MED437
King Saud University

RADIOLOGY 437 TEAM

Radiology of Rheumatic diseases

Color Index:

- ✓ Important
- ✓ Notes
- ✓ Extra

Editting File

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

Sources

Lecturer:
Ahmad Al-BOUKAI
Same 436 lecture Slides:
YES

Done by:

Dawood Ismail
Saleh Mahjoub

Revised by:

Yazeed Al-Dossare

Lecture outline

1. Terminology in bone trauma
2. Important concepts
3. Two perpendicular views
4. Physeal plate (growth plate) Injury
5. Pathological Fractures
6. Stress Fractures
7. Correlation with cross sectional Imaging
8. Arthritis
9. Rheumatoid Arthritis
10. Osteoarthritis
11. Psoriatic arthritis
12. Gouty arthritis
13. Extra pictures for better understanding

- Physeal injury, means to the growth plate.
- Subluxation mean dislocation.
- Open fracture, it has to be Compound fracture.
- Paired bone concept, mean fixed by joints.
- If you are not sure about an injury in pediatrics group, Image the other side.

Terminology in bone trauma

Pathological fracture:

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

Describe Fracture Location:

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

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.

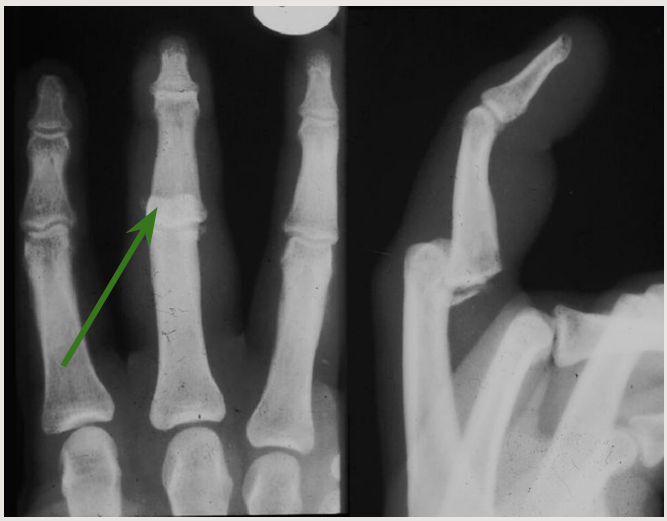
Describe Fracture Severity: Open *vs.* Closed

- 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 soft tissue structures (muscles / ligaments / tendons) in Adults, the physeal plate (growth plate) in children.

Two perpendicular views



-Bone hessiness.
-dislocation.
-Bones overlap each other which means dislocation.

A 6 year old boy with trauma

Spiral fracture

-Crush injury.
-R picture is from the lateral view.

Total dislocation.

Physeal plate (growth plate) Injury

I II III IV V

Traumatic Osteolysis of epiphyseal plate

I- Avulsion or adduction or separation, which will lead to widening of growth plate.

II- widening when avulsion injury of the corner of the metaphyseal shaft. (Most frequently seen)

III-Fracture of epiphysis.

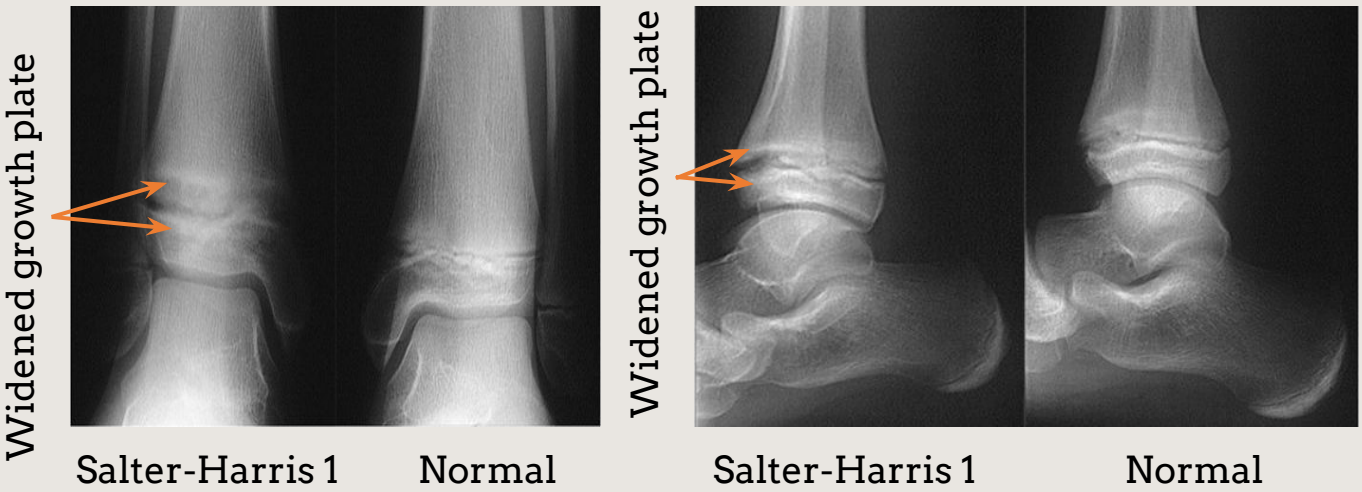
IV- When both II and III combined in one injury.

