Imaging the Musculoskeletal System

The Extremities

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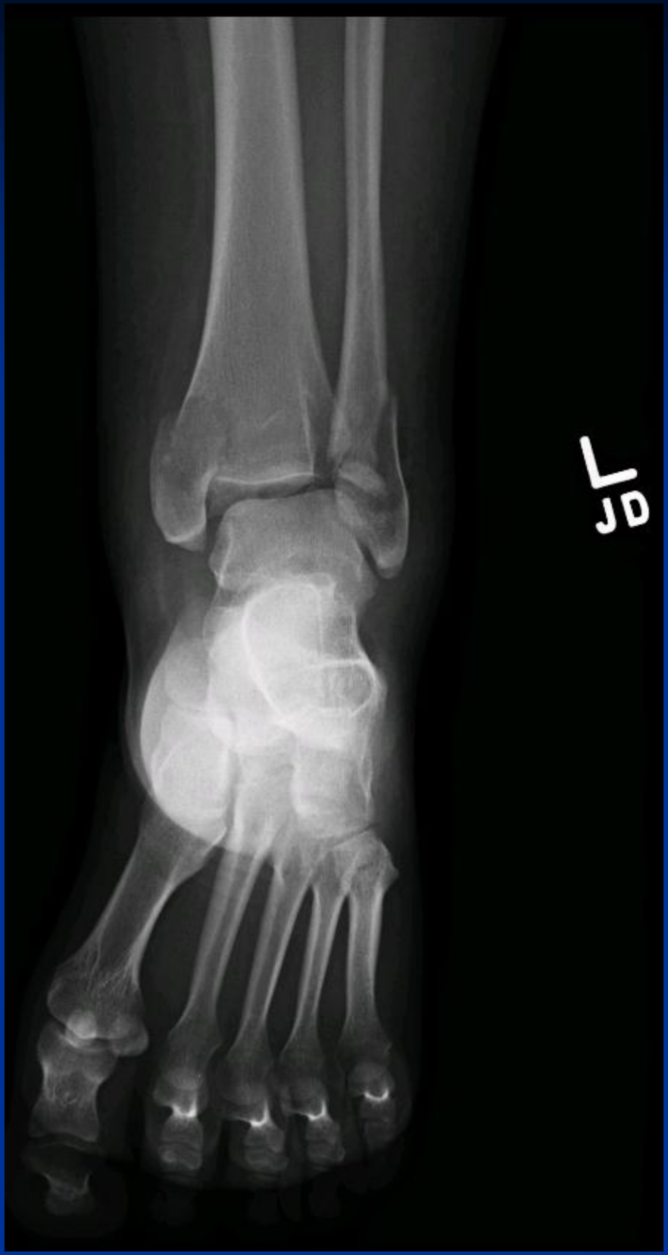
Objectives

- Discuss:
  - commonly used imaging modalities in the musculoskeletal system
  - normal imaging anatomy in the extremities
  - fracture description

Imaging Techniques

- Plain x-rays
- CT
- MRI
- Ultrasound
- Nuclear Medicine (bone scan)



Plain x-rays

For joints like the ankle, elbow or wrist we always take 3 views:

AP, lateral and oblique

3 views: AP, oblique and lateral

Advantages of plain x-rays

- Quick
- Not expensive
- Relatively low radiation

Disadvantages of plain x-rays

- Not 3 dimensional
- Can miss pathology
- May still require other imaging studies

CT scanner

This is a CT scan: a longitudinal cross section

This CT shows a fracture through the medial cunieform

Advantages of CT scanning of the musculoskeletal system

- Excellent anatomic detail
- Will detect almost all pathology related to cortical bone injury
- Great for showing displacement or joint involvement
- Now multiplanar

Disadvantages of CT

- Expensive (x-ray $100, CT $1000)
- More radiation
- Often not necessary

MRI scanner

Looks more like a tunnel, must be very careful of metal

This is an MRI of the knee

There is no radiation used

Circled is a normal posterior cruciate ligament

Advantages of MRI

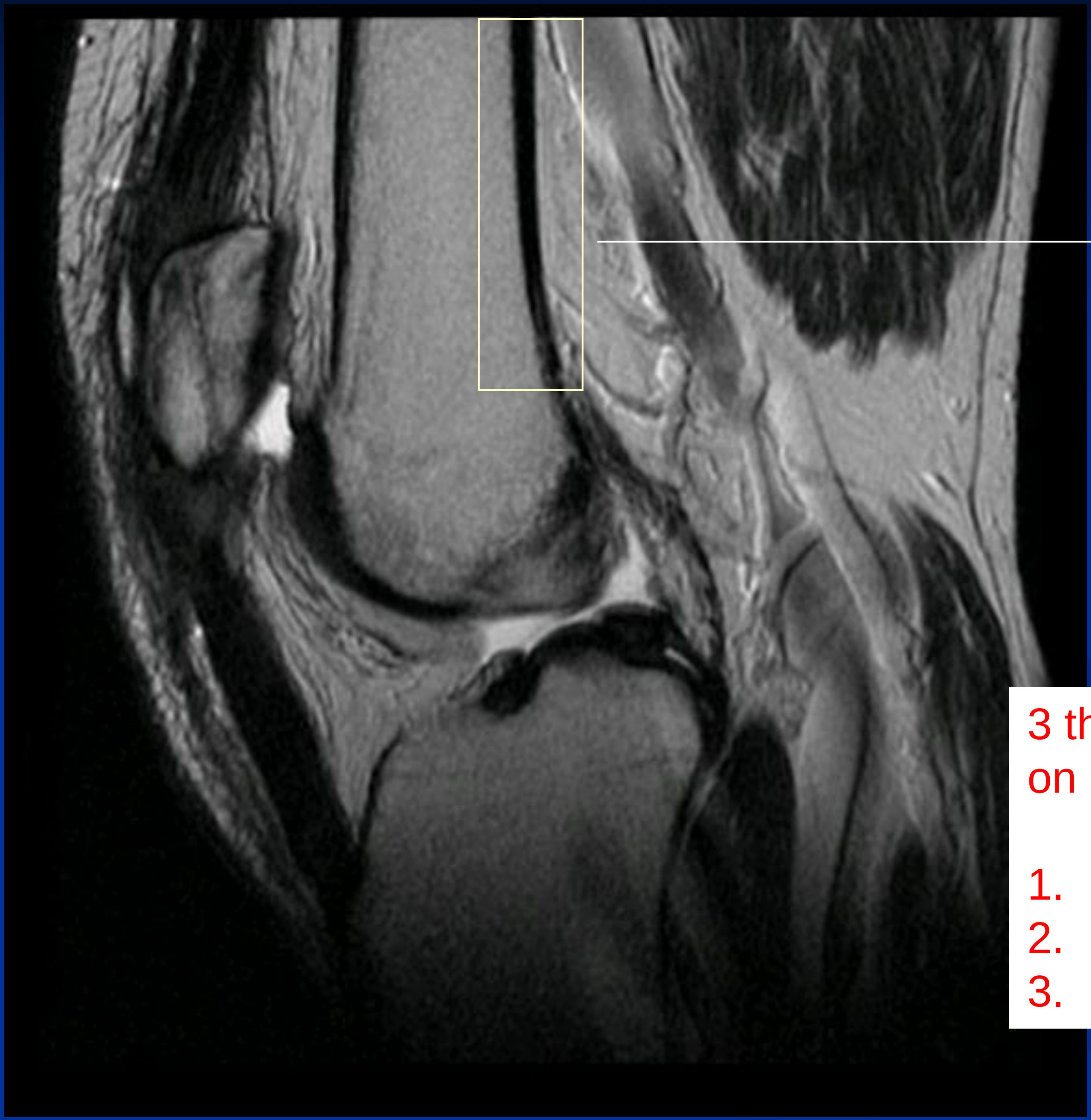
- No radiation
- We can slice through the body using any imaging plane
- Looks "inside" bone. **Marrow** evaluation.
- MRI is very good for looking at the **soft tissues** (muscles, ligaments, tendons and cartilage)
- MRI is very sensitive in detecting **water**

MRI shows water (fluid) behind the patella

Do you see fluid anywhere else?

Disadvantages of MRI

- Very expensive (x-ray $100, CT $1000, MRI $2000)
- Not as good as CT for cortical bone



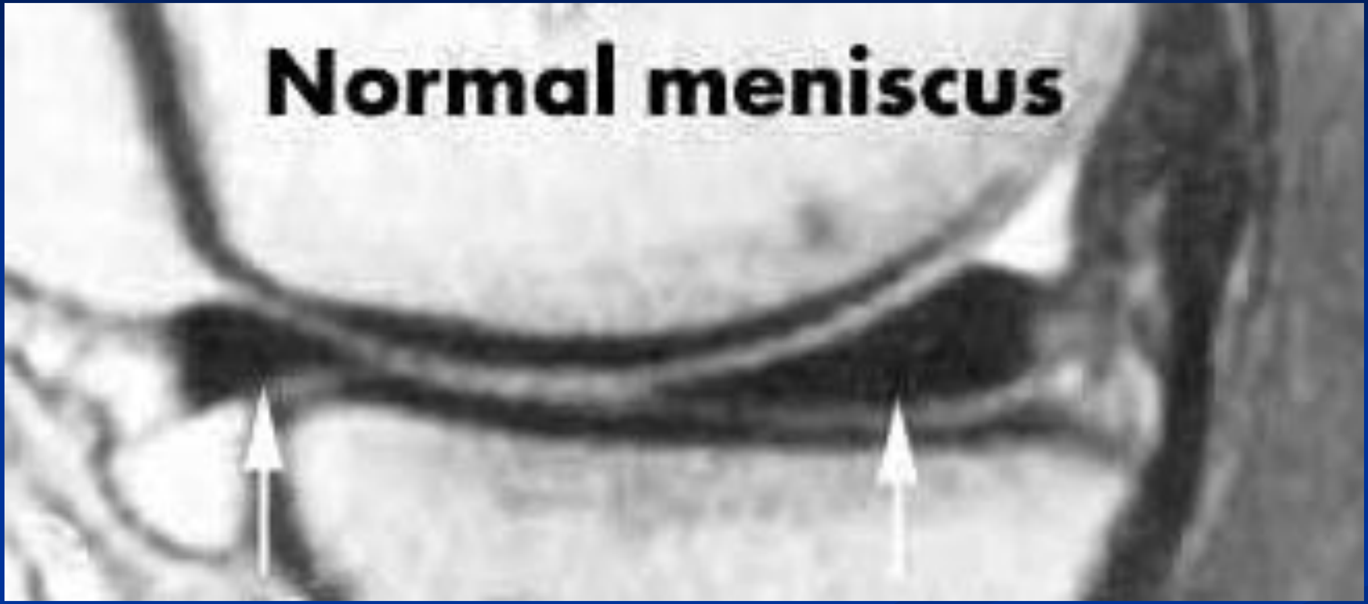
This long black line
Is the cortex or cortical bone

3 things are always black on MRI:

