



**Radiology**  
Team 438

# Radiology of Rheumatic Diseases

## Lecture 16

### Objectives



- ❖ Understanding basics of image formation and anatomical landmarks
- ❖ Developing system of analyzing findings:
  - Where to look “important site”
  - What to look for” bone density & texture, bone marrow ,articular cortices ,soft tissue”
- ❖ Recognizing imaging features axial spondyloarthritis
- ❖ Introduce Imaging approach to skeletal trauma and Identify important findings including sequelae and complications.
- ❖ Introduce Imaging approach to skeletal inflammatory process “arthritis” and Identify important findings including sequelae and complications

Color Index:

♦ Important

♦ Doctor's Notes

♦ Extra

♦ Female slides

♦ male slides

### Team Leaders



Omar Aldosari



Leena Alnassar



Shahd Alsalamh

Done by:

Faisal Alqifari

## Pathological fracture

- ❖ Green stick & Torus fractures (usually in pediatric).
- ❖ Physeal injuries (usually in pediatric).
- ❖ Stress fractures (Occurs in patient with repeated minor trauma in certain area, it affects normal bones with excessive stress).

## Describe Fracture Alignment

- ❖ Dislocation vs. Subluxation in dislocation there's disturbance of the alignment of the joint (extension, flexion, rotation), while subluxation is partial displacement.
- ❖ Displaced / Non-displaced.
- ❖ Angulated
- ❖ Depressed.

## Describe Fracture Location

- ❖ Diaphyseal / Metaphyseal.
- ❖ Peri-articular / Intra-articular.

## Describe Fracture Severity

- Open vs. Closed the overlying skin
- ❖ Simple.
- ❖ Comminute / Segmented segmented refers to large fragments of the fracture while comminuted is multiple tiny fractures.

## » important concepts in imaging bone trauma

- ❖ Two perpendicular views (because the bones are cylindrical).
- ❖ Radiograph should include the joint nearest to the trauma.
- ❖ The paired bone concept: when we suspect a fracture in an area with two bones (such as forearm) we should look for both radius and ulna.
- ❖ **The weakest link concept** (Adult vs. Children) In adult the soft tissues are weaker while in children the bones are weaker.
- ❖ Comparison films A normal radiographic film to compare it with the abnormal film.

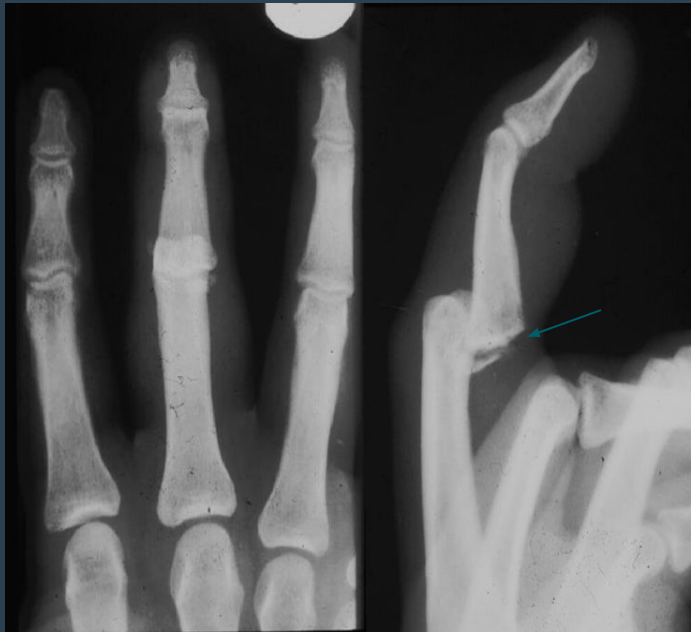
## » the weakest link

- ❖ **The weakest link:**
  - The soft tissue structures (muscles / ligaments / tendons) in Adults
  - the physeal plate an anatomical landmark within the bone (growth plate) in children.

# Two perpendicular views

frontal

lateral



Malalignment and displacement  
 Not apparent on frontal view but  
 very clear on lateral view  
 Arrow: chip fracture

lateral

frontal

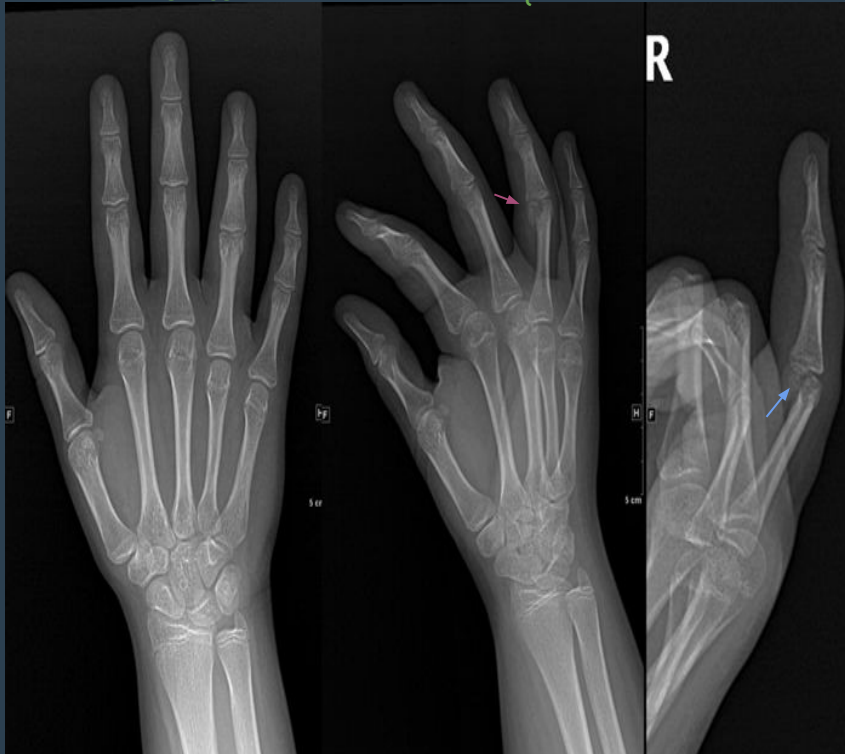


A 6 YO boy with trauma  
 Arrow: obvious fracture line  
 Not obvious on the frontal view

frontal

Oblique

lateral



Frontal view looks normal  
 Oblique view shows fracture and  
 displacement  
 Lateral view shows anterior angulation

Right

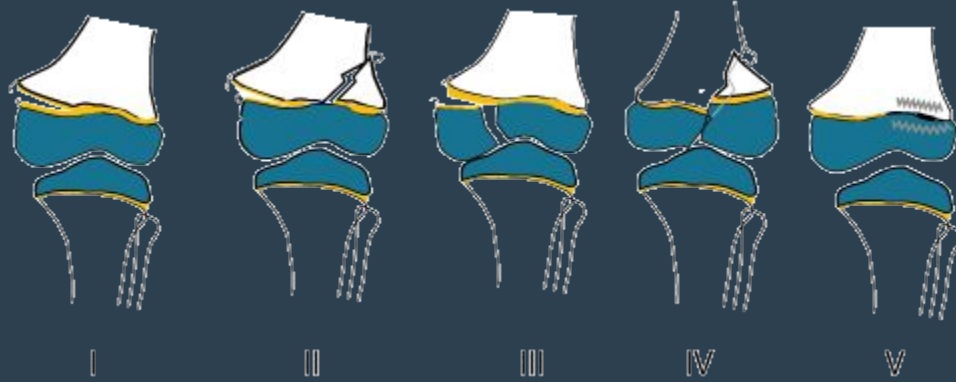
left



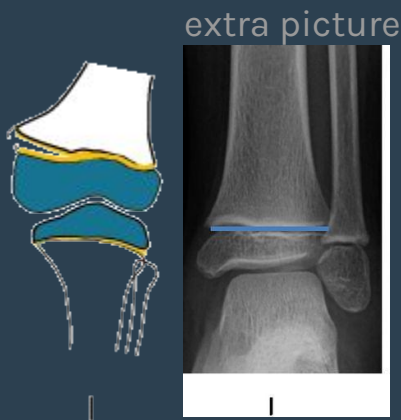
as if they are aligned in one axis  
 (arrow)  
 Total dislocation (arrow)

