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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SAFETY

At least he's not in the front seat.

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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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ARS

- Please submit answers!:
  - Text “GALAXY2024” to 22333 to join, then text your answers to the same number when the question displays on the screen
  - Via internet at pollev.com/galaxy2024

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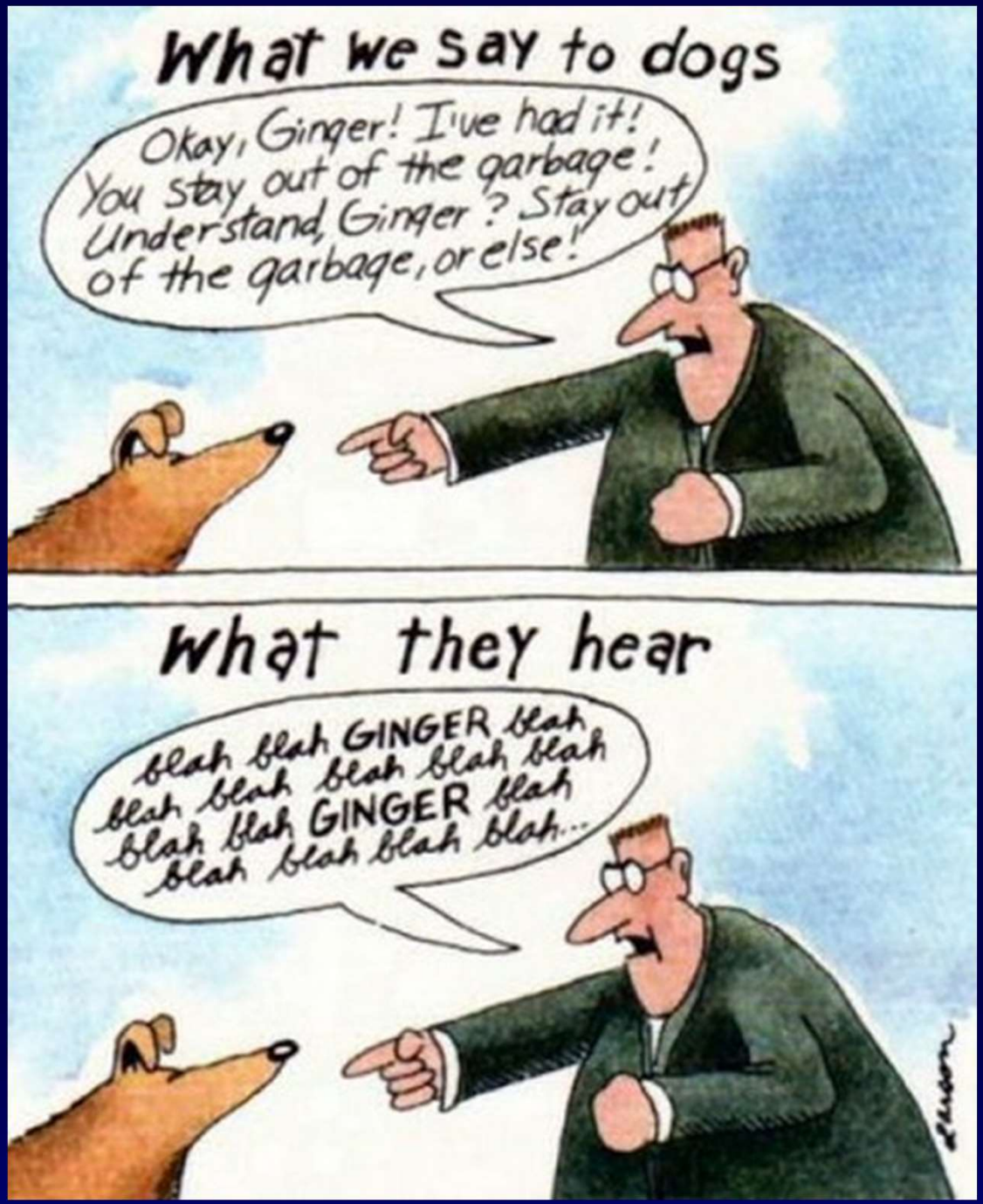

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Example

- 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

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“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?

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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

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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”

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TRADITION

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

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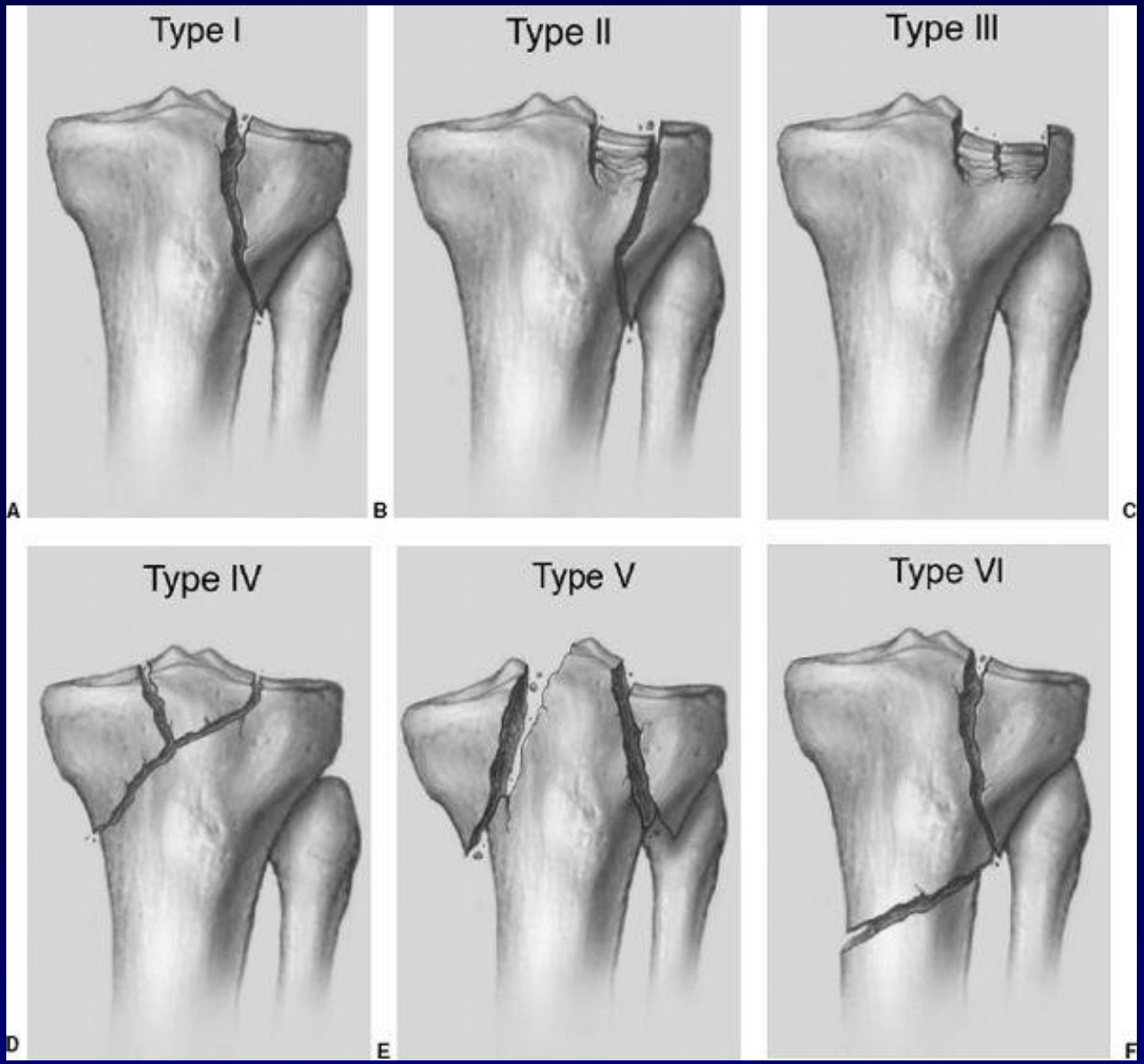
Tibial Plateau - Schatzker



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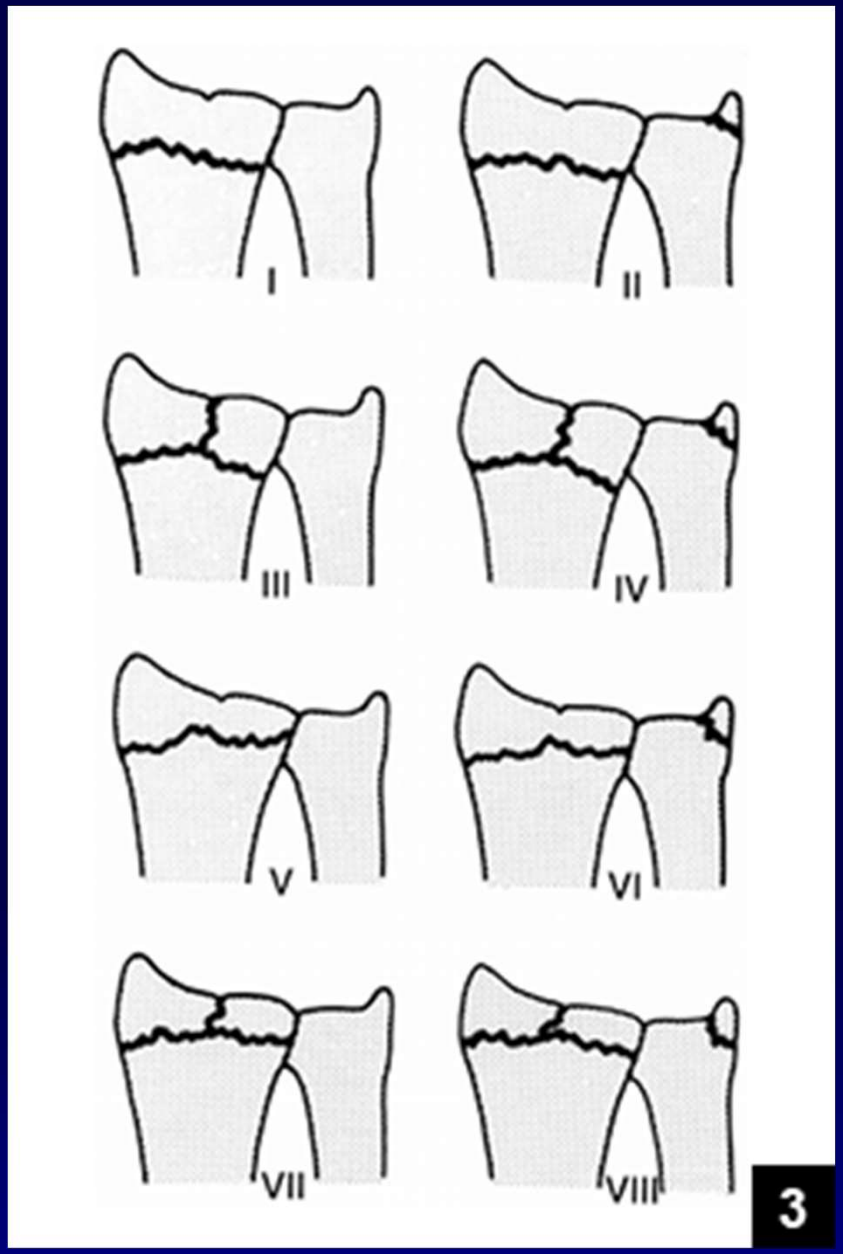
Distal Radius - Frykman



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Eponyms

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

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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

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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

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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?

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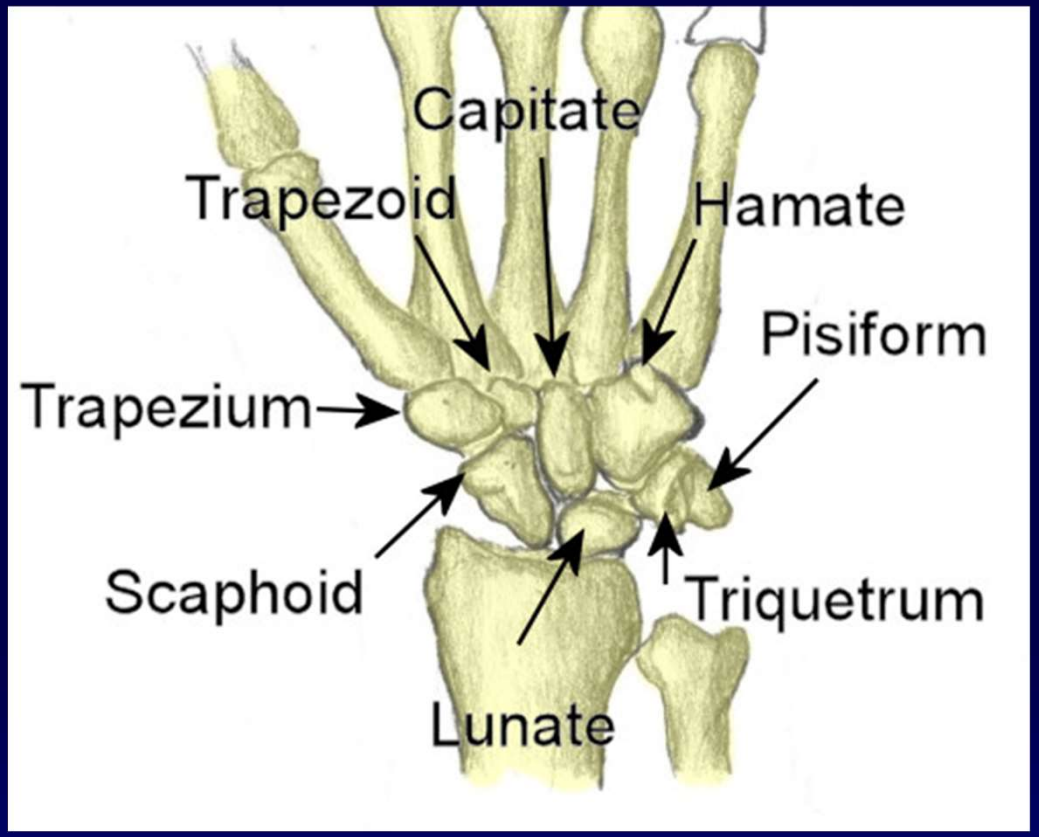
Which bone is broken?

