Imaging the Musculoskeletal System

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PART 1 - 2012

Radiology Team 429

In this team we used the outlines from the:

Doctor's slides

Lecture notes are in red boxes

427 Radiology team

Diagnostic Imaging –PETER ARMSTRONG – 6Th Edition

Sorry we don't hold responsibility for any missing information or perhaps – perhaps -wrong material.

We tried our best to present this lecture in the best way, and we hope what we wrote is enough to cover the subjects.

Team Leaders:

Abdulmajeed Al-Sadhan, Ibrahem Al-Sadhan, Sarah Mahasin

Team Members:

Arwa Al Madani, Abdullah Alessa

Best Wishes :)

OBJECTIVES

The main focus and objective of this lecture is to help student to be competent in looking at MSK images and interpreting findings, by learning:

- Normal radiological anatomic landmarks
- System of analyzing findings

"Where to look & What to look for"

IMPORTANT SITES

BONE DENSITY
BONE TEXTURE
DISTORTION / DISPLACEMENT OF NORMAL STRUCTURES

- Recognize features of certain disease entity

IMAGING OF MUSCULOSKELETAL SYSTEM

PLAIN FILM — Corner Stone

COMPUTED TOMOGRAPHY

MAGNATIC RESONANCE IMAGING

ULTRASOUND

ANGIOGRAPHY

NUCLEAR MEDICINE

Useful in complex skeletal trauma

Useful in bone, joint, soft tissue

IMAGING OF MUSCULOSKELETAL SYSTEM

- Tendons/ligaments/muscles.
- Detect fluid collections around joints or within muscles.
- Soft tissue masses and cysts.

ULTRASOUND

ANGIOGRAPHY

bone scan is very sensitive but is relatively non-specific

NUCLEAR MEDICINE

Notes Imaging Modalities

- Plain Film:
  - Most diseases bone can be diagnosed by film
  - Certain areas: shoulder, pelvis may need further analysis CT is better than MRI for bone trabecule and surrounding structure
- CT: Useful in complex skeletal trauma
- MRI:
  - Useful in bone, joint, soft tissue
  - bone marrow changes, the joint, the capsule of the joint, surrounding structures
- Ultrasound:
  - Tendons/ligaments/muscles.
  - Detect fluid collections around joints or within muscles. Soft tissue masses and cysts
  - initial for the soft tissue structures, architecture of the tendon and ligament
  - fluid: hematoma in the soft tissue of the muscle
- Angiography:
  - vascular structures, imp in surgical management (underlying pathology), not specific but high sensitivity, not a diagnostic modality
- Nuclear Medicine:
  - bone scan is very sensitive but is relatively non-specific

Interpreting Images

Look at:

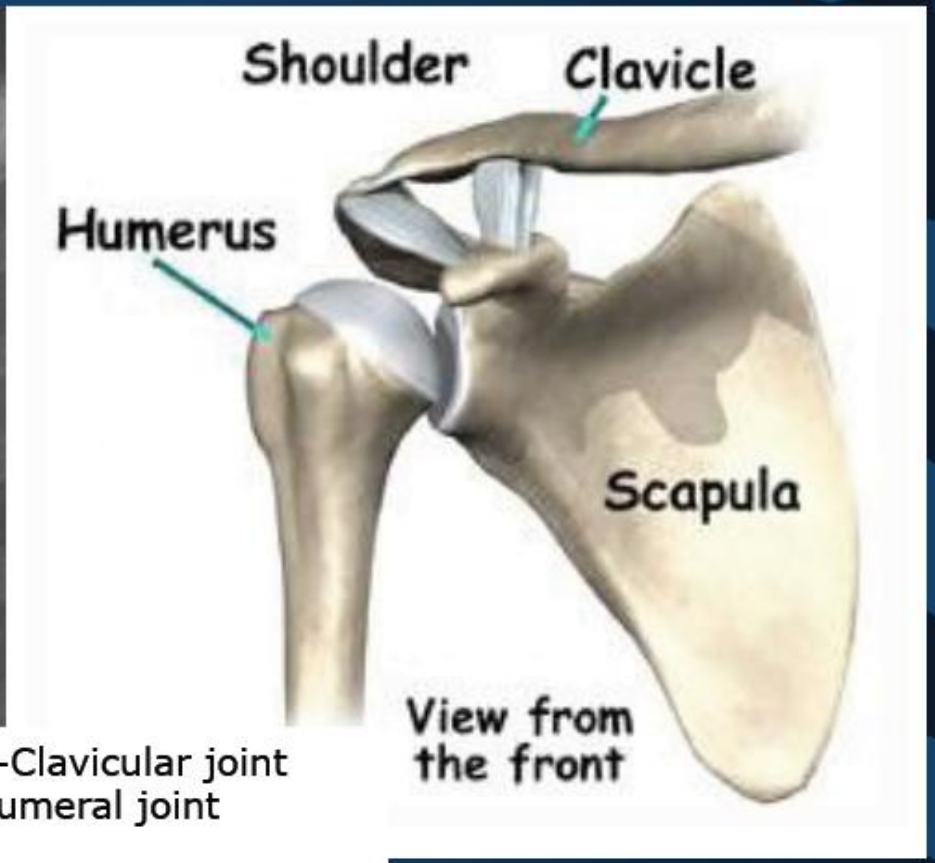
- Bone density
- Bone texture
- Distortion /displacement of normal structures

- Cortex of the bone
- Margins of the bone
- Articular surface of the joint
- Junction between the cortex and the medulla
- Pediatric: epiphyseal plate

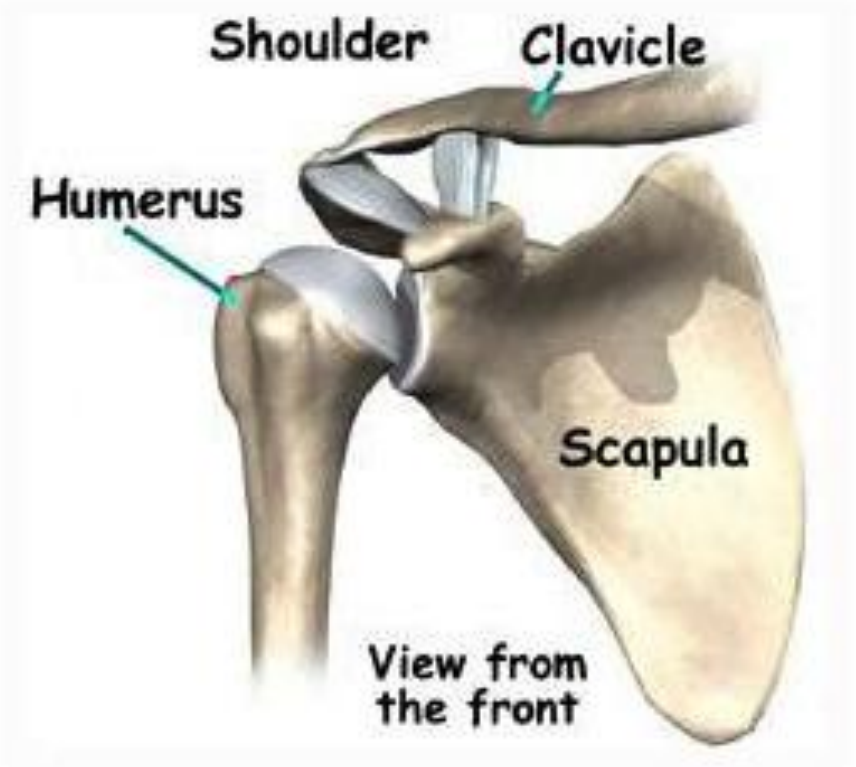
MUSCULOSKELETAL RADIOLOGICAL ANATOMY

A A Al-BOUKAI-5

Musculoskeletal Radiological Anatomy

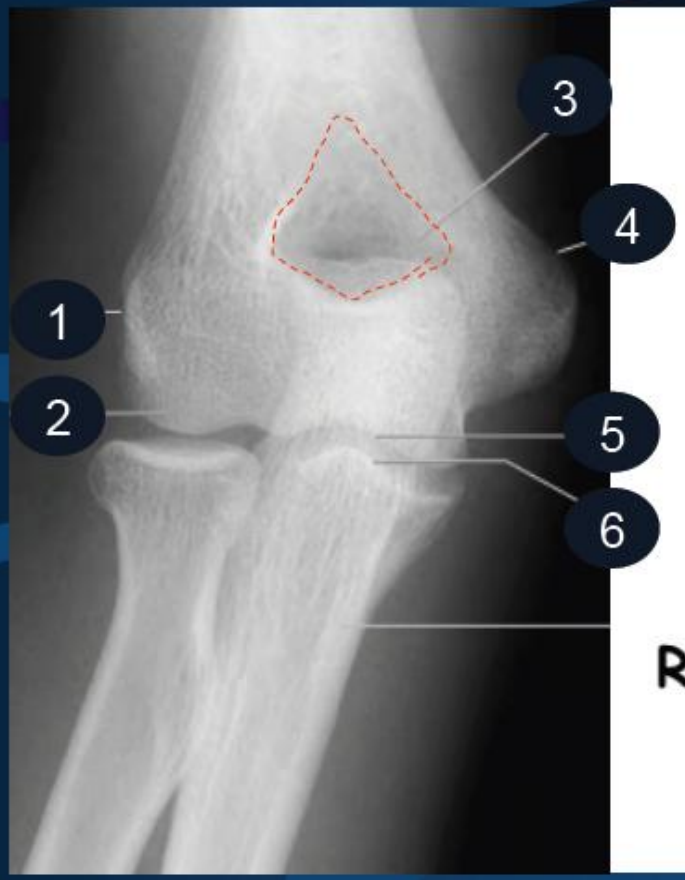


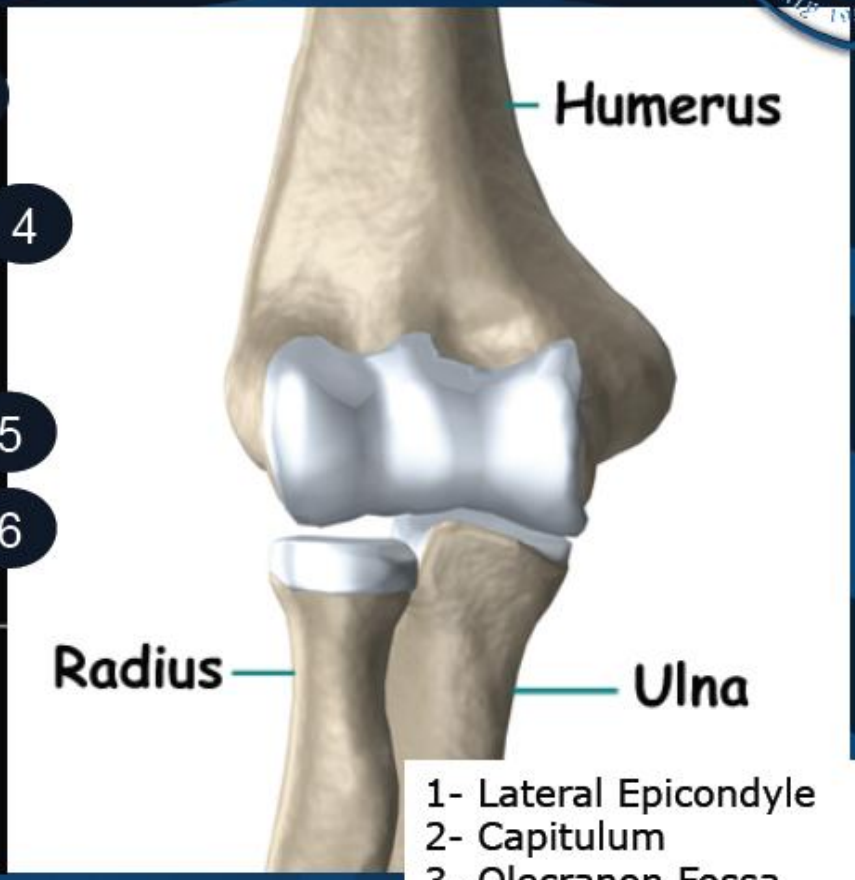
A- Acromio-Clavicular joint
B- Gleno-Humeral joint
1- Clavicle
2- Acromiom process
3- Coracoid process
4- Glenoid process
5- Humerus



