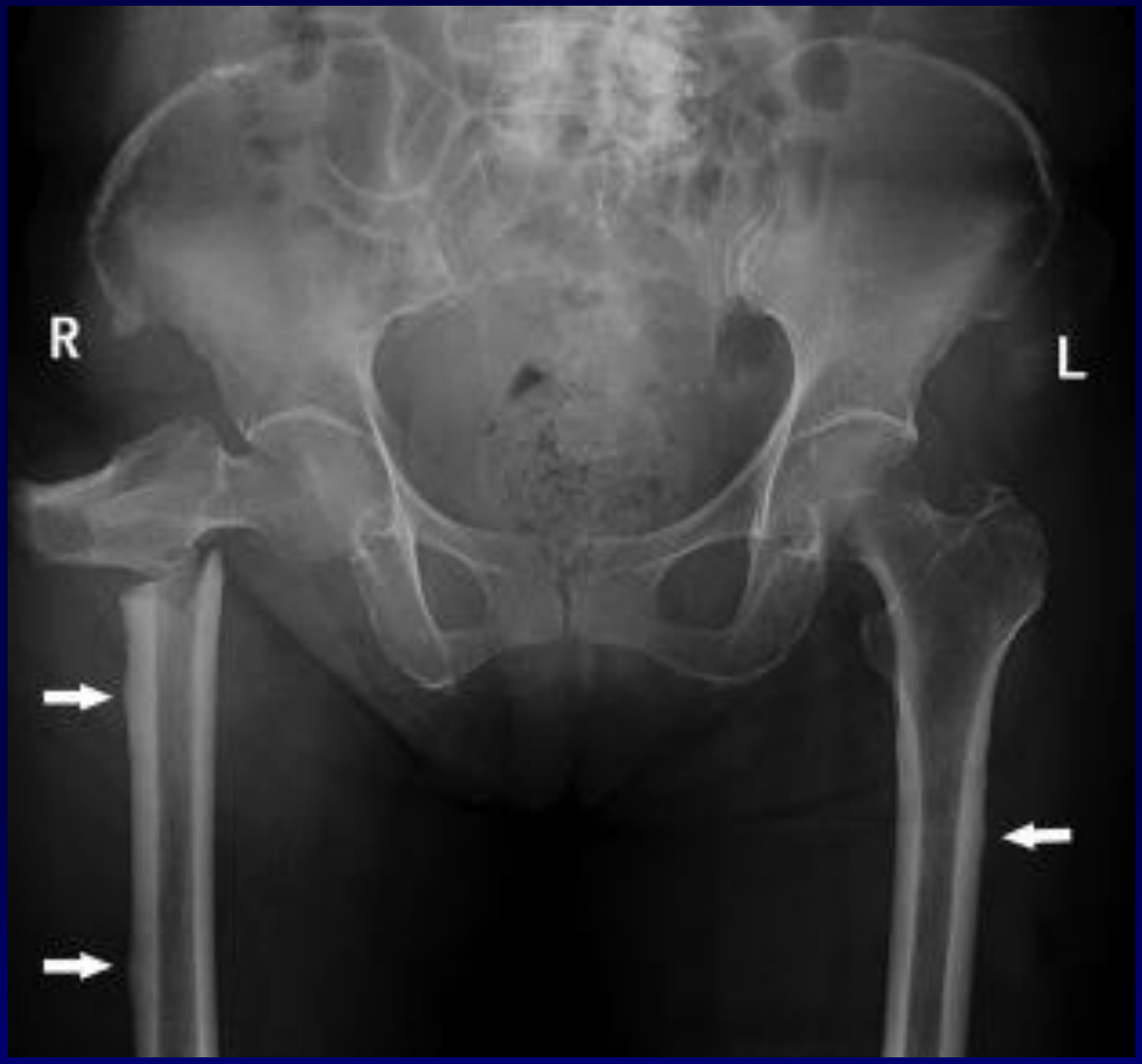
Stress Fractures



Bisphosphonate Fractures

- Bisphosphonate therapy minimizes bone loss and reduces fracture risk
- Associated with typical femoral shaft fractures
- Occur with minimal/no trauma
- Predominately transverse
- Involves both cortices
- Periosteal reaction

Bisphosphonate Fractures



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Pathologic Fractures

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

Pathologic Fractures

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Pathologic Fractures

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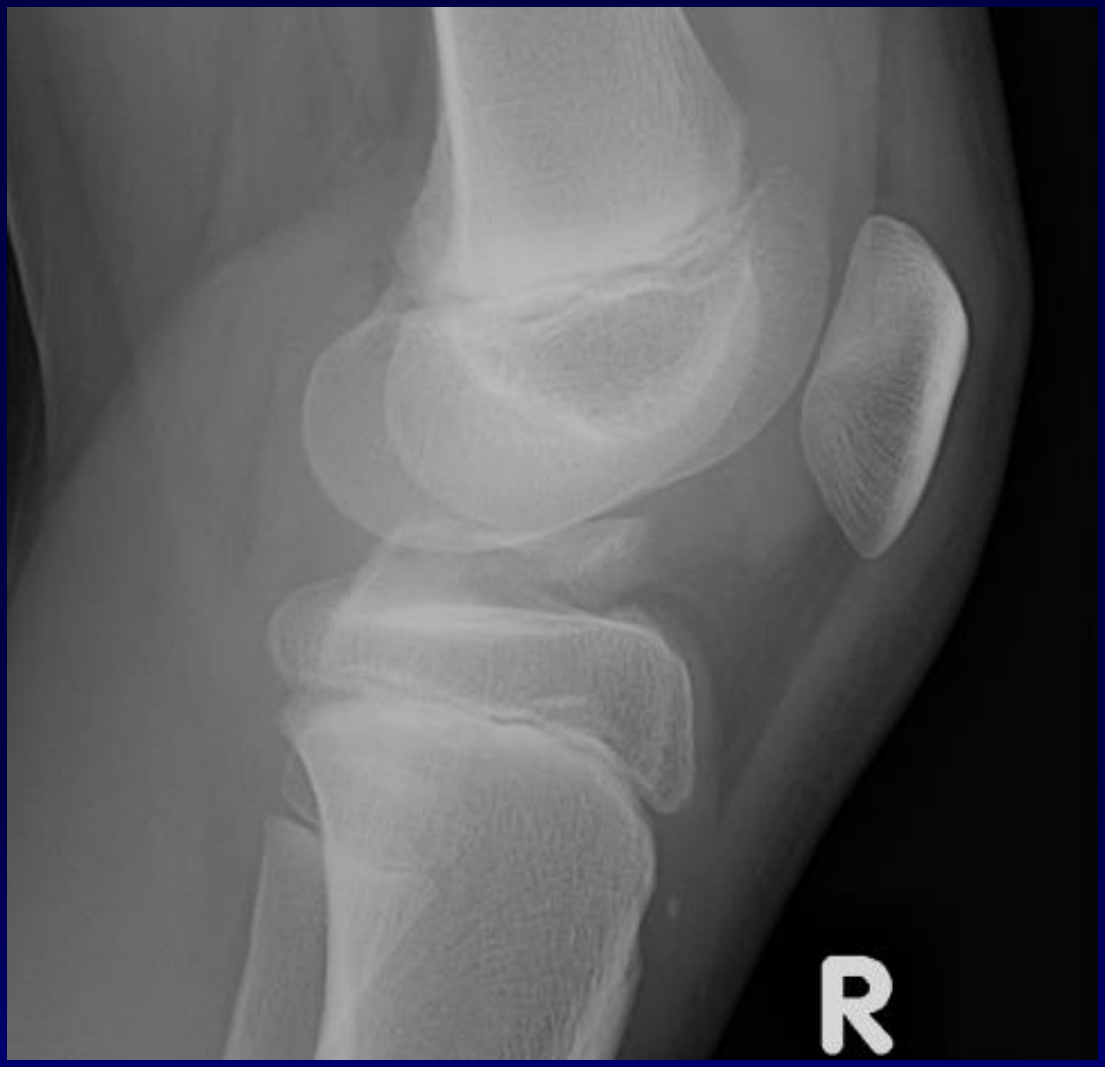
AvulsionFractures