# Physeal plate Injury

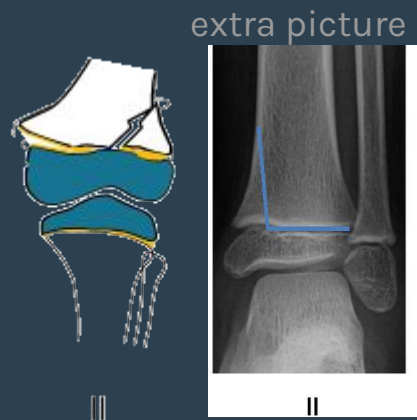
## » physeal plate (growth plate) injury (other name: salter-harris)



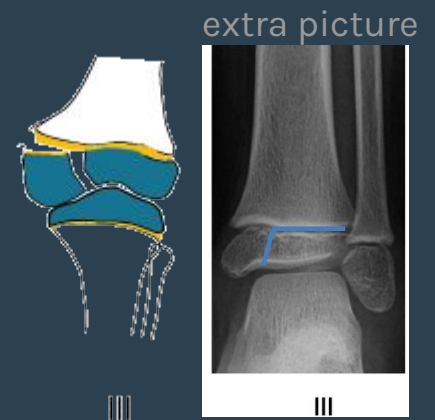
weakest point (child)



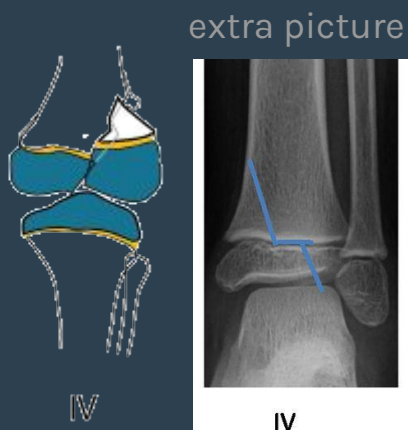
I- Avulsion or adduction or separation, widening of growth plate.



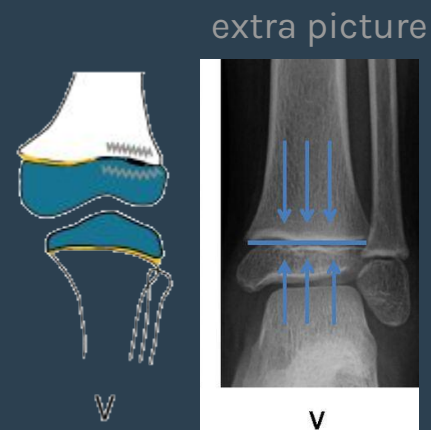
II- widening of the growth plate with a fracture on metaphyseal shaft. (Most frequently seen).



III- Fracture of epiphysis.

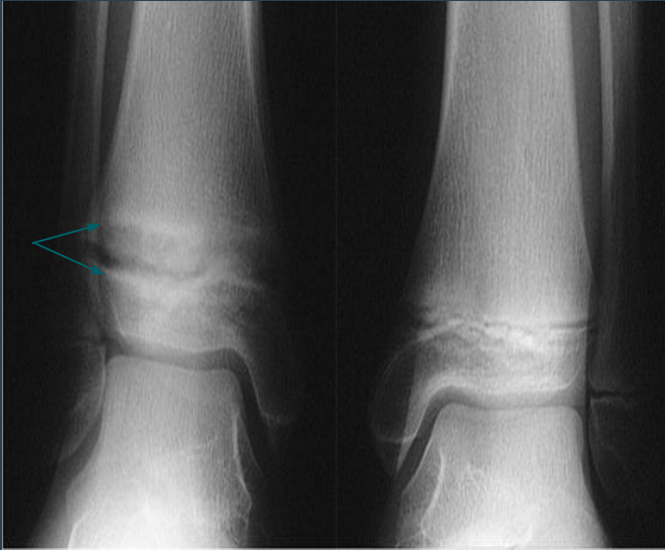


IV- When both II and III combined in one injury.



V- Impaction instead of separation. with force directed opposite to each other, for example child jump from high to floor it can alter the growth of the bone (the worst prognosis)

## » Salter-Harris injury type I :



Widened growth plate

normal



Widened growth plate

normal

## » Salter-Harris injury type II :

11 years old boy with swelling of wrist pain.



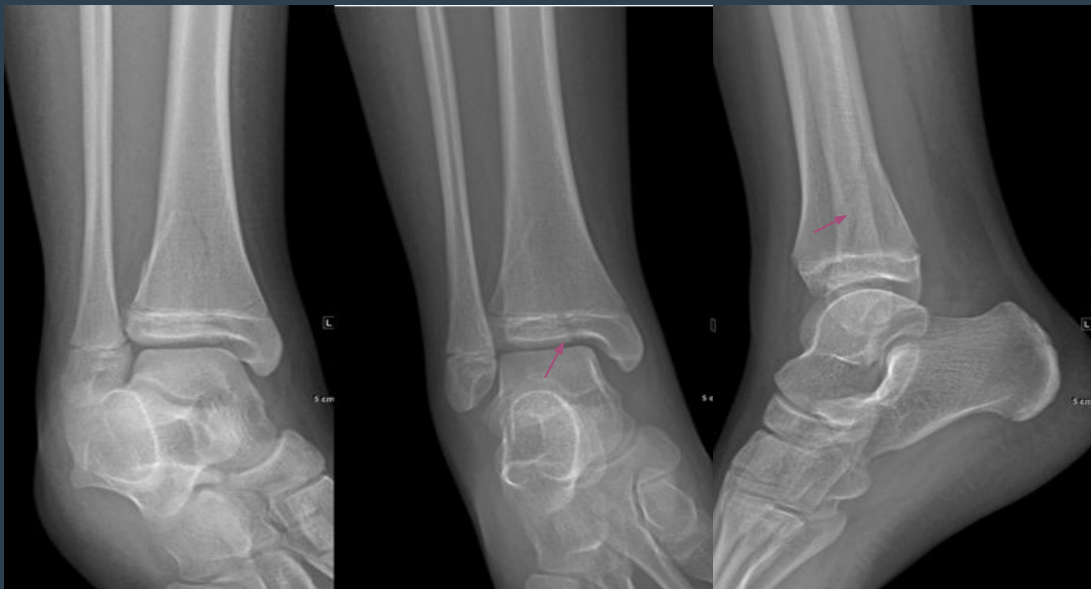
Not closed yet

small piece of separated bone

soft tissue swelling

## » Salter-Harris injury type IV :

A 12 year old girl fell down



Oblique

frontal

lateral

fracture in the epiphysis (arrow)

## » Salter-Harris injury type IV :

12 year old girl fell down.

Computed tomography delineate more clear



it's IV because of the extension into the metaphysis (arrow)

## » Salter-Harris injury type V :

Short finger  
a complication

A 9 year old boy with pain in his right hand.