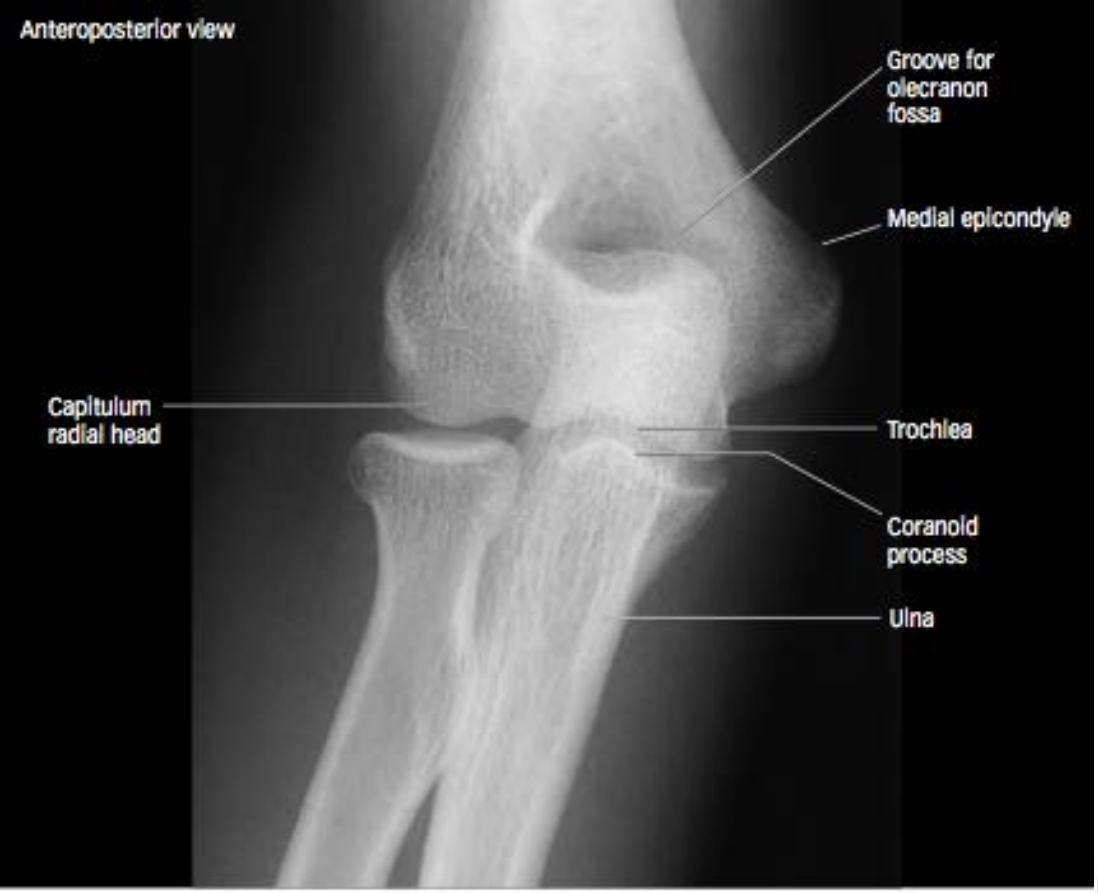
The shoulder joint

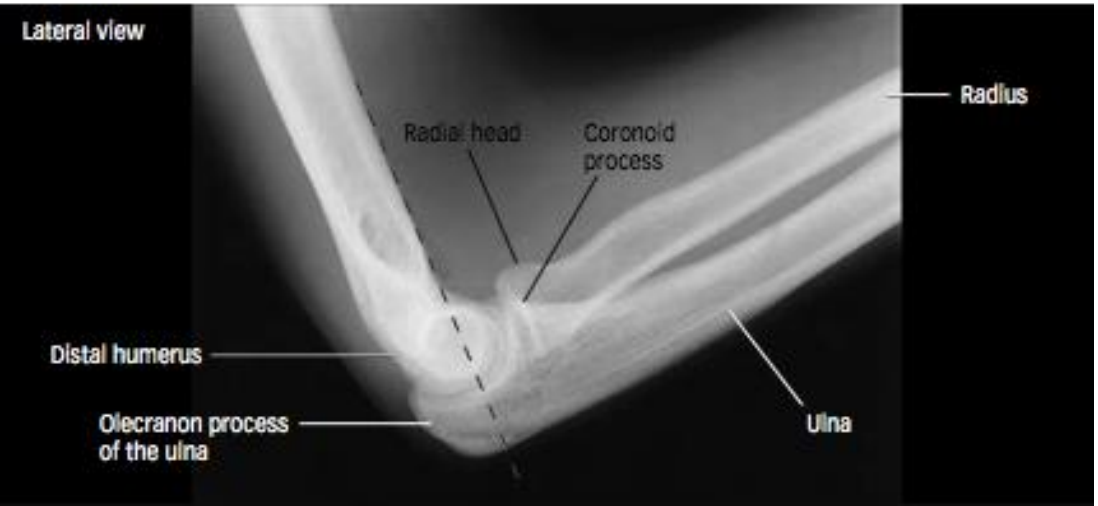
Musculoskeletal Radiological Anatomy

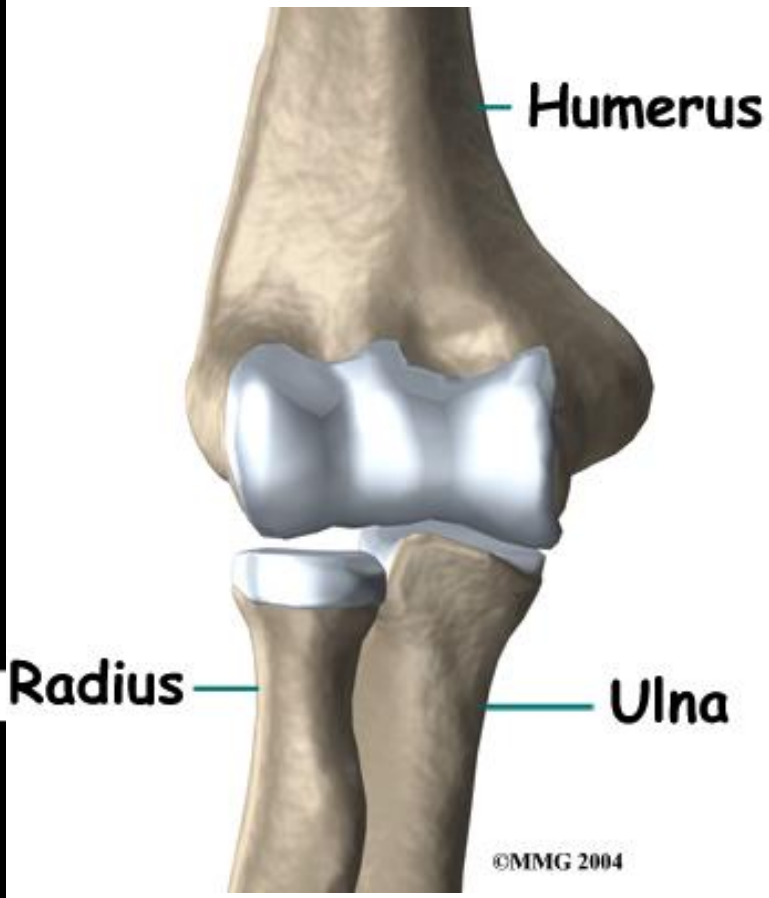




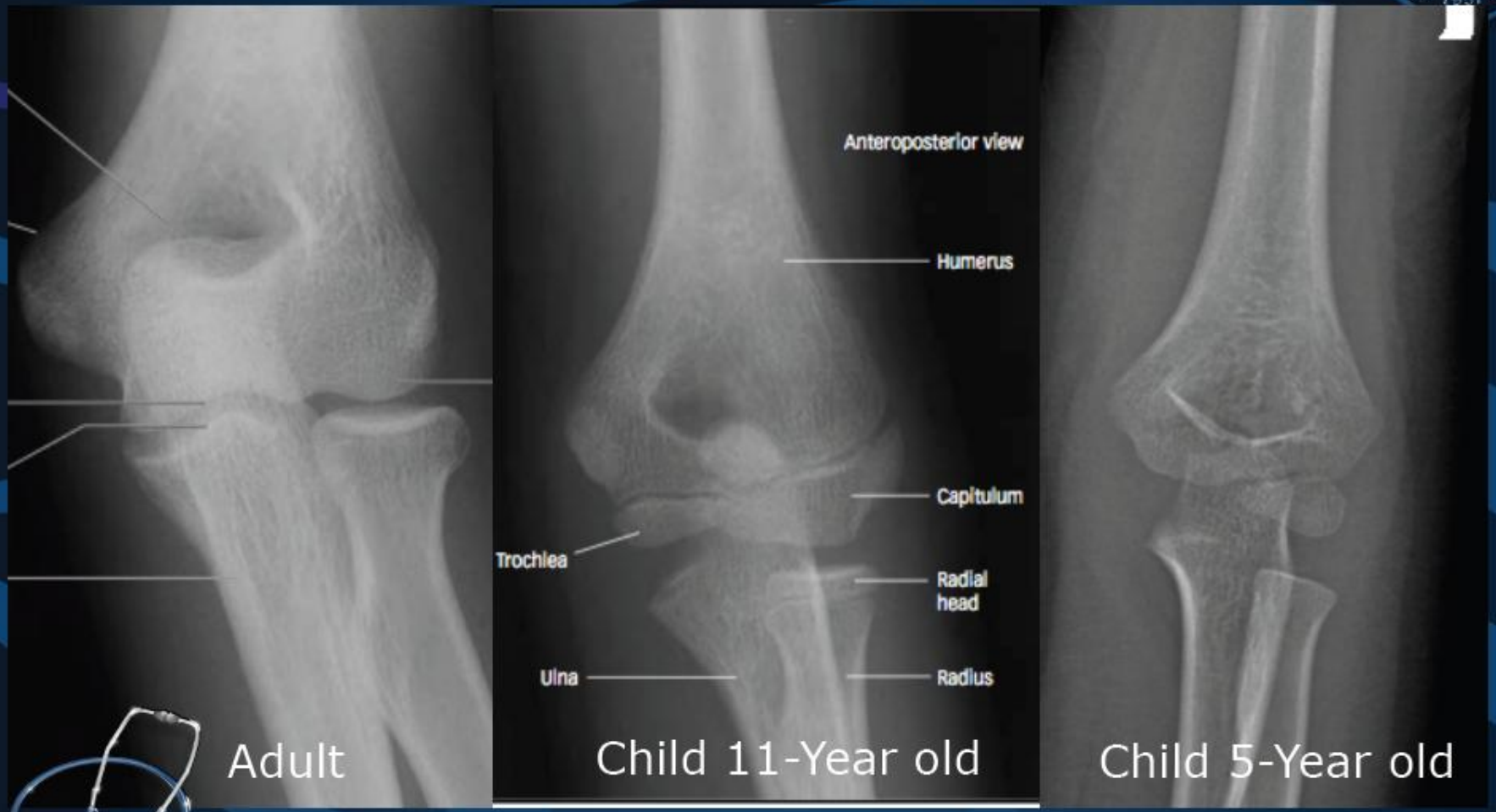
1- Lateral Epicondyle
2- Capitulum
3- Olecranon Fossa
4- Medial Epicondyle
5- Trochlea
6- Coracoid Process


Anteroposterior view
Groove for olecranon fossa
Medial epicondyle
Capitulum radial head
Trochlea
Coranoid process
Ulna