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

AvulsionFractures



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Other Signs of Fractures

- Callus
- Periosteal reaction
- Soft tissue swelling – Friedman's Red Flag
- Periarticular fluid (lucency)
  - "Sail sign"

Periosteal Reaction

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“Sail” Sign

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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

Example

- PA working in ED: “I have a consult for you.”
- Me: “OK great whatcha got?”
- PA: “68 yo lady who fell and has a right closed displaced comminuted midshaft tibia fracture.
- Me: “OK thanks—I’ll see you shortly”
- PA: “I’ve got her iced, elevated, and she is reasonably comfortable.”
- Me: “You went to the Galaxy course didn’t you?!”

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Fracture Description Quiz

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Case #1

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Case #1

1. Angulated displaced transverse radial shaft fracture with associated ulnar dislocation
2. Galleazzi fracture-dislocation
3. Angulated displaced transverse ulnar shaft fracture with associated radial head dislocation
4. Oblique varus angulated ulnar shaft fracture with radial head dislocation
5. Impacted varus angulated radial shaft fracture with proximal ulna dislocation

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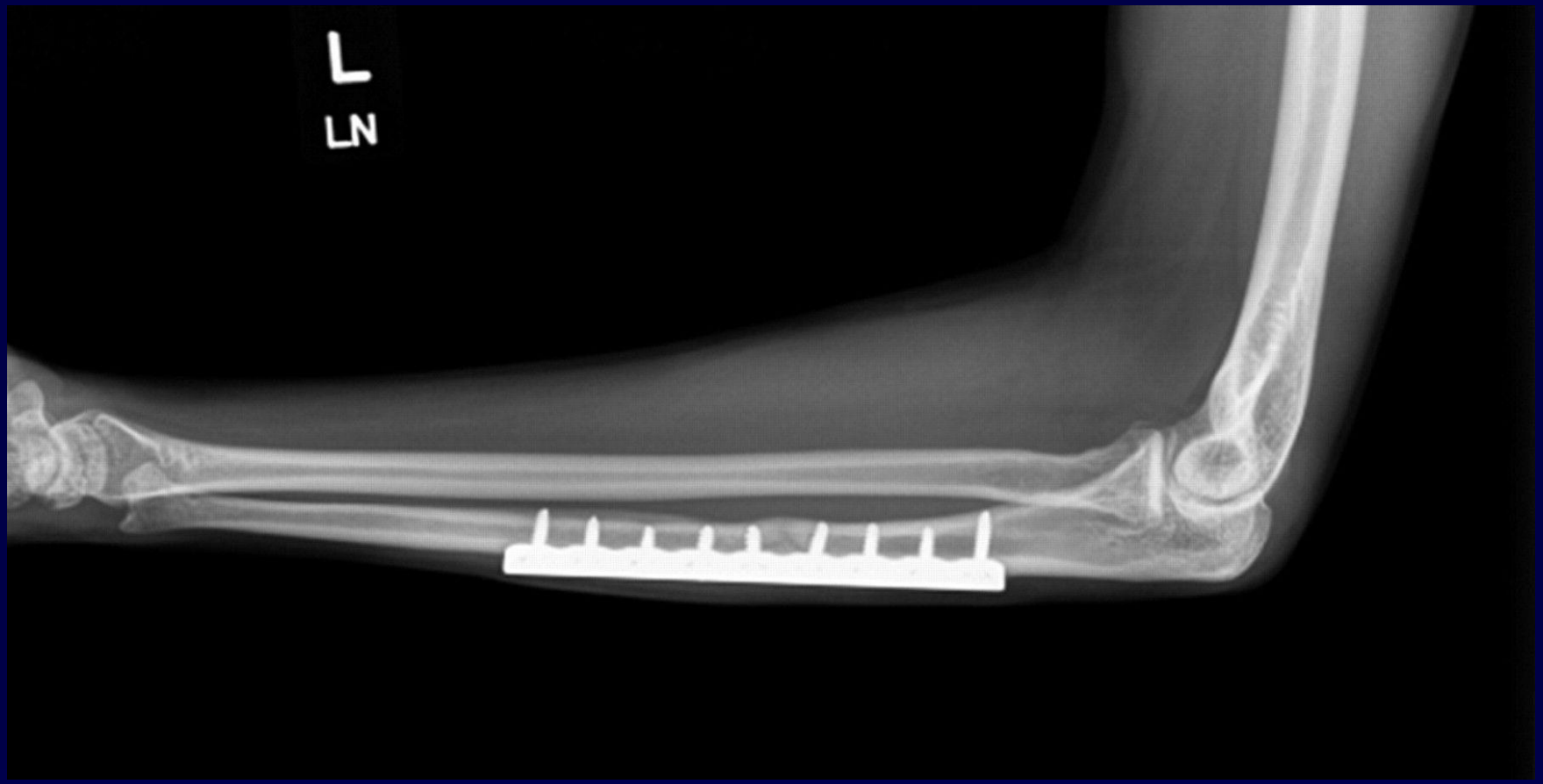

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Case #2

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Case #2

1. Valgus angulated displaced distal tibia and fibula fractures with ankle dislocation
2. Varus angulated distal fibula fracture with avulsion fracture of distal tibia
3. Angulated transverse fibula shaft fracture with associated ankle dislocation
4. Impacted valgus angulated medial and lateral malleolus fracture with ankle dislocation
5. Bimalleolar ankle fracture-dislocation