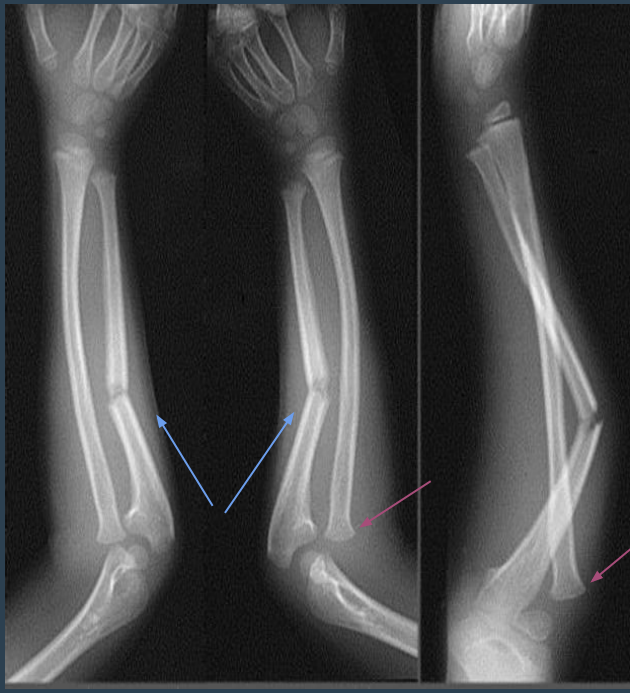


Old Fracture  
growth plate is  
lost

Short middle finger because of An old insult in the physeal plate → premature closure of the physeal plate (impaction) → shortening of the bone. So any fracture in growth plate (physeal fracture) results in Salter-Harris injury type V.

## » paired bone concept

radiograph should include the joint nearest to the trauma and paired bone concept  
there are 4 paired bones: radius and ulnar, tibia and fibula. if one breaks it becomes shorter  
The other bone will either fracture or dislocate or bow. so, it's important to look at both bones (paired bone concept)



Fracture Ulna & Dislocated Radius

radial and ulnar are fixed by two joints  
the wrist and the elbow.

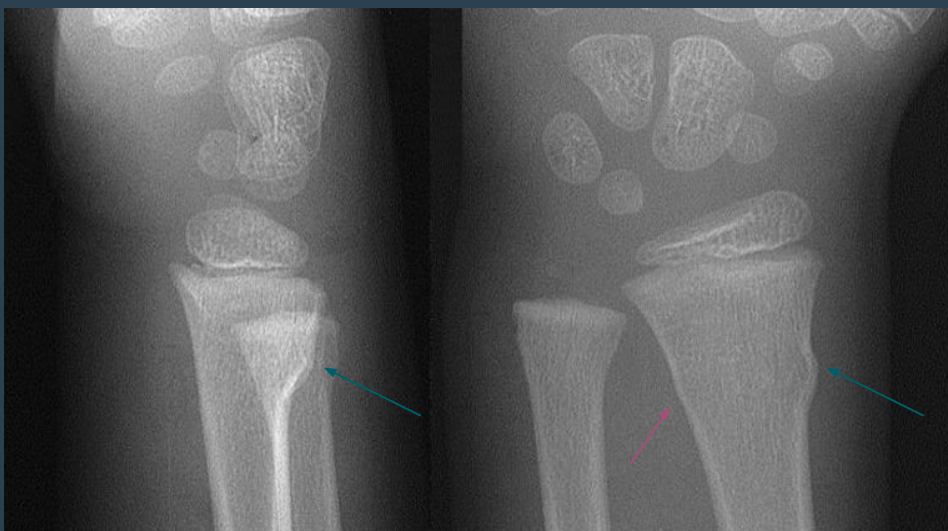


Bowing fracture ulna & fractured radius

radial shaft fracture (arrow), so what happened to the ulnar? it became curved (arrow)

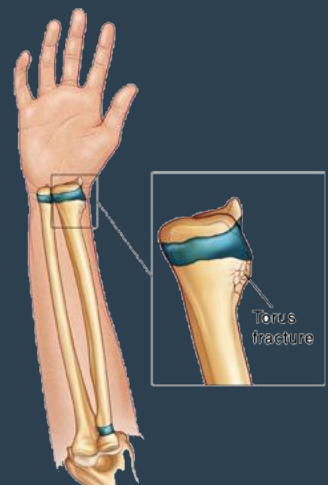
## » torus fracture

seen in children



cortical bending (arrow)  
mild on the other side (arrow).

extra picture



circumferential bending

## » Greenstick fracture (In paediatric)

there is involvement of one side of the bone while the opposite side is intact



looks normal  
could be  
missed



it's clear on the lateral view  
disruption of the  
cortex (arrow)



Fracture (arrow)  
intact (arrow)



wow, such empty



## » Pathological fracture

a diseased or weak bone, any minor trauma can lead to disruption

Fracture occurs in a diseased bones like :

1

enchondroma.

2

Bone cyst

3

osteosarcoma

## » fracture secondary to enchondroma

1



Fracture (arrow)

cortical thinning (arrow), lytic lesion (arrow)

Enchondroma is a type of benign bone tumor that originates from cartilage. Most often it affects the cartilage that lines the inside of the bones.

Notice the osteolytic (blackish) circular lesion, it led to the small fracture after the bone became weaker.

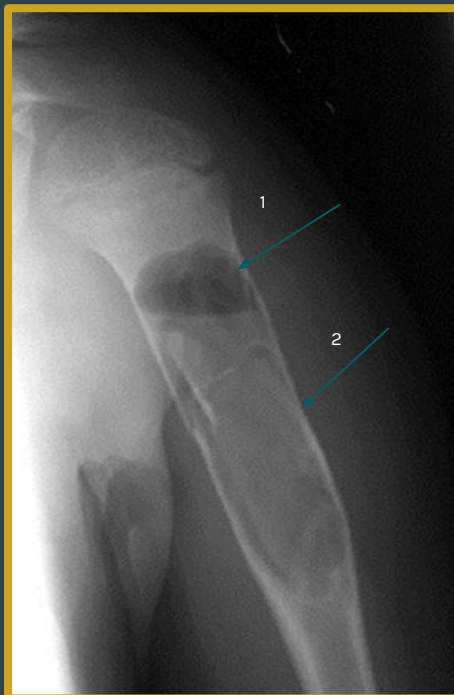
## » fracture secondary to bone cyst

occurs in disease more

2

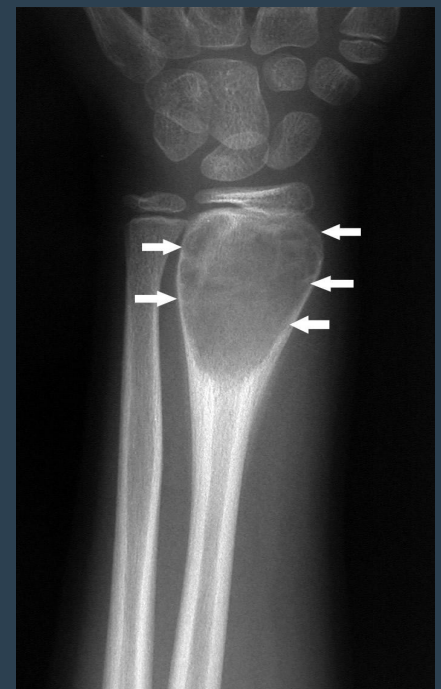


Fracture



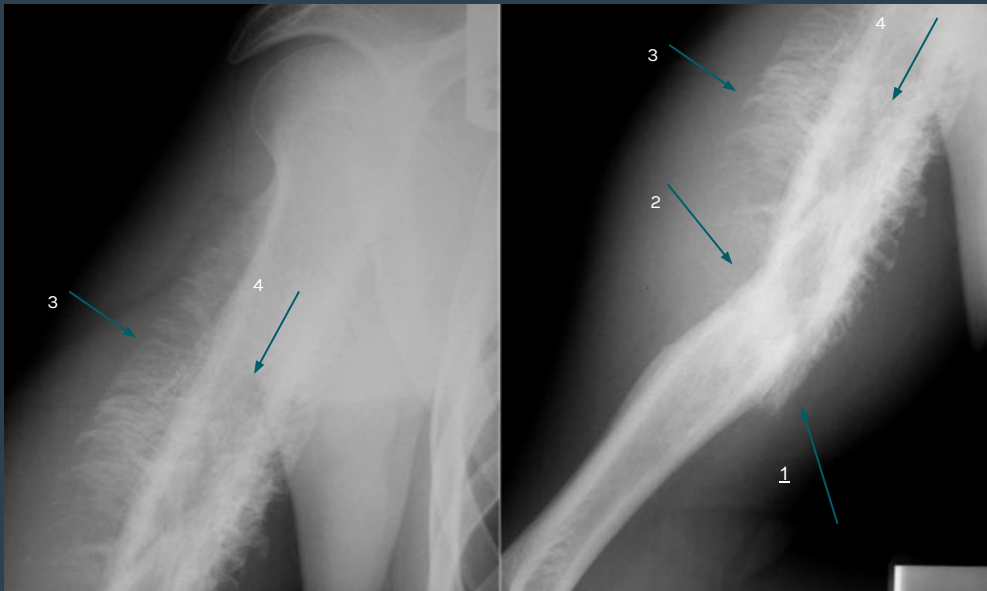
1- bone cyst  
2- Cortex thinning.