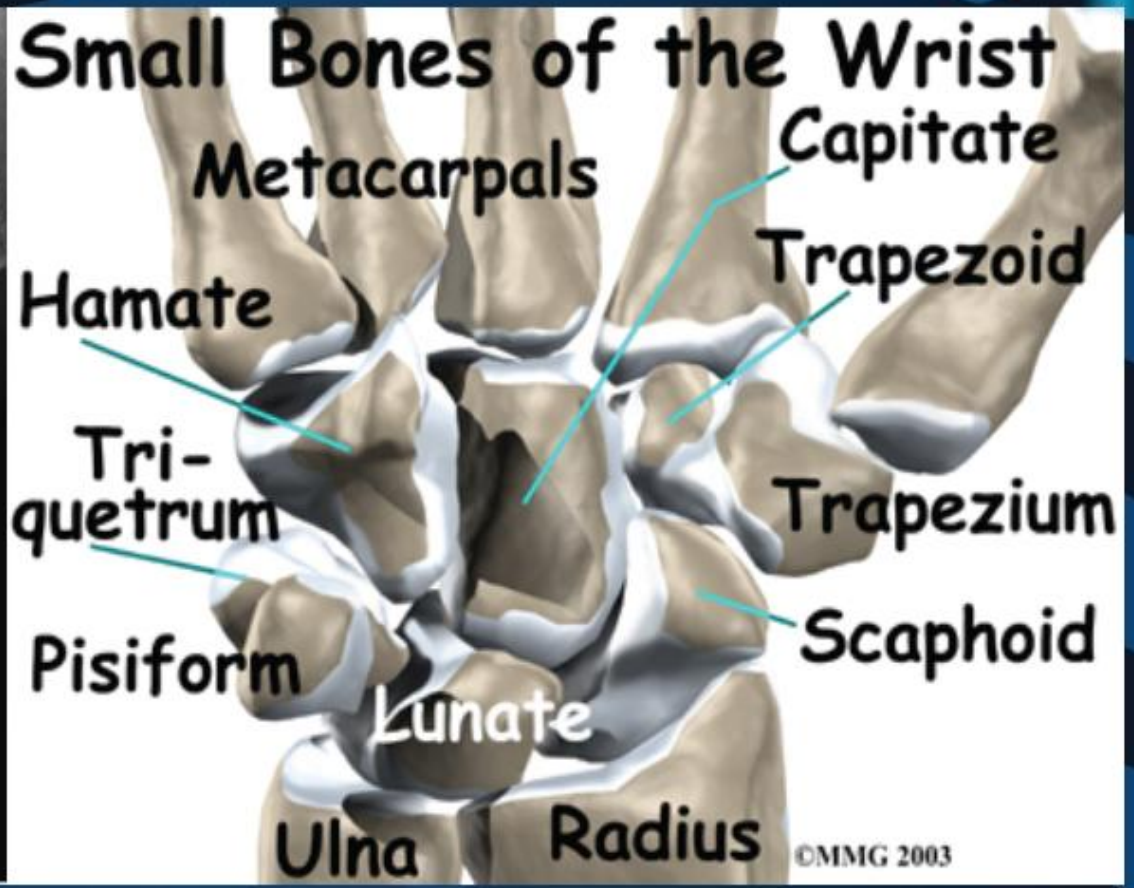

Lateral view
Radius
Radial head
Coronoid process
Distal humerus
Olecranon process of the ulna
Ulna