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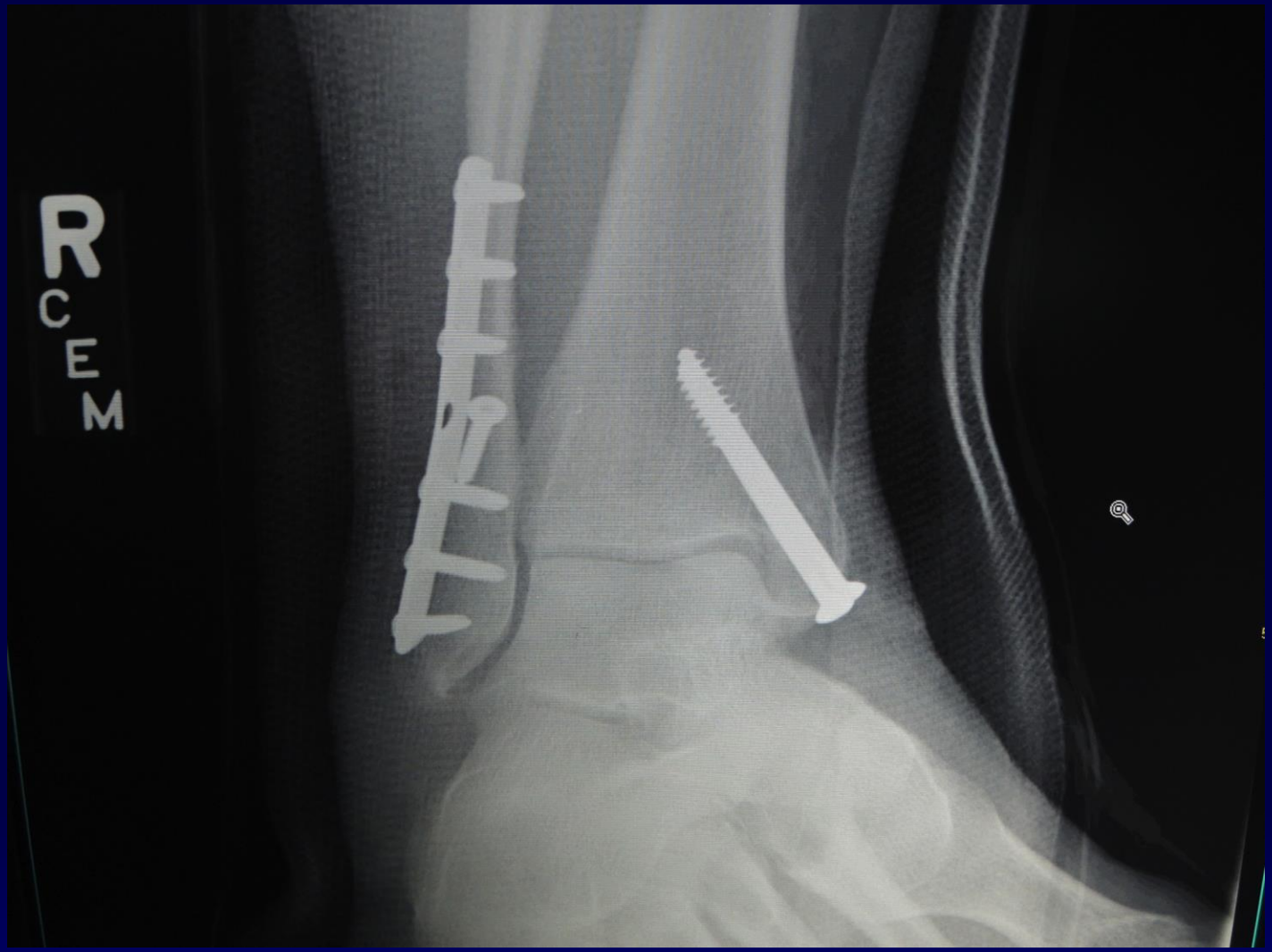

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Case #3

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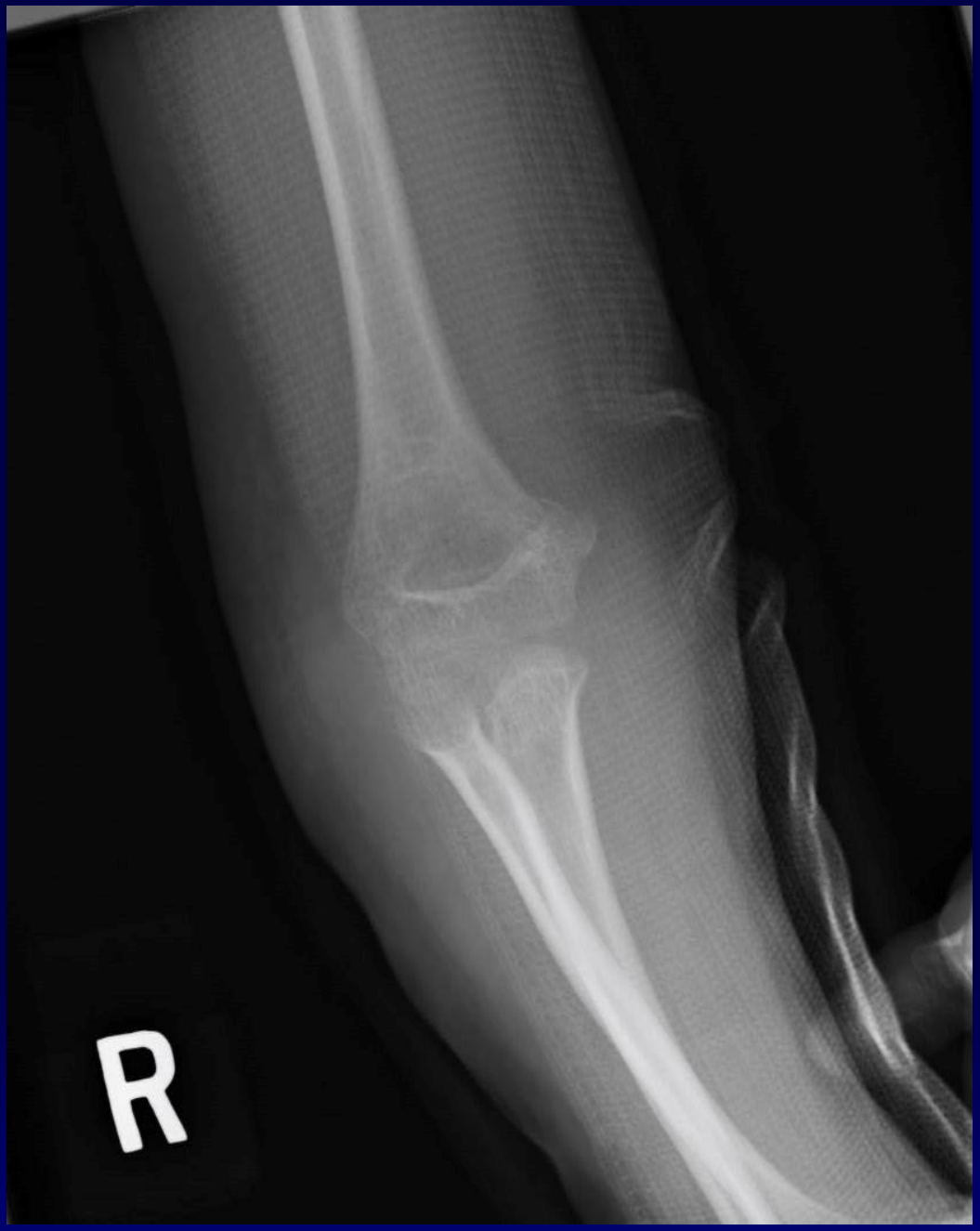