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

Why Physeal plate injuries are important ?.
1-Pediatric group only
2-It's important because it's growth area, could lead to premature closure of plate, and lead to shortening of the limb.

Physeal plate (growth plate) Injury

a) Salter-Harris injury type 1:

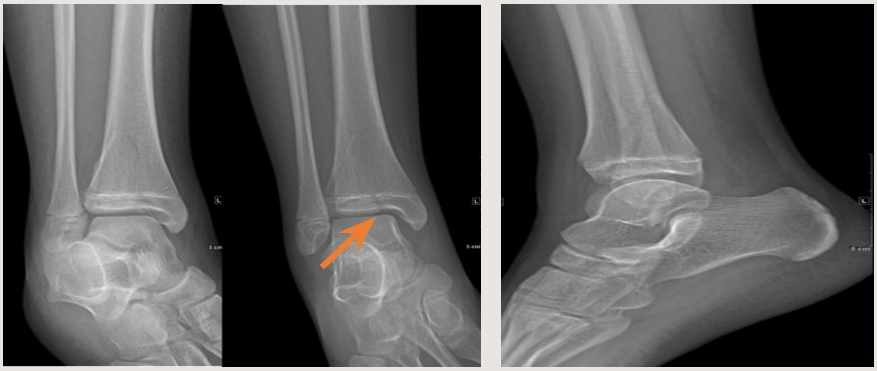


b) Salter-Harris injury type II: 11 years old boy with swelling of wrist pain.

Avulsion of metaphysis

Physeal plate (growth plate) Injury

c) Salter-Harris injury type III: A 12 year old girl fell down



Fractures

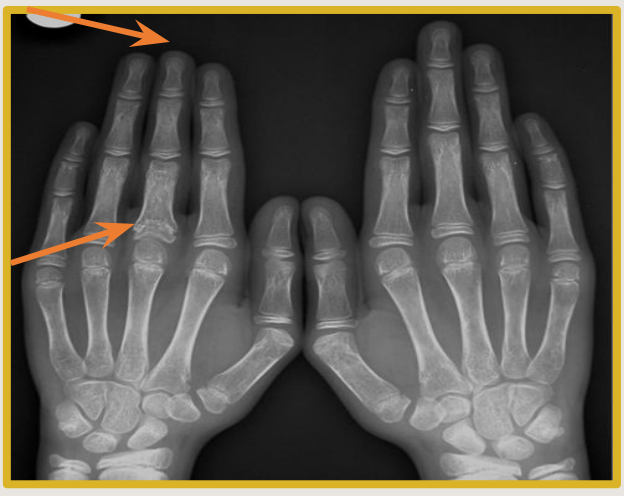
d) Salter-Harris injury type IV: 12 year old girl fell down.

Computed Tomography delineate fracture more clear

e) Salter-Harris injury type V: A 9 year old boy with pain in his right hand.

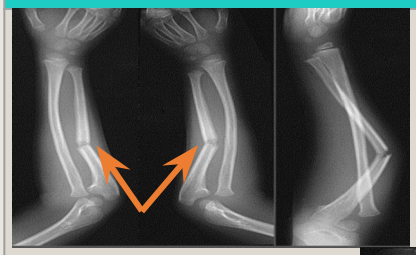
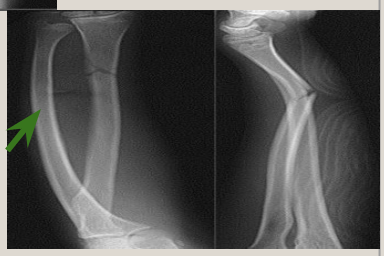
Short finger

Old Fracture



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.