Humerus
Radius
Ulna
©MMG 2004

Musculoskeletal Radiological Anatomy

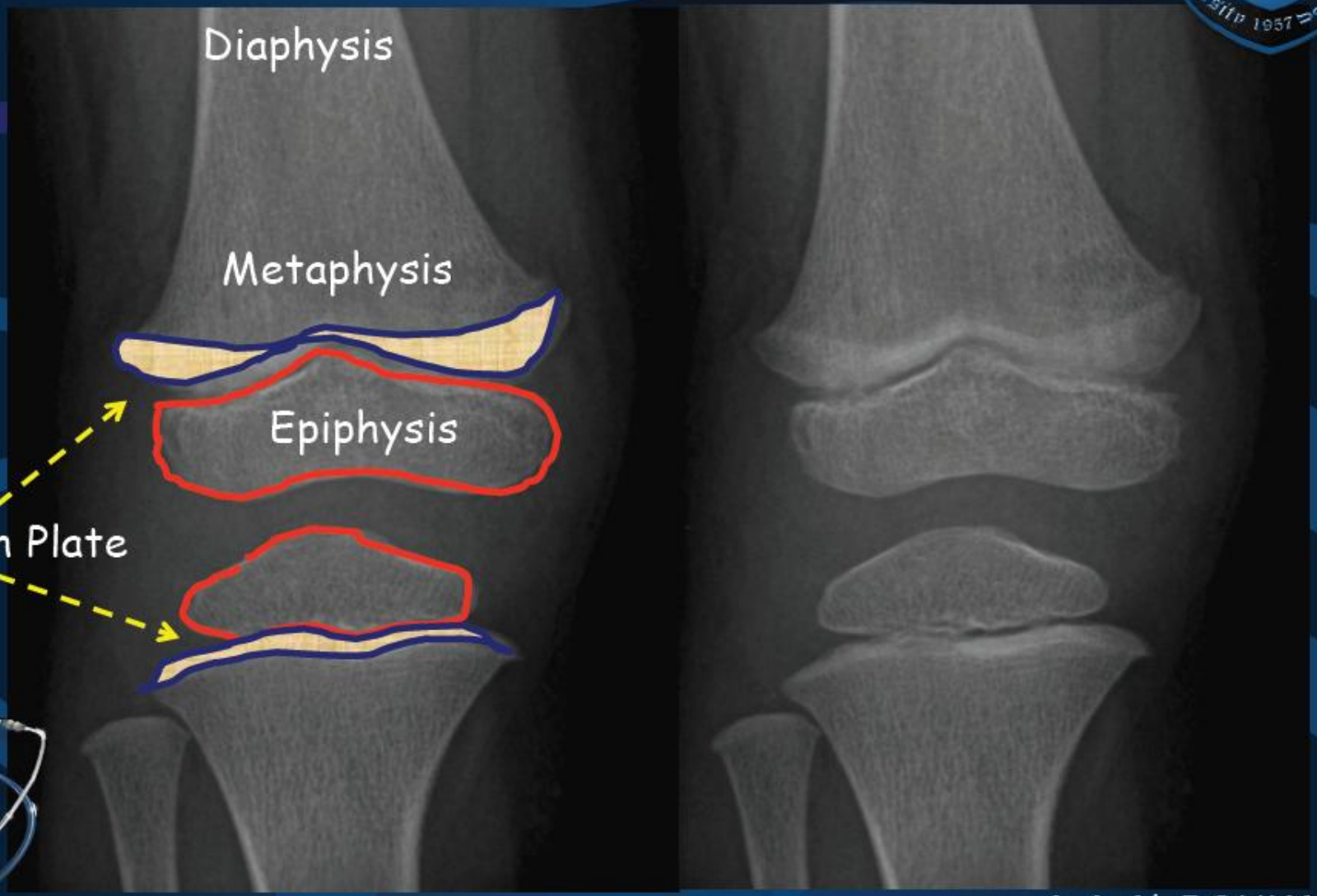


Musculoskeletal Radiological Anatomy

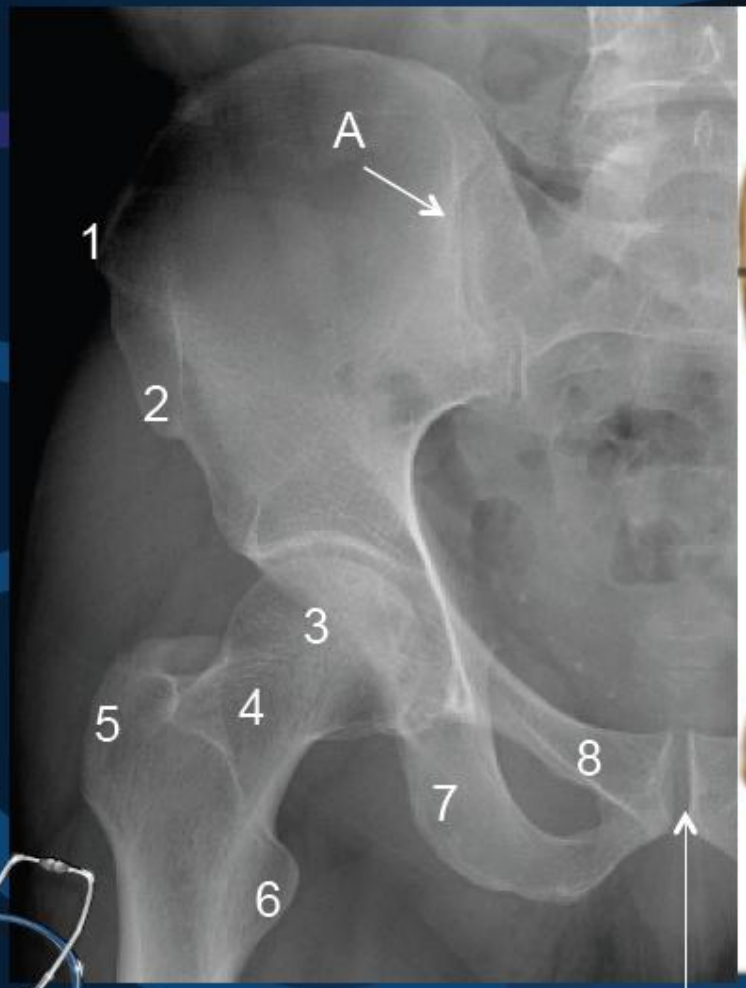


8 Carpal bones : 4 proximal, 4 distal

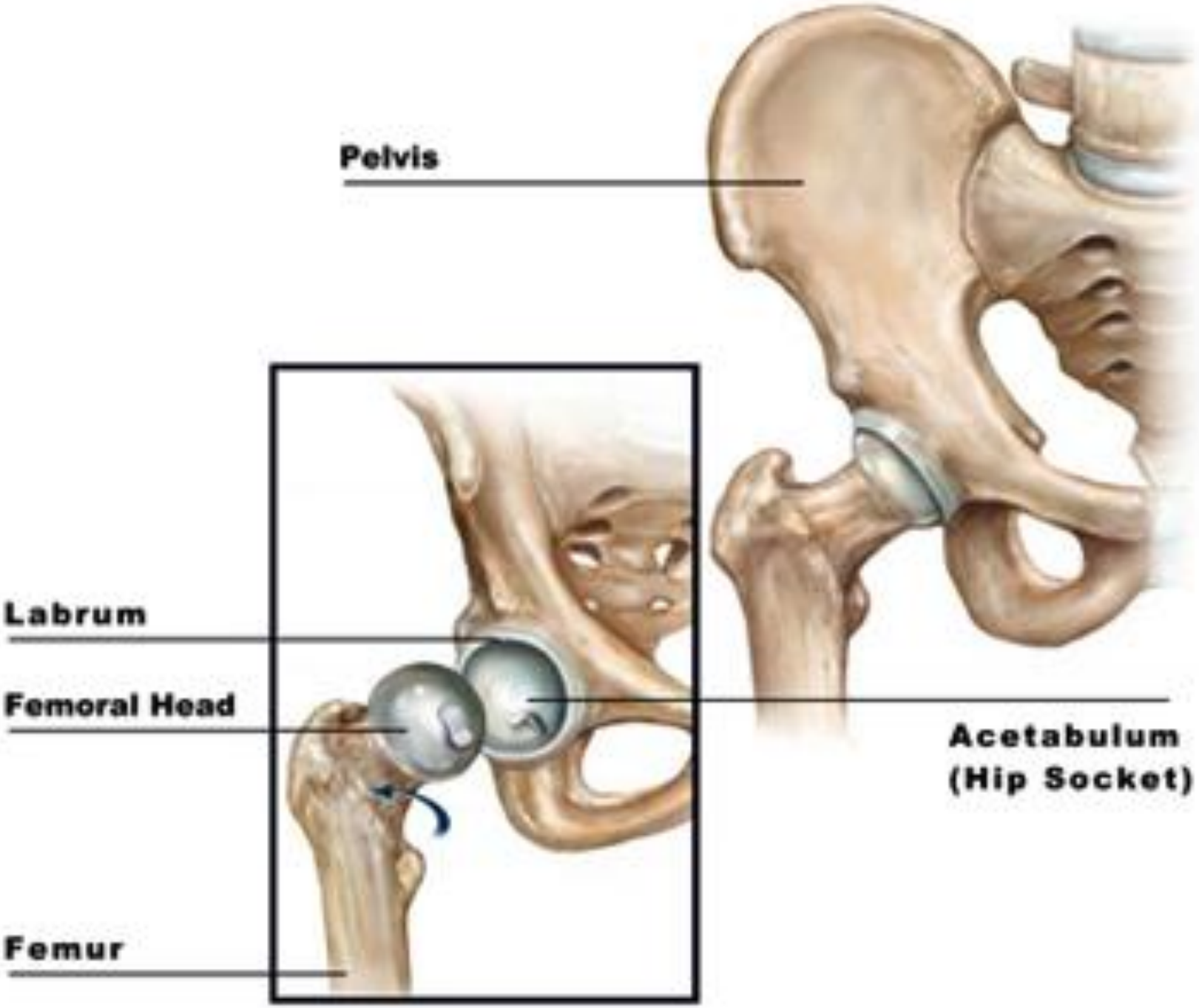
Musculoskeletal Radiological Anatomy



Musculoskeletal Radiological Anatomy

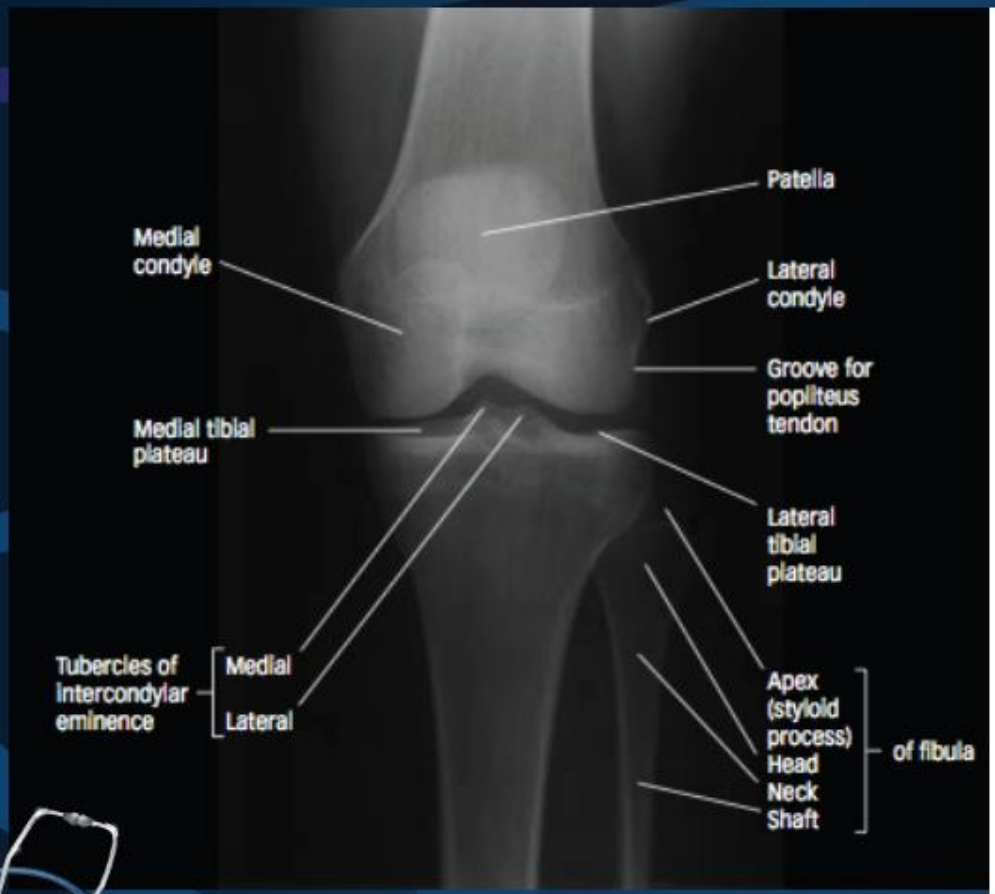


A-Sacro-iliac Joint
B-Symphysis Pubis
1- Superior Anterior Iliac Spine
2- Inferior Anterior Iliac Spine
3- Femur Head
4- Femur Neck
5- Greater Trochanta
6- Lesser Trochanta
&- Ischium
9- Superior Pubic Ramus


Pelvis
Labrum
Femoral Head
Femur
Acetabulum
(Hip Socket)


R

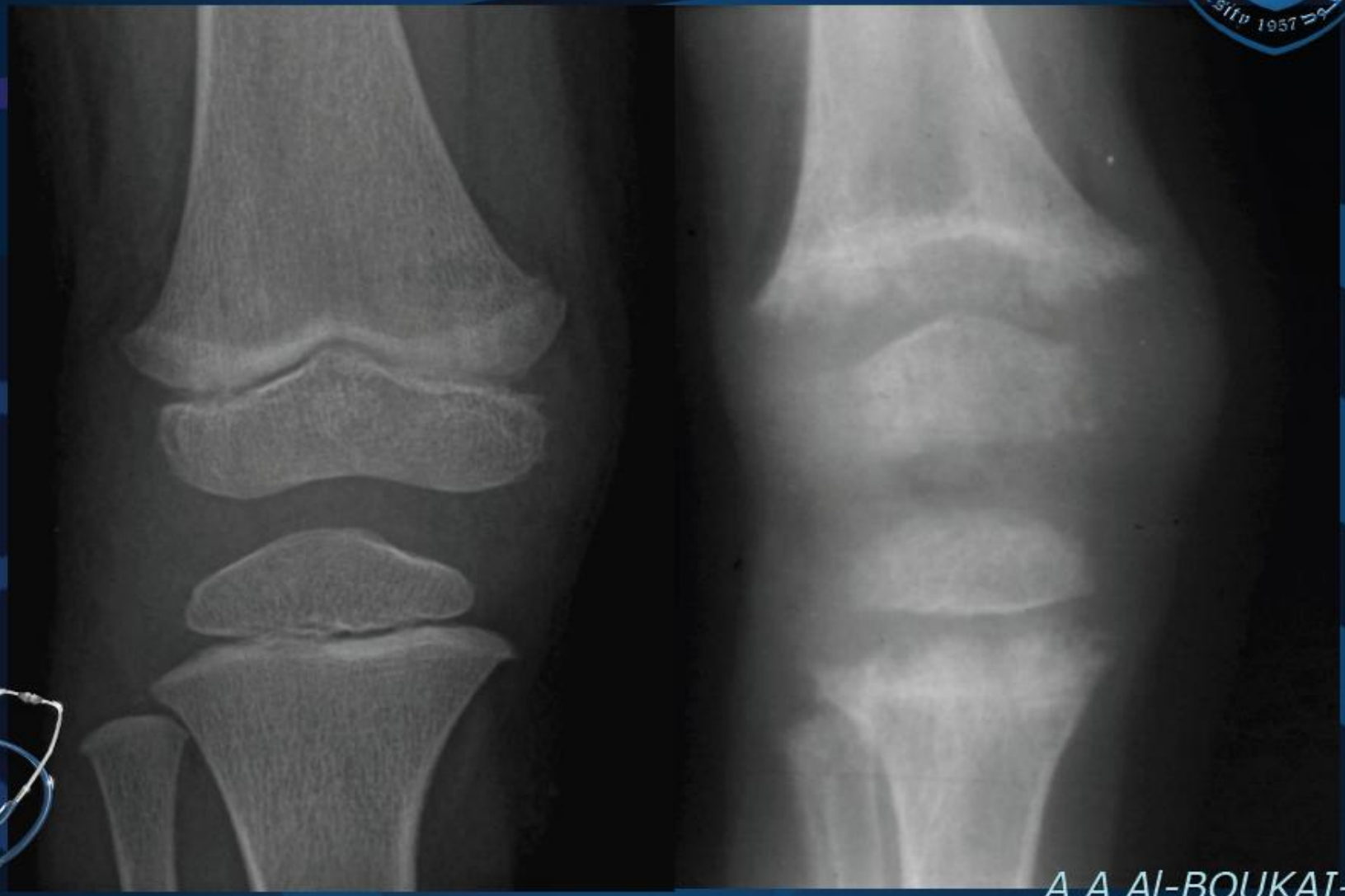
Musculoskeletal Radiological Anatomy



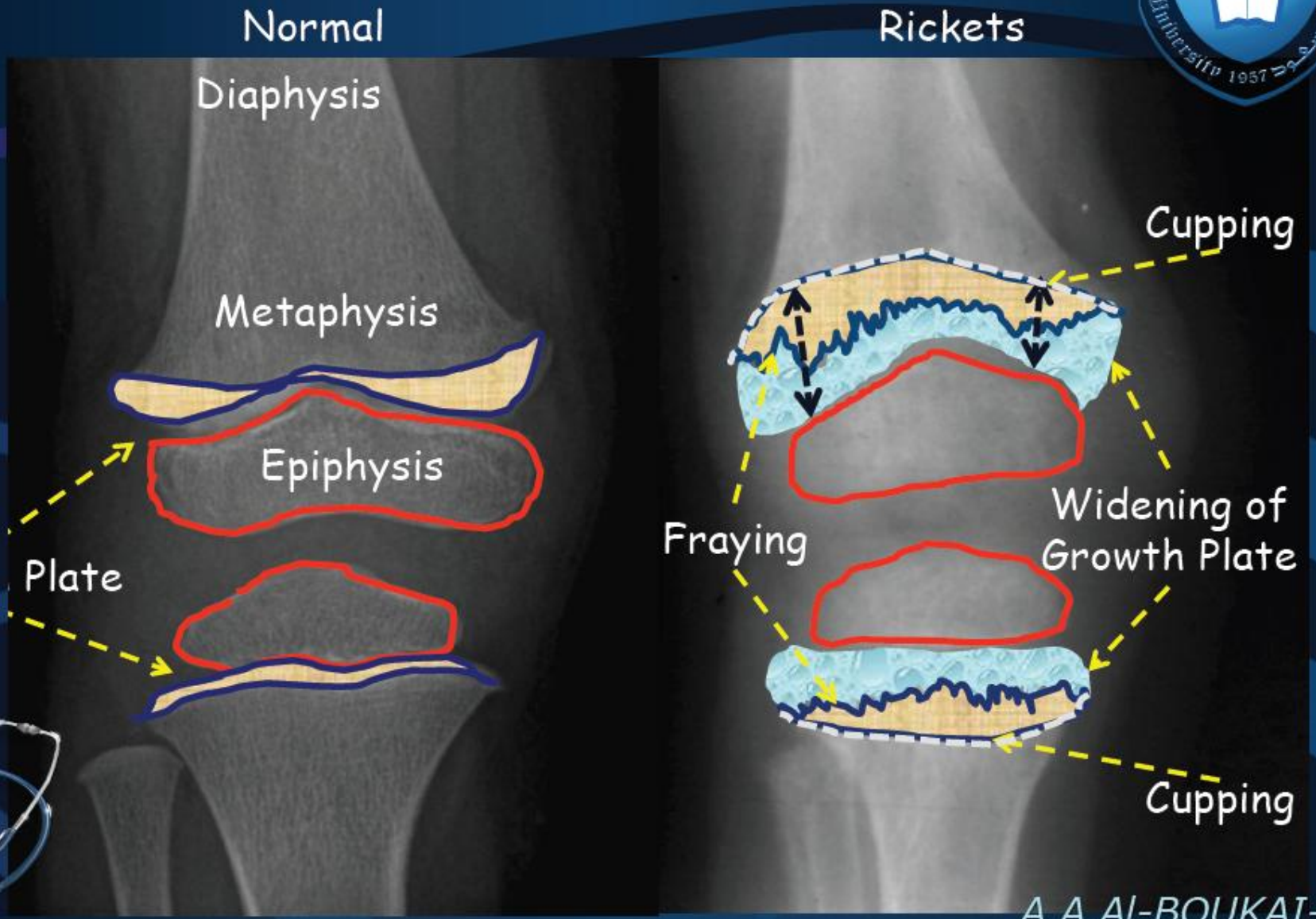
INTERPRETATION

Normal

Rickets



INTERPRETATION



- Borders are not sharp, ill defined
- Trabecule is hazy, hazy texture
- Growth plate is widened
- Metaphyseal margin is irregular
- Cartilage invaginates the bone
- Patella is normally not ossified in a pediatric patient

OBJECTIVES

NORMAL

HYPERPARATHYROIDISM

"Where to look & What to look for" *A A Al-BOUKAI-15*

MUSCULOSKELETAL PATHOLOGY

Congenital

Trauma

Arthritis

Infectious

Metabolic

Hematological

Neoplastic

MUSCULOSKELETAL RADIOLOGICAL TRAUMA

A A Al-BOUKAI-17

BASIC PRINCIPLES IN RADIOLOGY OF BONE TRAUMA

- Two perpendicular views.
- Radiograph should include the joint nearest to the trauma.
- The paired bone concept.
- The weakest link concept (Adult *vs.* Children).
- Comparison films.

Basic Principles

- Two perpendicular views
  - Frontal
  - Lateral
- Paired bone concept:
  - Ex. radius and ulna: if one is fractured check the other
- Weakest link concept: the weakest component in children is the bone, adult is the soft tissue (bone is more consolidated)
  - Adults: The soft tissue structures (muscles/ ligaments/ tendons)
  - Children: The physeal plate (growth plate)

TERMINOLOGY IN BONE TRAUMA

DISLOCATION *vs.* SUBLAXATION

CLOSED vs. OPENED FRACTURES

GREENSTICK *vs.* TORUS FRACTURES

PHYSEAL INJURIES

STRESS FRACTURES

PATHOLOGICAL FRACTURES

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Bone Trauma Terminology

1. **Dislocation:** bones in a joint become displaced or misaligned . It is often caused by a sudden impact to the joint. The ligaments always become damaged as a result of a dislocation.
1. **Sublaxation:** is an incomplete or partial dislocation of a joint or organ. The fracture is partial and intact in some position and displaced.
2. **Closed fracture:** is a broken bone that does not penetrate the skin
3. **Open (compound) fracture:** involve wounds that communicate with the fracture and disruption of overlying skin. May expose bone to contamination
4. **Greenstick fracture:** a fracture that penetrates (perforate) one cortex while the opposite one is still intact (ramifies within the medullary bone). It is an incomplete fracture of a long bone, usually seen in young children.
5. **Torus fracture (Buckle fracture):** is an injury which is insufficient to break the cortex and instead it will produce buckling usually metaphyseal in location. It often results from trabelcular compression from an axial type loading force (along long axis of bone). Usually seen in children, frequently in the distal radius diaphysis or metaphysis.