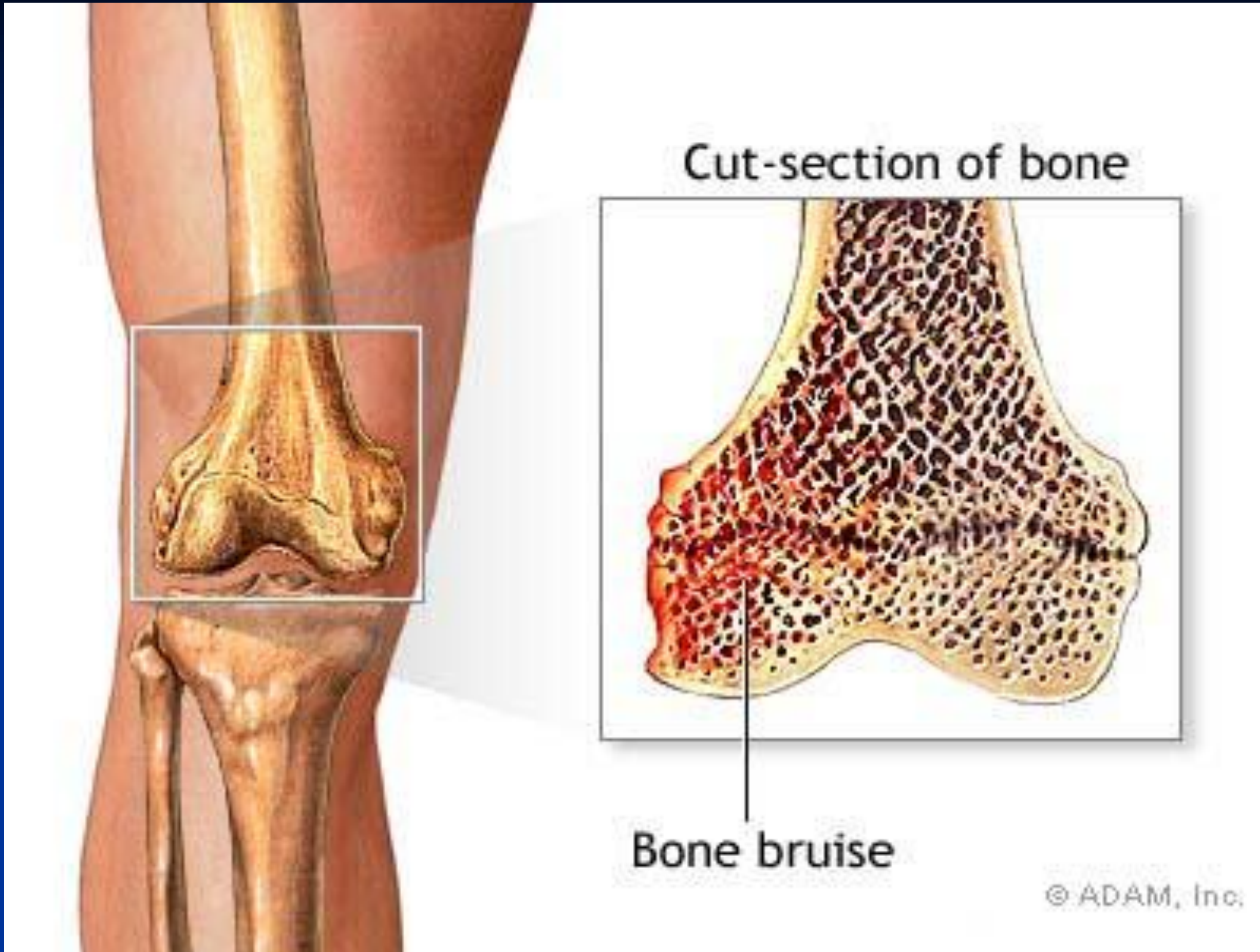
1. Air
2. Cortical bone/tendons/ligaments
3. Flowing blood


NORMAL ACL

Posterior cruciate ligament



anterior and posterior
horns “bow tie”


Cut-section of bone
Bone bruise
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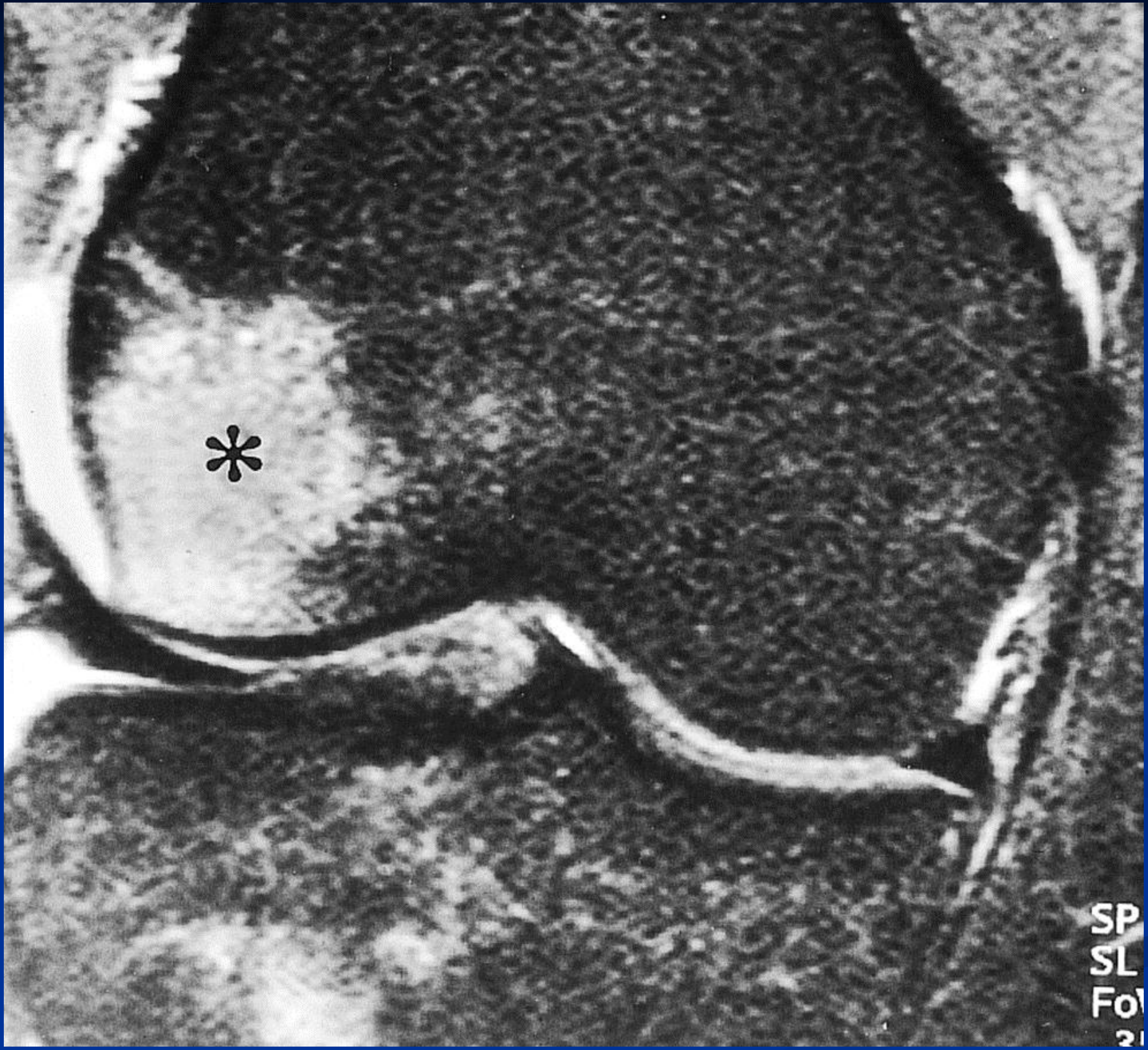
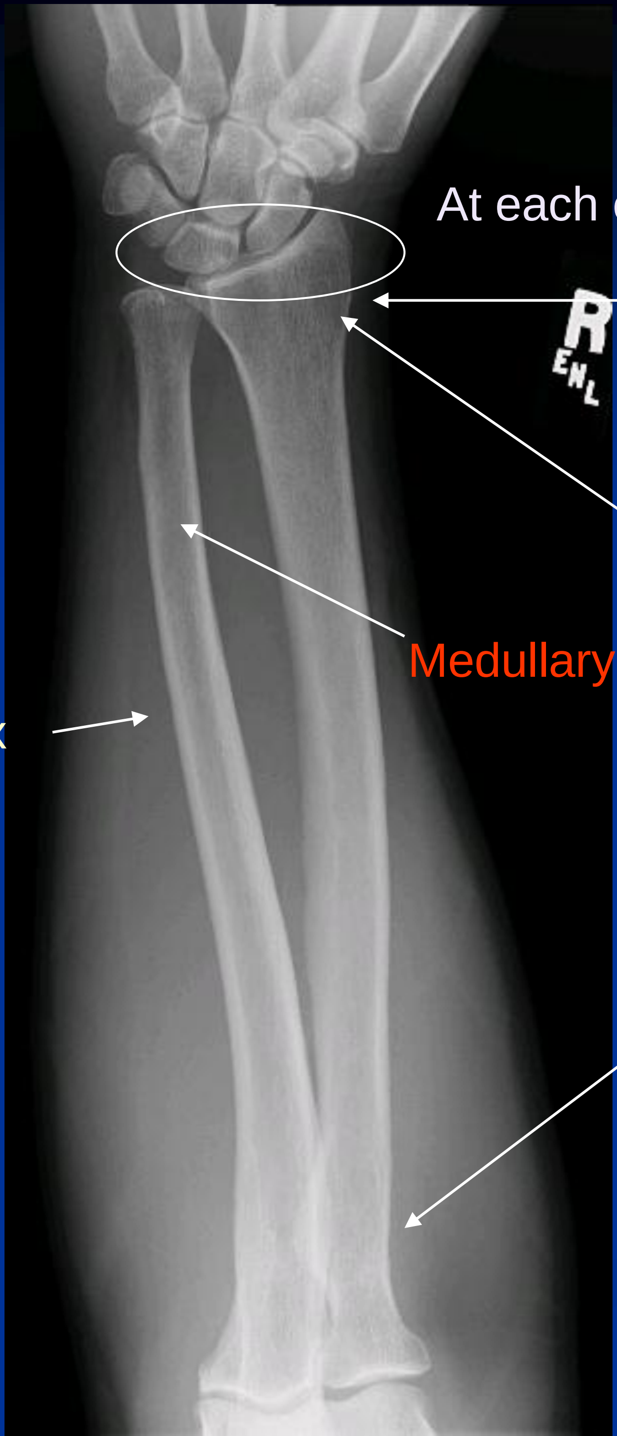

SP
SL

Normal Imaging Anatomy in the Extremities

What are the parts of a long bone?