Radiograph should include the joint nearest to the trauma & Paired bone concept.

X-ray	Notes
 Fracture Ulna & Dislocated Radius Bowing fracture of ulna & fractured radius 	The other bone will either fracture or dislocate or bow. so, it's important to look at both bones (paired bone concept)
 **Torus Fractures** (also called buckling fracture)	In torus fracture there will be buckling (or bending) of the cortex circumferentially all the way through the whole surface of the bone. This fracture is not seen in adults because the bone and cortex are consolidated but in children it is still fragile so you might have buckling of the fibers of the cortical aspect of long tubular bones.
 **Greenstick Fractures** 	In greenstick fracture there is involvement of one side of the bone while the opposite side is intact. **Note:** In torus and greenstick the fracture involves the cortex without traversing the bone in total.

Pathological Fractures:

fracture occurs in a diseased bones (like bone cyst and osteosarcoma)

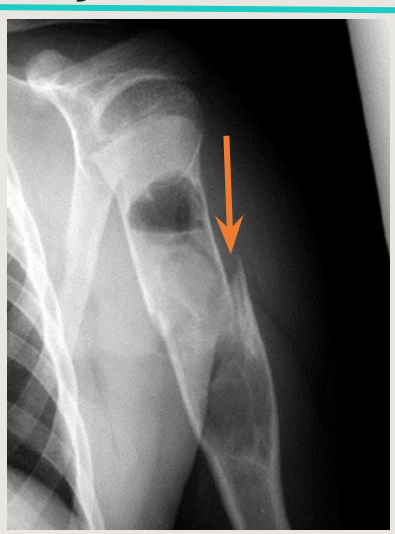
a) Pathological fracture secondary to enchondroma:

fracture

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.

b) Pathological fracture secondary to Bone cyst:

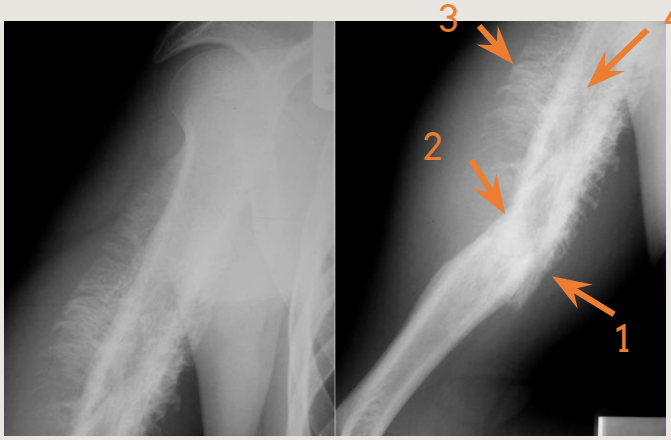
Fracture



-Expansile cyst of medulla.
-Cortex thinning.

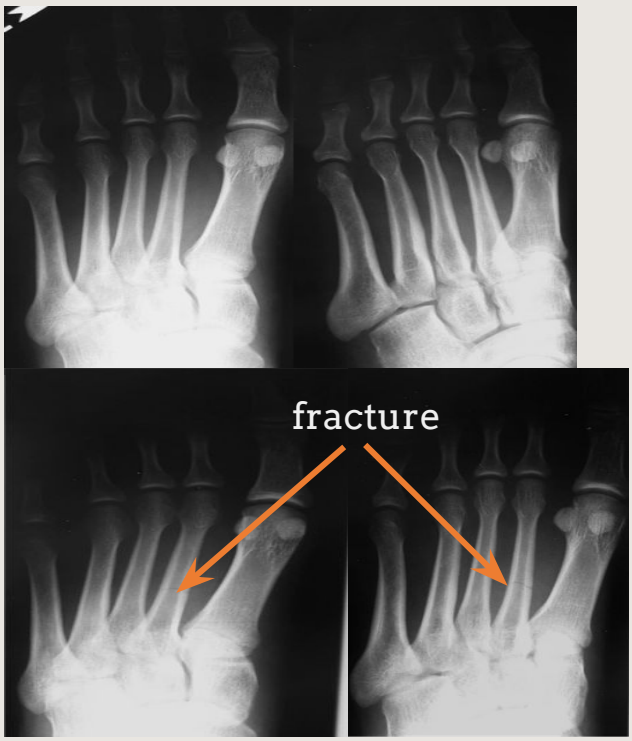
Bone cysts

c) Pathological fracture secondary to osteosarcoma:



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

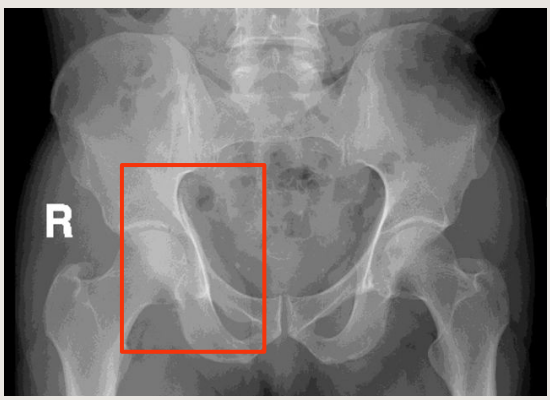
Stress Fractures



Stress fracture is a fine (not obvious), minor, hair-like fracture that involves the shaft of the tubular bones.
This type of fracture can happen in soldiers, athletics and patients who walk a lot (chronic stress on bones).
Important example: Soldiers.

Correlation with cross sectional Imaging:

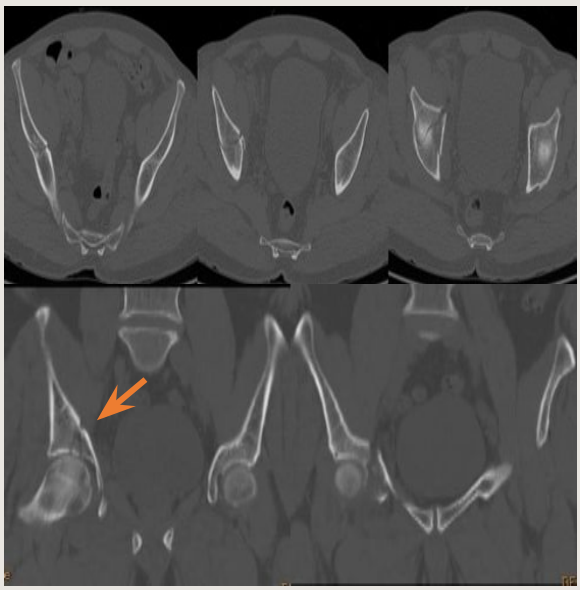
A- A 55 year old man with hip pain and limping (walking with difficulty, typically because of a damaged or stiff leg or foot.).

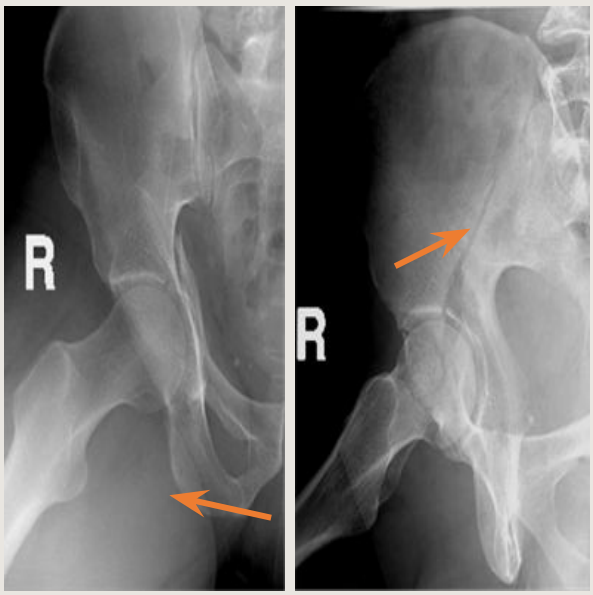


-Pelvic prim

Correlation with cross sectional Imaging:

B- A 55 year old man with hip pain and limping Supra-acetabular fracture.



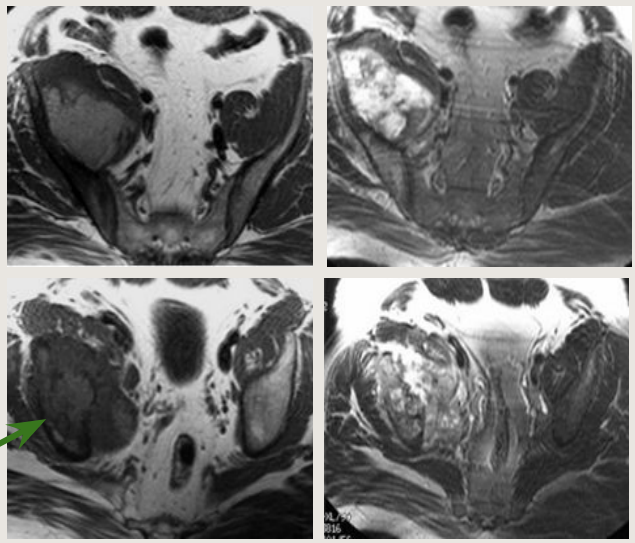


-Branching fracture.
-Free bone particle could lead to joint locking if moved inside it
-important to notice it for management