Bone Trauma Terminology

6. **Stress Fractures:** overuse injuries of bone. These fractures, which may be nascent or complete, result from repetitive sub-threshold loading that, over time, exceeds the bone's intrinsic ability to repair itself . It typically occurs in weight-bearing bones, such as the tibia and metatarsals (bones of the foot). ex. soldiers, high heels (symptom: pain in the forefoot, image: affects shaft and fracture lines are vertical)
7. **Pathological fractures:** are fractures that occur in a bone that is affected by a destructive process that results in altered bone texture and strength. Causes of weakened bone include tumors, infection, and certain inherited bone disorders.

SALTER-HARRIS INJURIES

I II III VI V

8. Physeal Injuries
Salter Harris Injuries

- **SH I:** This fracture typically traverses through the hypertrophic zone of the cartilaginous physis, splitting it longitudinally and separating the epiphysis from the metaphysis.
- **SH II**: The fracture splits partially through the physis and includes a variably sized triangular bone fragment of metaphysis. This particular fracture pattern occurs in an estimated 75% of all physeal fractures, and it is the most common physeal fracture.
- **SH III:** This fracture pattern combines physeal injury with an articular discontinuity. This fracture partially involves the physis and then extends through the epiphysis into the joint .
- **SH IV:** This fracture runs obliquely through the metaphysis, traverses the physis and epiphysis, and enters the joint .
- **SH V:** These lesions involve compression or crush injuries to the physisand are virtually impossible to diagnose definitively at the time of injury. Knowledge of the injury mechanism simply makes one more or less suspicious of this injury. No fracture lines are evident on initial radiographs, but they may be associated with diaphyseal fractures.
- This type has the worst prognosis, because it affect bone growth. Impaction injury: the bone will be fused together, lead to premature closure of growth plate

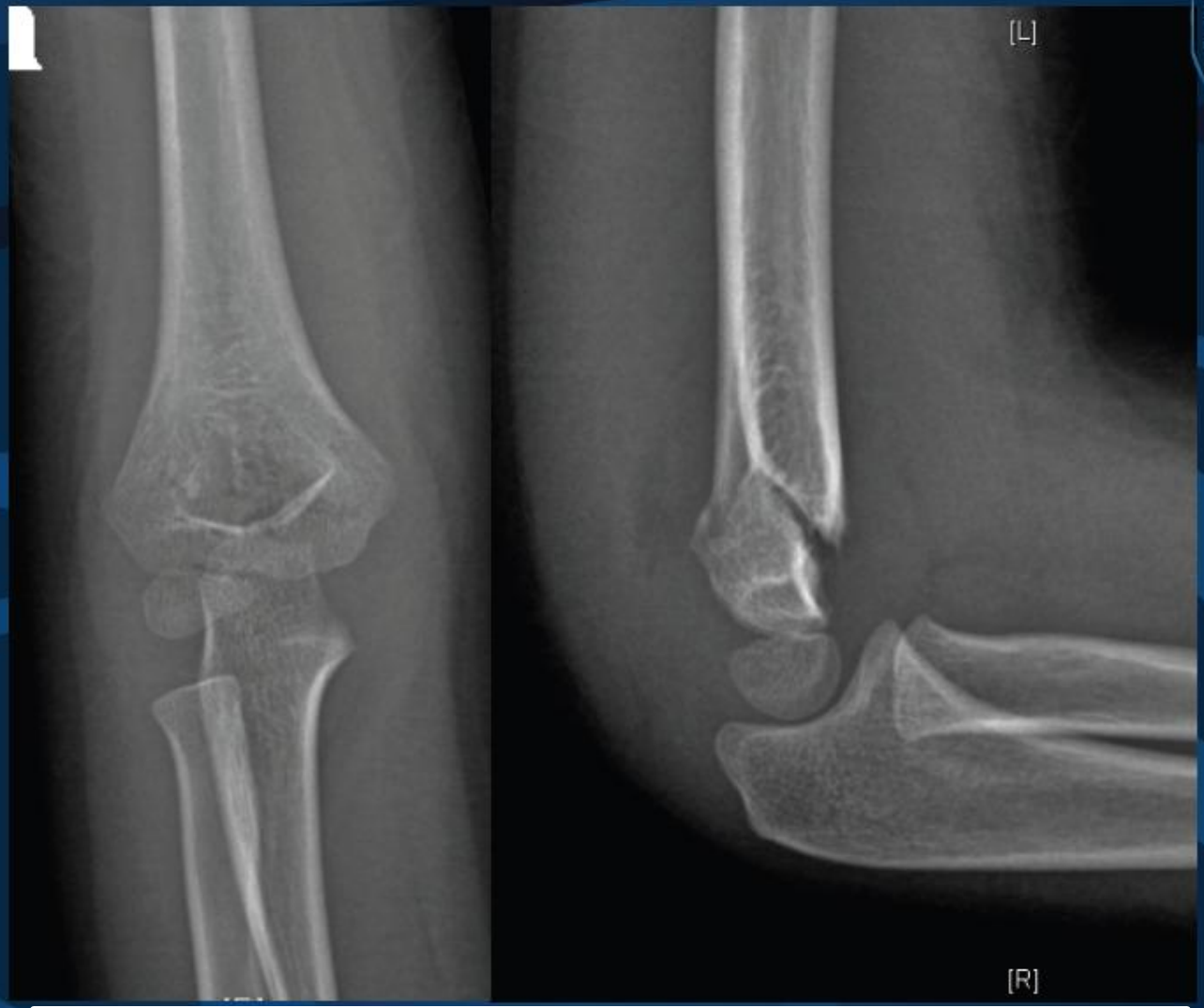
Case: man admitted to the ER with injury to the finger

Frontal view: phalanges of middle finger are not aligned

Lateral view: fracture, dislocation

- Displacement of the ulna
- Frontal view: ulnar misalignments
- Lateral view: dislocation of radial and ulna and displacement

Case: Child presented ER with history of trauma, swelling of elbow joint

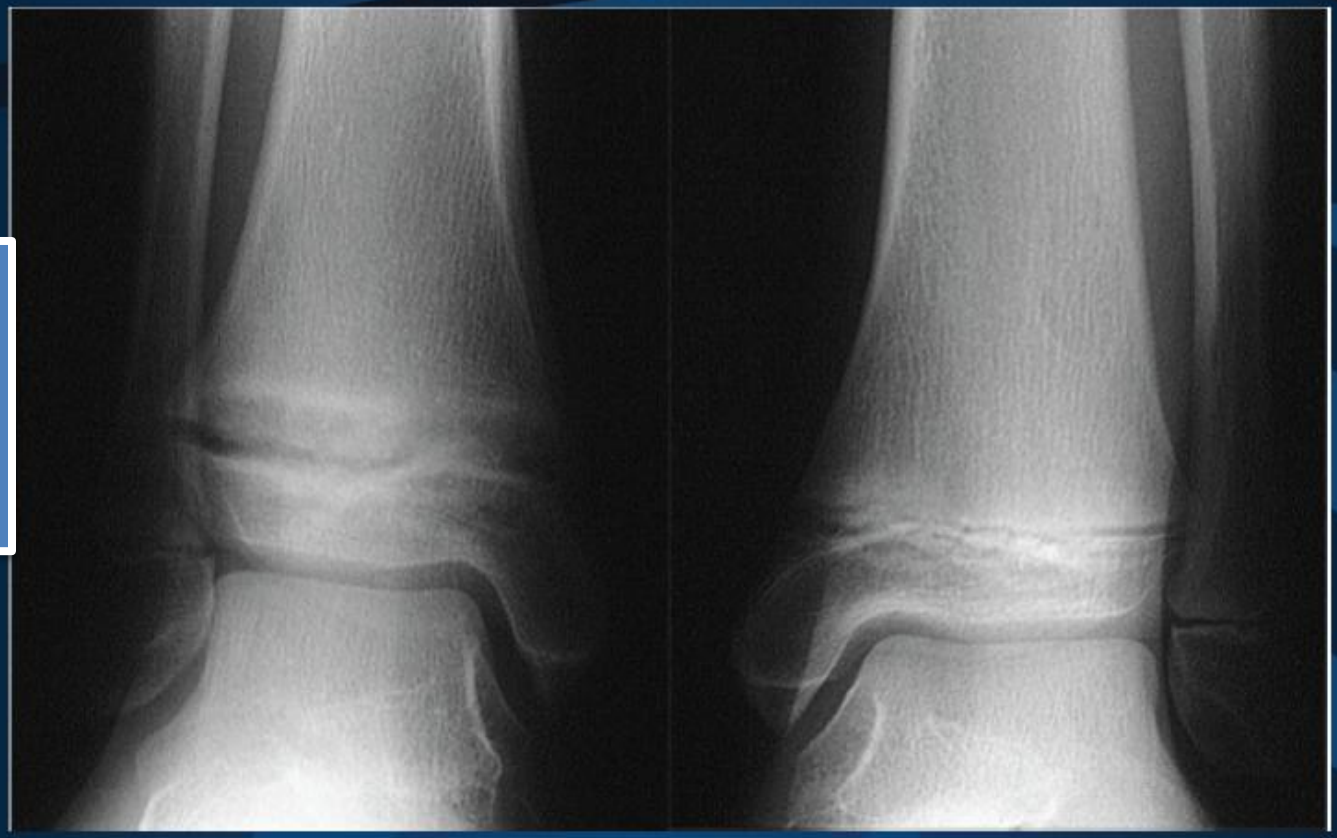


Frontal: fracture
Lateral: one side, greenstick fracture, opposite side is intact

SALTER-HARRIS INJURIES

I II III VI V

Salter-Harris 1 Normal



- Wide and irregular growth plate
- Type 1 (separation)

Traumatic Osteolysis of epiphyseal plate
Salter-Harris injury Type1

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Salter-Harris 1 Normal

Traumatic Osteolysis of epiphyseal plate
Salter-Harris injury Type1

11years old boy with swelling of wrist pain

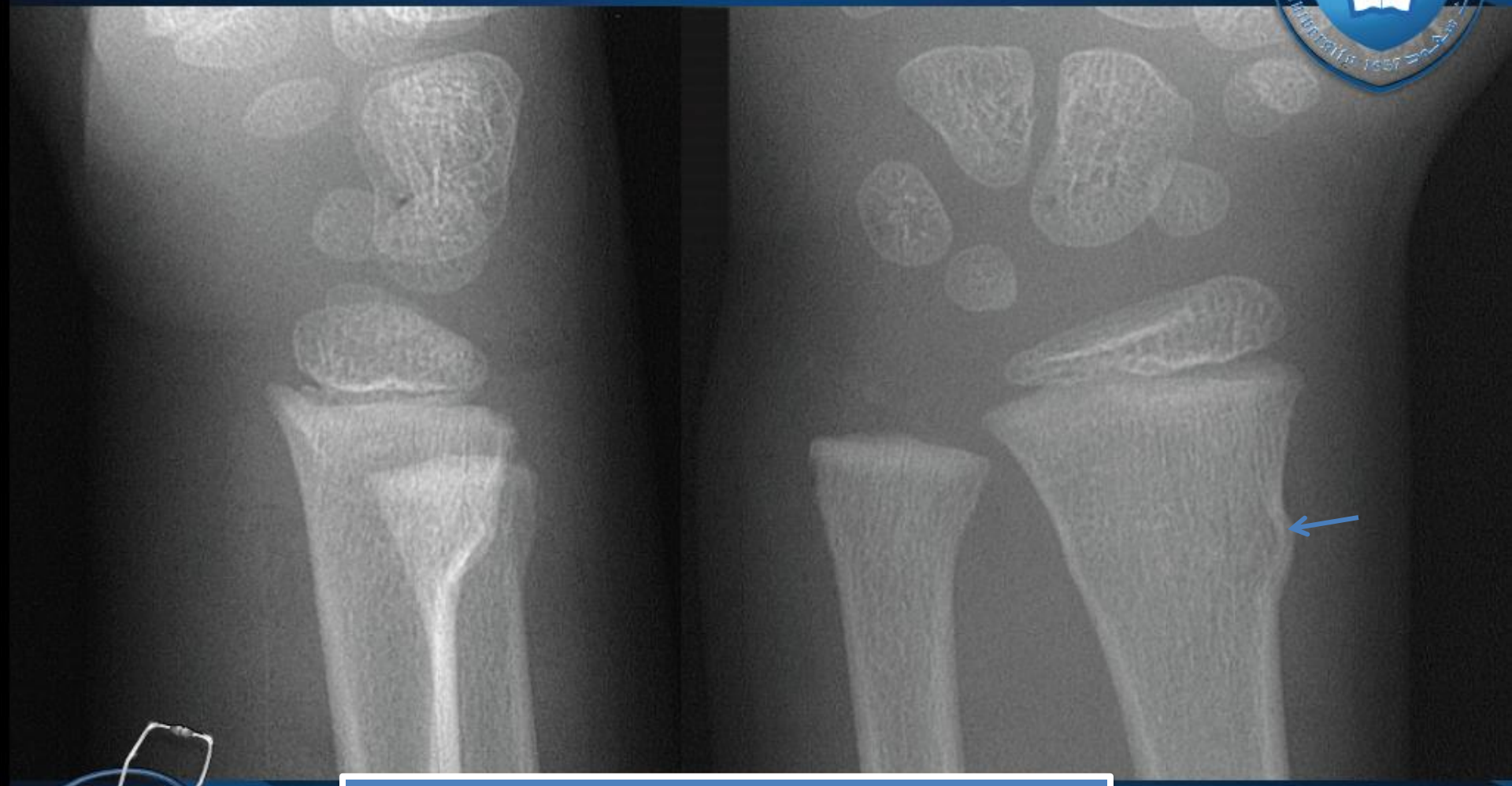
- Type 2 avulsion of the metaphysis
- Avulsion of the metaphysis
- Most common type