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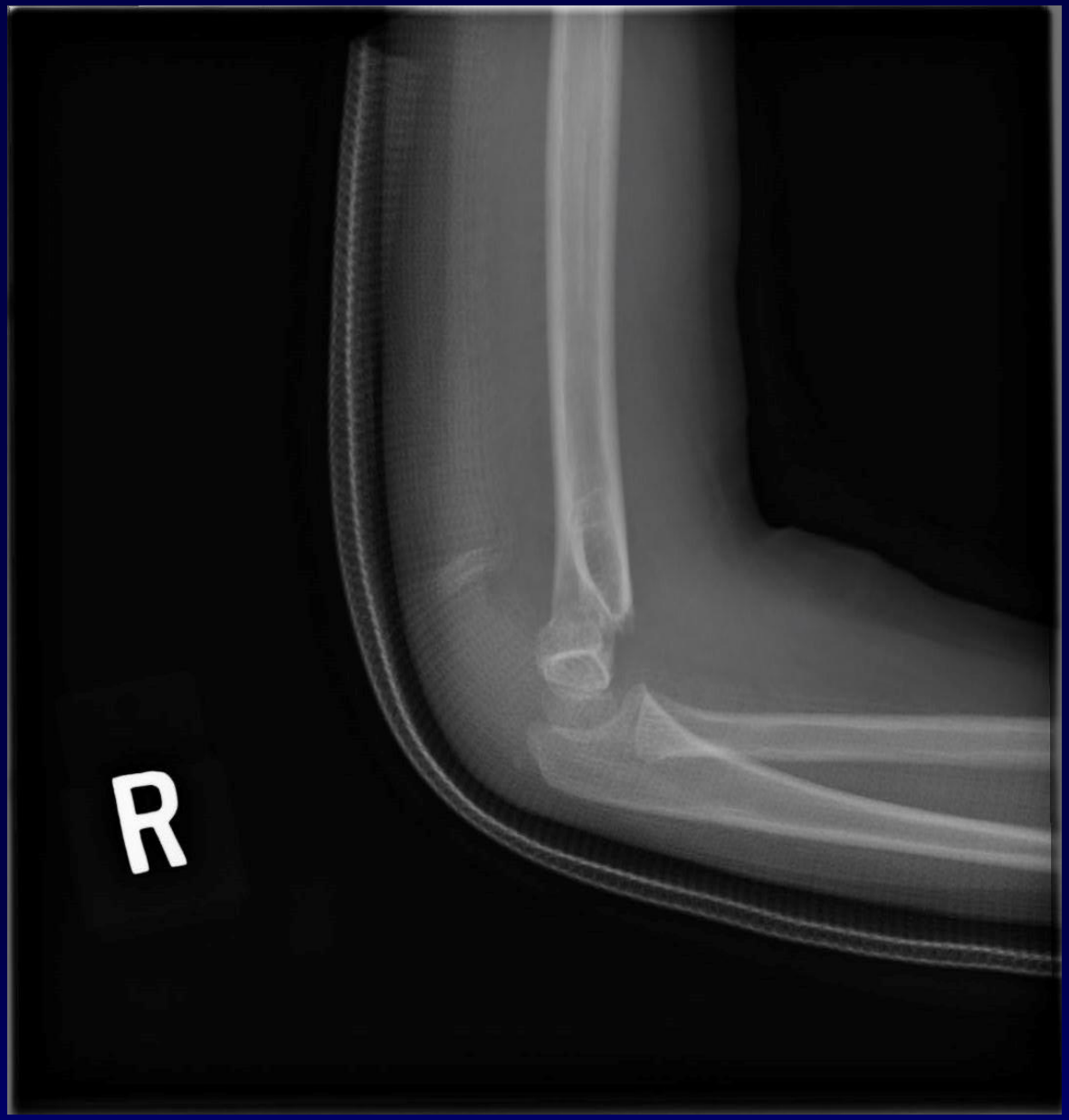

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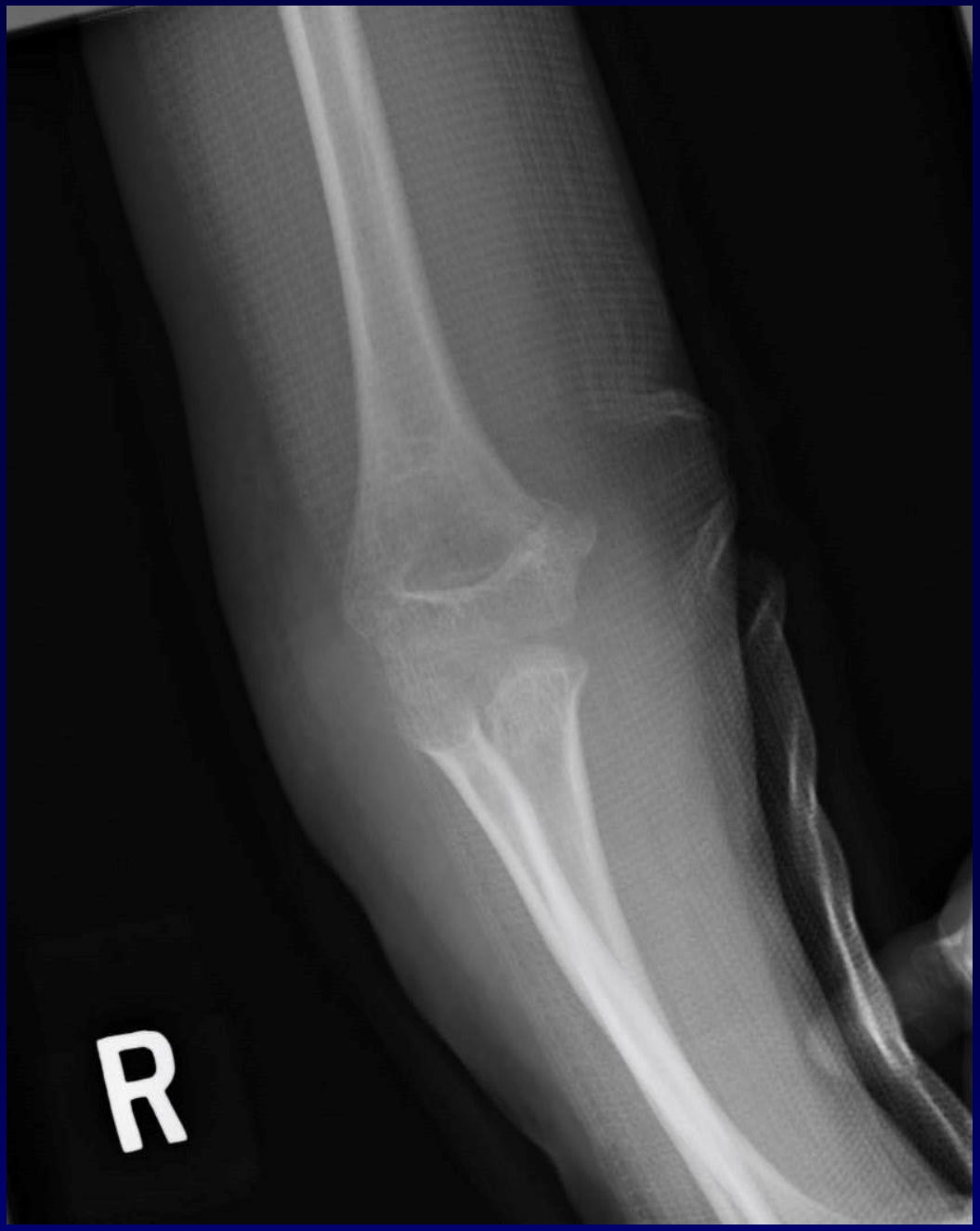
Case #3