extra picture of cyst



## » fracture secondary to osteosarcoma

3



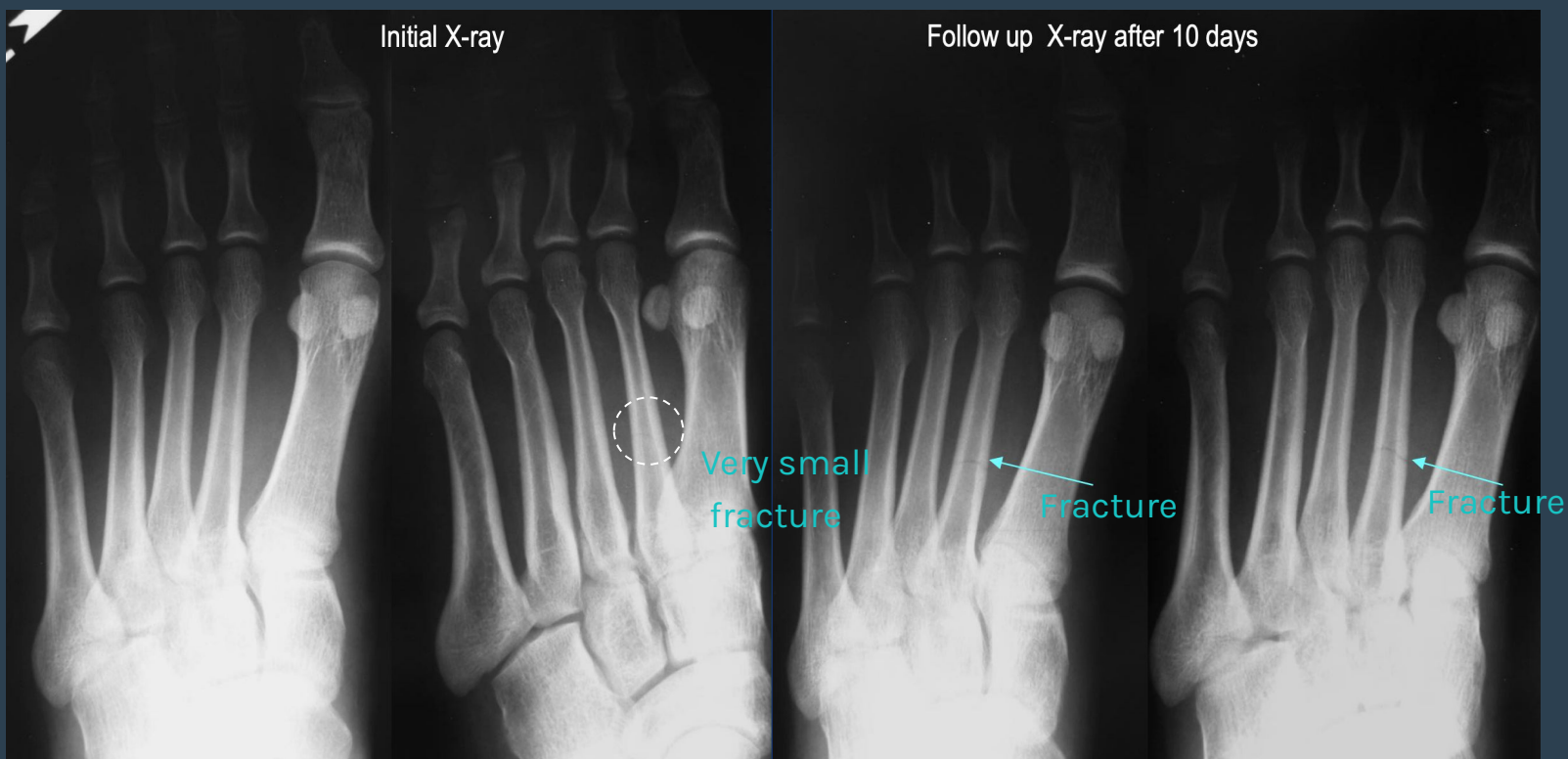
- 1- Fracture.
- 2- Fracture.
- 3- Periosteal reaction.
- 4- Heterogeneous bone texture.

the cortex is ill defined, the pathology is in the proximal limb while the distal limb is normal. the osteosarcoma is more aggressive

## » Stress Fractures

Repeated minor trauma on otherwise normal bone causing perpendicular small fracture. Stress fractures are easily missed.

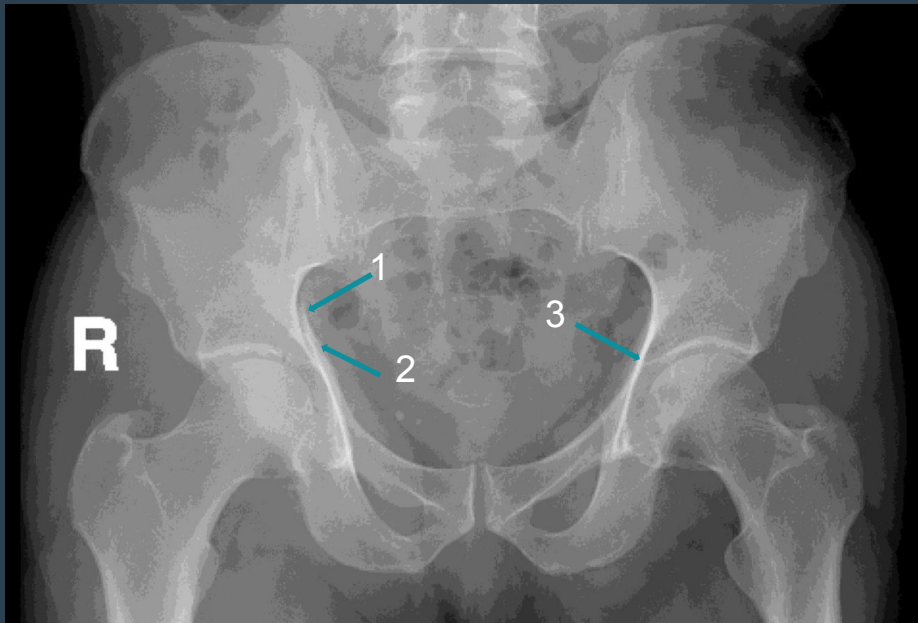
Ex: soldiers when they do the military walk they raise their foot and slam it down, with time it may cause a stress fractures.



The patient visited complaining of pain as shown in the initial X-ray on the left was dismissed as normal, then come for the follow up with the stress fracture more visible.