Growth plate injury (Salter-Harris injury type II)

9years old boy with pain

- Length of the finger, right side middle finger has disturbed growth
- Epiphyseal plate is invaginated inside
- Type 5

Salter-Harris injury Type V



- Torus fracture
- Margin of the radius, minimal change
- Cortical bending/buckling
- Due to longitudinal force opposing each other

Greenstick fracture

radius is fractured and ulna is bent

Bowing Fracture

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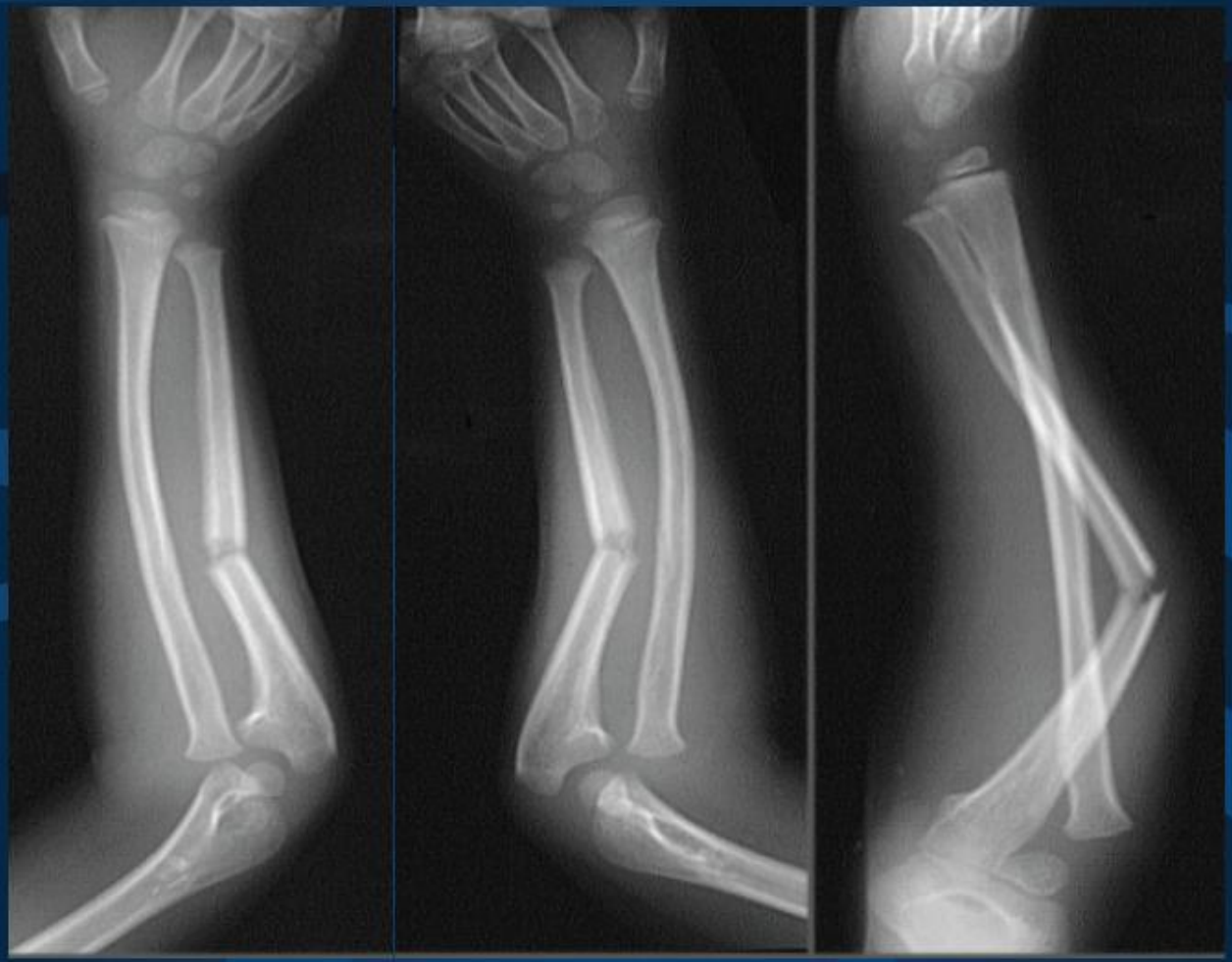
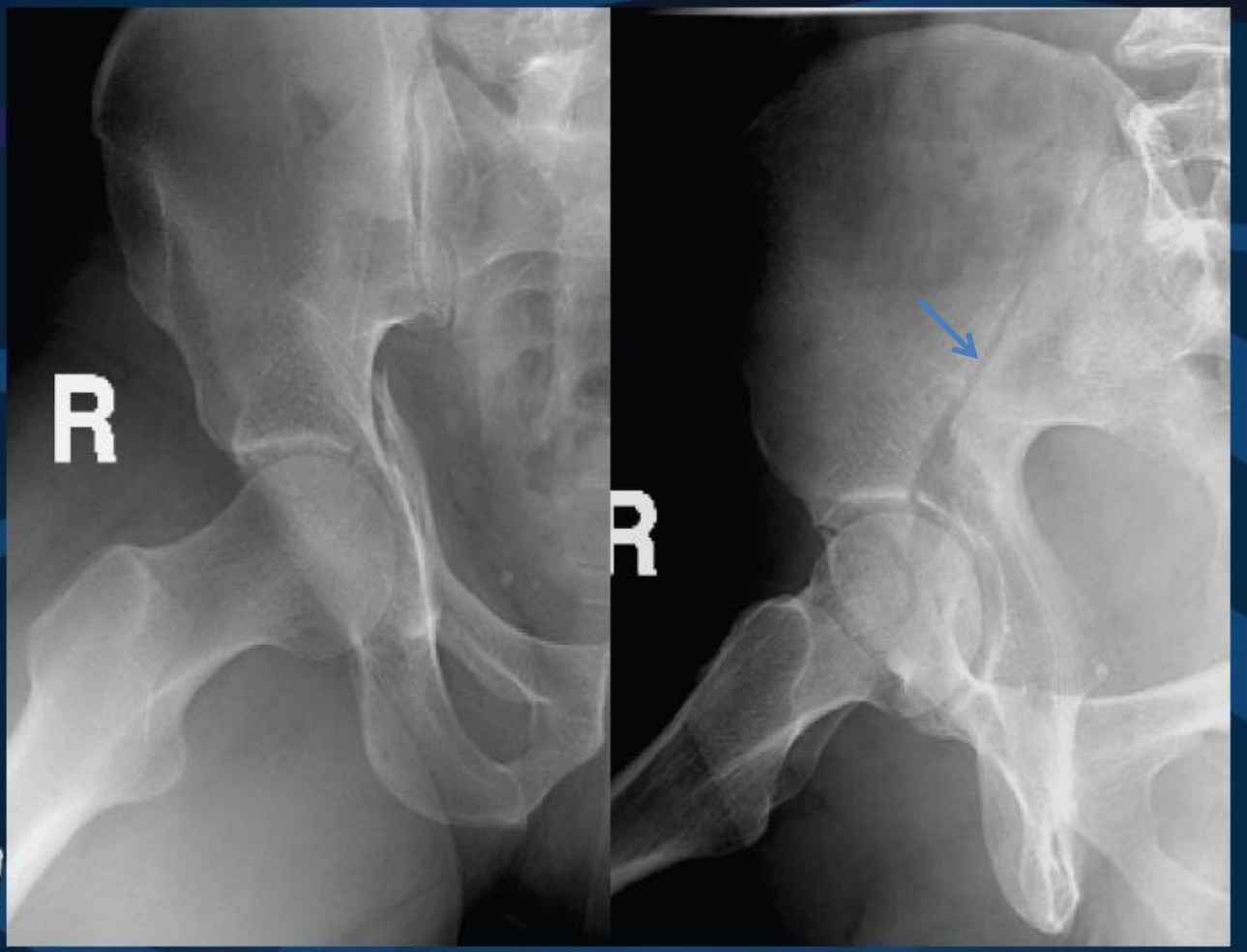


55 years old patient limping with hip pain

Supra-acetabular fracture

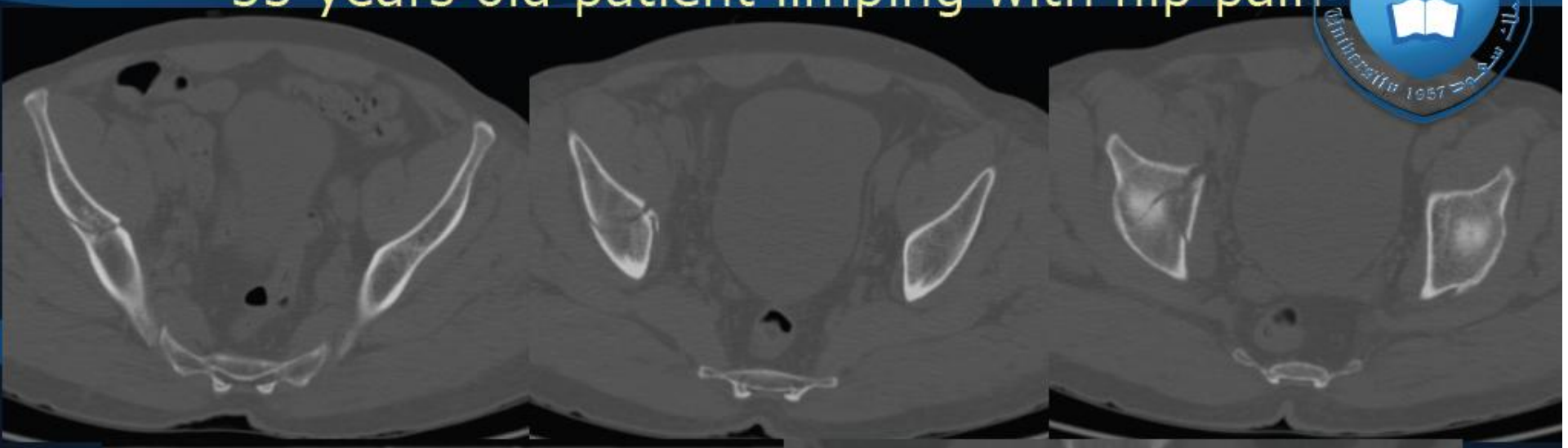
55 years old patient limping with hip pain