1. Displaced, angulated intercondylar distal humerus fracture
2. Mildly displaced distal humerus fracture with apex anterior angulation
3. Valgus angulated proximal ulna fracture
4. Valgus angulated distal humerus fracture with radial head dislocation
5. Distal humerus avulsion fracture with 75% posterior displacement



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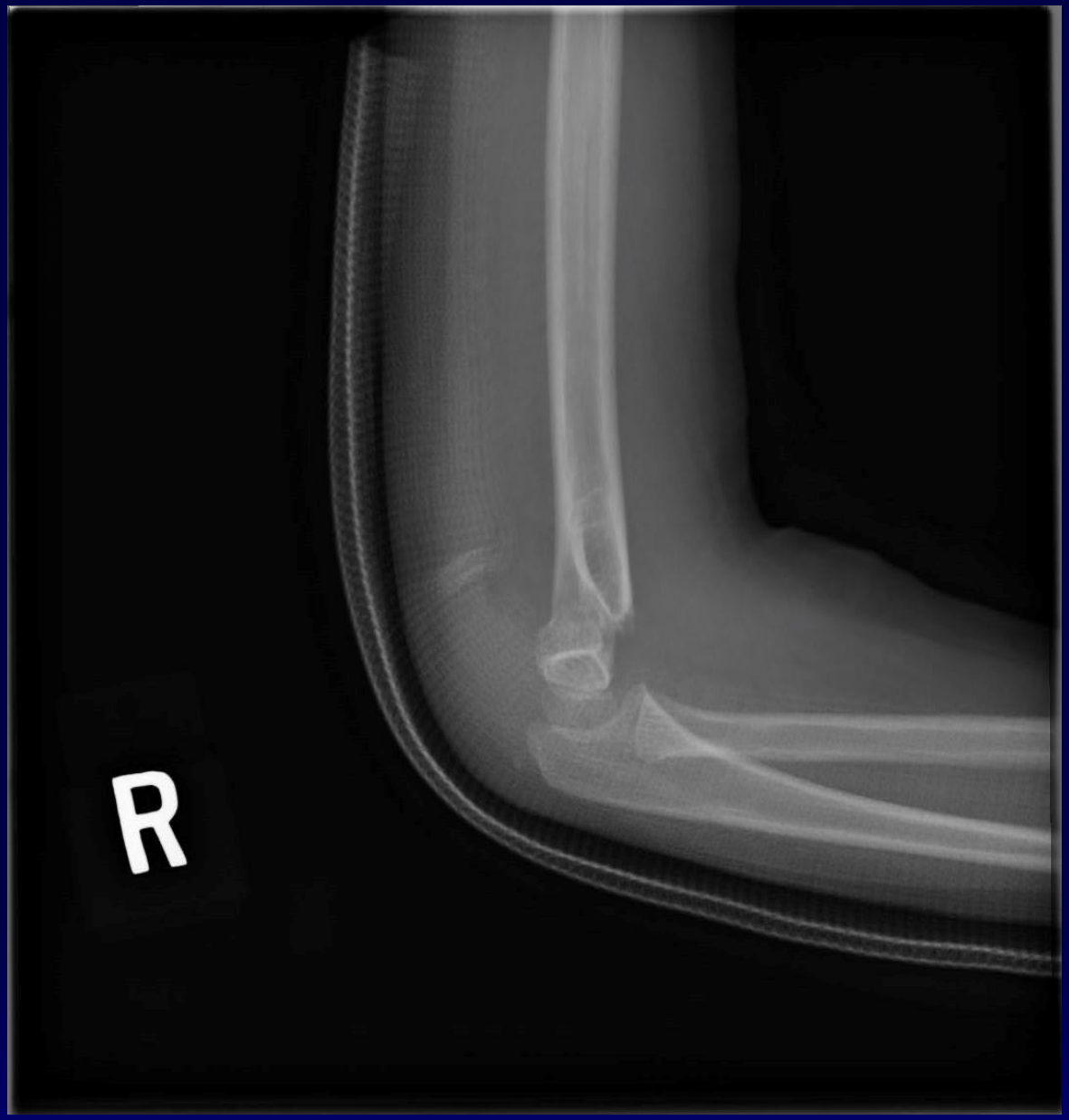