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



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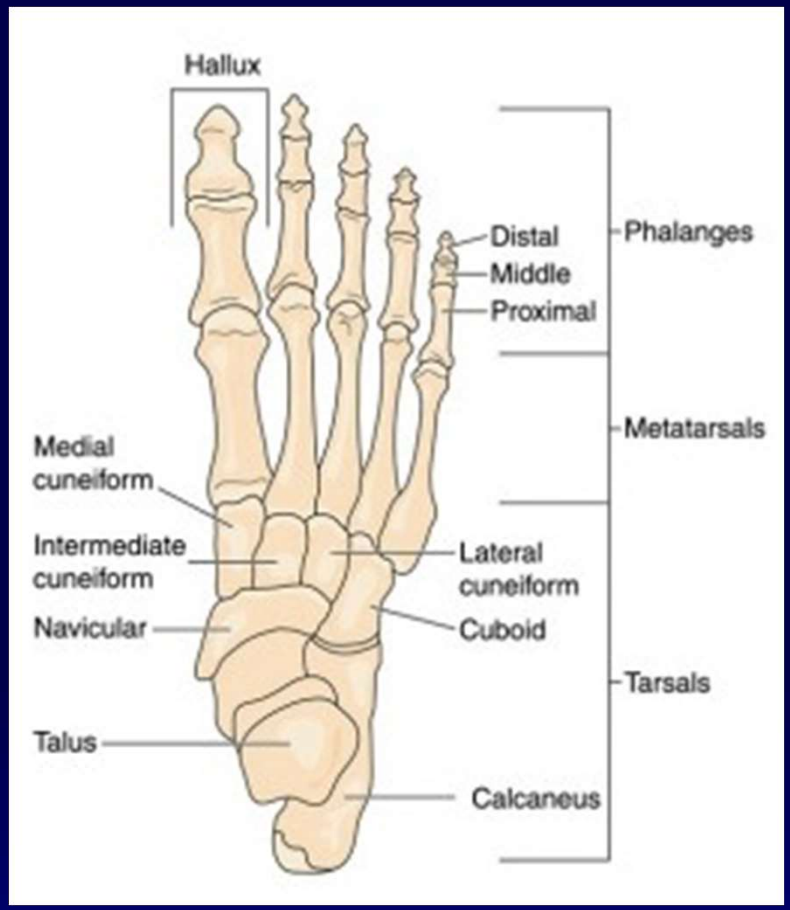

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Which part is broken?

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

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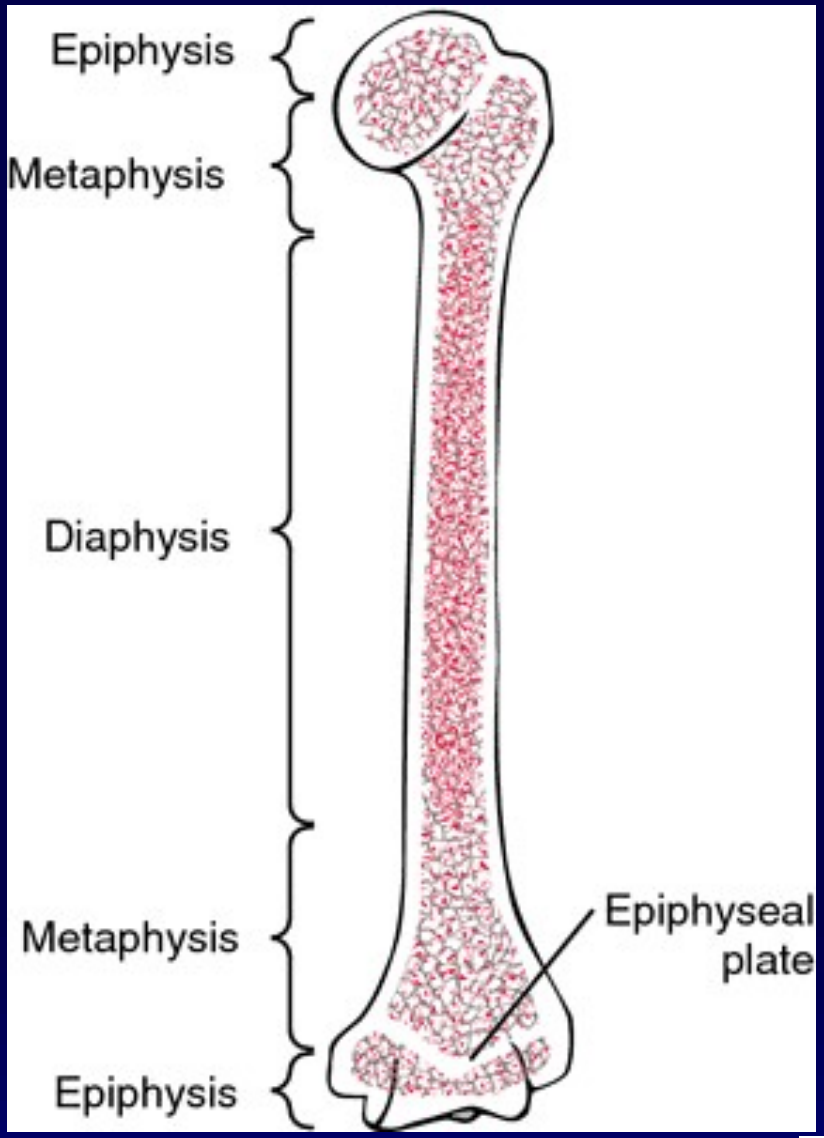
Which part is broken?



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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

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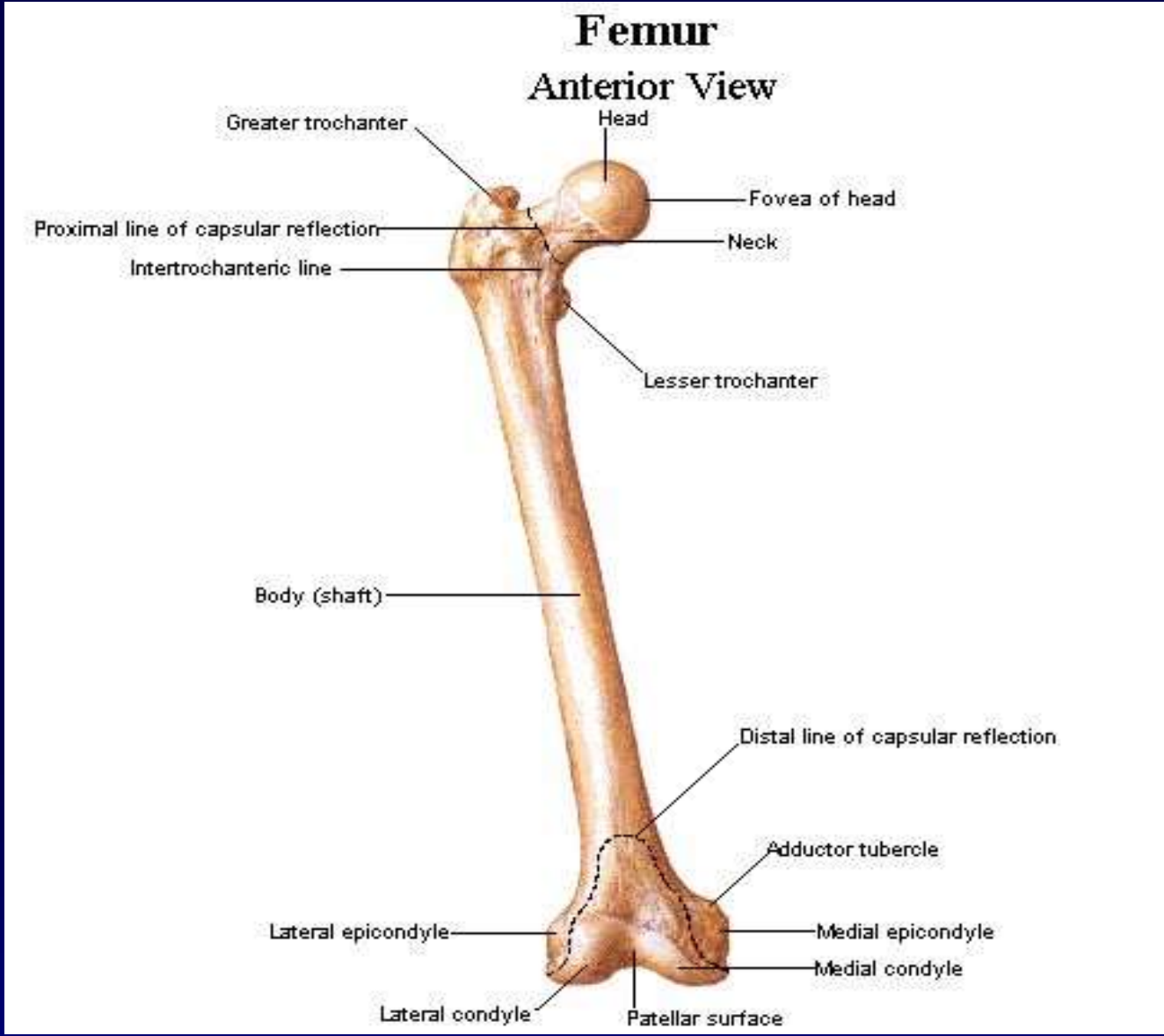
Which part is broken?



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How many fragments are there?

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

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Simple Fracture

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Comminuted Fracture

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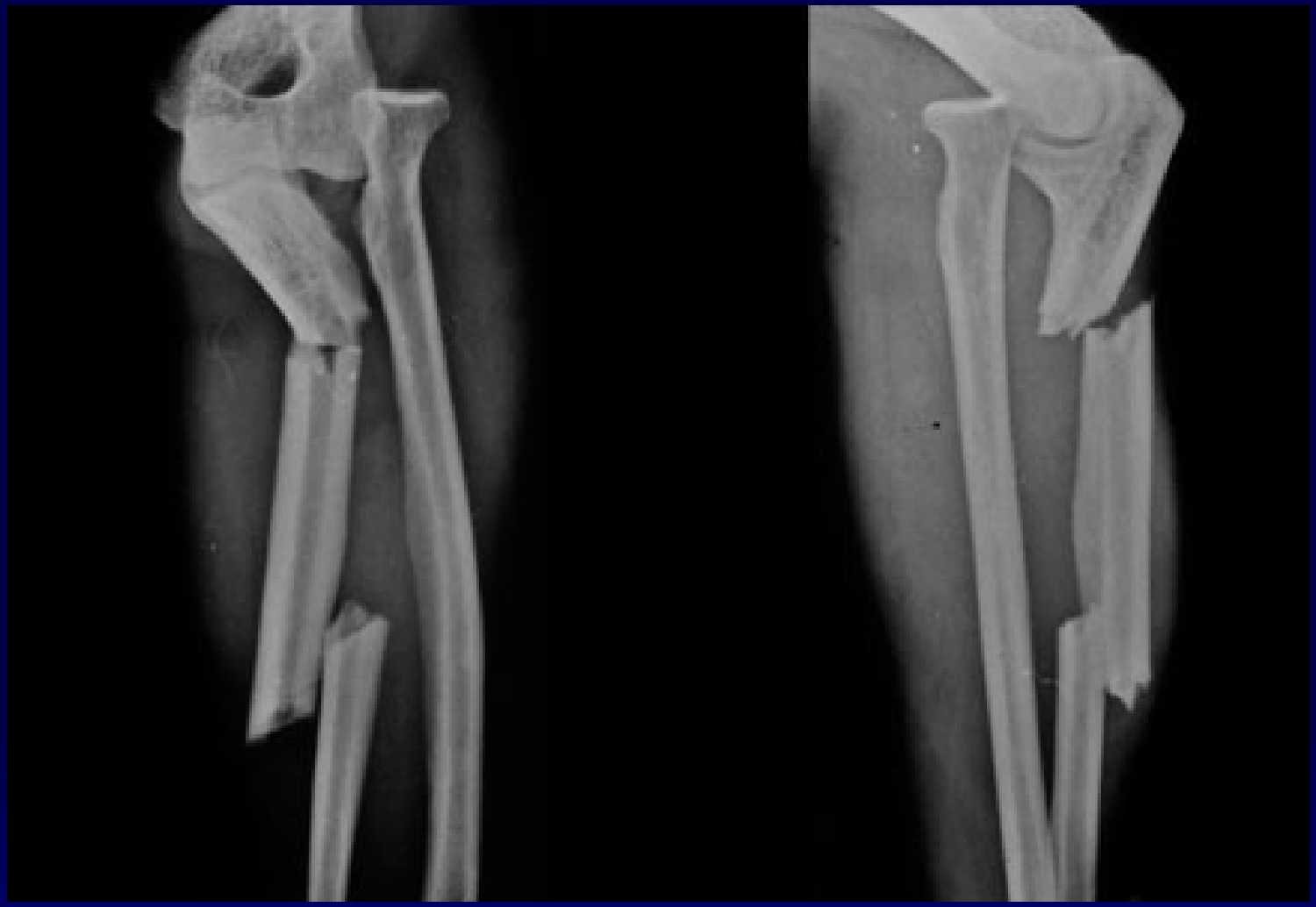
Segmental Fracture



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What is the Fracture Pattern?