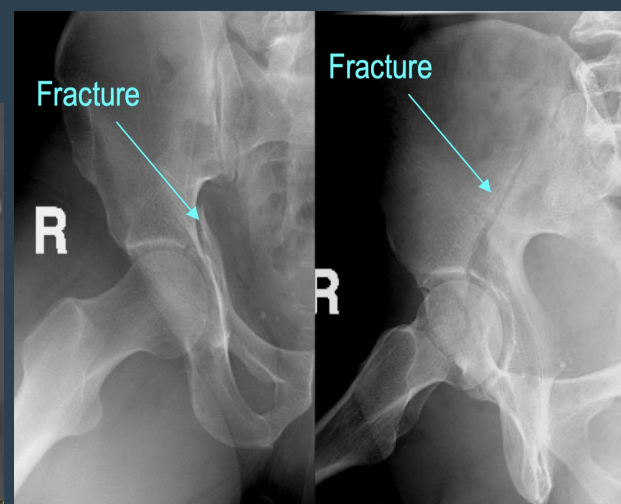
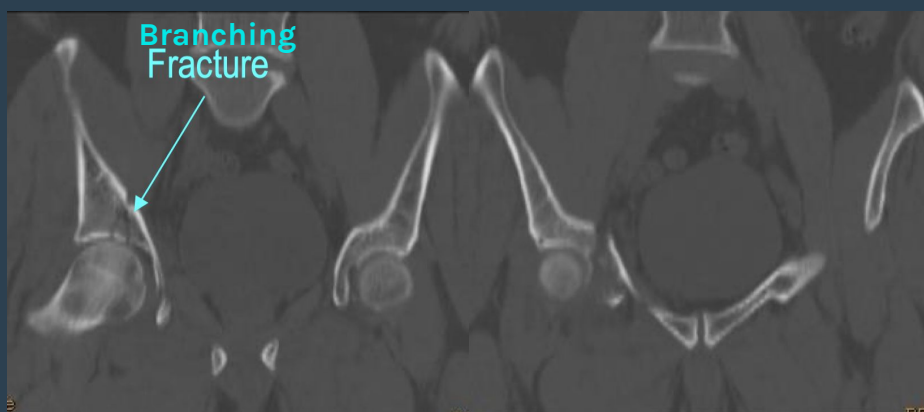
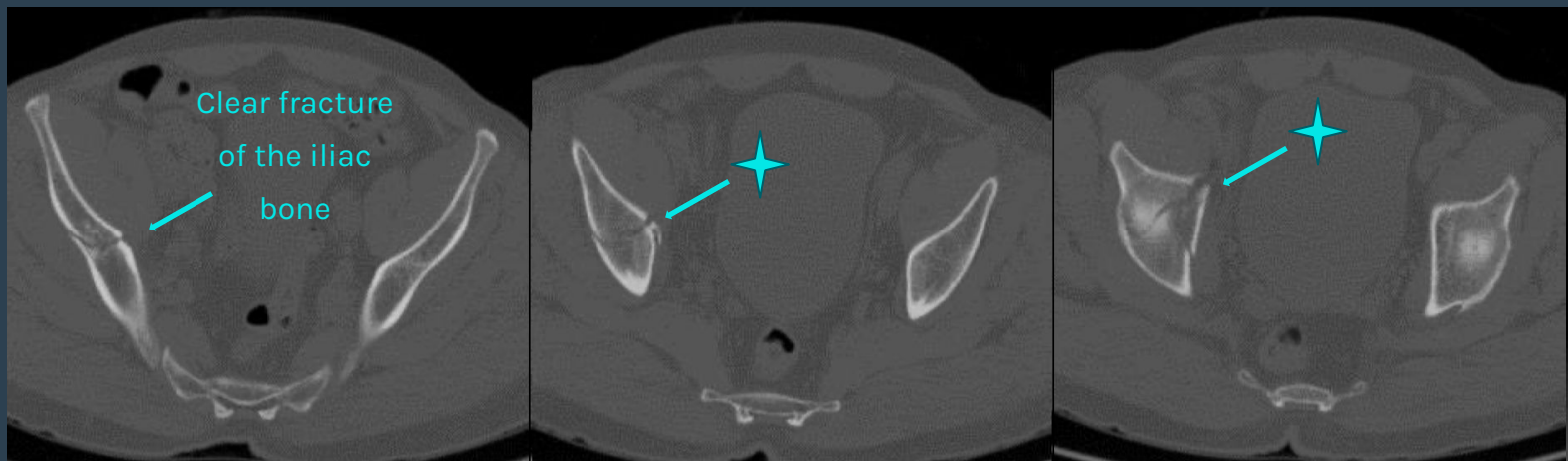
## » Hip Fractures

A 55 years old man with hip pain and limping



- 1 Fracture line
- 2 Disruption of the cortex outline
- 3 Normal cortex outline

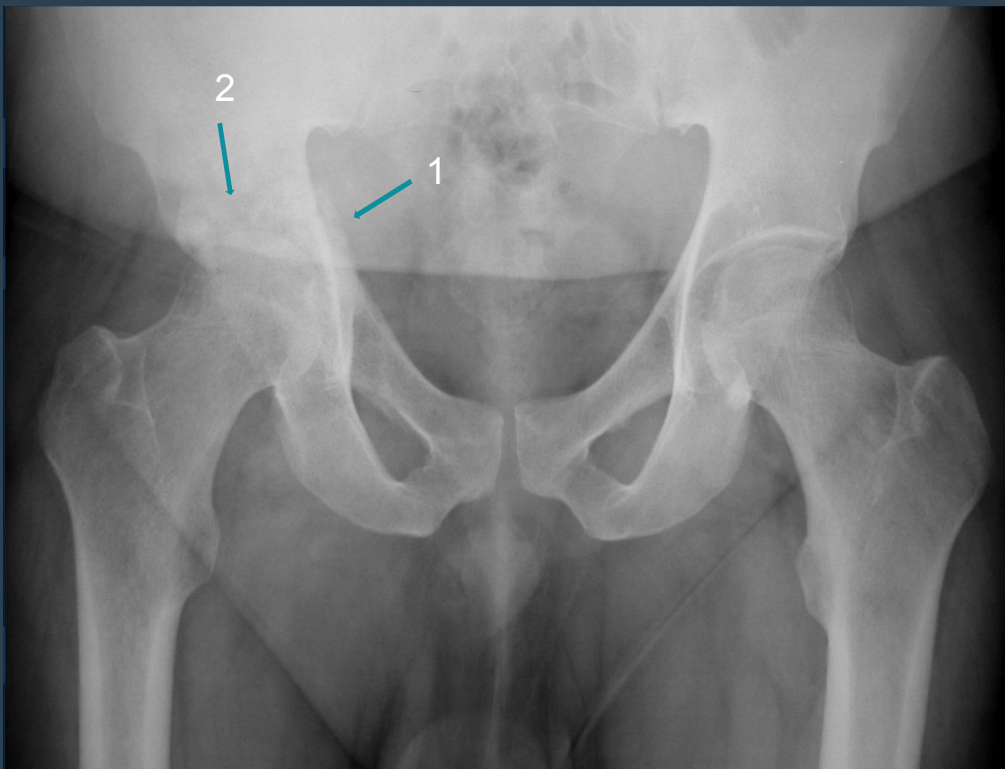
### Correlation with Cross sectional Imaging