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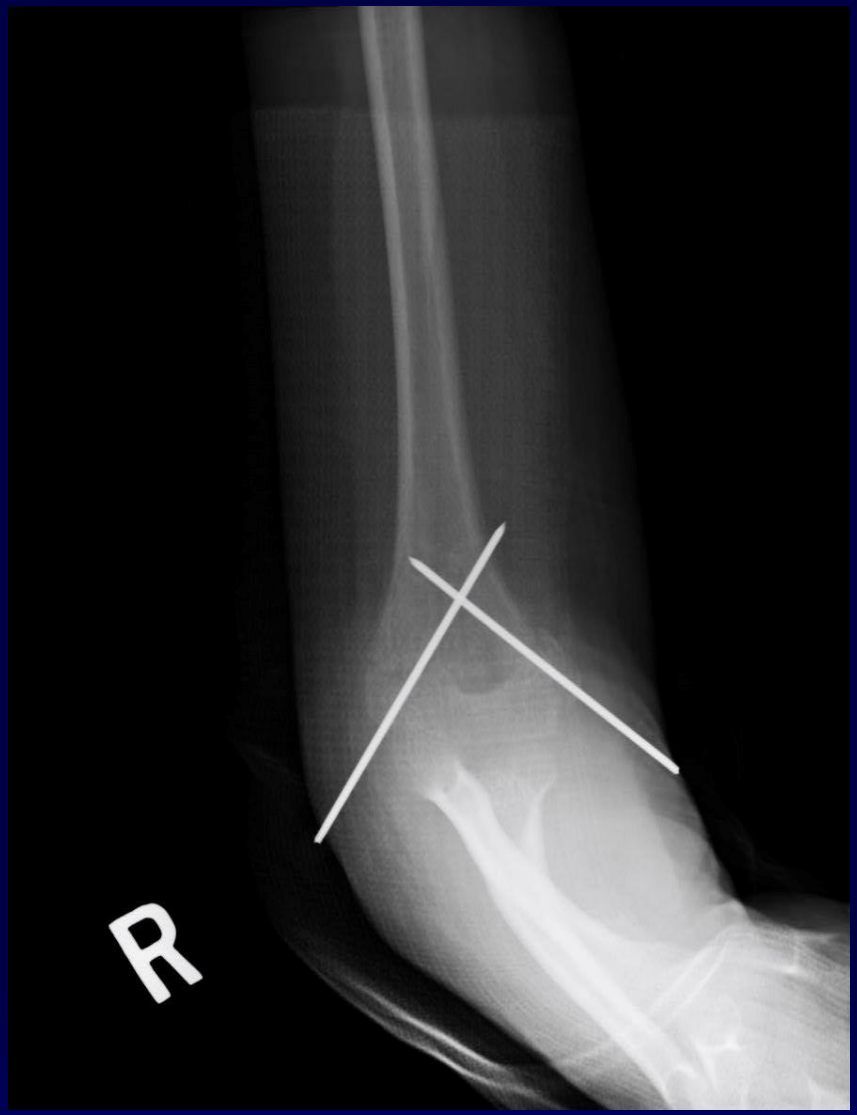

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Case #4

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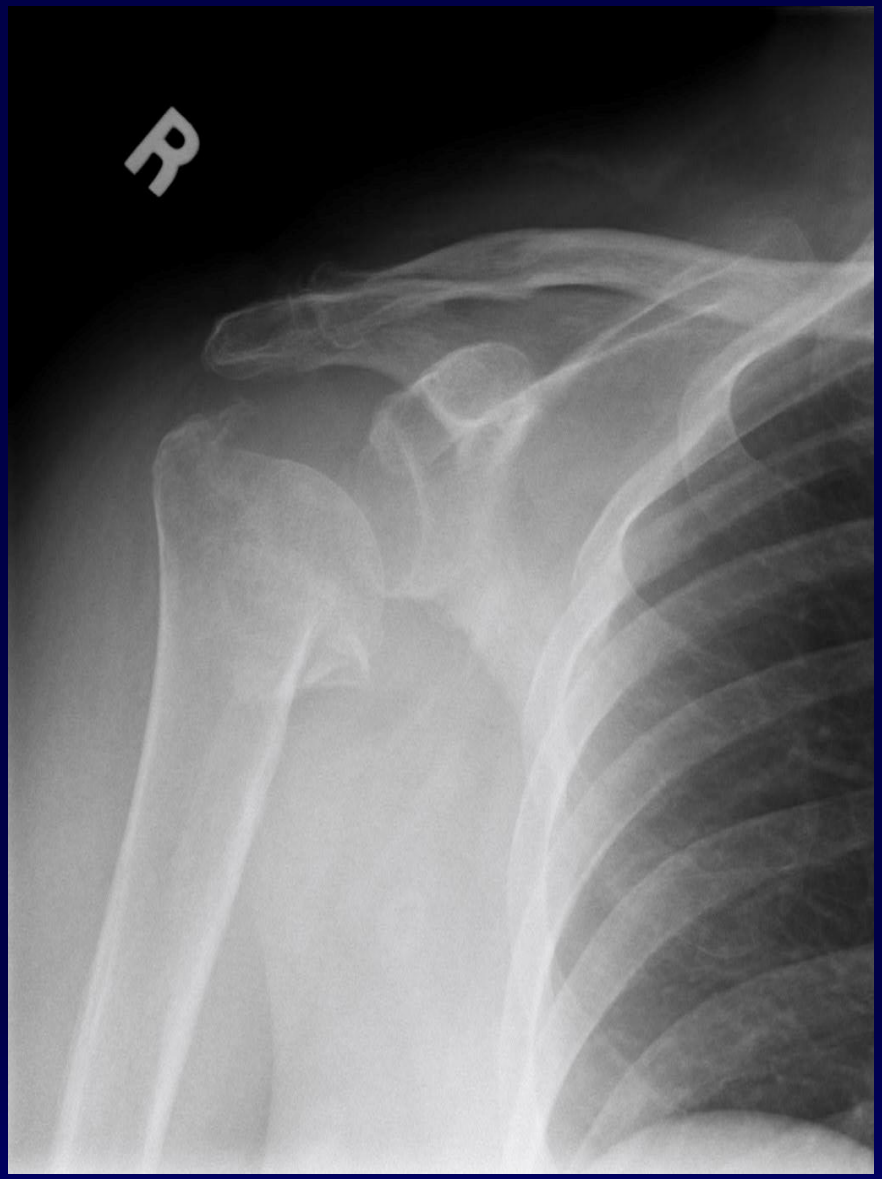