- Terms you will need to know:
  - Cortex
  - Medullary cavity (marrow)
  - Diaphysis
  - Metaphysis
  - Epiphysis

DME



At each end of a long bone is the __________

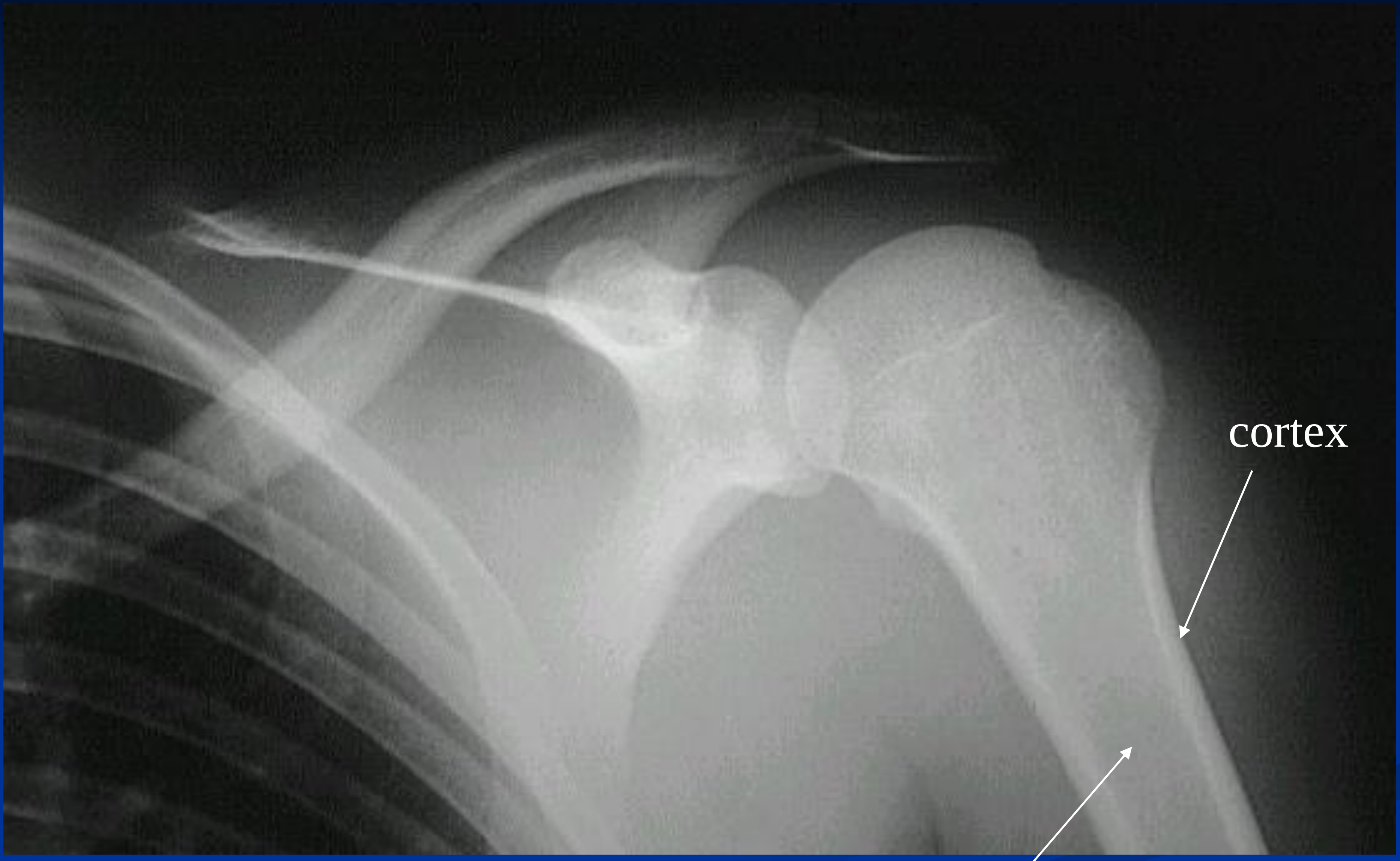
The tapered part of the bone is the ___________

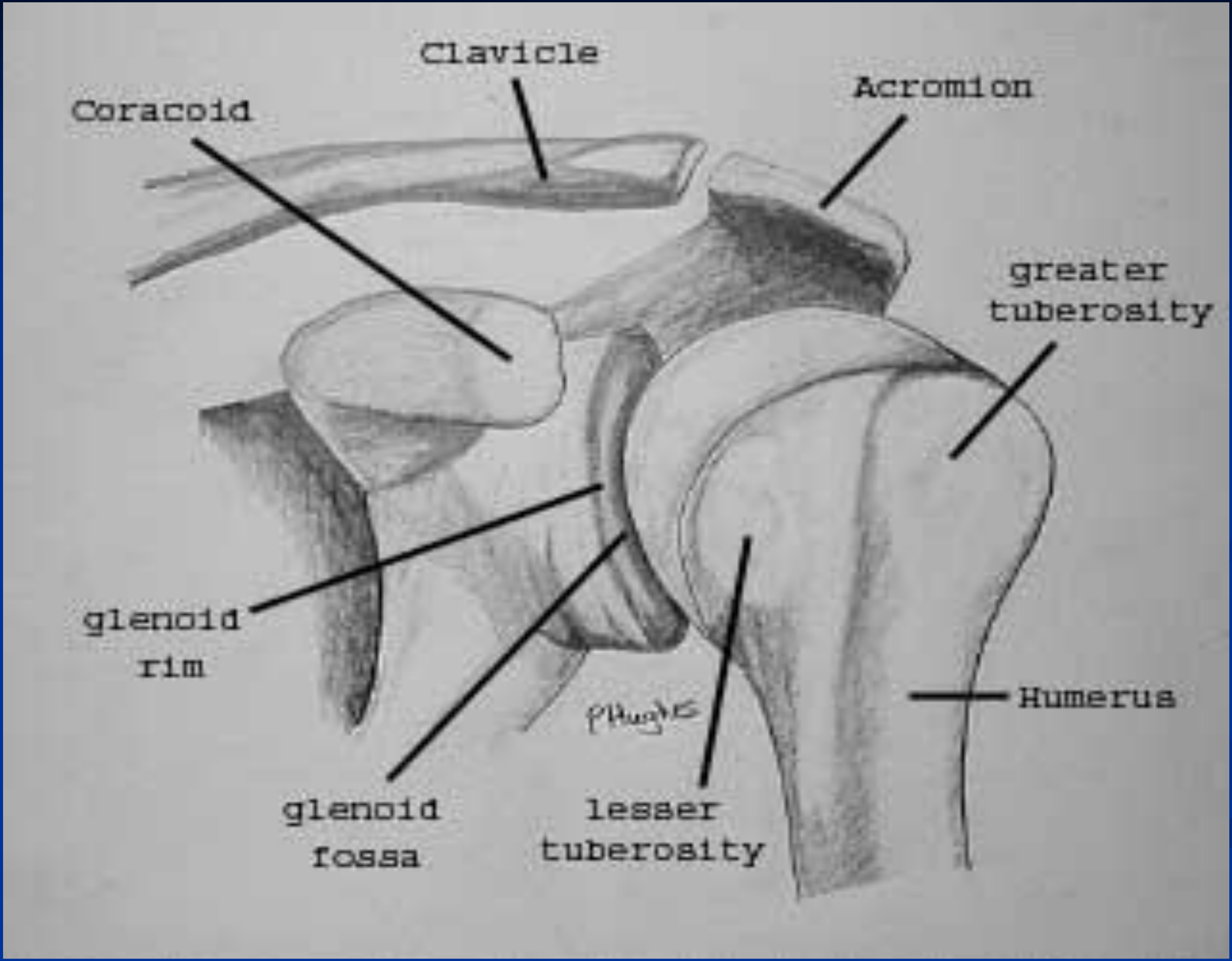
Medullary cavity (marrow)