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

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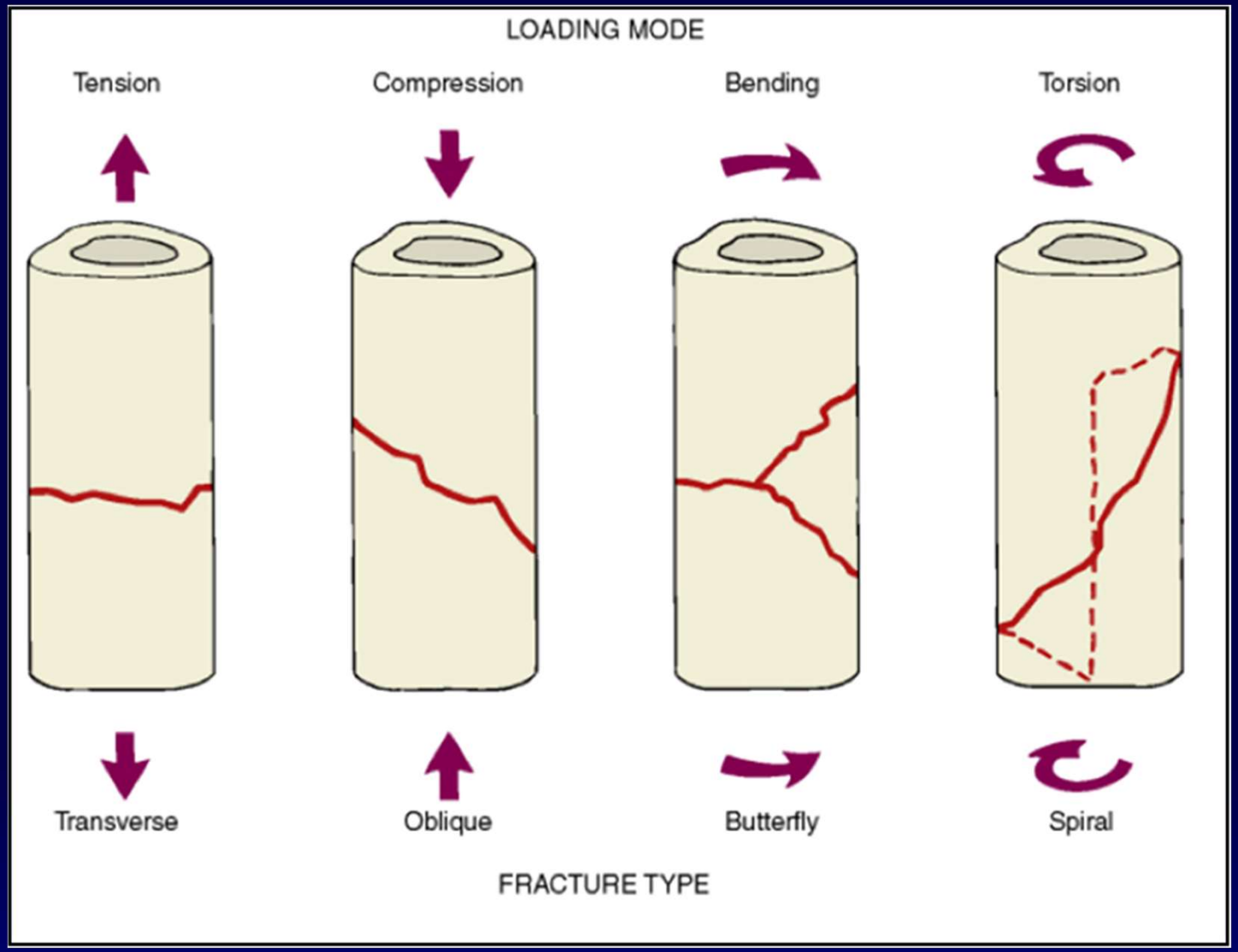
What is the Fracture Pattern?



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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

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Nondisplaced Fracture

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50% Displaced Fracture

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100% Displaced Fracture

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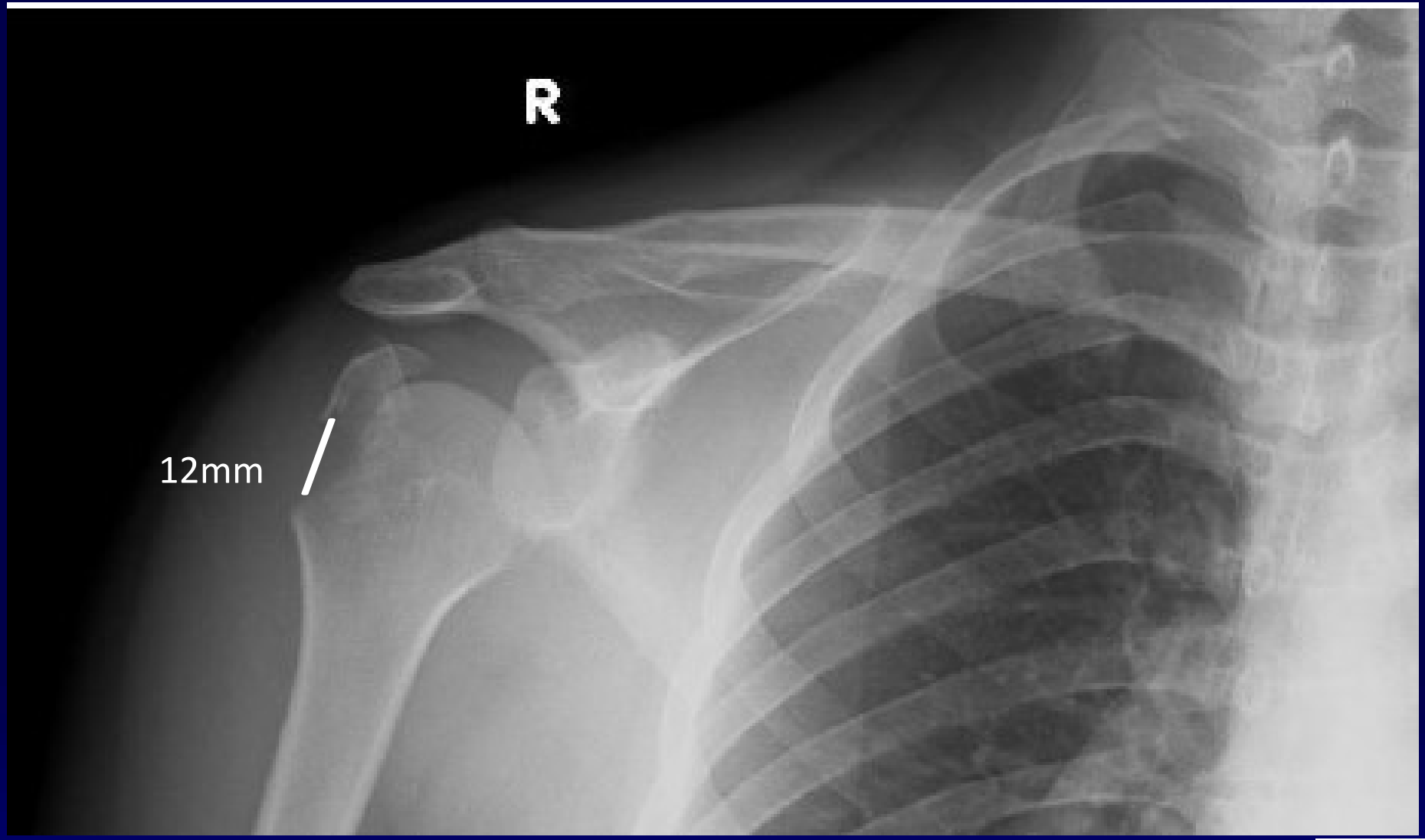
Measured Displacement



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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

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Are the fragments aligned?

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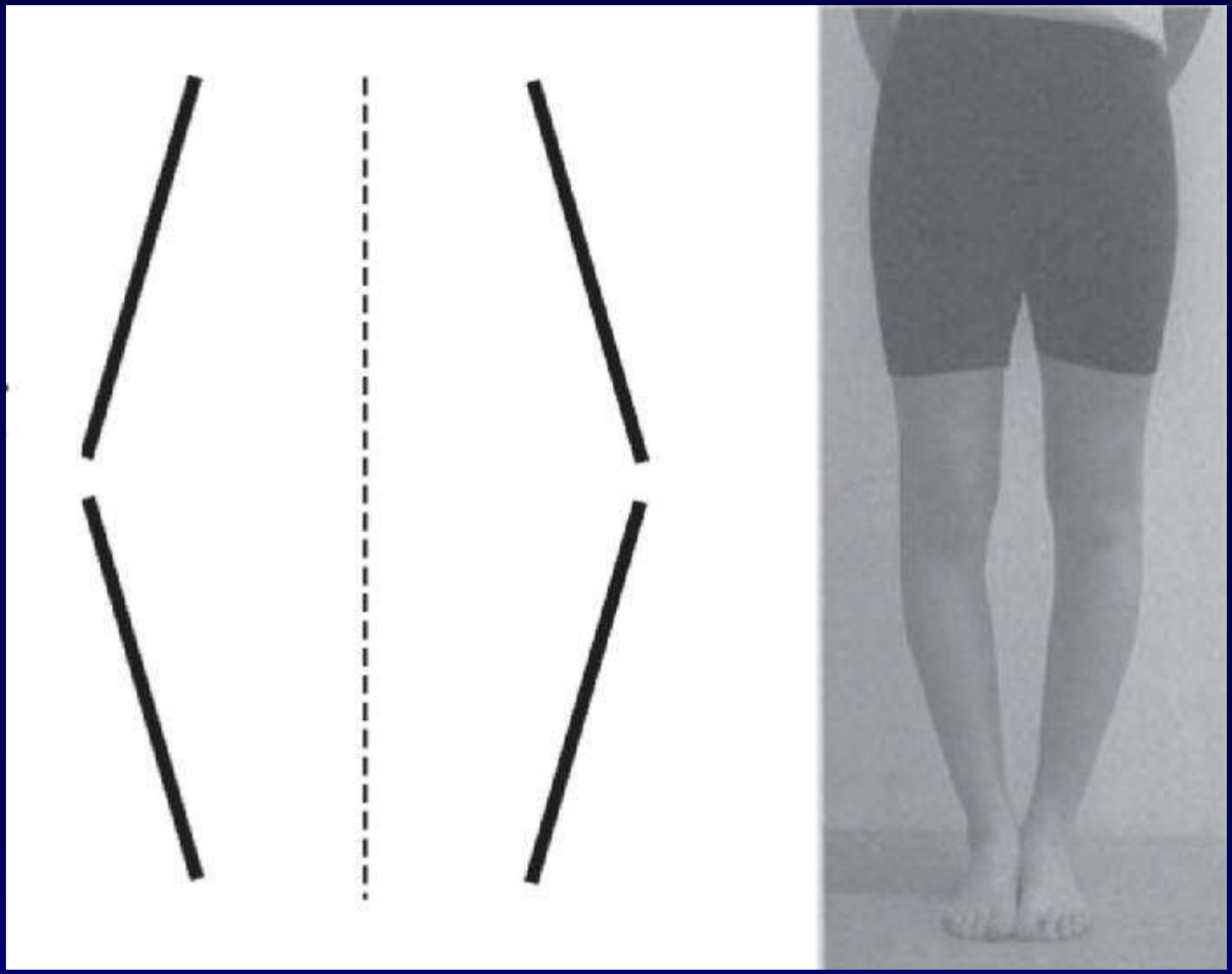
Varus Alignment



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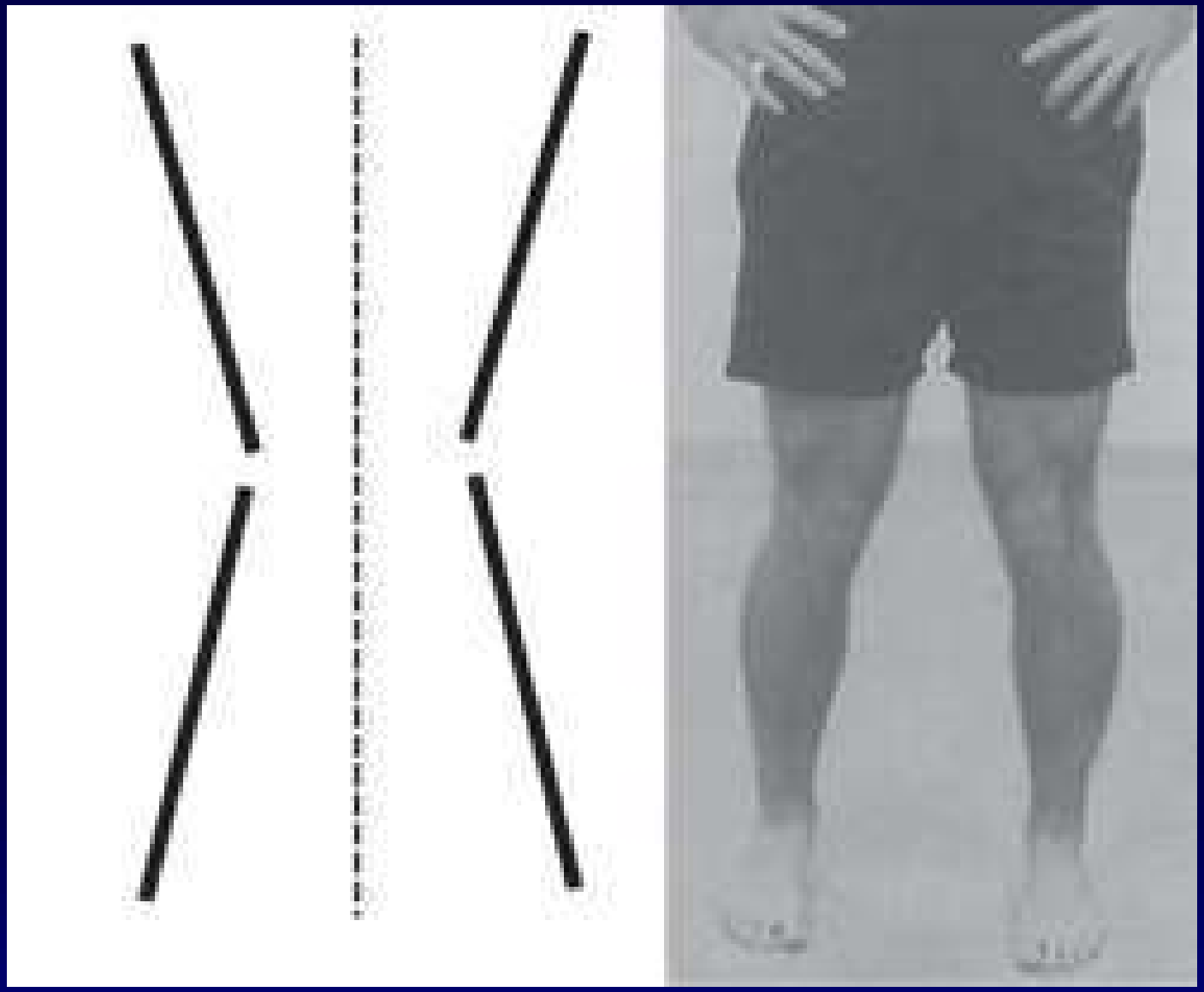
Valgus Alignment