★ Supra-acetabular fracture

## » Hip Fractures

A 50 years old man with hip pain and limping



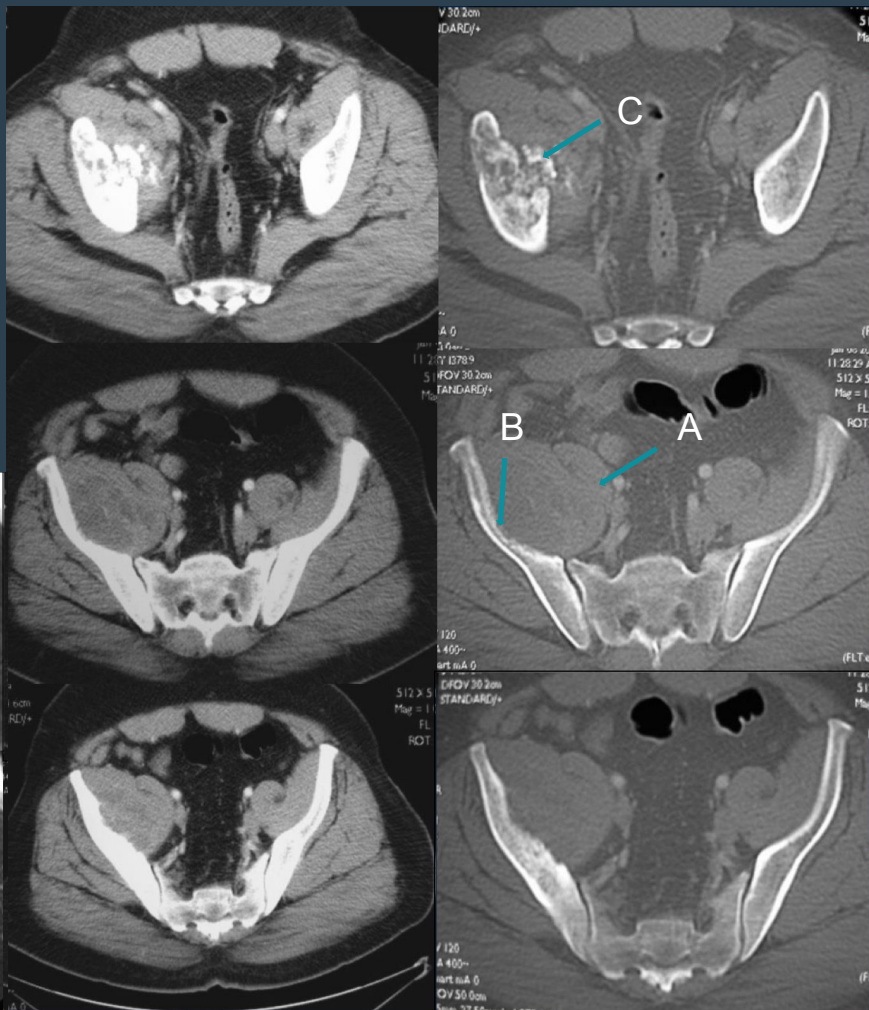
**1** Disrupted and ill defined fracture line and asymmetry of the cortex outline

**2** Sclerotic area

## » Fracture secondary to sarcoma

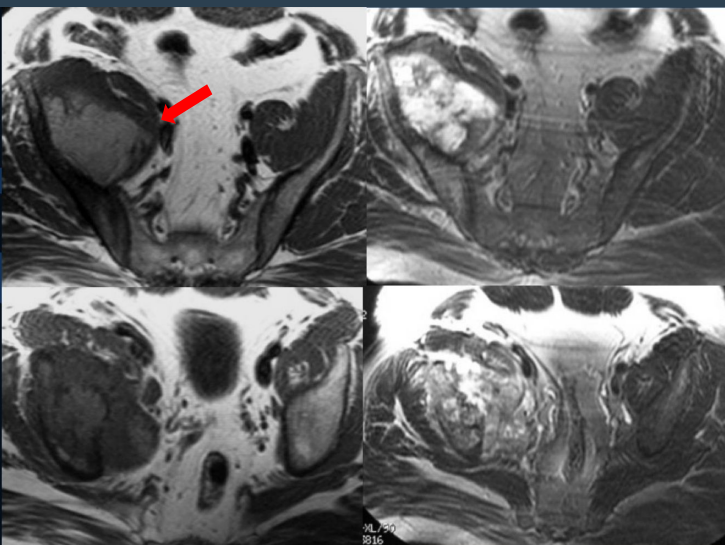
CT

- A** soft tissue swelling
- B** ill defined cortex of the iliac bone
- C** expansion of the medulla and fragmentation of the bone



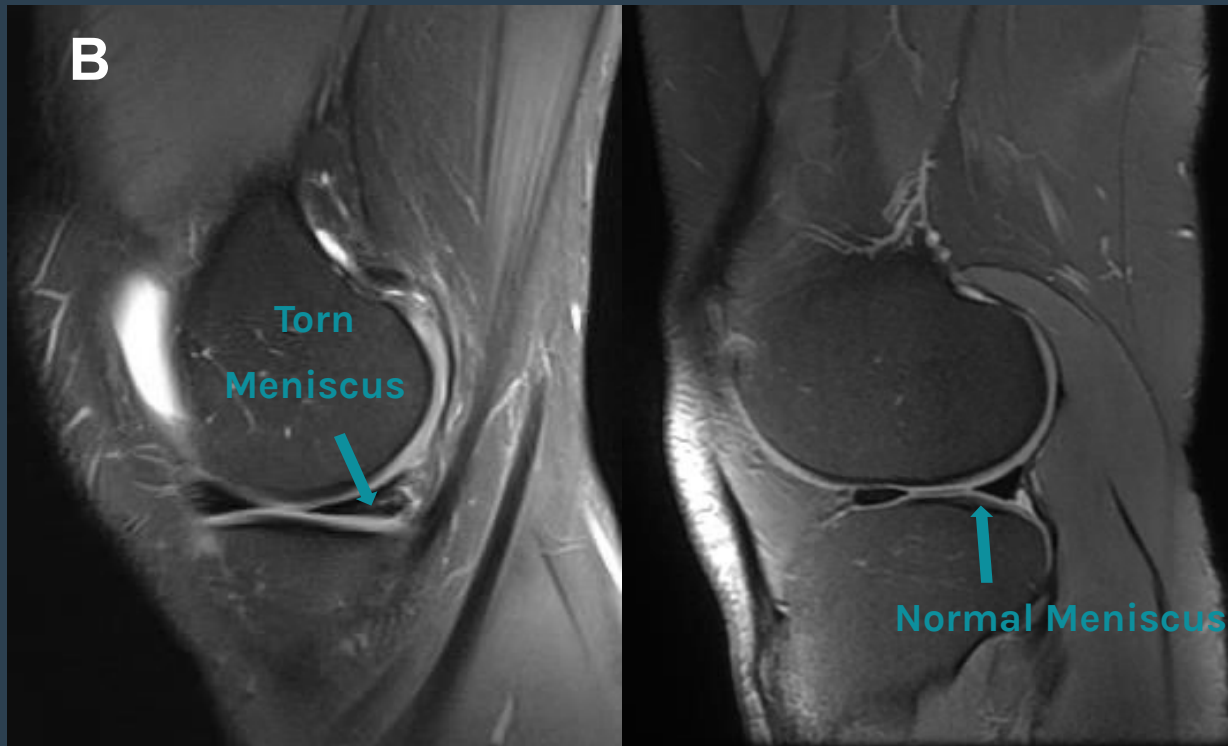
MRI

Blood



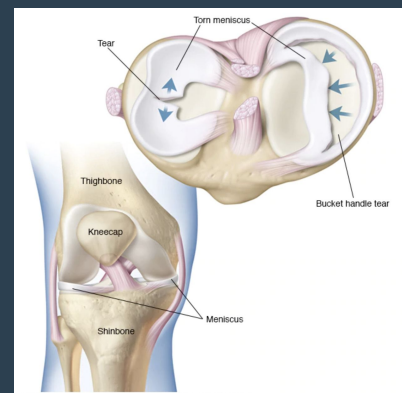
Correlation with Cross sectional Imaging