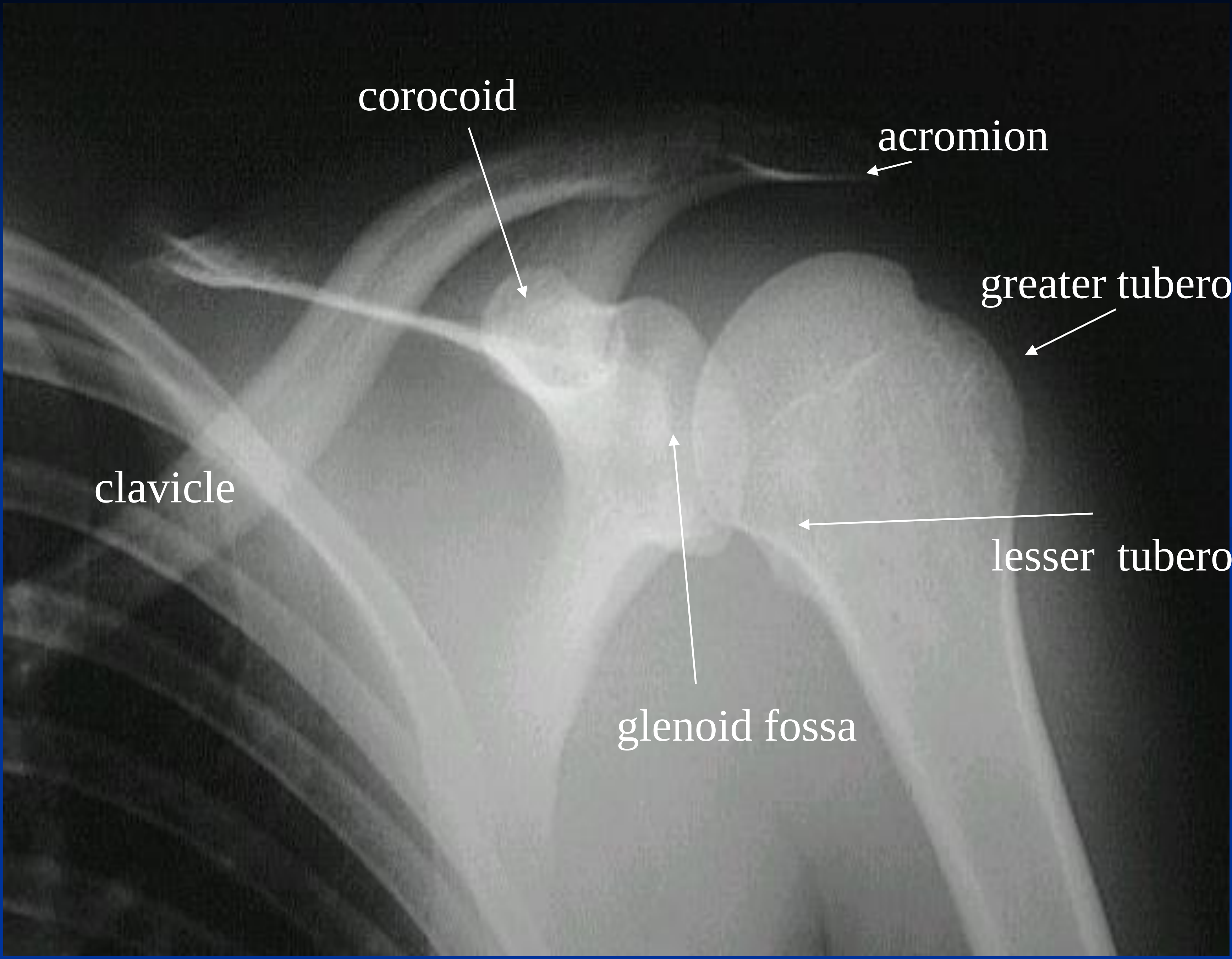
cortex

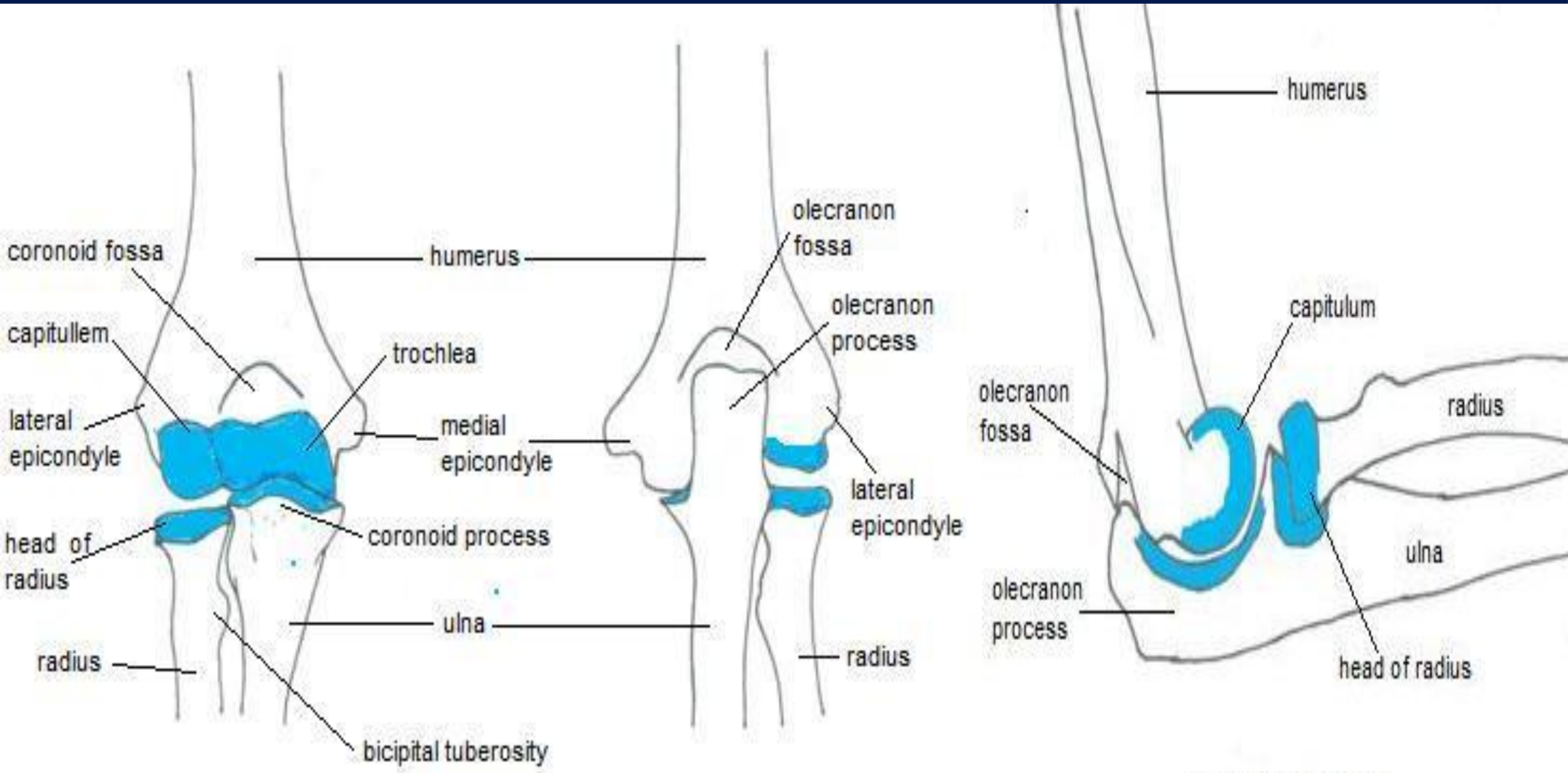
The shaft of the long bone is the _________

Diaphysis
Metaphysis
Epiphysis


cortex
medullary cavity


Clavicle
Coracoid
Acromion
greater tuberosity
glenoid rim
Humerus
glenoid fossa
lesser tuberosity