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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

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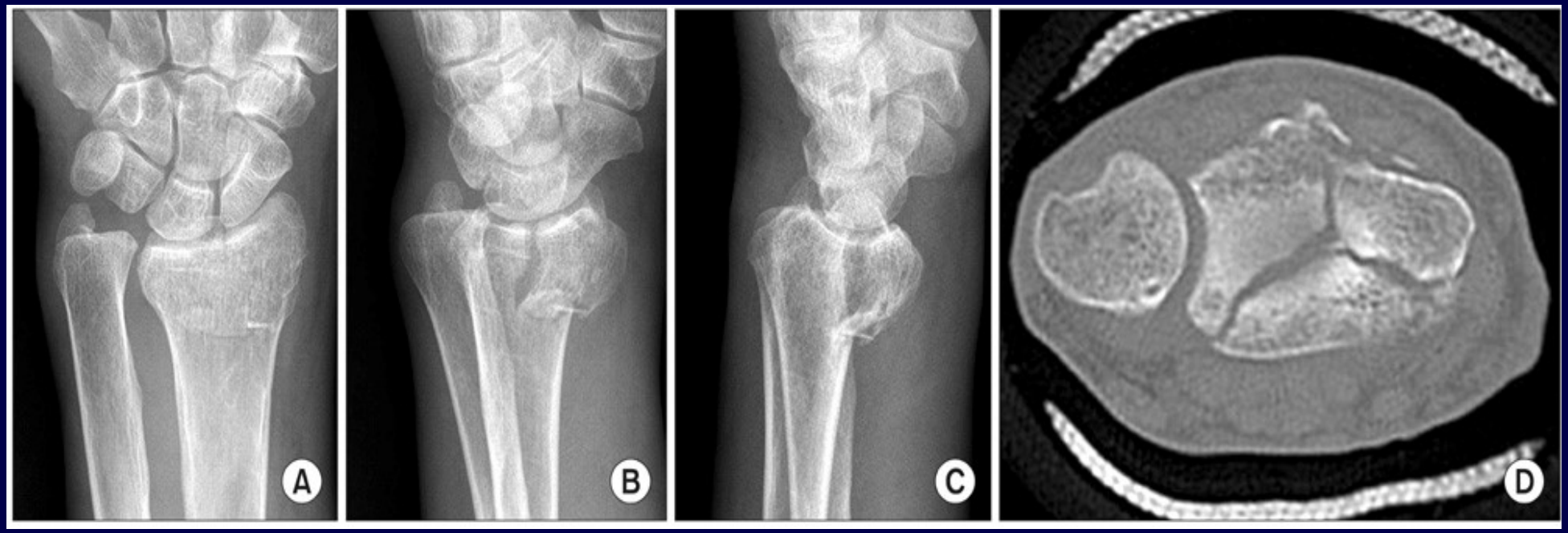
Intra-articular Fractures



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Intra-articular Fractures

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Intra-articular Fractures

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Intra-articular Fractures

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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

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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

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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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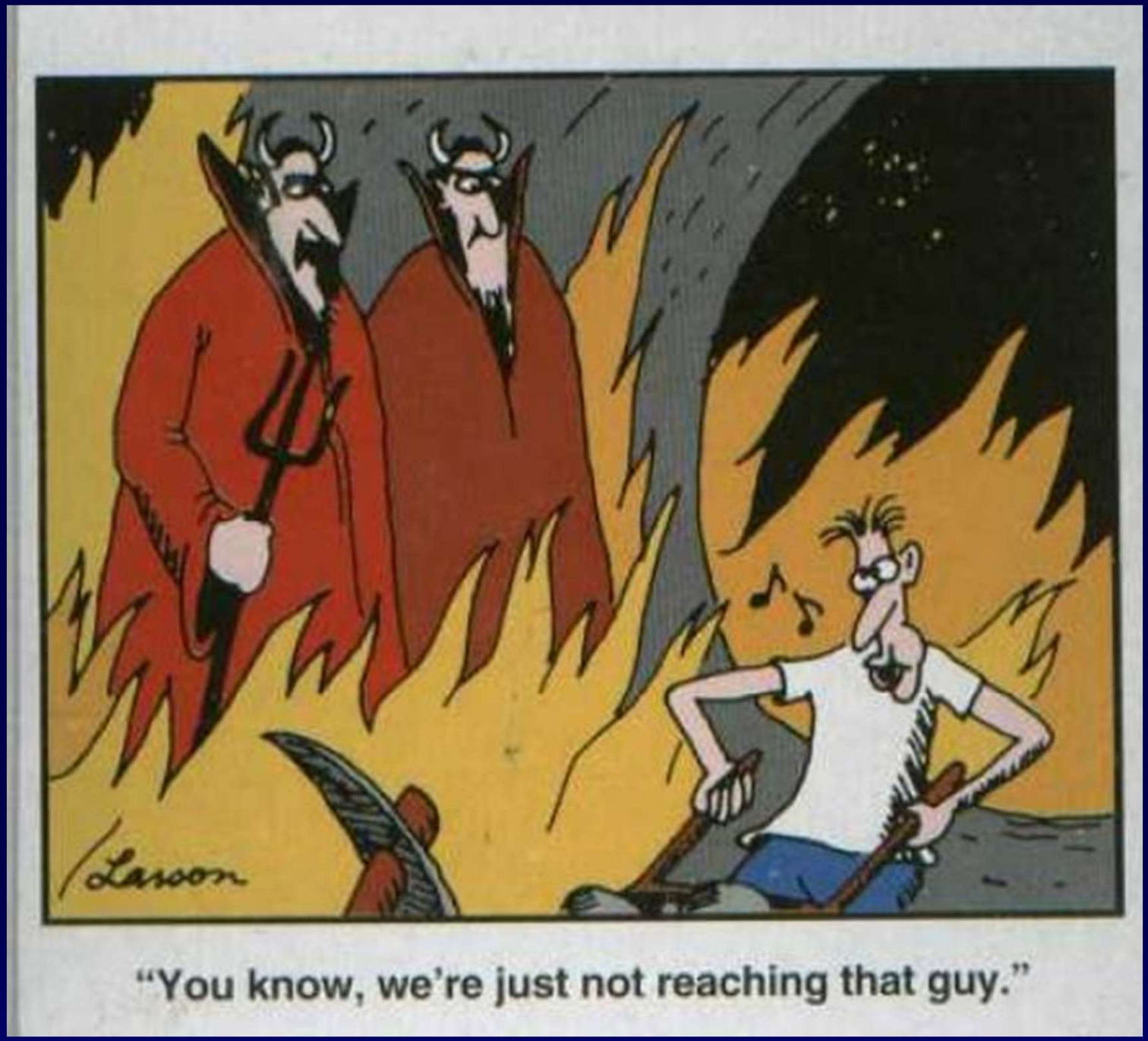

"You know, we're just not reaching that guy."

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Special Cases

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

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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

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Salter-Harris Classification

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

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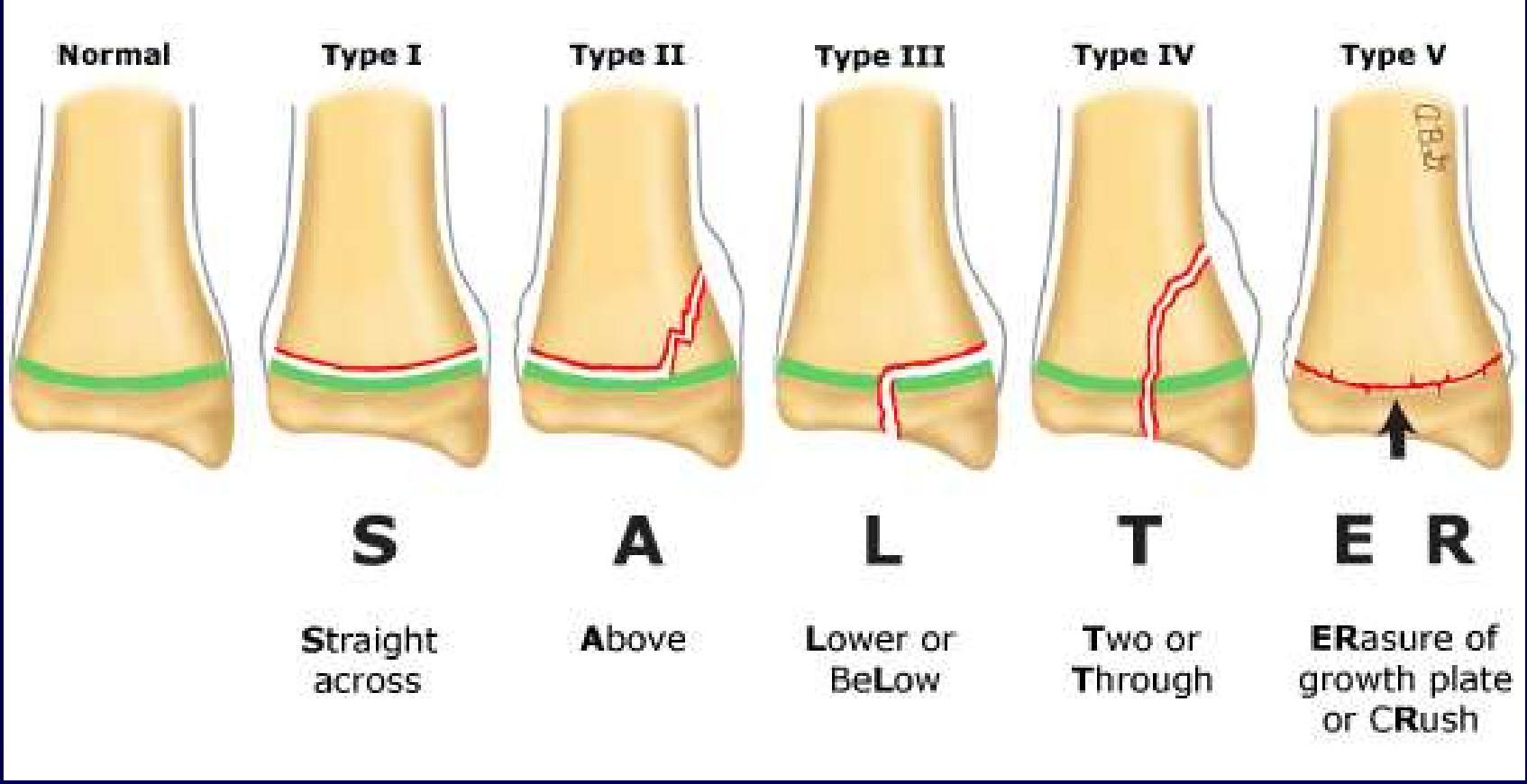
Salter-Harris Classification



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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
- Beware of inconsistent history/findings
- 50% will have a fracture
- 85% < 3yo; 70% < 1yo
- Fractures in multiple stages of healing
- “Rare” or unusual fractures

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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.[9]

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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

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Stress Fractures

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Stress Fractures

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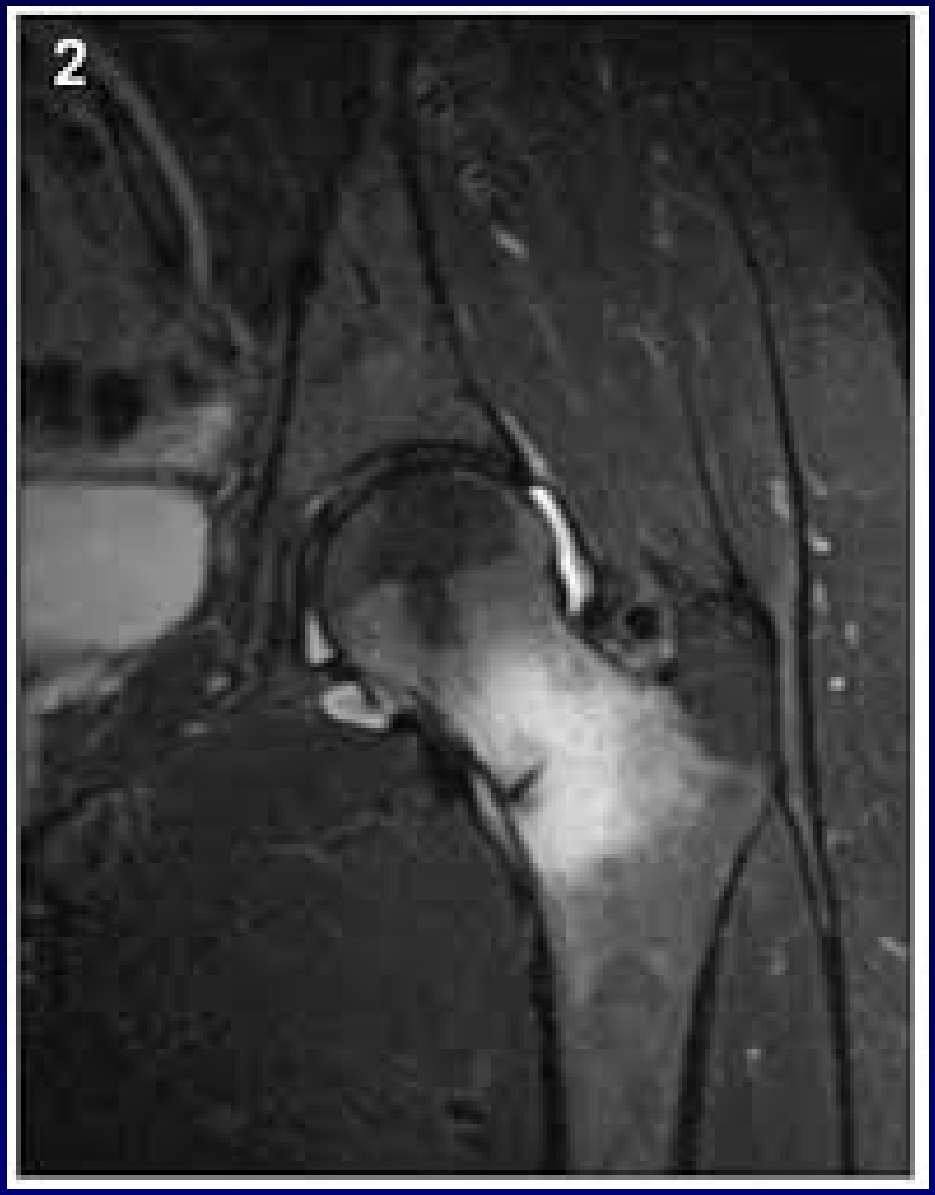
Stress Fractures