## » Knee injuries



**A** ACL injury, you can't see the ACL clearly & it doesn't have the smooth black band.

**B** extra picture



## Types :

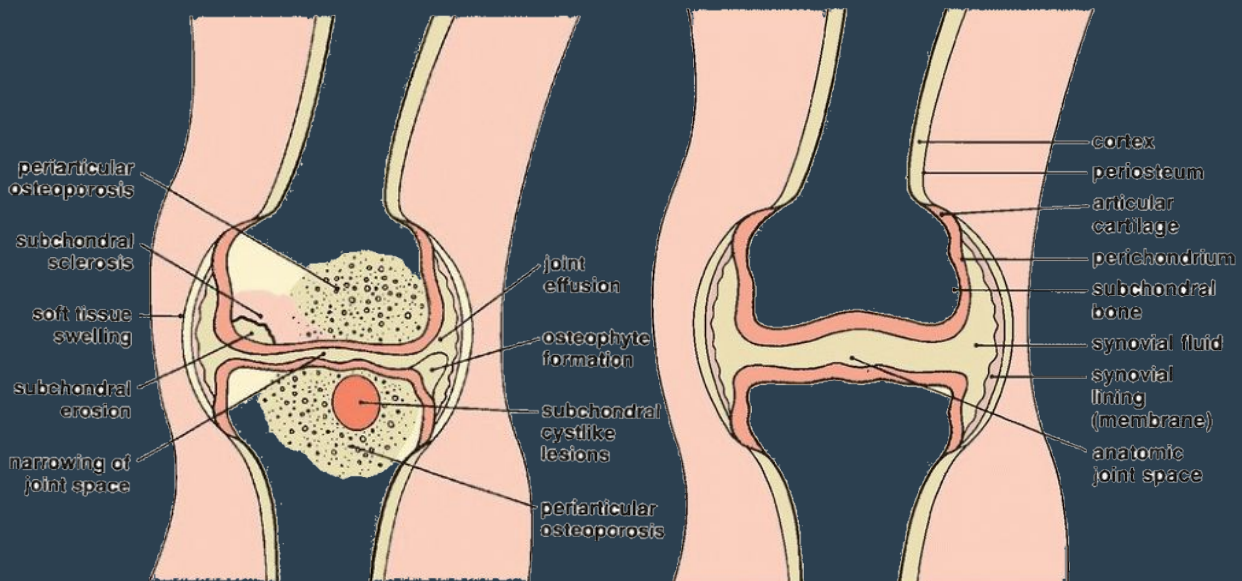


## Features to look for:

- |   |   |  |  |
|---|---|--|--|
| <p><b>1</b> <b>Bone density:</b><br/>Osteopenia vs. Osteosclerosis.<br/>Periarticular / Generalized</p> | <p><b>2</b> <b>Bone cortex :</b><br/>Osteolytic vs. Osteoproliferation.<br/>Erosive / Osteophyte.</p> | <p><b>3</b> <b>Bone alignment:</b><br/>Distribution / Deformities.</p> | <p><b>4</b> <b>Soft tissue changes:</b><br/>Effusion / Density / Calcification</p> |
|---|---|--|--|

how to know?

compare it to the soft tissue around it



- 1- Joint effusion.
- 2- Osteophyte formation.
- 3- Subchondral cystic changes.
- 4- Periarticular osteoporosis.
- 5- Subchondral sclerosis.
- 6- Soft tissue swelling.
- 7- Subchondral erosion.
- 8- Narrowing of joint space.

# Rheumatoid Arthritis

40 YO woman with joint pain



Dorsal view

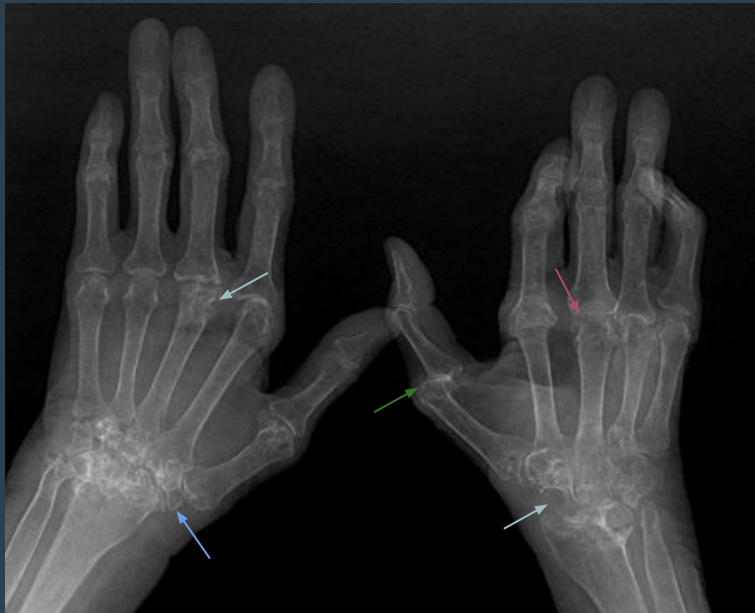


Palmar view

## Normal

- ❖ Normal bone density & texture.
- ❖ Preserved joint space.
- ❖ No erosions.
- ❖ Normal alignment.
- ❖ Normal soft tissue.

48 year old female presented with joint pain of the hands & feet. X-ray of hand was requested :



## Findings:

- ❖ Generalized / Diffuse Osteopenia.
- ❖ Joint space narrowing (proximal > distal).
- ❖ Periarticular erosions & destruction & collapse of carpal bone.
- ❖ Subchondral cystic changes.
- ❖ Subluxation.

Decreased bone density, Whenever you have a reduction in bone density this indicates inflammatory rather than degenerative.

- eaten bone (arrow)
- loss of metacarpophalangeal articulation (arrow)
- loss of articulation of the radius and the carpal bones (arrow)
- malalignment (arrow)

Zoomed images of the above x-ray



comparison



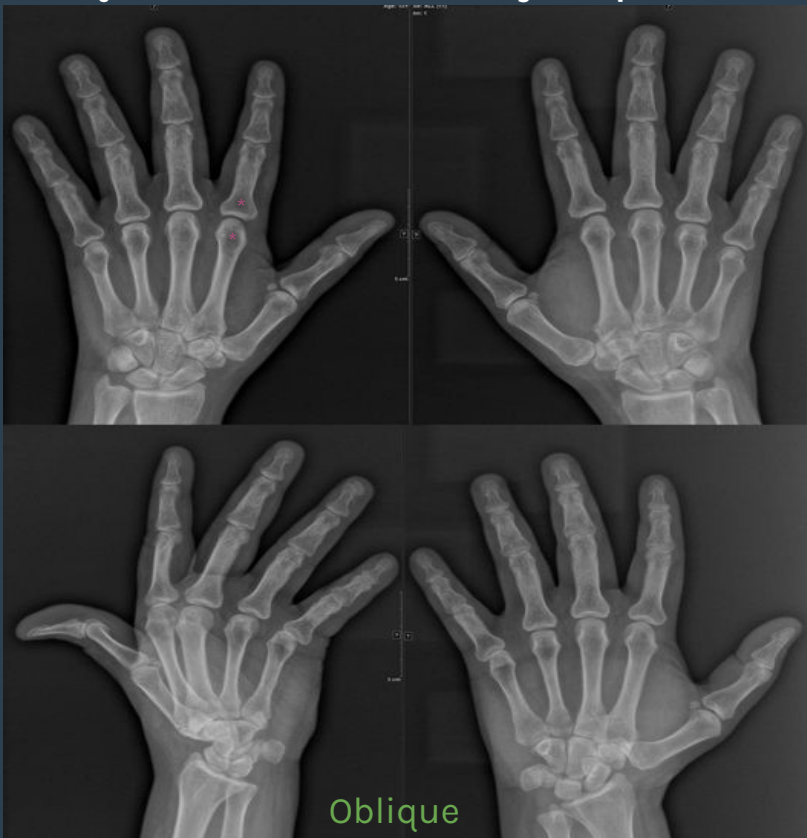
Normal



Diffuse Osteopenia

- Density almost same as soft tissue.
- No corticomedullary differentiation

53 year old man with small joint pain :



- Diffuse osteopenia on top of periarticular / no erosions
- generalized decreased bone density but more prominent around the joints

## Findings:

- ❖ Periarticular osteopenia\*star (radiolucent areas). localized
- ❖ Preserved joint space.
- ❖ No erosions.
- ❖ Normal alignment.
- ❖ Normal soft tissue.