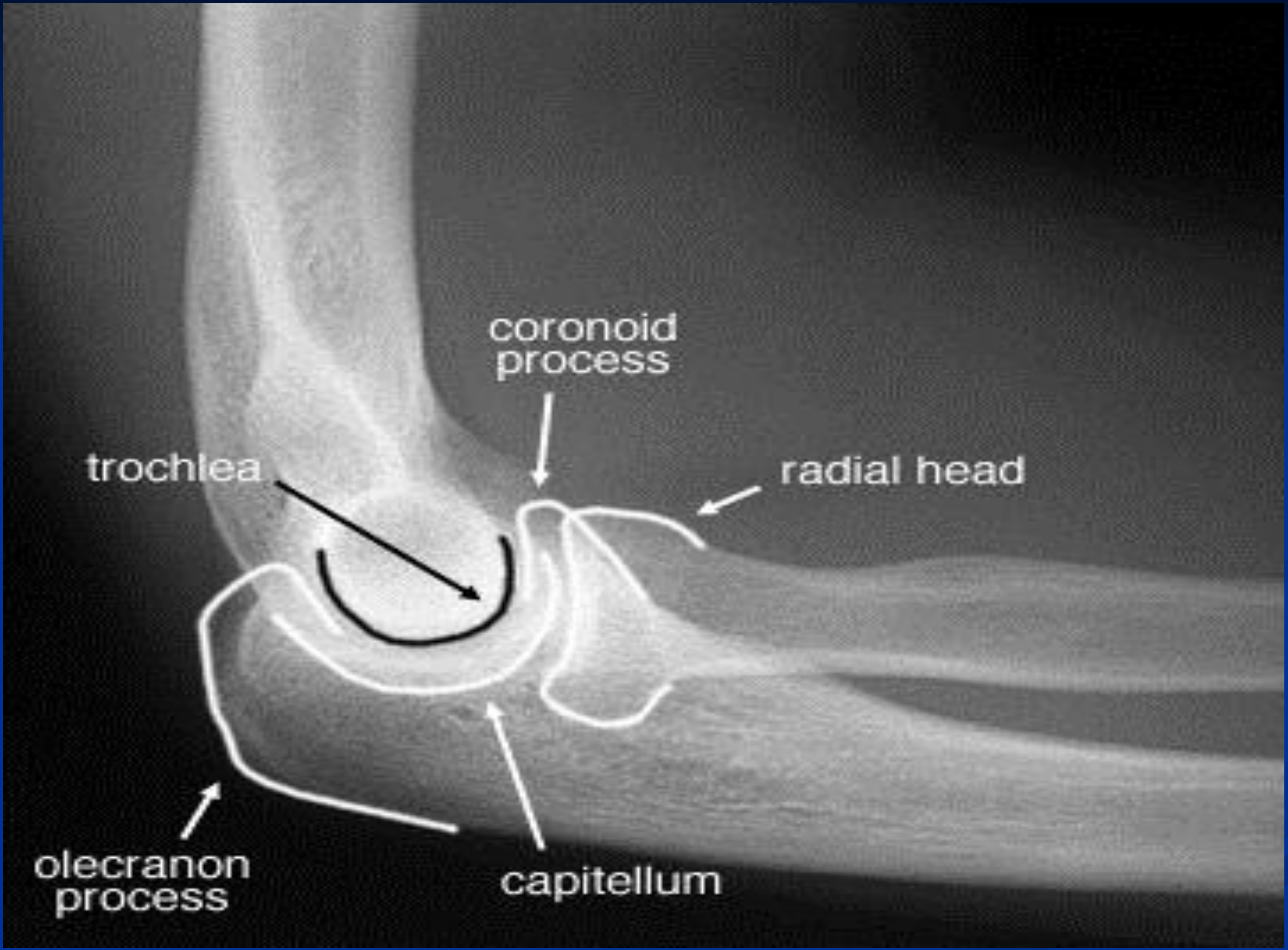

corocoid
acromion
greater tuberosity
clavicle
lesser tuberosity
glenoid fossa

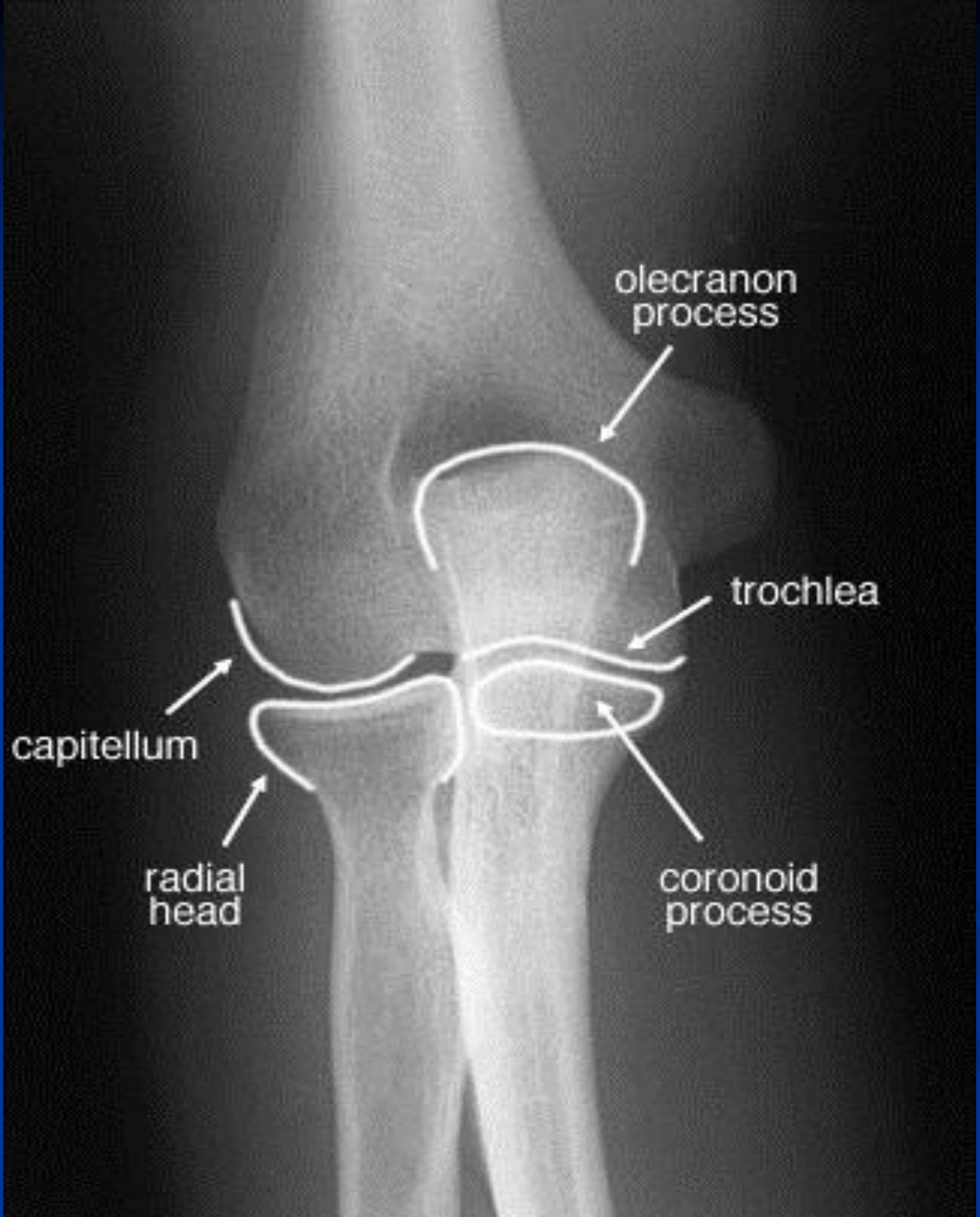


ANTERIOR (FRONT) VIEW

POSTERIOR (BEHIND) VIEW

LATERAL (SIDE) VIEW


coronoid process
trochlea
radial head
olecranon process
capitellum


olecranon process
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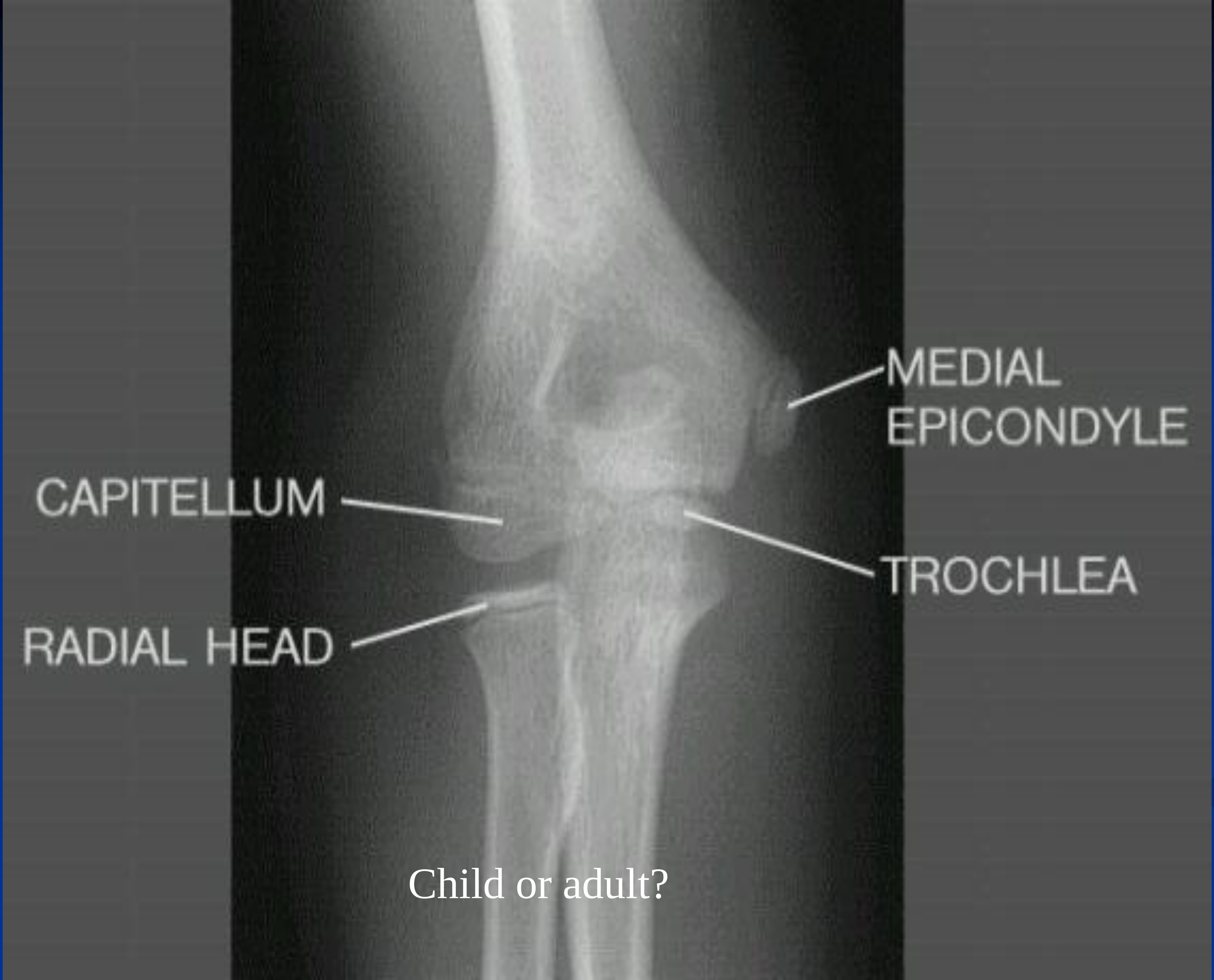
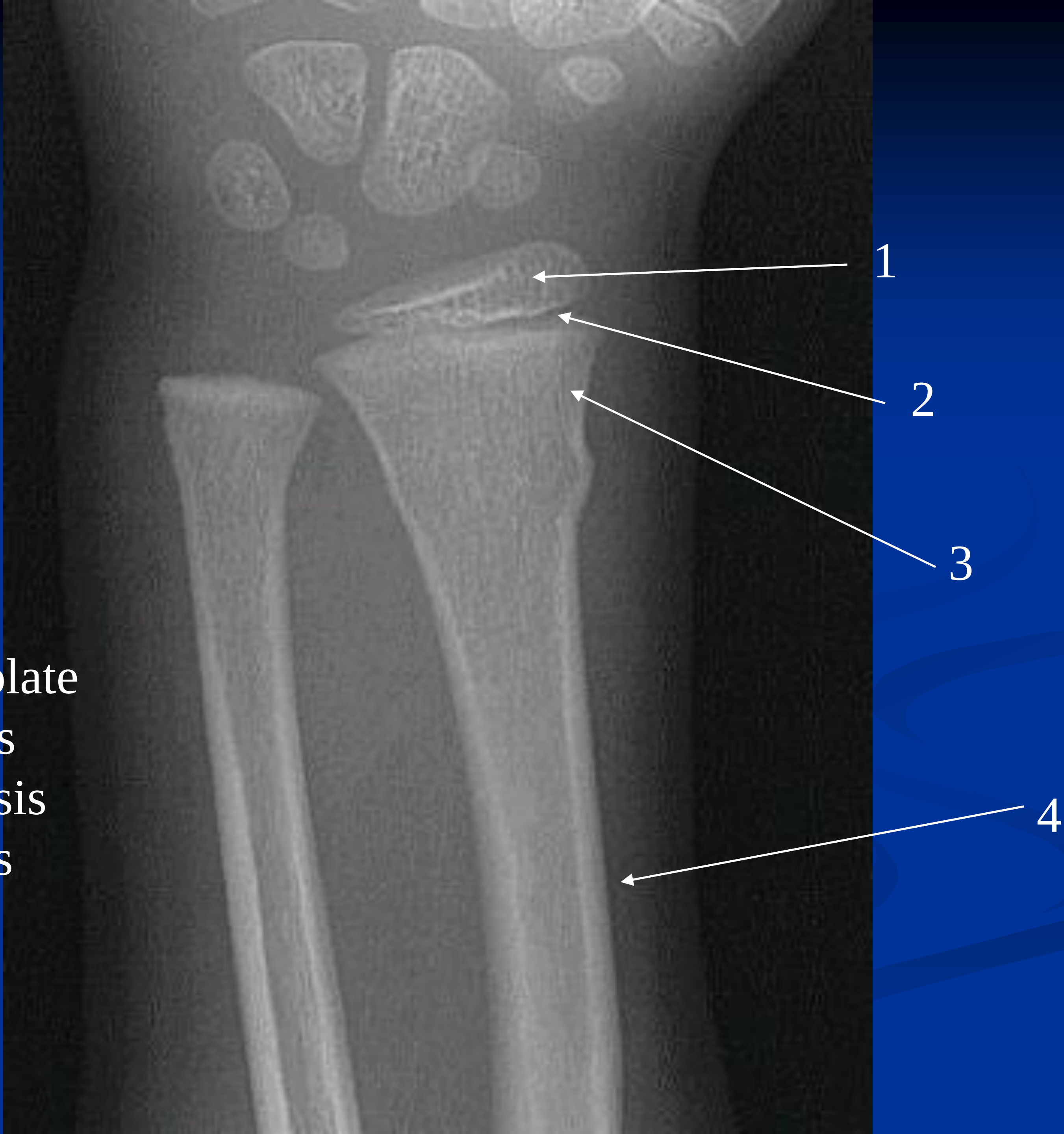
capitellum
radial head
coronoid process



Child or adult?

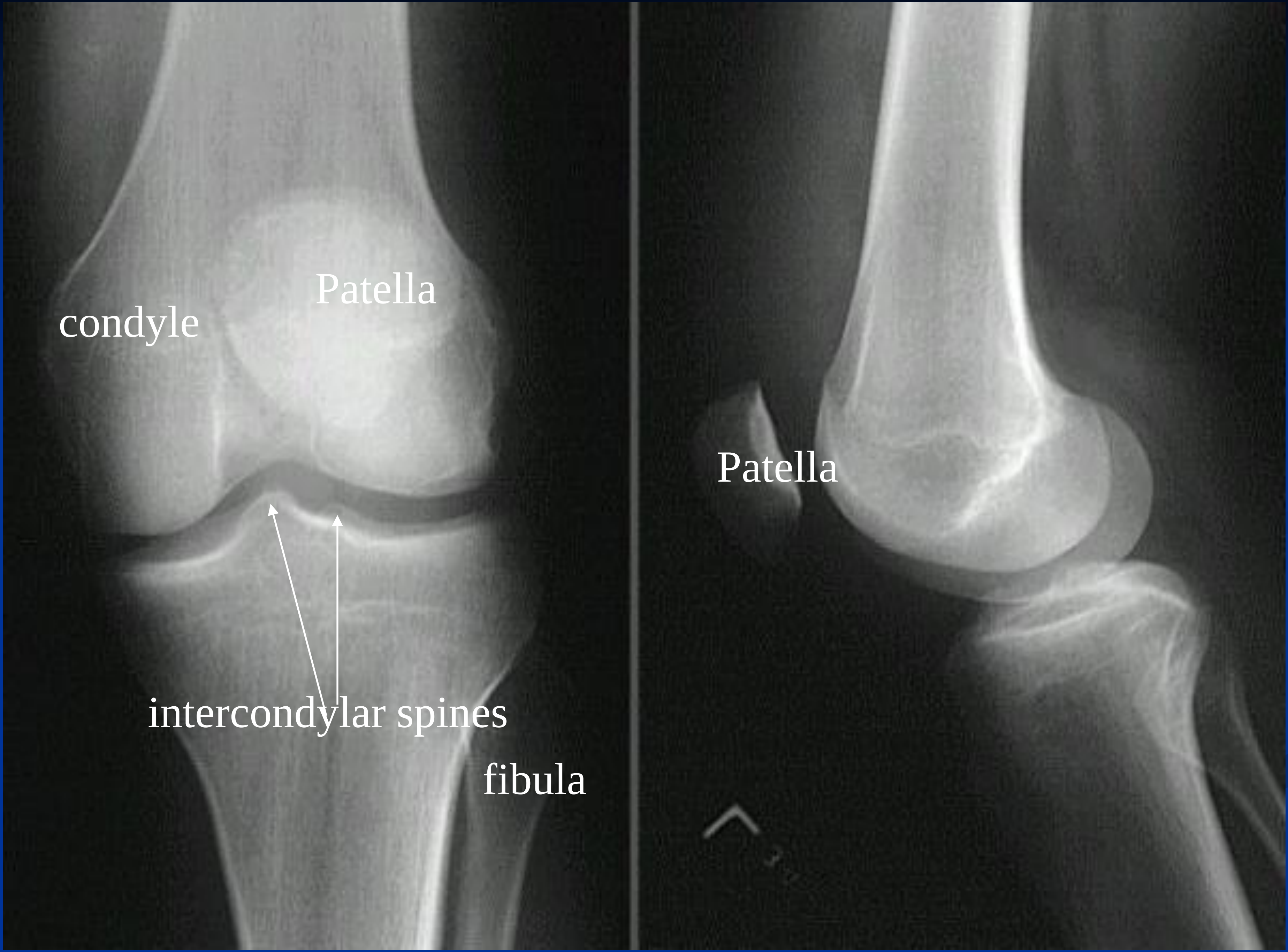

3rd
metacarpal
2nd
metacarpal
4th
metacarpal
1st
metacarpal
5th
metacarpal
trapezoid
hamate
trapezium
capitate
triquetrum
scaphoid
(navicular)
pisiform
lunate
ulna
radius