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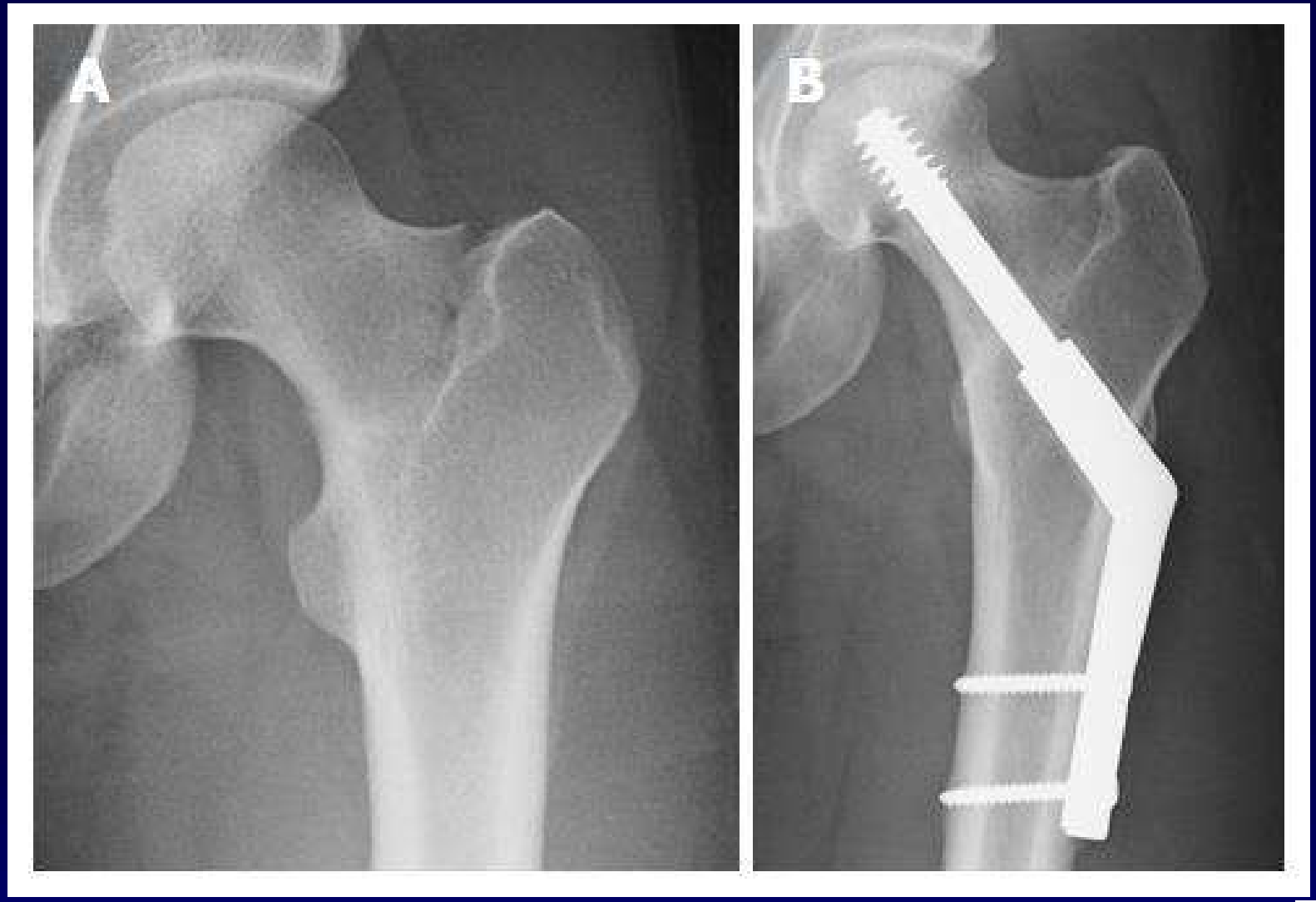
Stress Fractures



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Bisphosphonate Fractures

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

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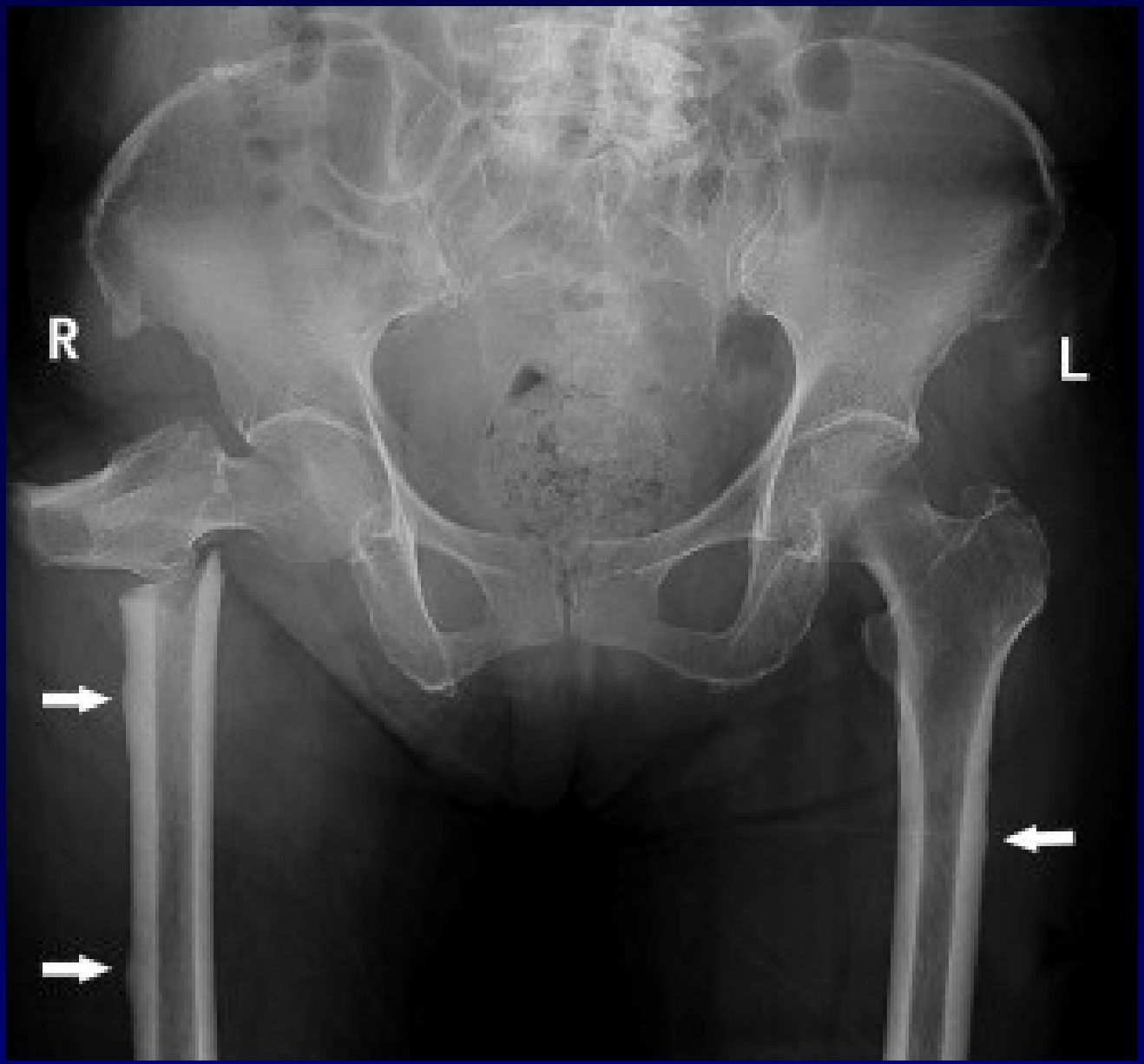
Bisphosphonate Fractures



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Pathologic Fractures

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

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Pathologic Fractures

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Pathologic Fractures

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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

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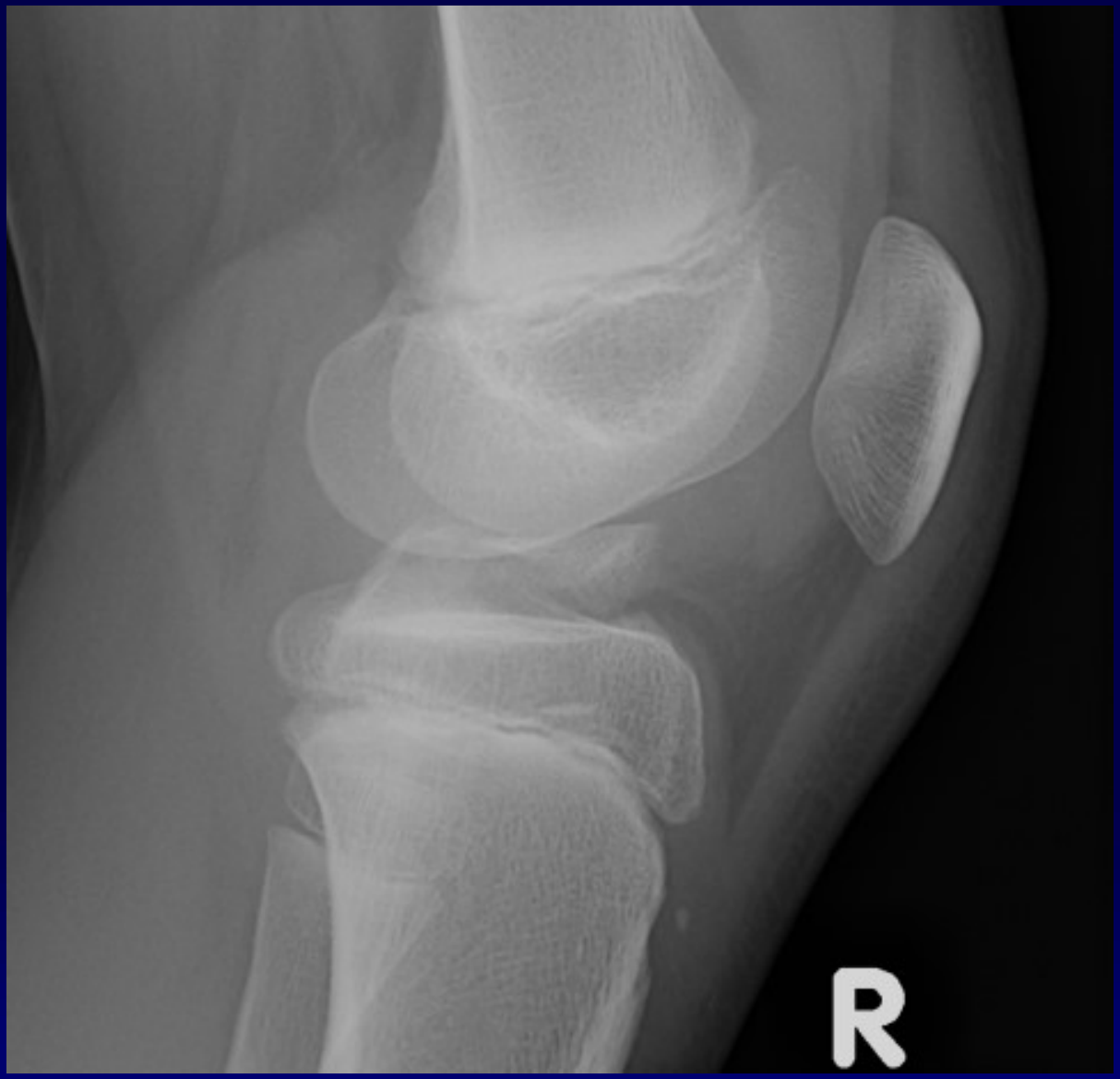
AvulsionFractures