# Rheumatoid Arthritis

29 year old women with **arthralgia** (early changes) :



Dorsal view



Palmar view

## Findings:

- ❖ Periarticular osteopenia (radiolucency -blackish- bone area around the joint).
- ❖ Joint space narrowing (radiocarpal & metacarpophalangeal). **arrow**
- ❖ Periarticular erosions. **arrow**
- ❖ Periarticular soft tissue swelling. **arrows**
- ❖ Normal alignment.
- ❖ Early manifestation of RA

## » Rheumatoid arthritis & deformities (late changes) :



- ❖ Osteoporosis.
  - **Early:** Juxta (nearby) articular.
  - **Later:** Diffuse.



- ❖ Erosions.
- ❖ Cartilage destruction.
- ❖ Deformities.

## » osteoarthritis

Elderly male patient presented with joint pain of the hands. An x-ray of the hand was requested :



### Findings:

- ❖ Normal bone density, subchondral sclerosis.
- ❖ Joint space narrowing (**Distal** interphalangeal).
- ❖ No erosions.
- ❖ Marginal osteophytes, look like sharpening of the joint edges.
- ❖ Distribution: weight bearing joints (hips, knees, back).
- ❖ In the hands: DIPs, PIPs, CMC of thumb.  
 DIP: distal interphalangeal joint  
 PIP: proximal interphalangeal joint  
 CMC: carpometacarpal



**Subchondral sclerosis** is the hardening of the bone just below the cartilage surface. It shows up in the later stages of osteoarthritis. And it is common in the bones found at the load-bearing joints

## » Erosive osteoarthritis



### findings:

- Normal bone density, subchondral sclerosis/cyst.
- Joint space narrowing (Distal interphalangeal)
- Erosions (proximal & distal).
- Marginal osteophytes, look like sharpening of the joint edges.

## ➤ Psoriatic arthritis :

**Psoriatic arthritis** is a type of arthritis that develops in some people with the skin condition psoriasis. It typically causes affected joints to become inflamed (swollen), stiff and painful. Like psoriasis, psoriatic arthritis is a long-term condition that can get progressively worse.

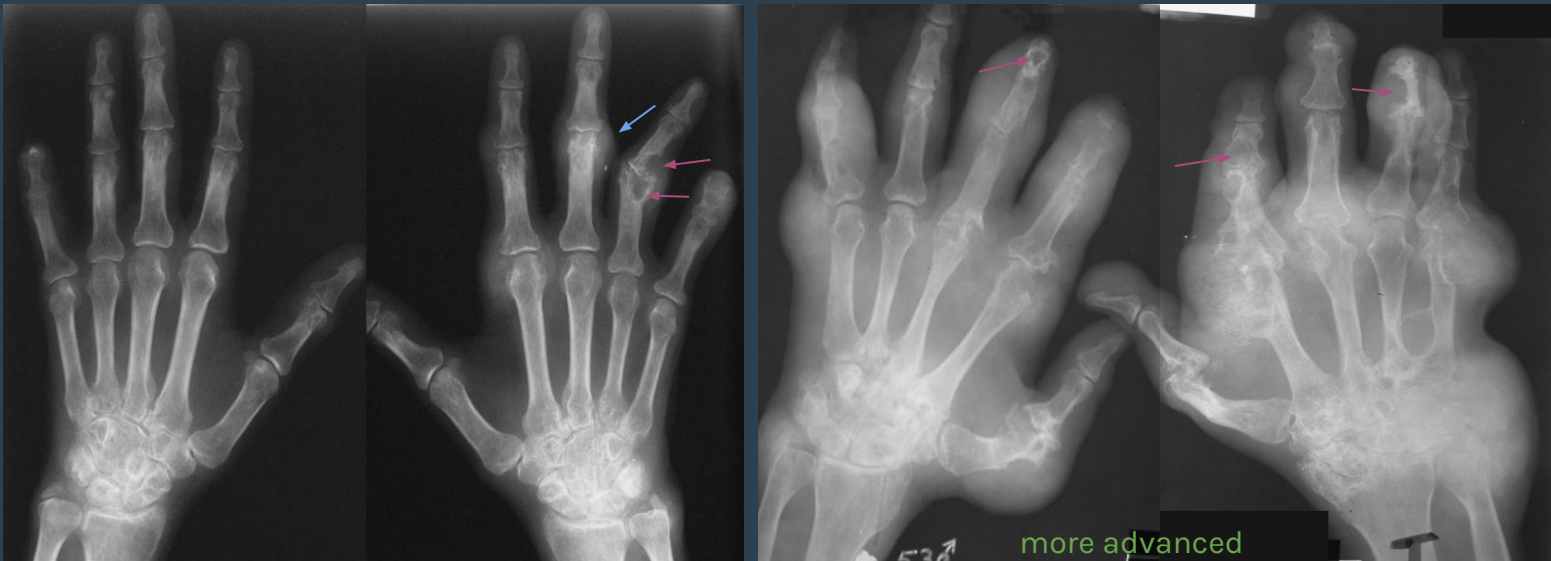


### Findings:

- ❖ Normal bone density, subchondral sclerosis/cyst.
- ❖ Joint space narrowing (distal & proximal) & fusion. (arrow)
- ❖ Erosions (proximal & distal).
- ❖ Marginal osteophytes proliferation. (arrow)
- ❖ Deformities.

## ➤ Gouty arthritis :

43 year-old male patient presented with pain and swelling in hands and feet, An x-ray of the hand was requested



### Findings:

- ❖ Normal bone density.
- ❖ Preserved joint space.
- ❖ Dense periarticular soft tissue tophi. (arrow)
- ❖ Erosions (periarticular & marginal **overhanging sign**). (arrow)
- ❖ Periostitis & Marginal osteophytes.
- ❖ Deformities.

## Terminology in bone trauma

Pathological fracture	Describe Fracture Location	Describe Fracture Alignment	Describe Fracture Severity
<ul style="list-style-type: none"><li>- <b>Green stick &amp; Torus fractures.</b></li><li>- Physeal injuries.</li><li>- Stress fractures.</li></ul>	<ul style="list-style-type: none"><li>- Diaphyseal / Metaphyseal.</li><li>- Peri-articular / Intra-articular.</li></ul>	<ul style="list-style-type: none"><li>- Displaced / Non-displaced.</li><li>- Angulated / Depressed.</li></ul>	<ul style="list-style-type: none"><li>- Simple.</li><li>- Comminute / Segmented.</li></ul>

## Important Concepts

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

## Physeal plate (growth plate) Injury

- Salter-Harris injury type I.
- Salter-Harris injury type II.
- Salter-Harris injury type III.
- Salter-Harris injury type IV.
- Salter-Harris injury type V.

## Arthritis

- Rheumatoid Arthritis.
- Osteoarthritis.
- Psoriatic Arthritis.
- Gouty Arthritis.

1- The abnormality seen in the following image is:

- a. Bowing fracture.
- b. Torus fracture
- c. Greenstick fracture
- d. Stress fracture



2- A physeal plate fracture results in:

- a. Salter-Harris injury type II.
- b. Salter-Harris injury type III.
- c. Salter-Harris injury type IV.
- d. Salter-Harris injury type V.

3- What is the best modality to assess the anterior cruciate ligament:

- a. MRI
- b. CT
- c. X-ray
- d. Nuclear imaging

4- Subchondral sclerosis is seen in:

- a. Osteoarthritis
- b. Rheumatoid arthritis
- c. Gouty arthritis
- d. Psoriatic Arthritis

5- :Osteopenia. Periarticular erosion of MCP joints is seen in?

- a. Rheumatoid arthritis
- b. Osteoarthritis
- c. Psoriatic arthritis
- d. Gouty arthritis

6-A child presented to ER with painful swelling of the left upper arm. No previous history of trauma. X-ray is shown below. What is the most likely diagnosis?

- a. Stress fracture of left humerus
- b. Osteosarcoma of left humerus
- c. fracture of the left humerus 2ry to bone cyst
- d. Ewing sarcoma of left humerus



Answers  
1)C  
2)D  
3)A  
4)A  
5)A  
6)C