Wrist

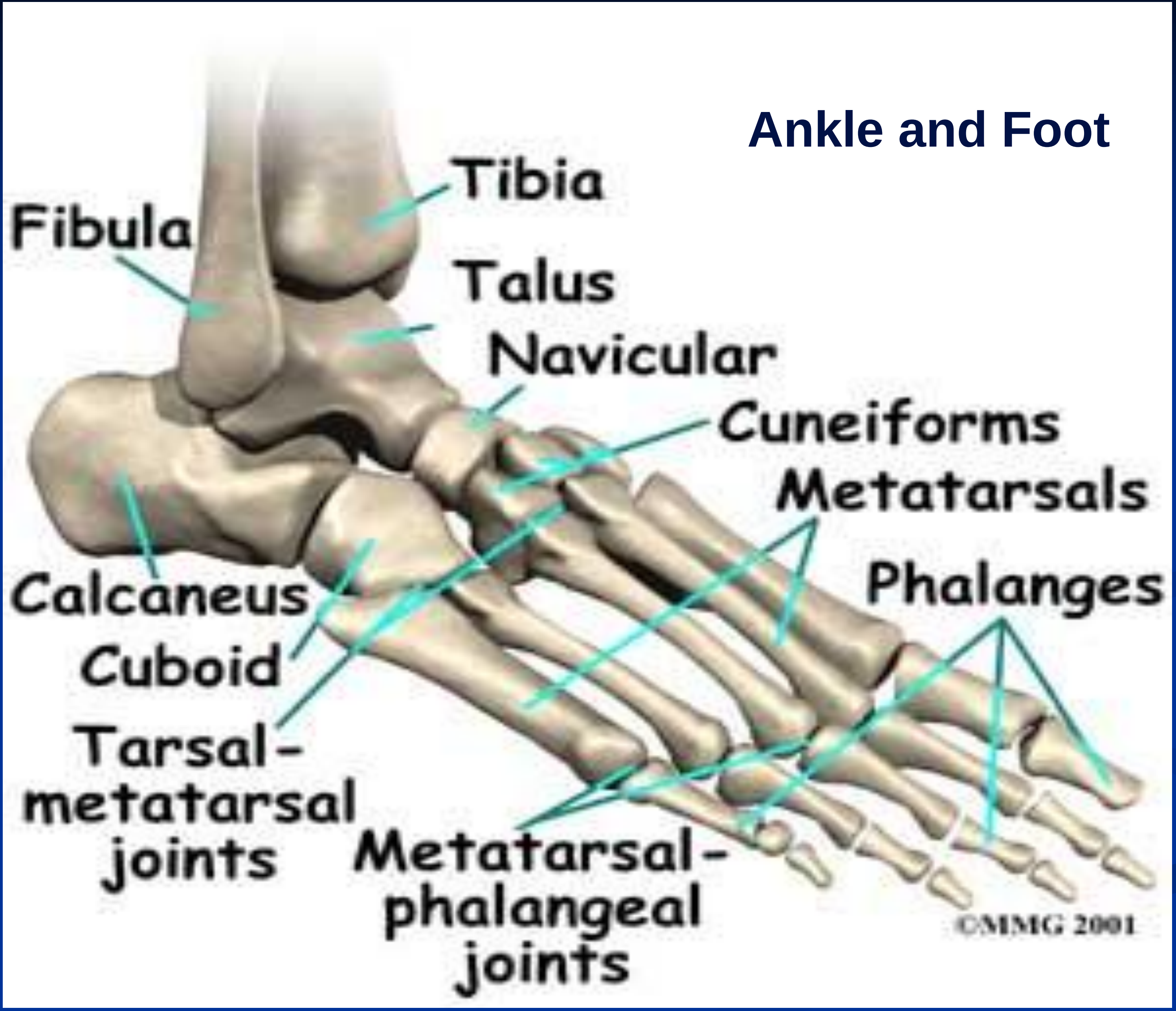


a. Growth plate
b. Diaphysis
c. Metaphysis
d. Epiphysis

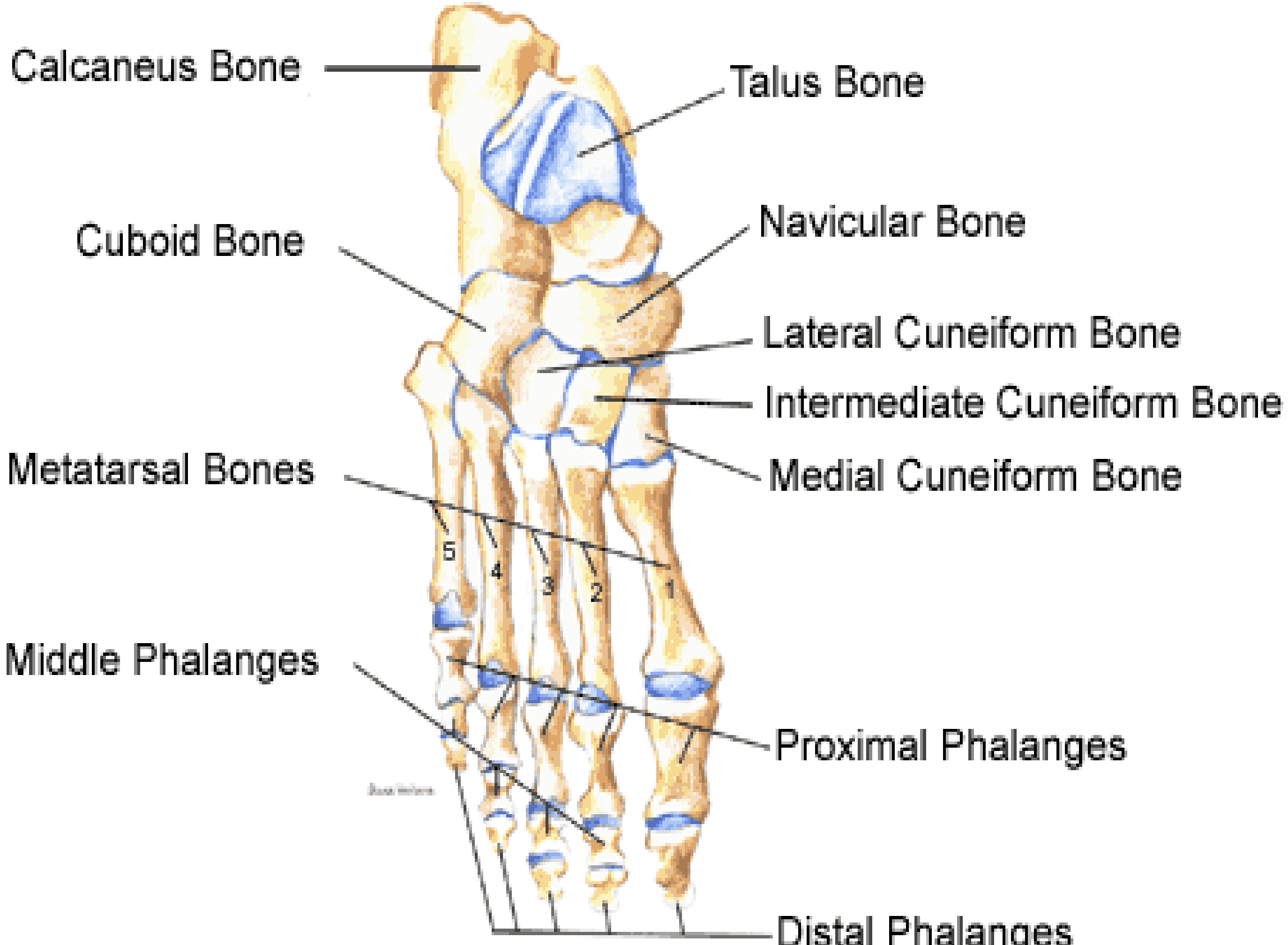

int. iliac spine
acetabulum
SI joint
greater trochanter
symphysis pubis

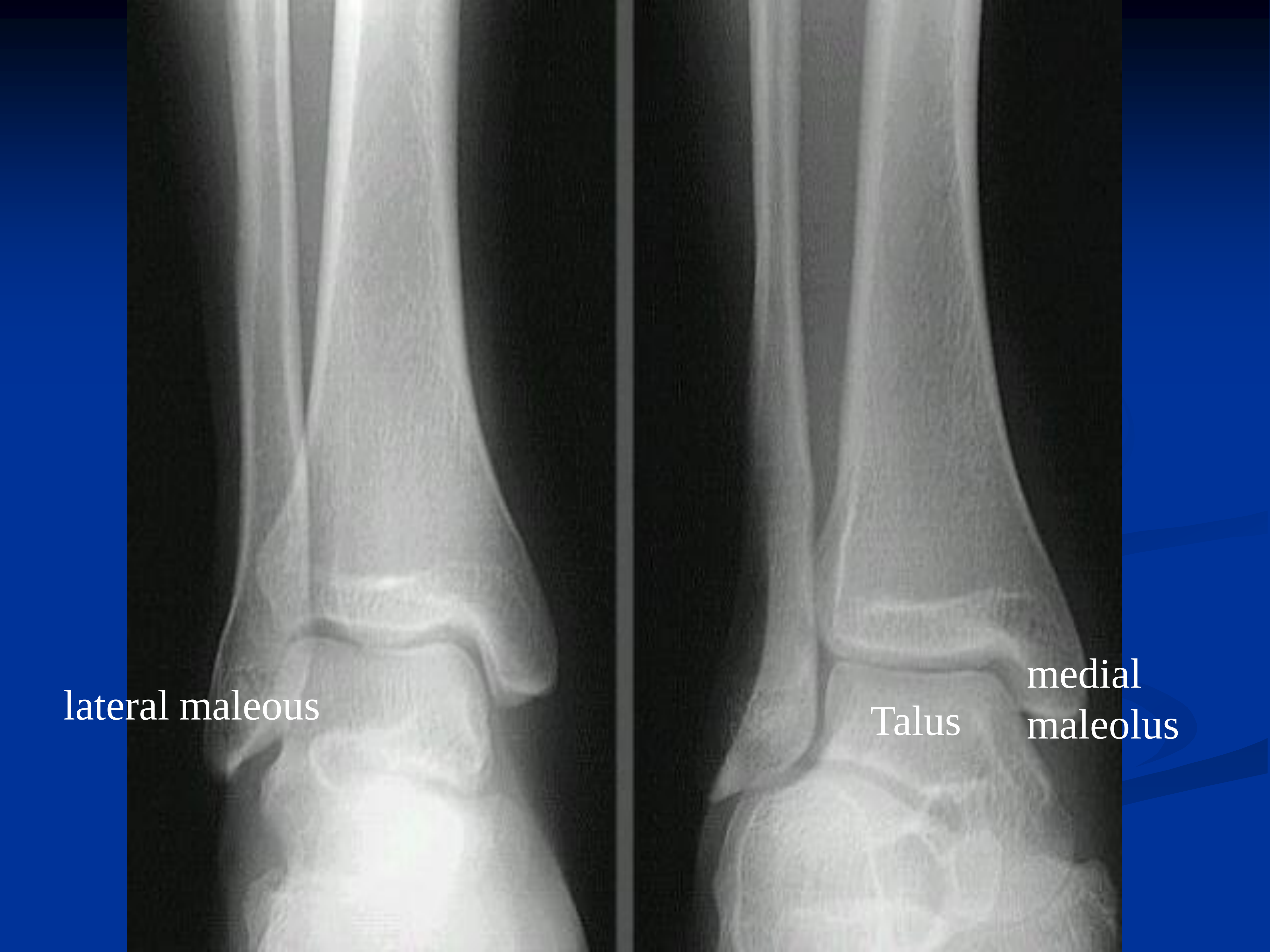

Patella
condyle
intercondylar spines
fibula
Patella

Ankle and Foot



Top View of Foot Bones



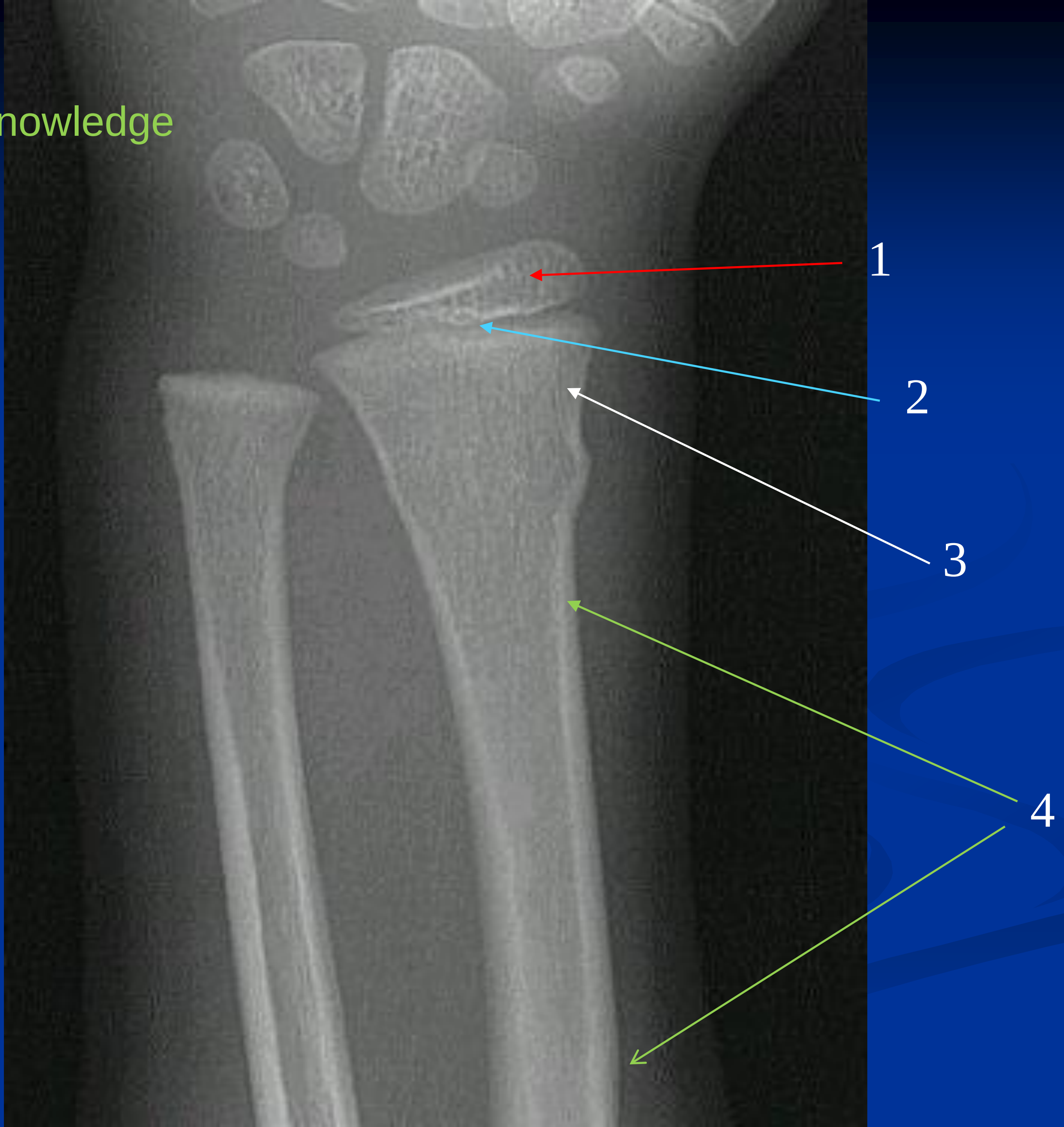

lateral maleous
Talus
medial
maleolus

Side view

Top view

A.D.A.M.

Test your knowledge



Finding a Fracture on X-Ray

- Start with soft tissue, look for swelling or fat pad displacement
- Examine the cortex along the entire length of the bone