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Other Signs of Fractures

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

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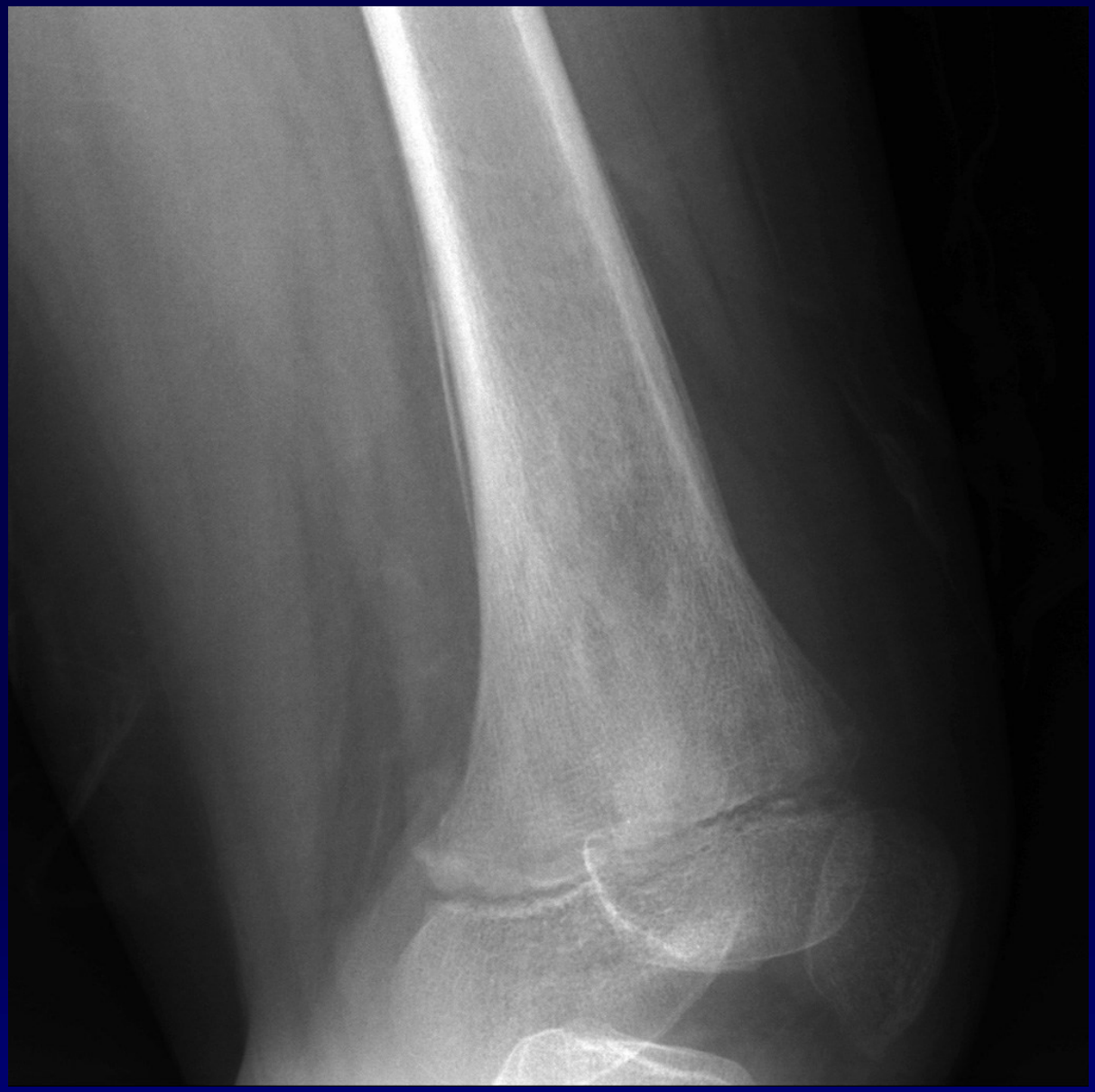
Periosteal Reaction



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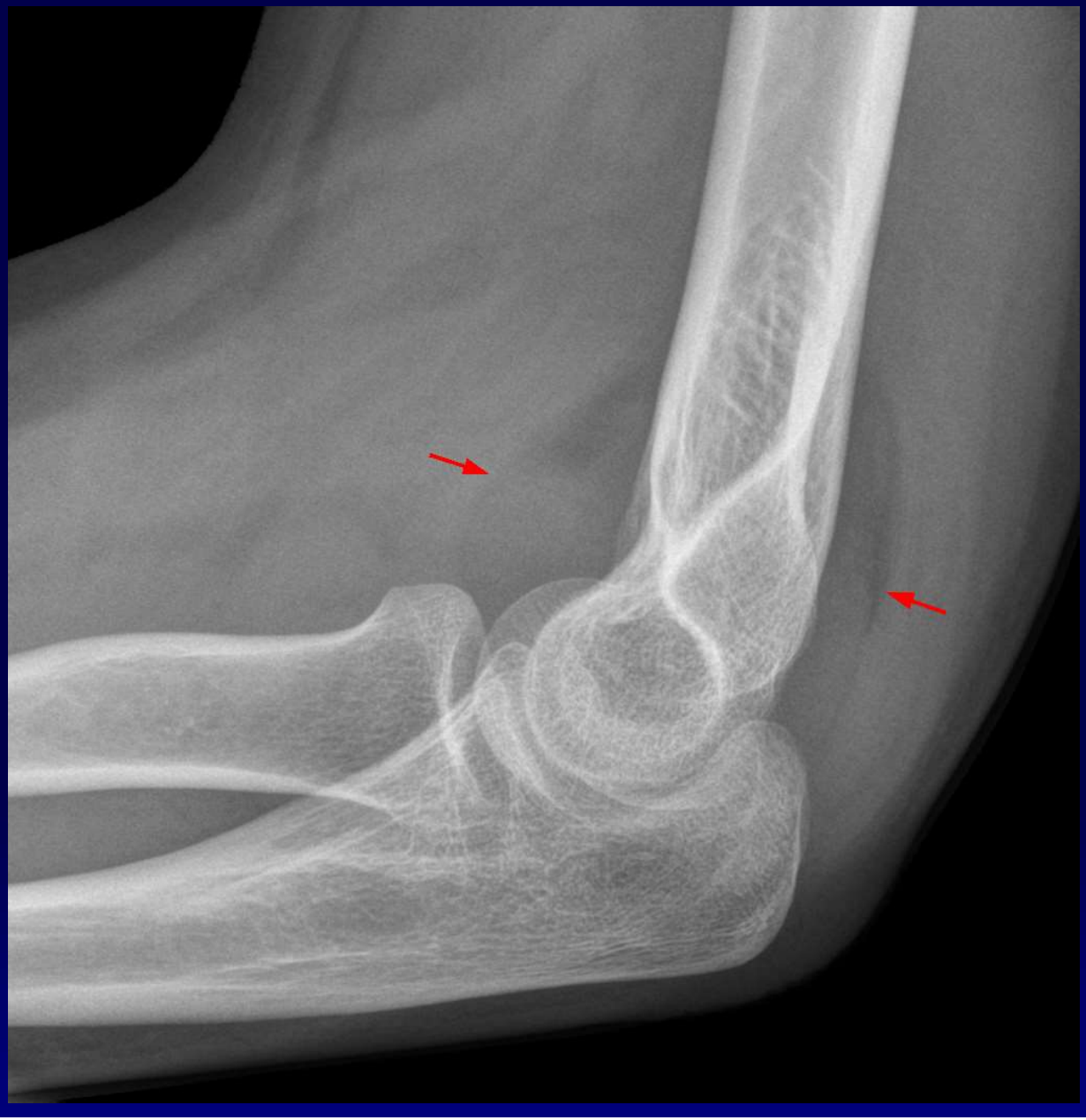
“Sail” Sign



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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

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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 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 Fx & ulnar D/L
2. Galleazzi fracture-dislocation
3. Angulated displaced transverse ulnar shaft Fx, rad head D/L
4. Oblique varus angulated ulnar shaft Fx with radial head D/L
5. Impacted varus angulated radial shaft Fx & prox. ulna D/L

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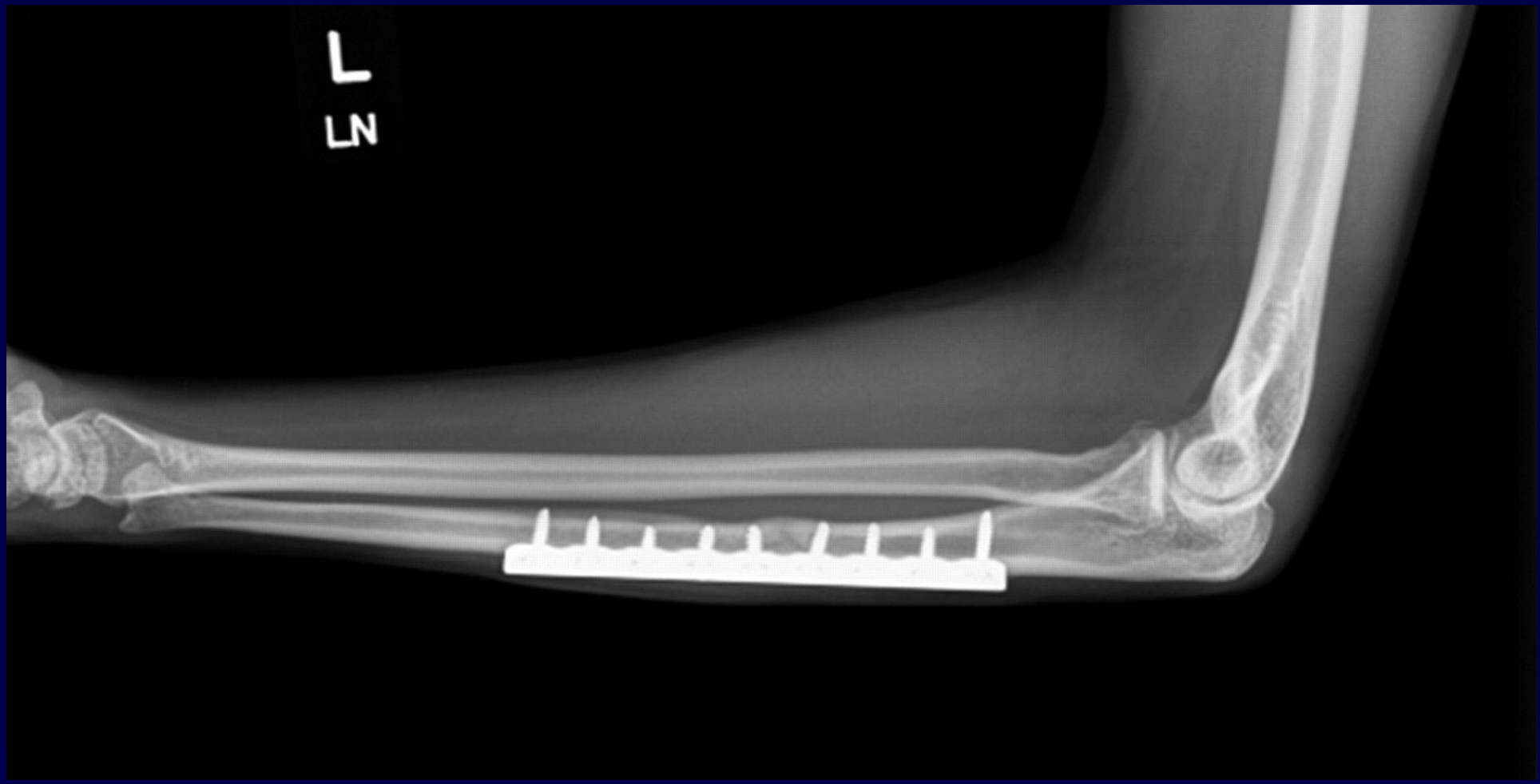

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Case #2

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Case #2

1. Valgus angulated displaced distal tib/fib Fxx, ankle D/L
2. Varus angulated distal fibula Fx, avulsion Fx of distal tibia
3. Angulated transverse fibula shaft Fx,

ankle D/L

4. Impacted valgus angulated med/lat malleolus Fxx, ankle D/L
5. Bimalleolar ankle fracture-dislocation

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Case #3

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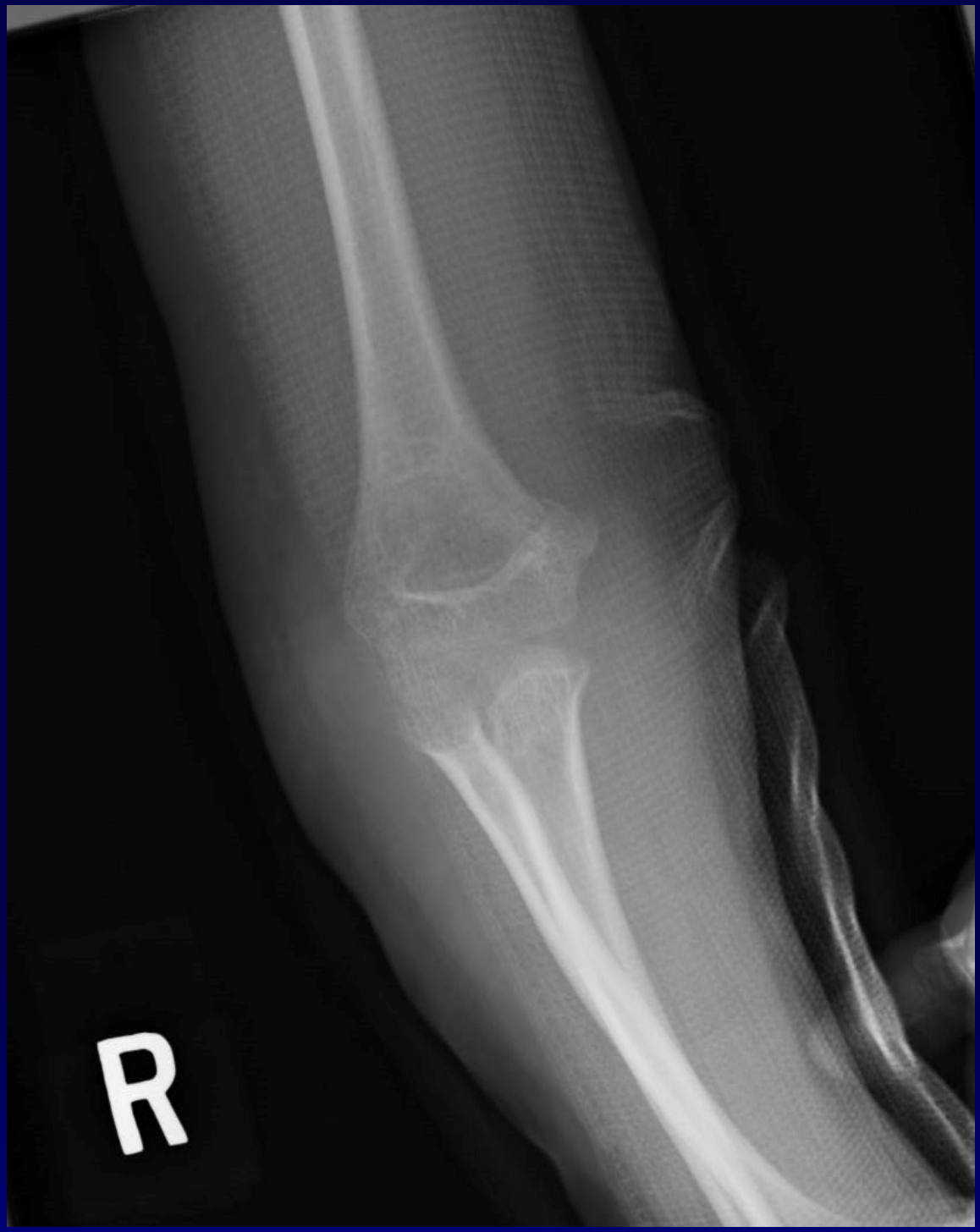