Supra-acetabular fracture

CT: Axial and Coronal
Continuous pain and damage if bone is not removed

55 years old patient limping with hip pain



Supra-acetabular fracture

A A Al-BOUKAI-35

50 years old patient limping with hip pain

Supra-acetabular fracture

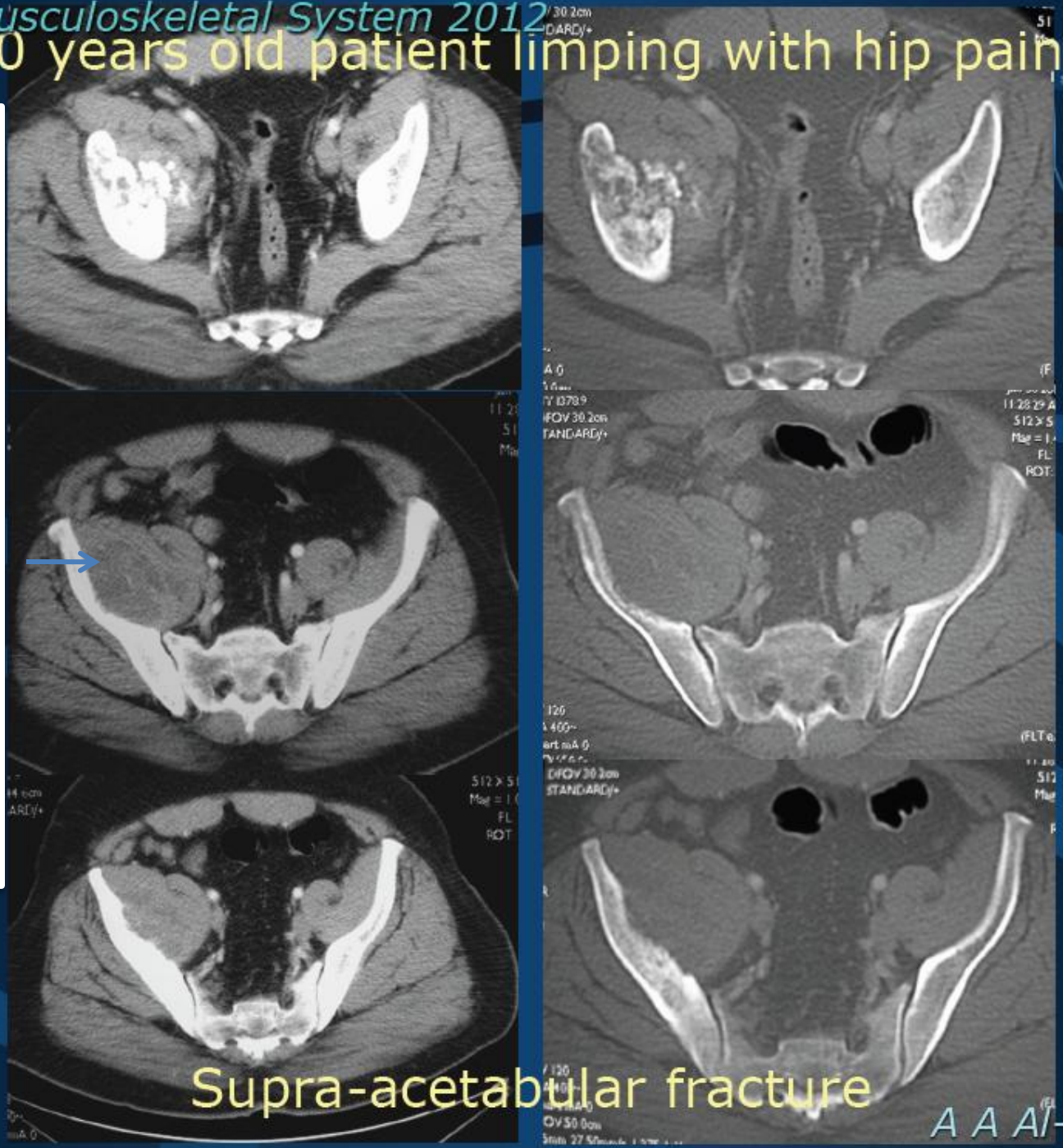
A A Al-BOUKAI-36

50 years old patient limping with hip pain

Supra-acetabular fracture

50 years old patient limping with hip pain

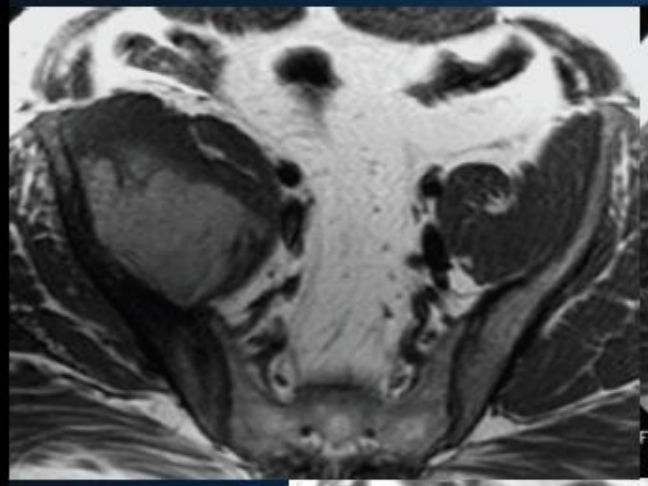
- Bone window: bone is abnormal
- Soft tissue window: mass on right
- Pathological fracture: tumor associated with soft tissue involvement, sarcoma of the bone led to the fracture

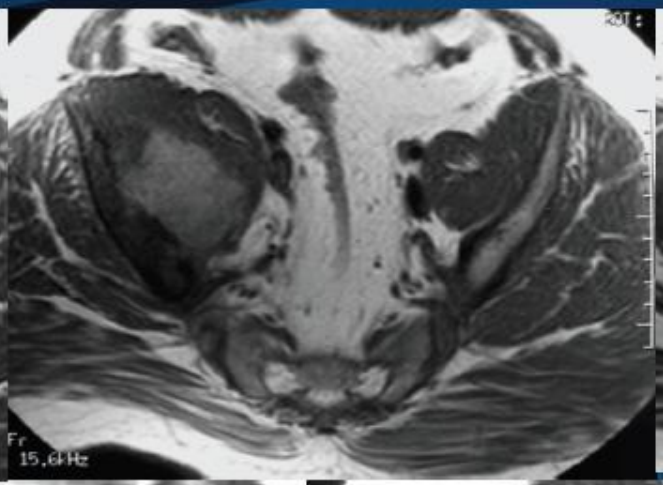


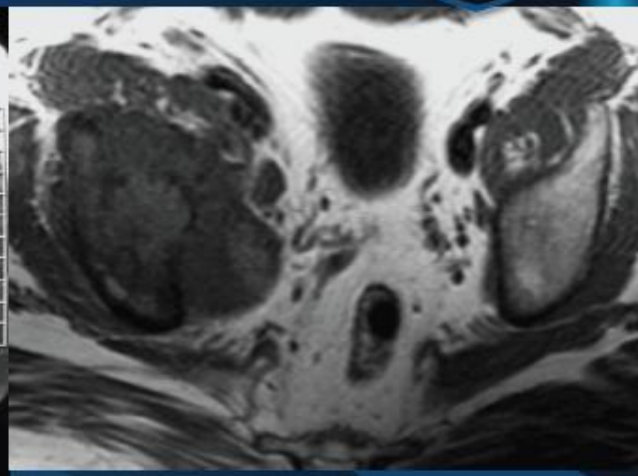
Supra-acetabular fracture

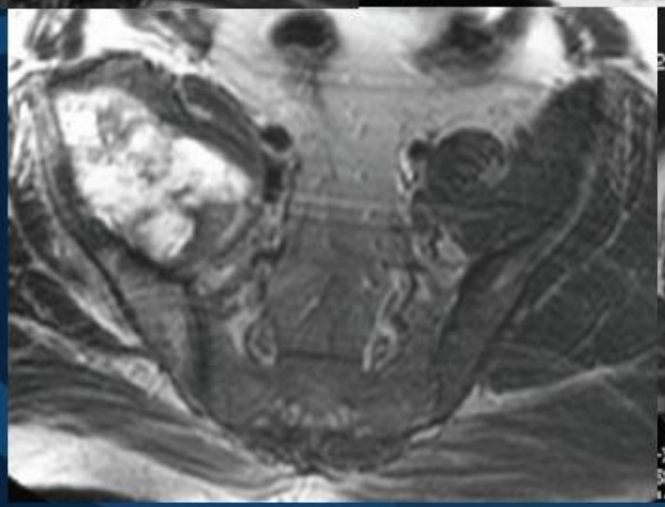
A A Al-BOUKAI-38

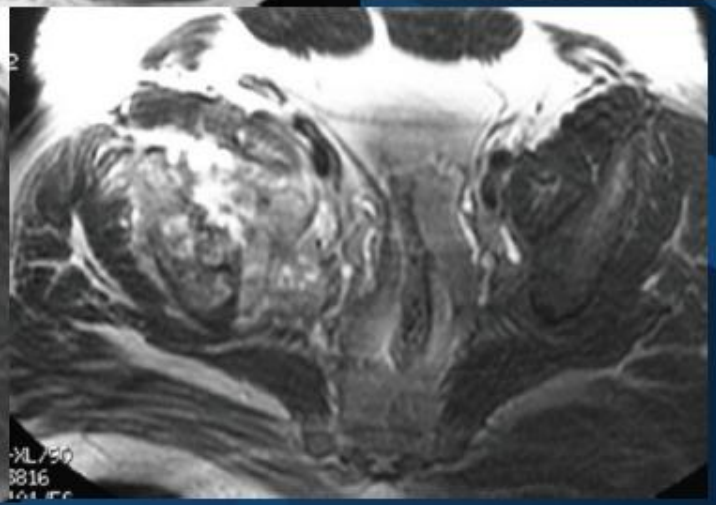
50 years old patient limping with hip pain









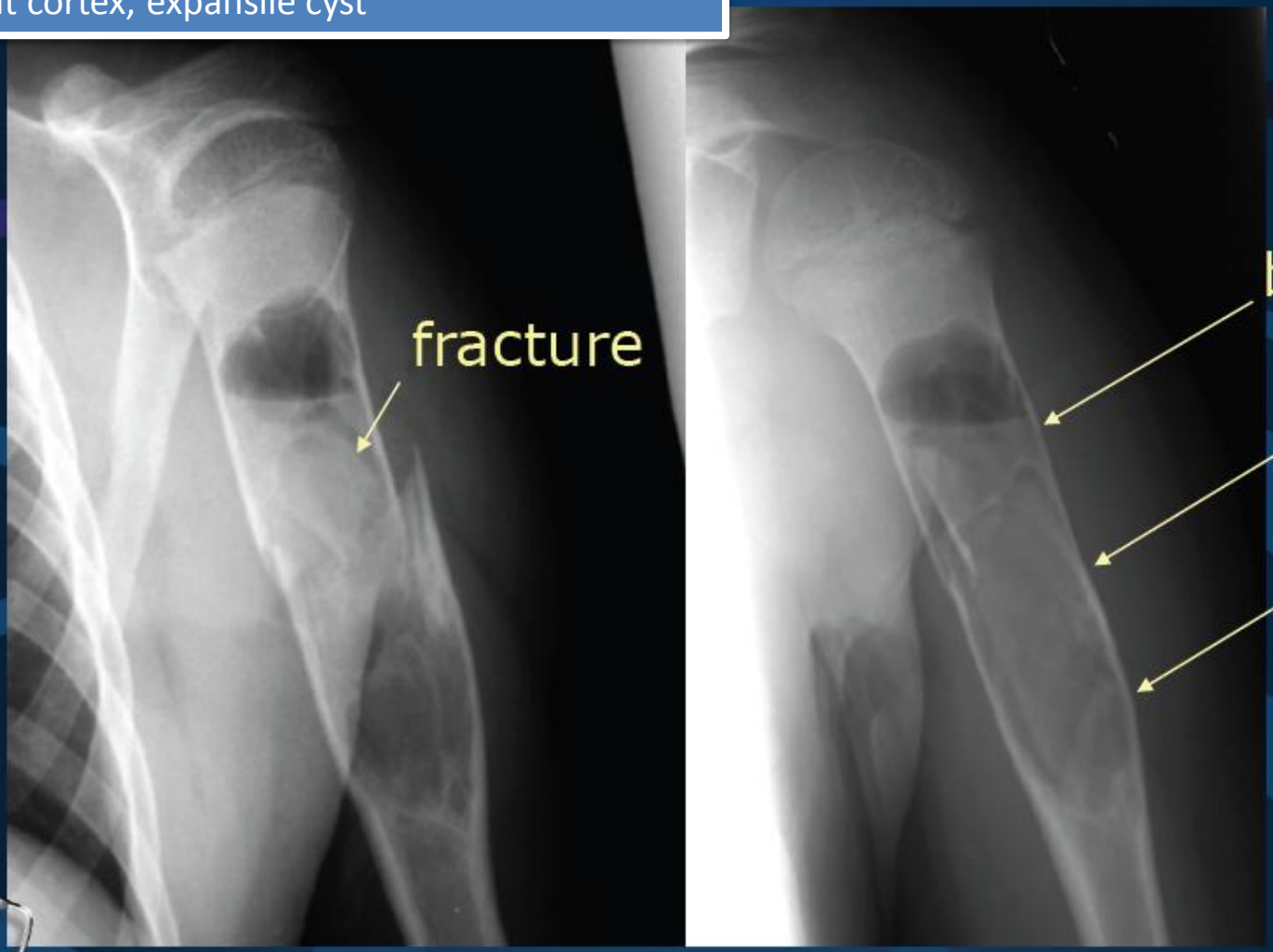


Supra-acetabular fracture !!