- Look for cortical irregularities, buckling, or evidence of impaction

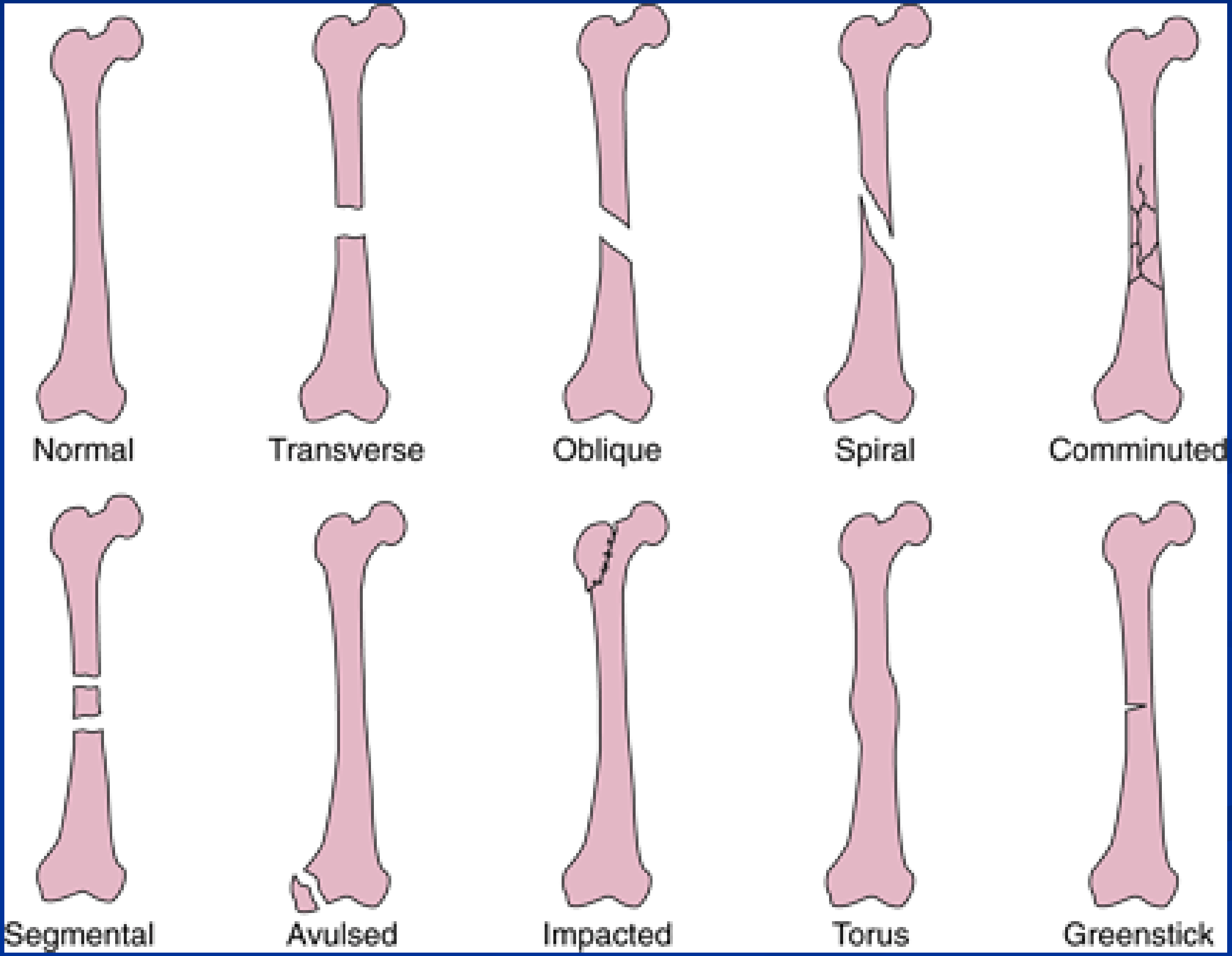
Fracture Terminology

- **Direction** of fracture line:
  - Transverse
  - Oblique
  - Spiral
  - Longitudinal
- **Alignment** of fracture: **Displacement**
- **Angulation**
- **Comminution**
- **Articular Involvement**

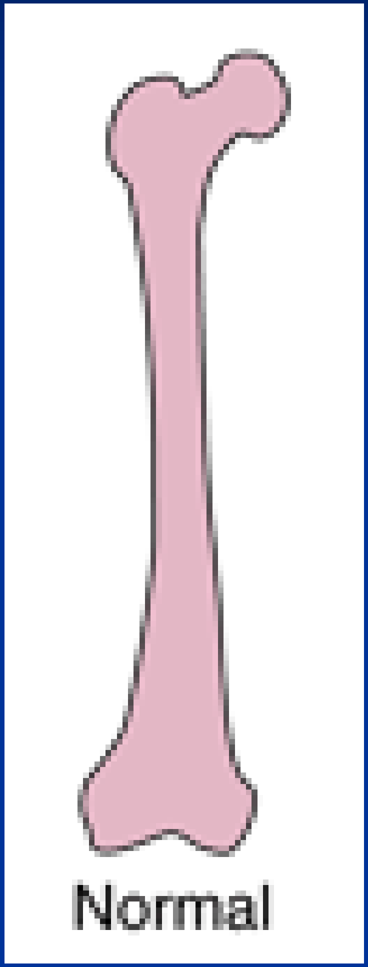
Fracture Terminolgy

- **Open** vs **Closed**: fracture is open when exposed to air (laceration or gross exposure)
- **Pathologic fracture**: implies fracture through weakened bone
- **Stress fracture**: implies misuse or overuse