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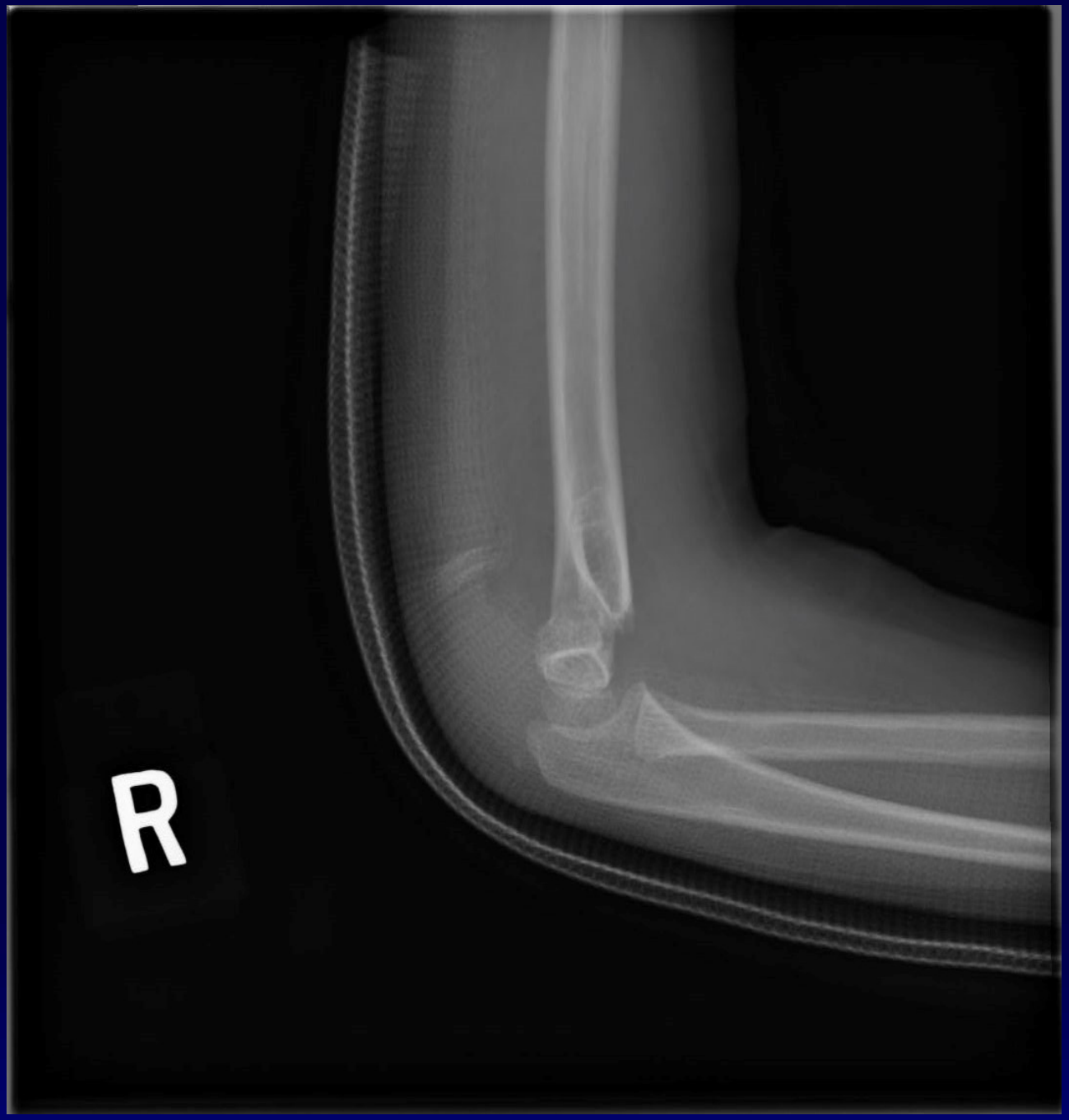

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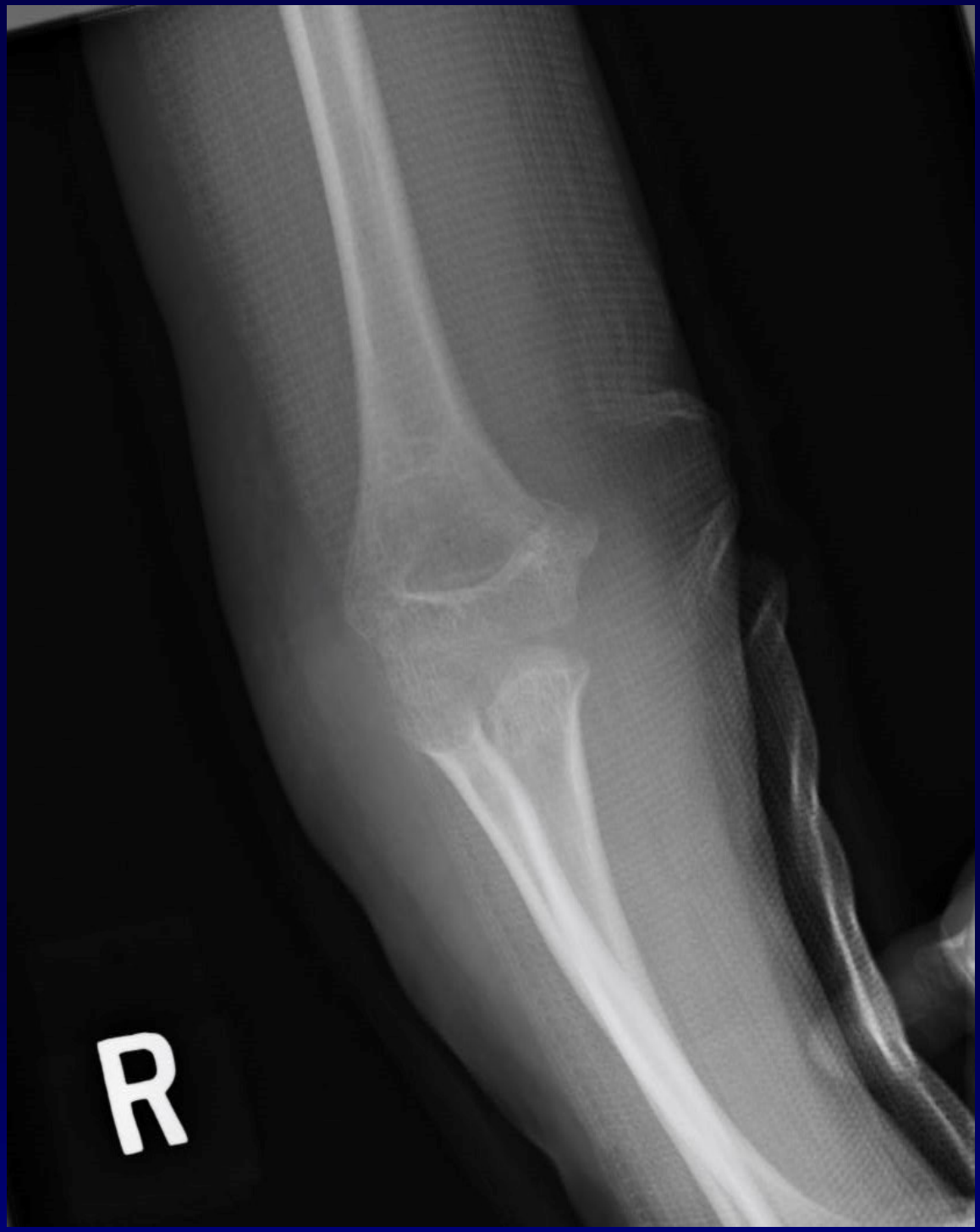
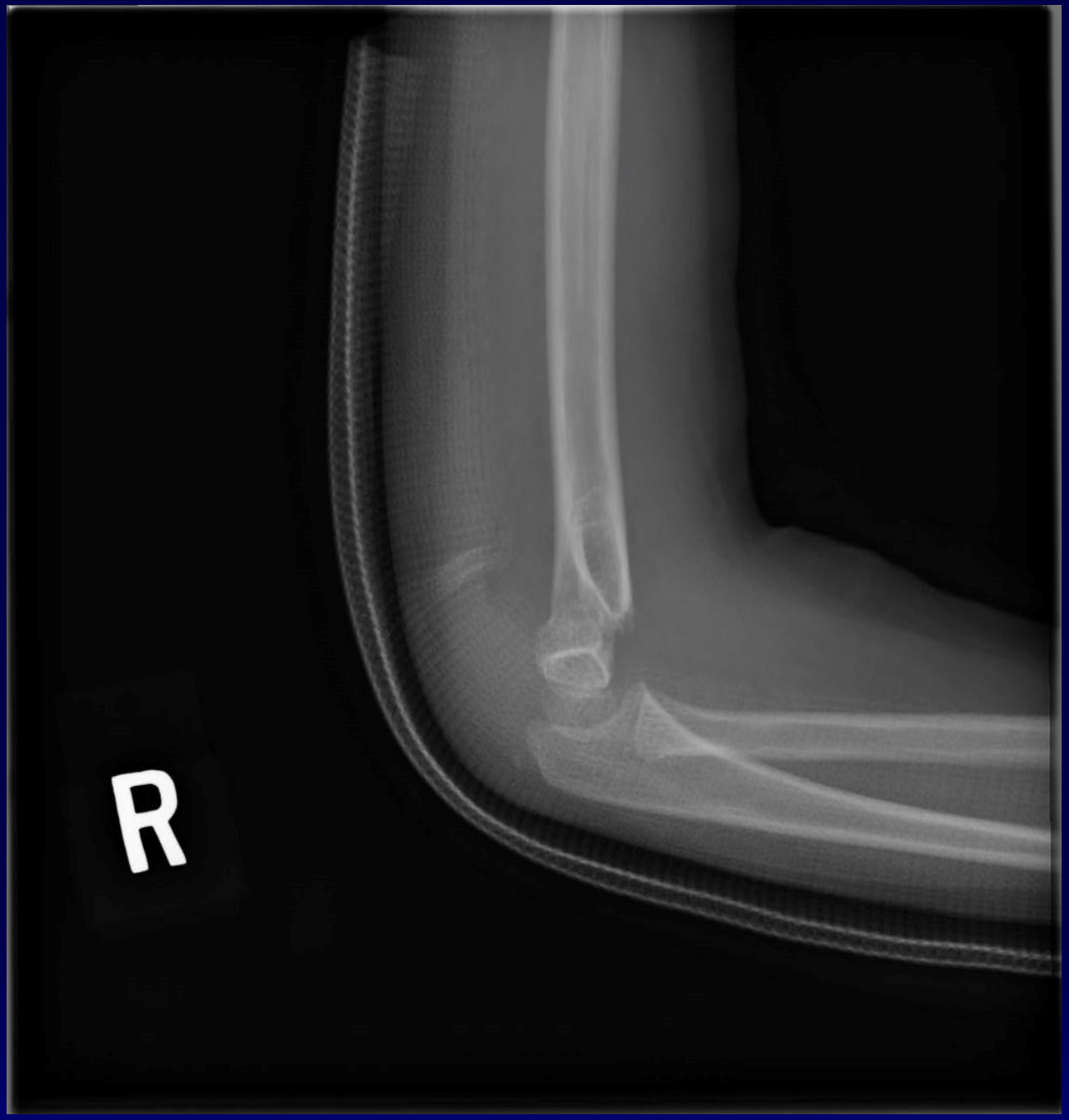
Case #3

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

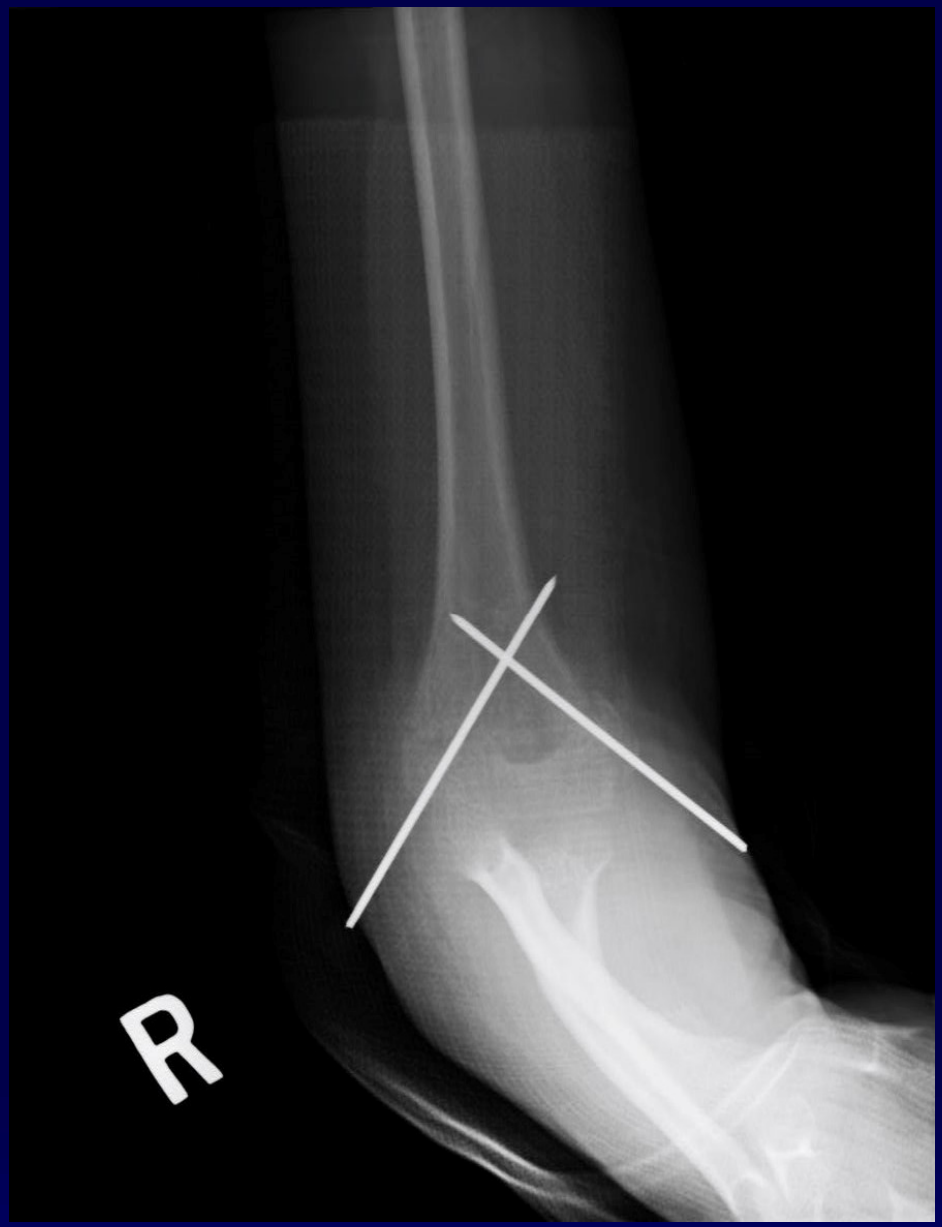
LOWER KEYS MEDICAL CENTER
KEY WEST - FLORIDA