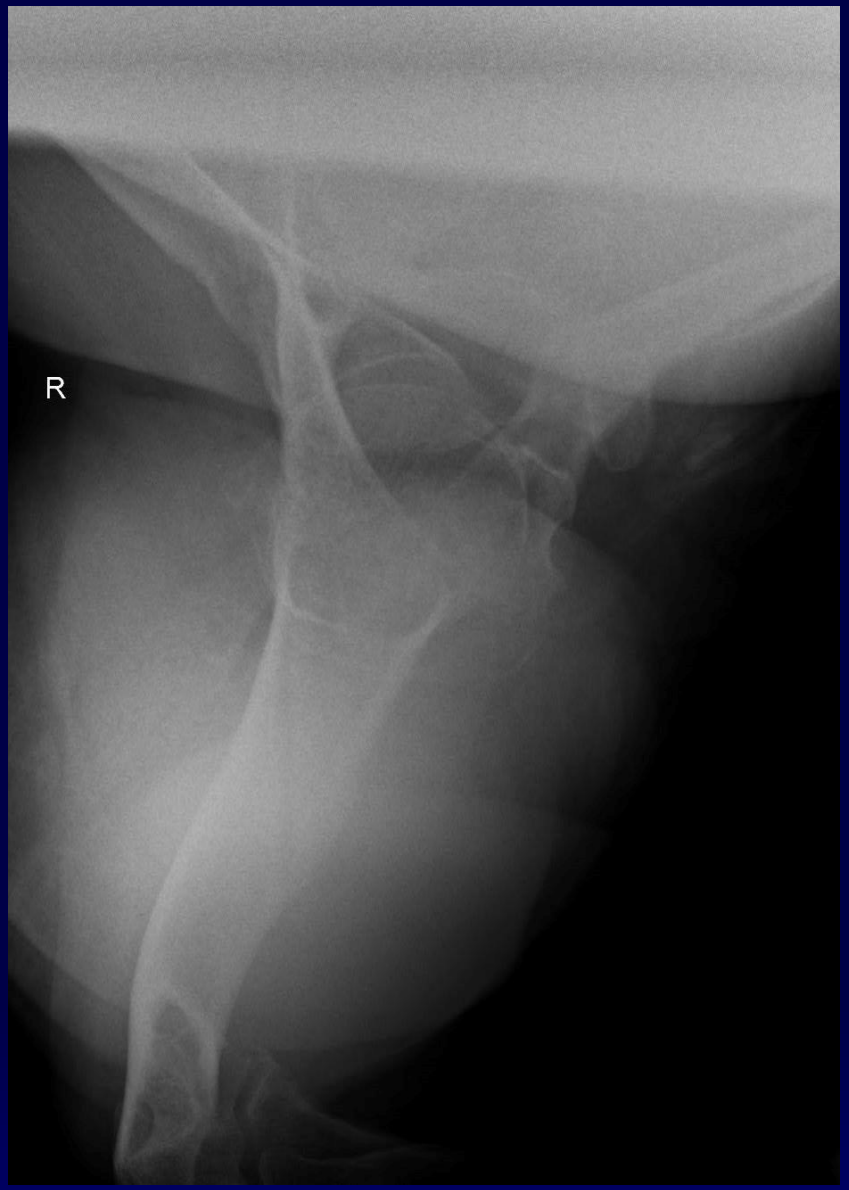

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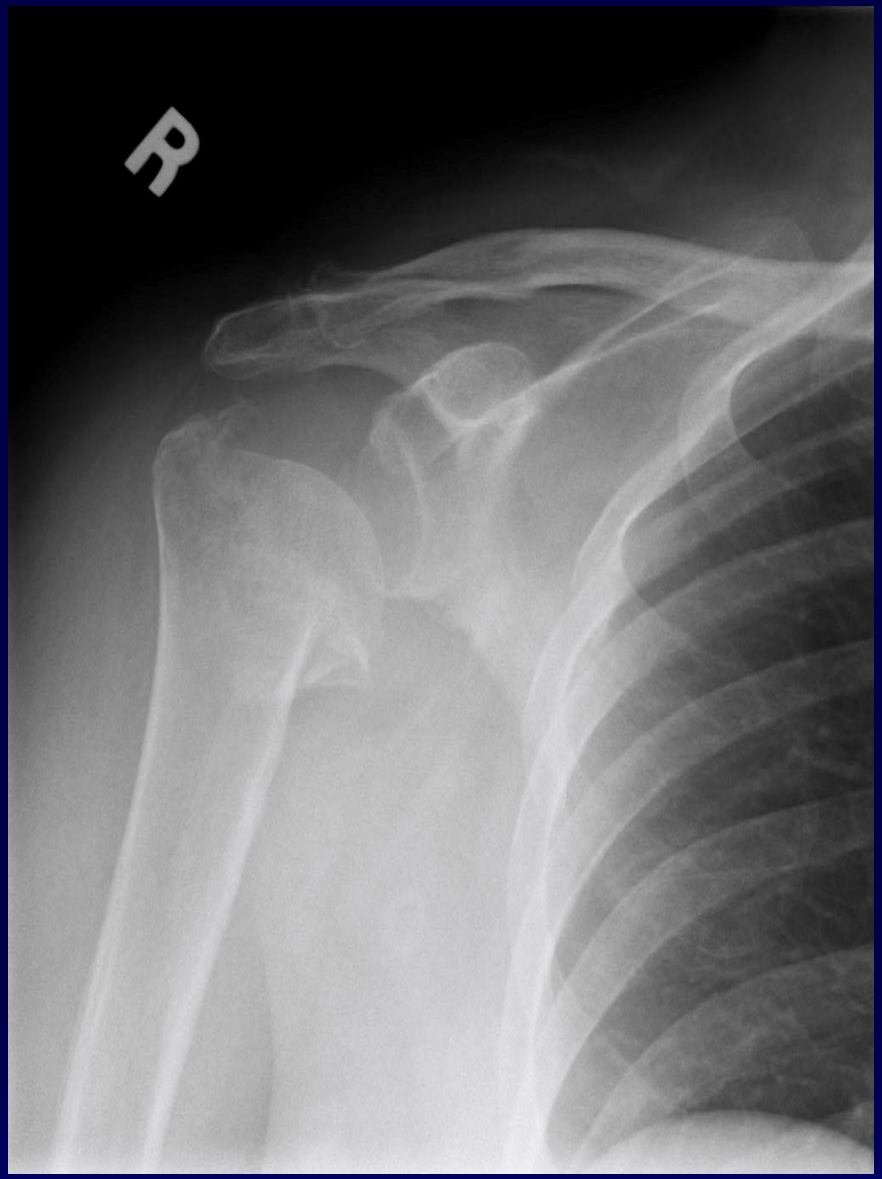
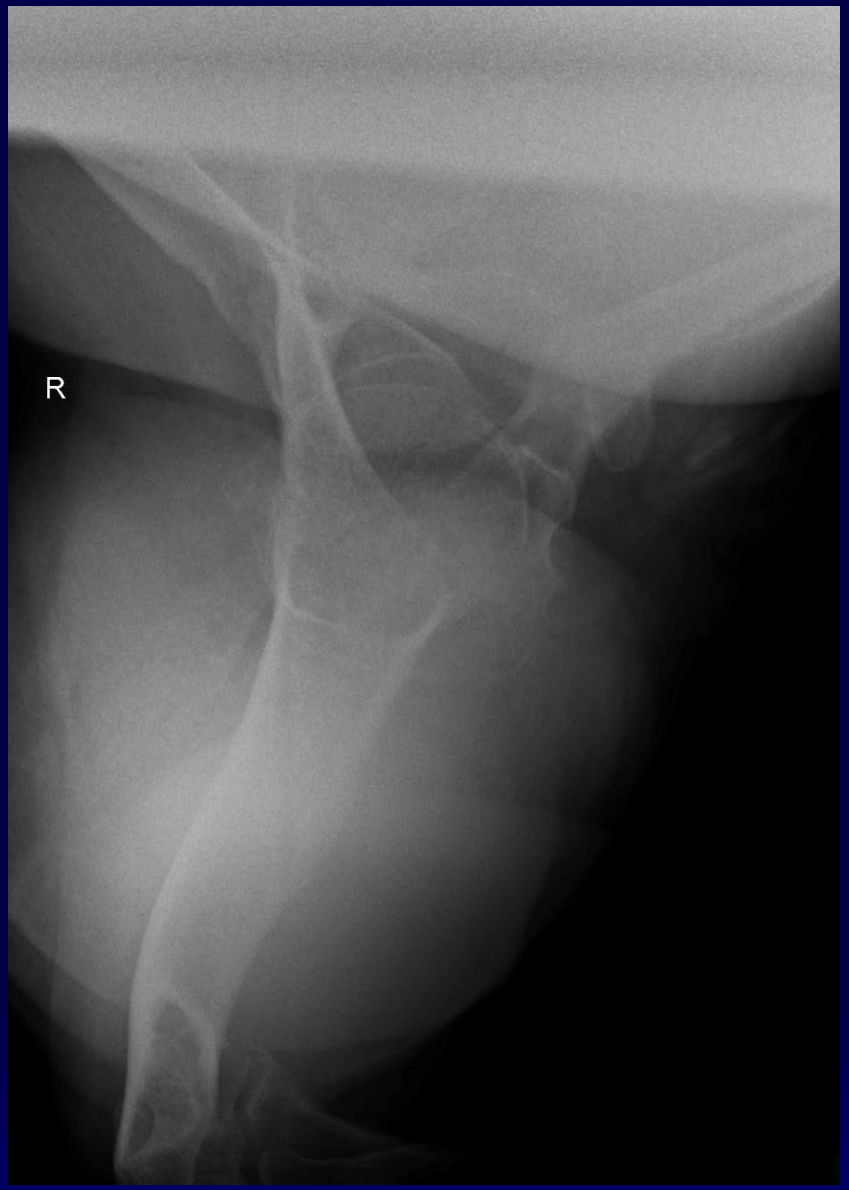
Case #4