50 years old patient limping with hip pain

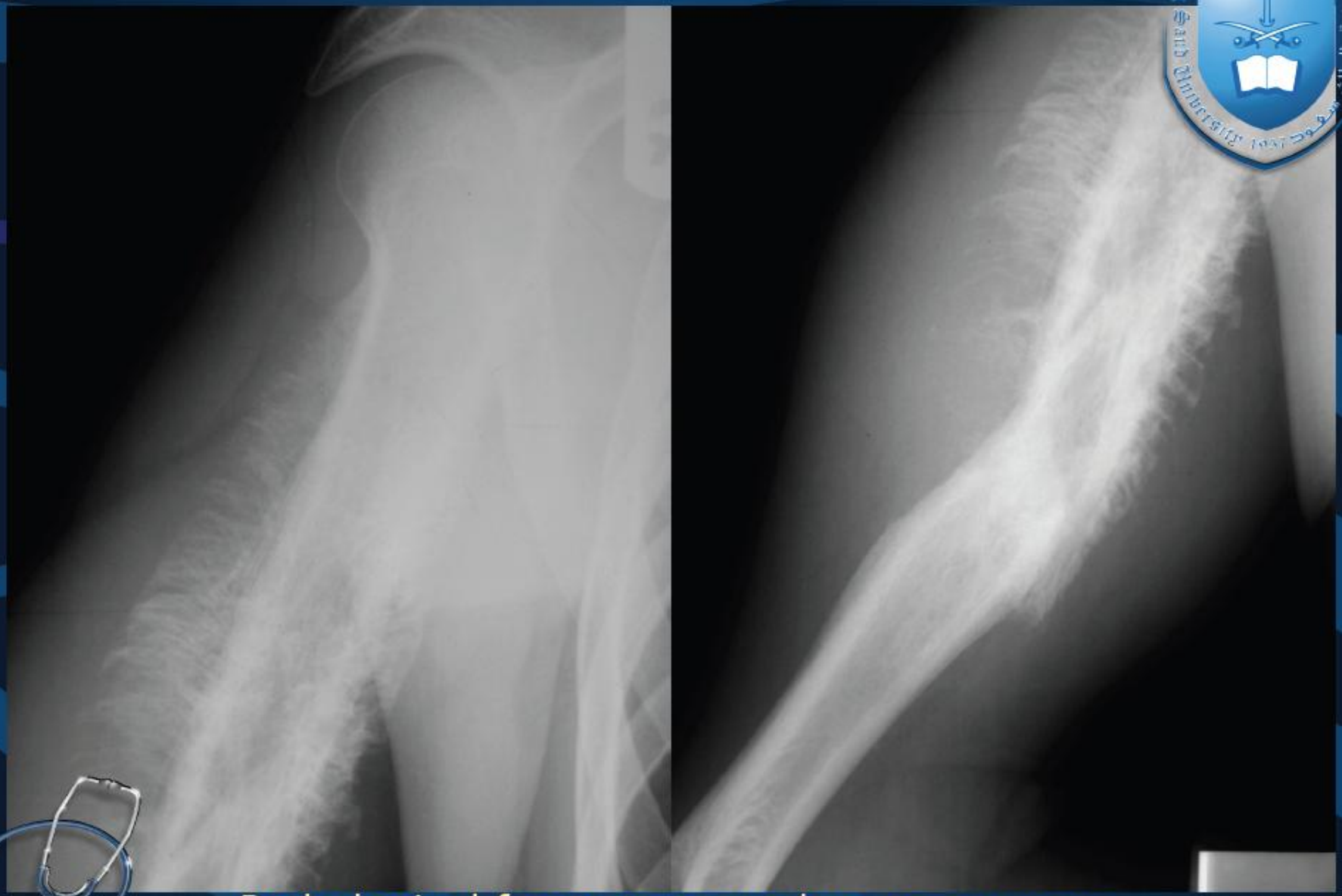
Pathological fracture secondary to sarcoma

Rotation:
- Fracture line is clearer
- Pathological fracture
- Thinned out cortex, expansile cyst



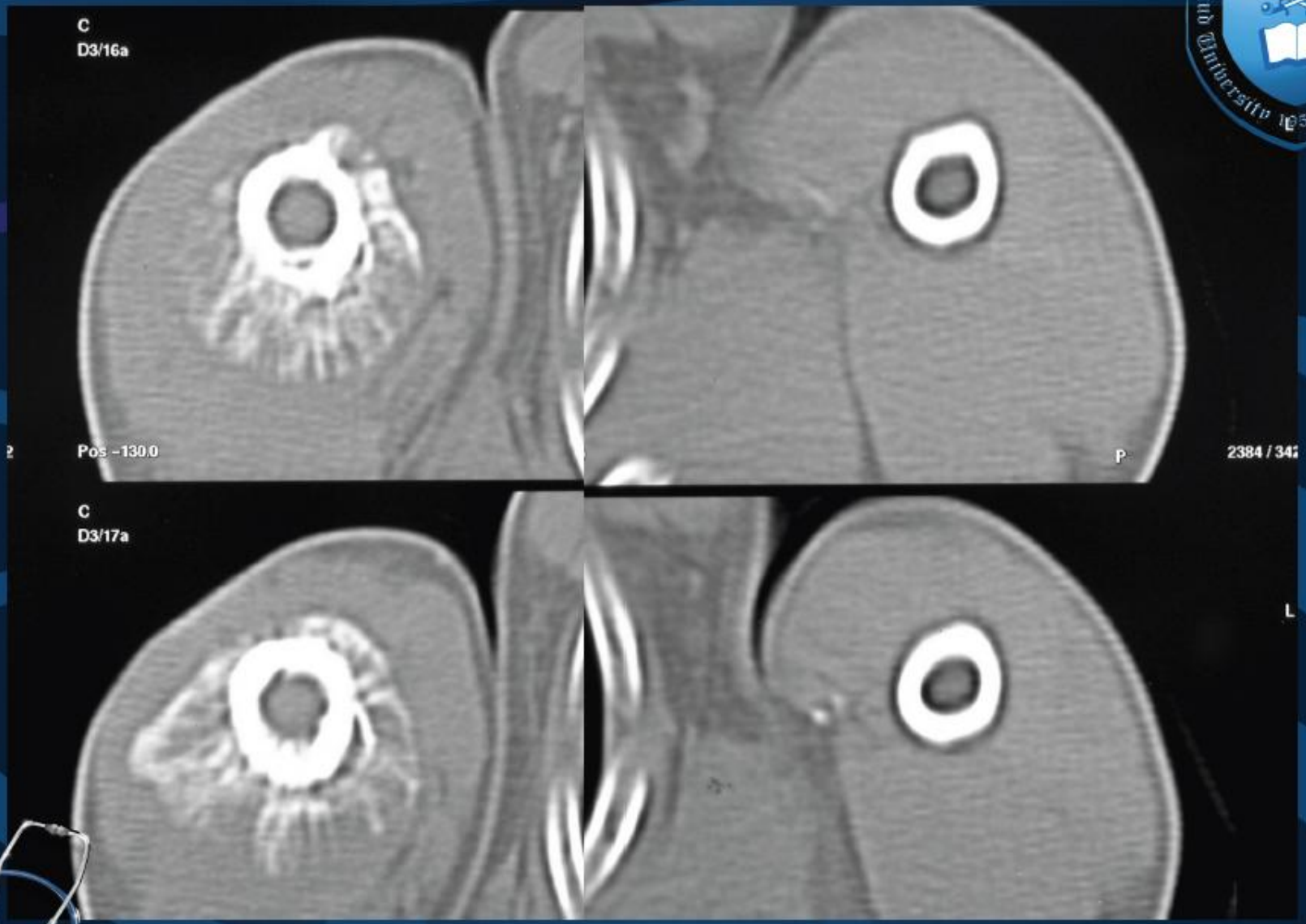
Pathological fracture secondary to bone cyst

20 Years old lady finger pain



Pathological fracture secondary to sarcoma

Ewing Sarcoma: sunburst appearance


C
D3/16a
Pos -130.0
P
2384 / 342
C
D3/17a
L

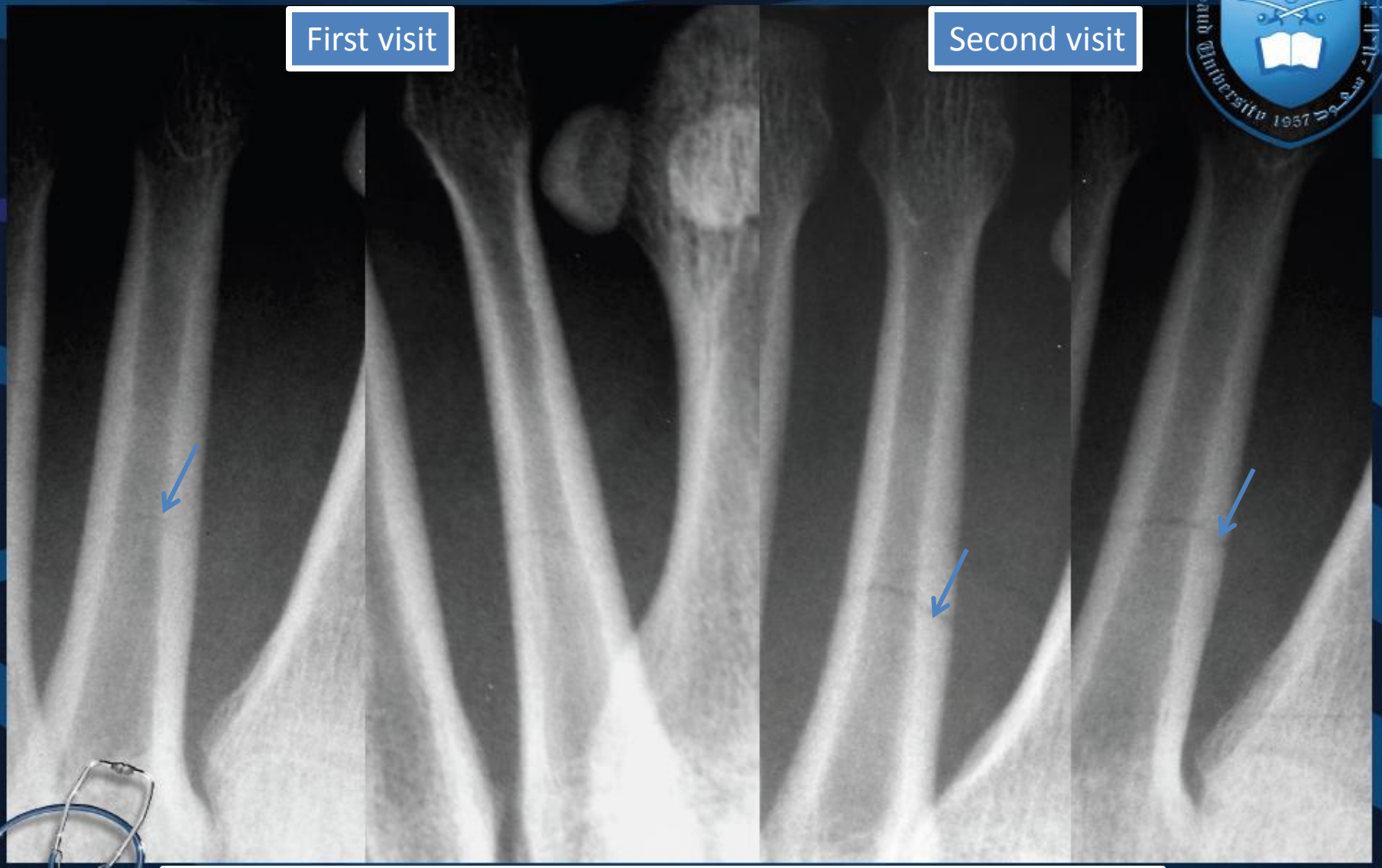
Stress fracture

Soldier complaining of pain of the forefoot
The patient was discharged without treatment

Stress fracture

The previous patient returned with worsening pain in the forefoot

Stress fracture after one week



Magnified image shows vertical stress fractures on the mid-shaft

Extra

- For more cases, visit this website:

http://radiopaedia.org/encyclopaedia/cases/musculoskeletal

- More images: http://radiopaedia.org/articles/musculoskeletal-curriculum

THANKS