LOWER KEYS
MEDICAL CENTER
KEY WEST - FLORIDA



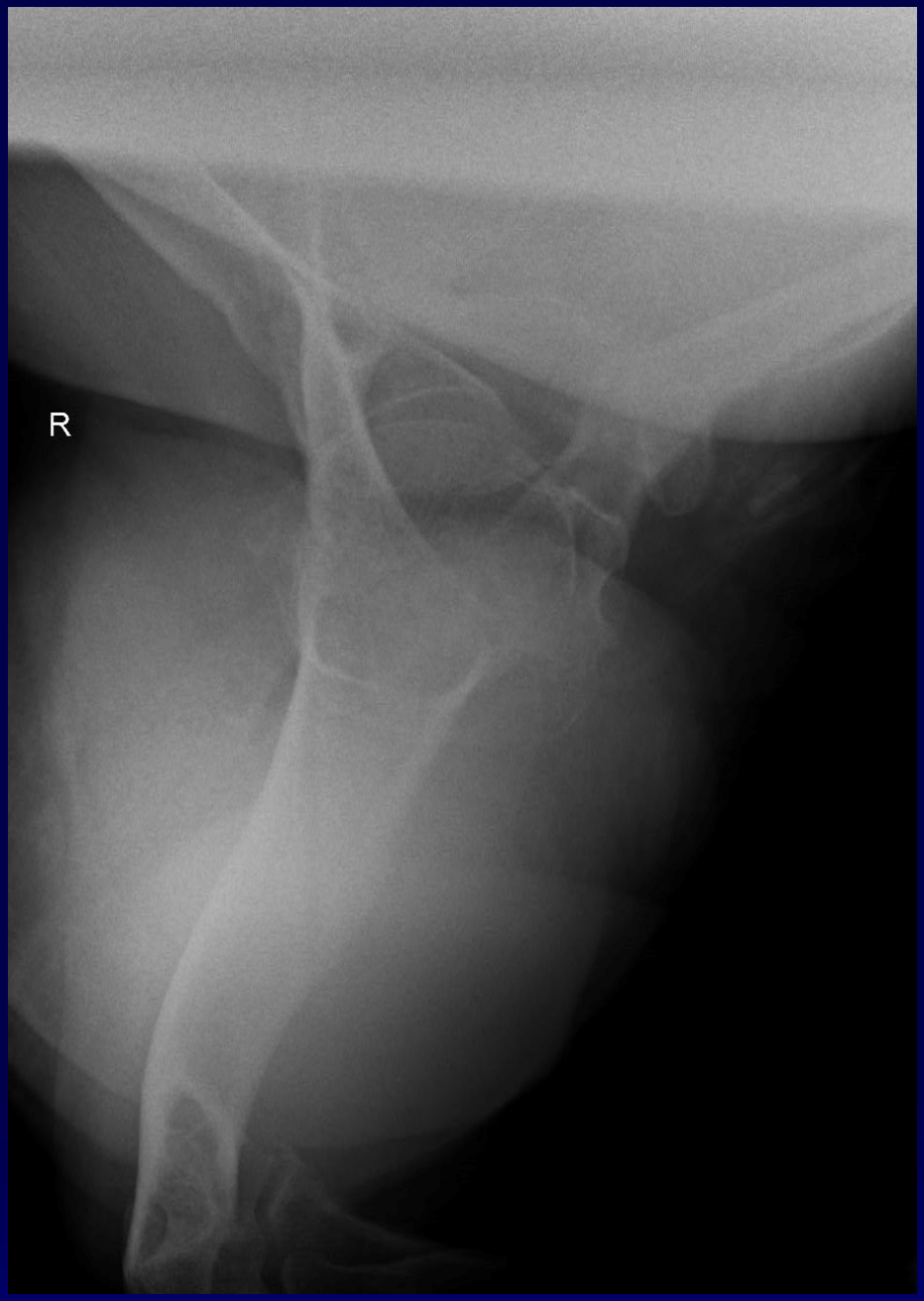
LOWER KEYS MEDICAL CENTER
KEY WEST - FLORIDA



LOWER KEYS MEDICAL CENTER
KEY WEST - FLORIDA

Case #4

LOWER KEYS MEDICAL CENTER
KEY WEST - FLORIDA

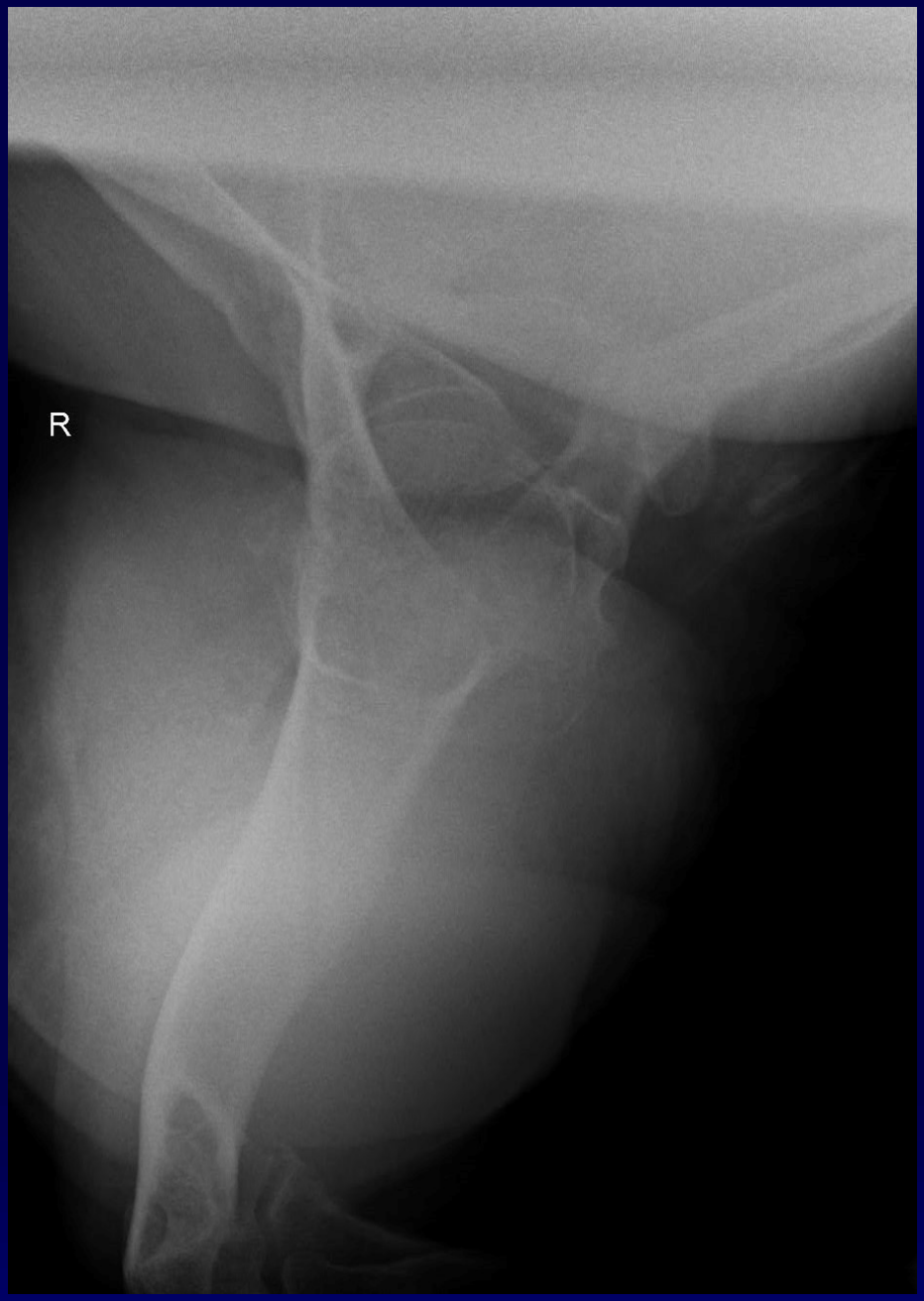


LOWER KEYS MEDICAL CENTER
KEY WEST - FLORIDA

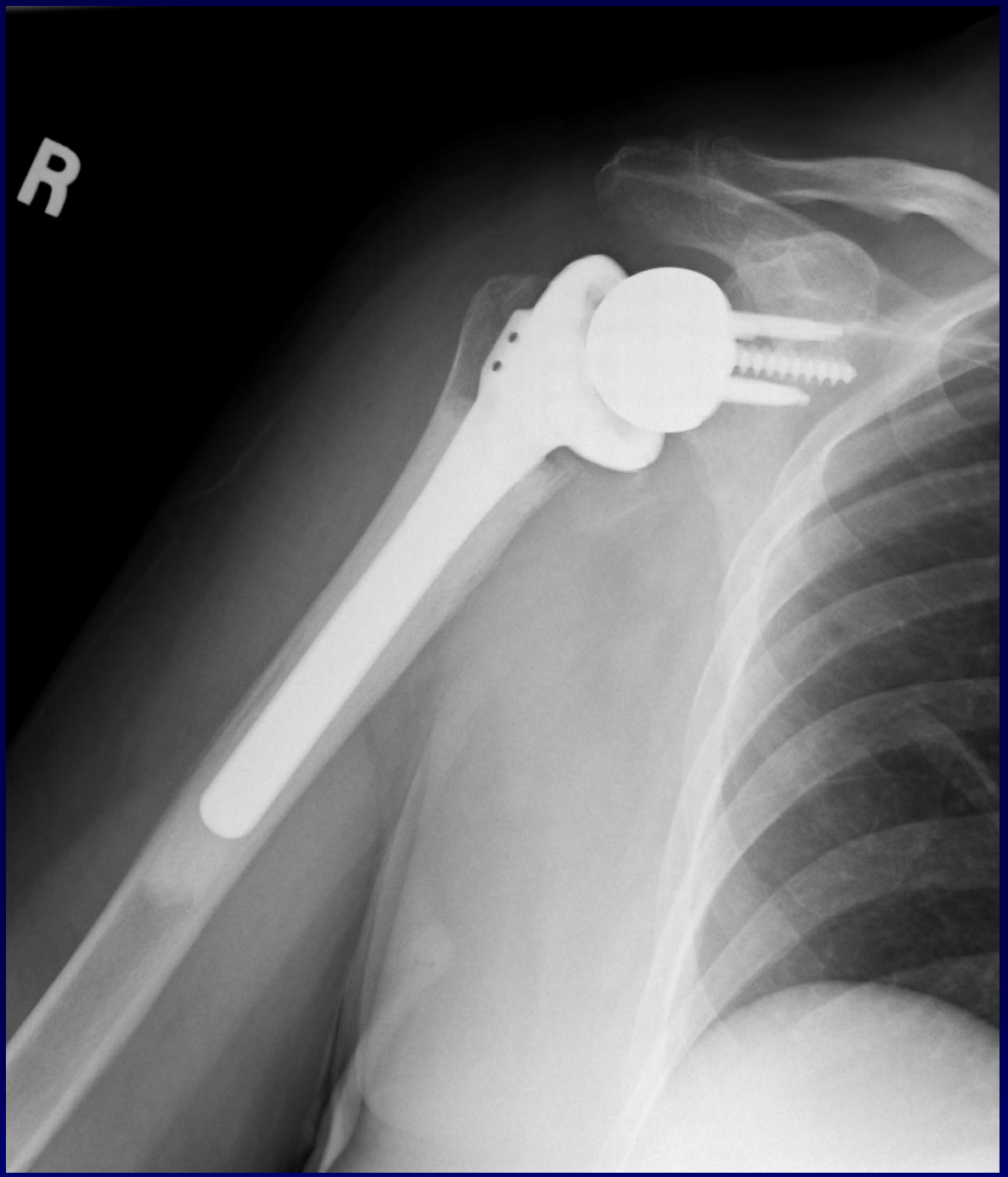
Case #4

1. Impacted, angulated greater tuberosity Fx, humeral head displaced
2. Varus angulated humeral neck fracture
3. Displaced 2-part proximal humerus fracture
4. Impacted comminuted humeral head & lesser tuberosity Fxx
5. Displaced humeral metaphyseal Fx, valgus angulation

LOWER KEYS MEDICAL CENTER
KEY WEST - FLORIDA



LOWER KEYS MEDICAL CENTER
KEY WEST - FLORIDA



LOWER KEYS
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KEY WEST - FLORIDA

Case #5

LOWER KEYS MEDICAL CENTER
KEY WEST - FLORIDA

LOWER KEYS MEDICAL CENTER
KEY WEST - FLORIDA

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 Fxx
5. Displaced intraarticular distal radius & ulnar styloid Fxx

LOWER KEYS MEDICAL CENTER
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LOWER KEYS MEDICAL CENTER
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Case #6

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LOWER KEYS
MEDICAL CENTER
KEY WEST - FLORIDA

Case #6

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

LOWER KEYS MEDICAL CENTER
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Case #7

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LOWER KEYS
MEDICAL CENTER
KEY WEST - FLORIDA

Case #7

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

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KEY WEST - FLORIDA

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BATS Fracture

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BATS Fracture

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Thank You!
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