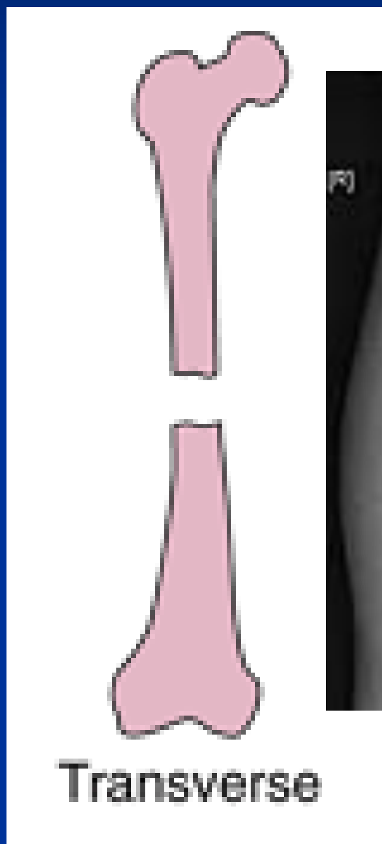
Path of the Fracture



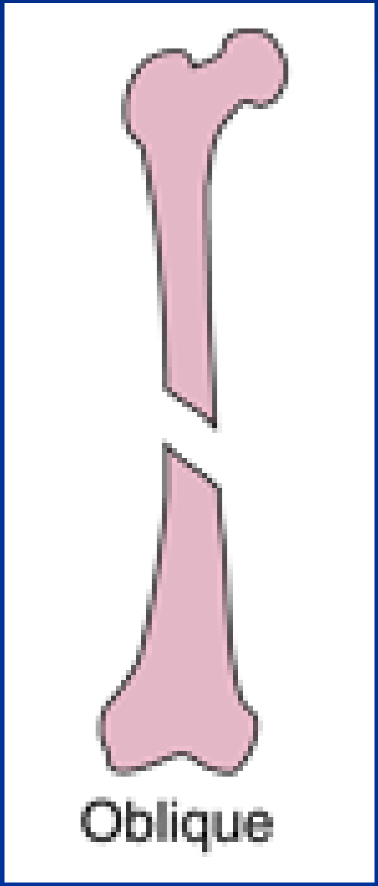
Normal



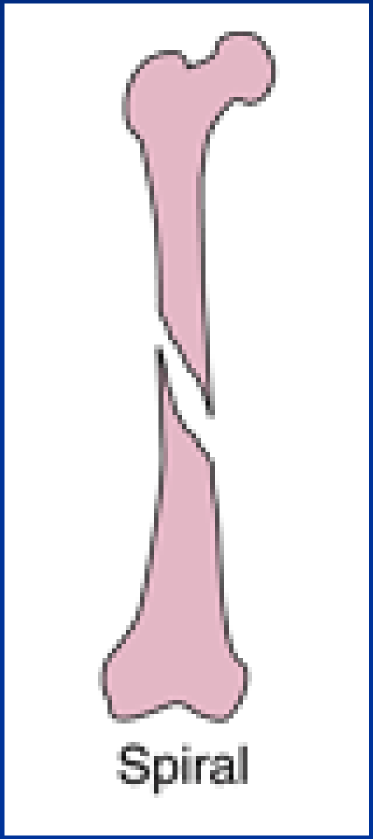
Transverse Fracture

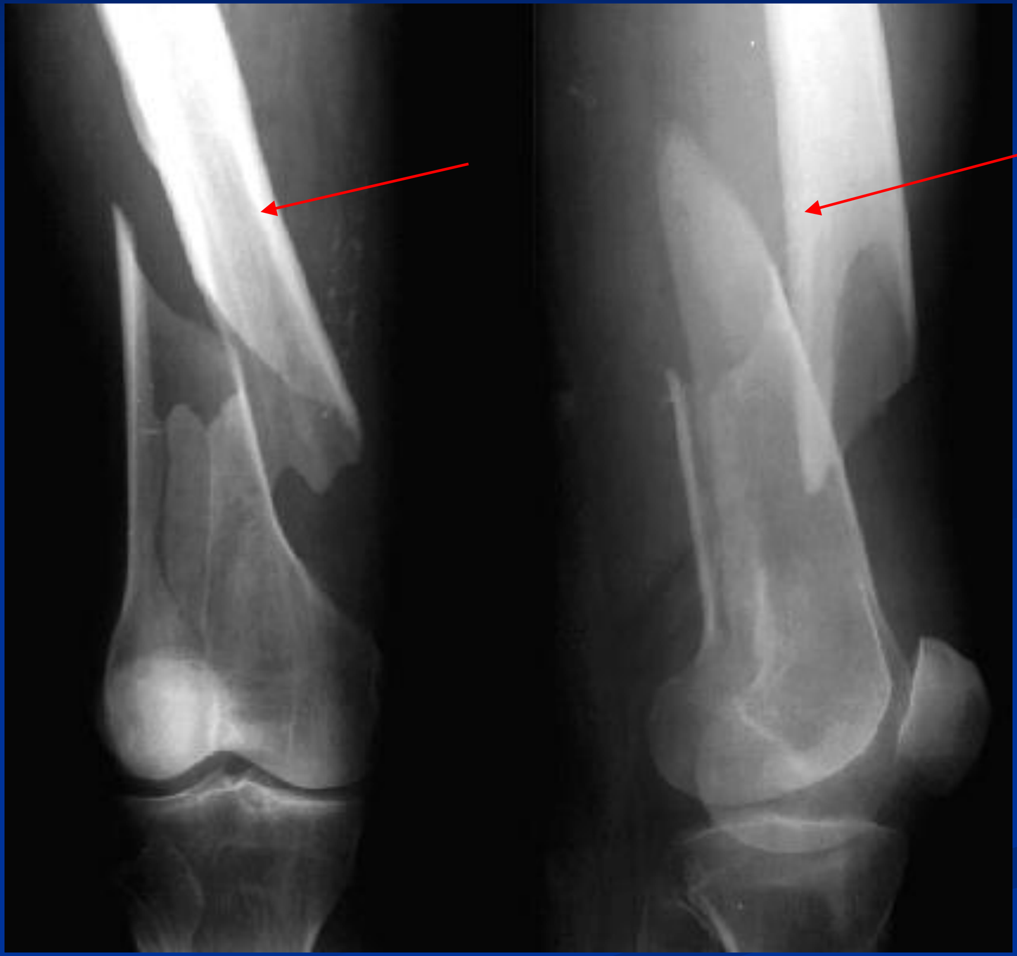


Oblique Fracture



Spiral Fracture

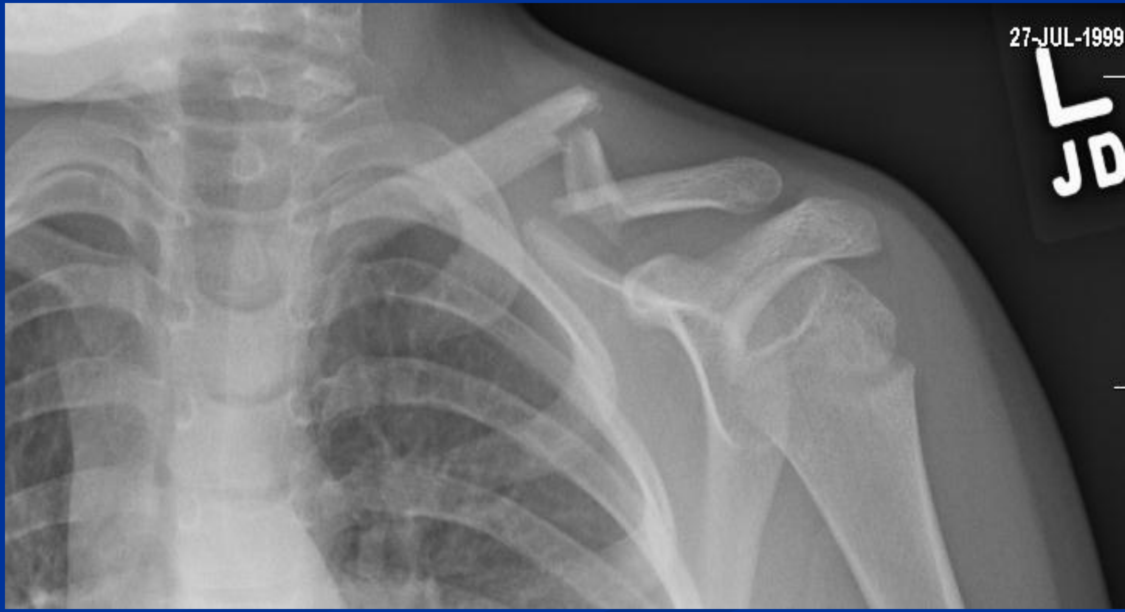




Longitudinal Fracture

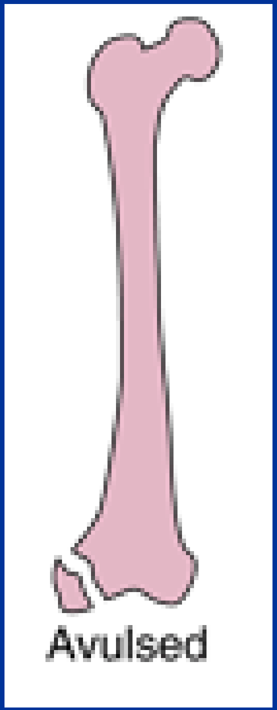
Simple vs Comminuted

- Simple-2 bone fragments
- Comminuted-greater then 2 fragments



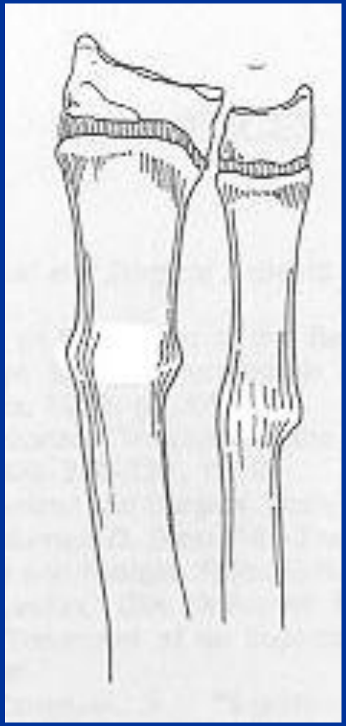
Avulsion Fracture

- A bony fragment produced by the pull of ligamentous or tendinous attachment



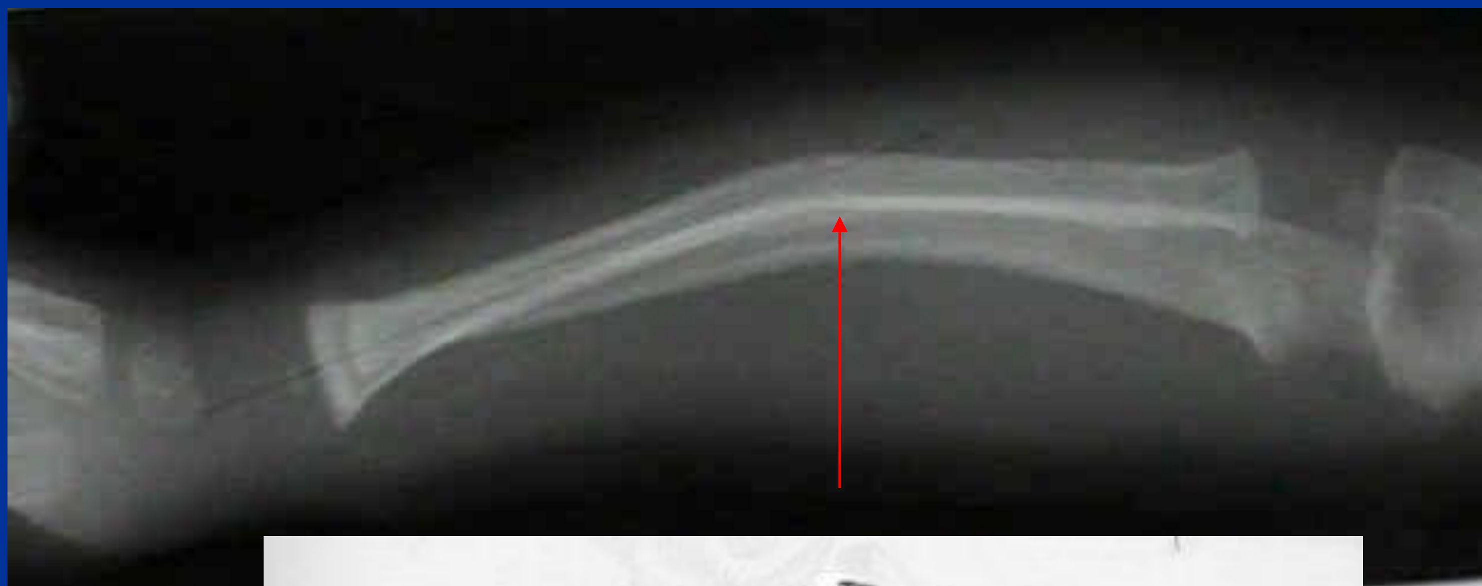
Torus Fractures

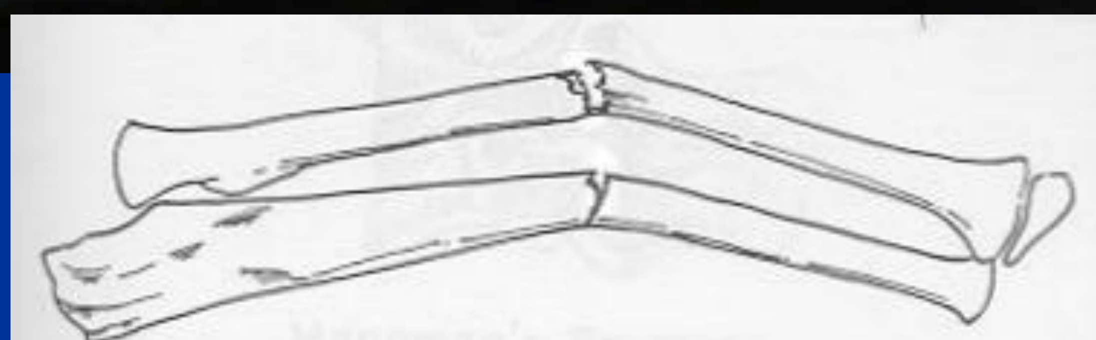
- Axial forces cause cortex to buckle
- Occurs most commonly in the metaphysis



Greenstick fracture

- Cortex broken on one side of the bone and only bent or buckled on the other side





Points to take home

- There are distinct advantages and disadvantages to plain x-rays, CT and MRI.
- Become familiar with terminology: epiphysis, metaphysis, diaphysis, cortex, medullary cavity
- Fracture description requires specific vocabulary