1. Impacted, angulated greater tuberosity fracture with humeral head displacement
2. Varus angulated humeral neck fracture
3. Displaced 2-part proximal humerus fracture
4. Impacted, comminuted, humeral head and lesser tuberosity fractures
5. Displaced humeral metaphyseal fracture with valgus angulation





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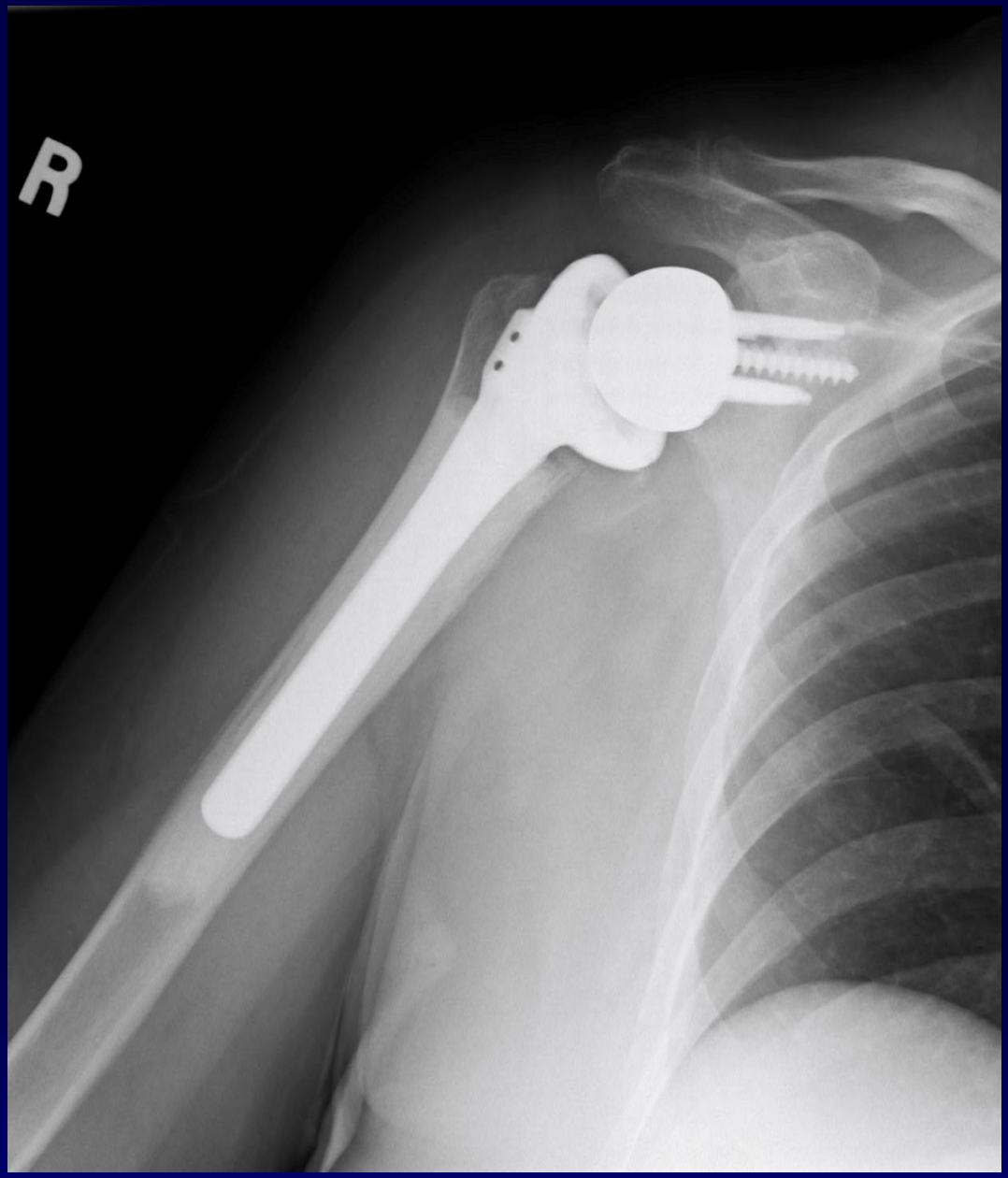

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Case #5

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Case #5

1. Displaced Salter-Harris Type 3 distal radius fracture
2. Intraarticular displaced radial head fracture
3. Displaced distal radius Colles fracture
4. Impacted, comminuted, distal radius and ulnar head fractures
5. Displaced intraarticular distal radius fracture with associated ulnar styloid fracture

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Case #6

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Case #6

1. Intraarticular displaced femoral neck fracture
2. Displaced, angulated subtrochanteric femoral shaft fracture
3. Comminuted, displaced proximal femur fracture with varus angulation
4. Valgus angulated, comminuted, displaced intertrochanteric femur fracture
5. Impacted, comminuted, intercondylar femur fracture with varus angulation

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Case #7

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Case #7

1. Varus angulated displaced distal femur fracture
2. Angulated transverse femoral shaft fracture with associated dislocation
3. Impacted valgus angulated femur fracture
4. Displaced angulated shortened segmental femoral shaft fracture
5. BATS Fracture

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BATS Fracture

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BATS Fracture

- Busted
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Thank You!
bensencv@gmail.com
828-773-9227