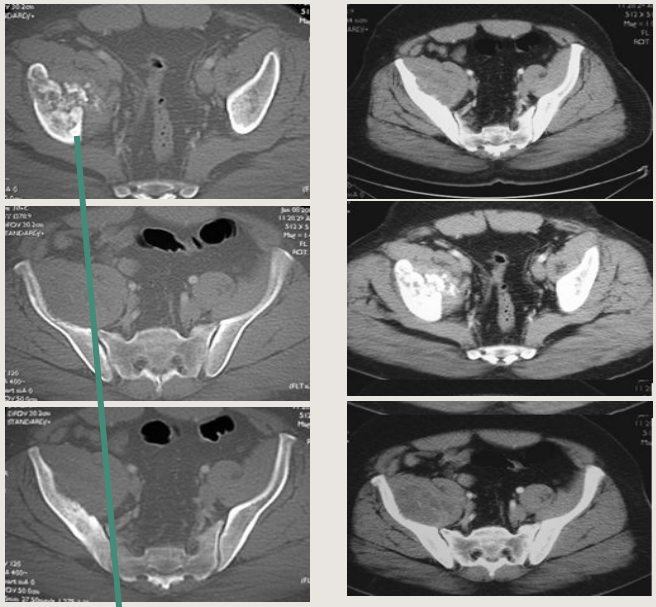
C- A 50 year old man with hip pain and limping

Correlation with cross sectional Imaging:

Pathological fracture secondary to sarcoma:

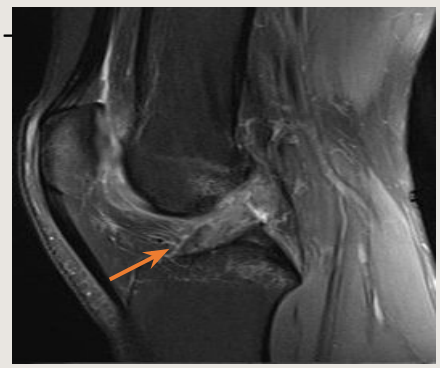


Fracture with a large soft tissue swelling as compared to the opposite side



-Fragmentation of bone.
-Muscle and soft tissue are swollen.
-Neoplastic process.

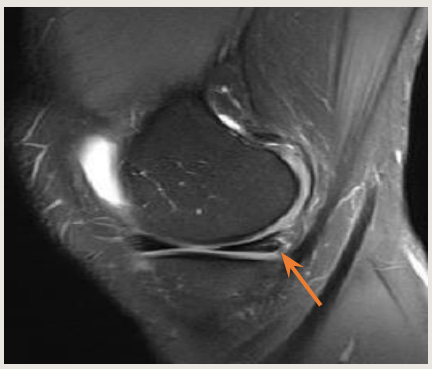
Torn anterior cruciate ligament



Normal anterior cruciate ligament

and the best modality to evaluate it is the MRI

Torn meniscus

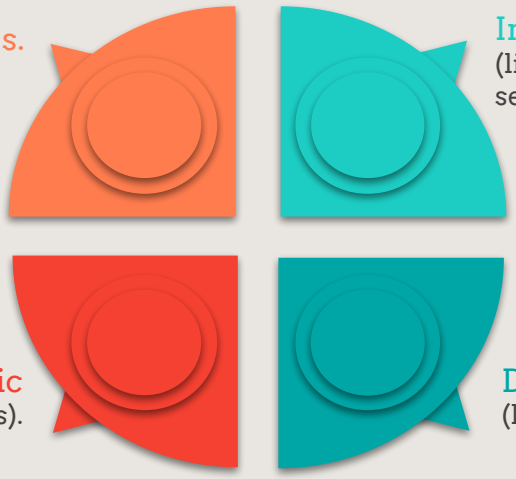


Normal meniscus

Notice the thin white line inside the black triangle, it represents the torn

Arthritis

Types:



Infectious.

Inflammatory
(like Rheumatoid arthritis and seronegative arthritis).

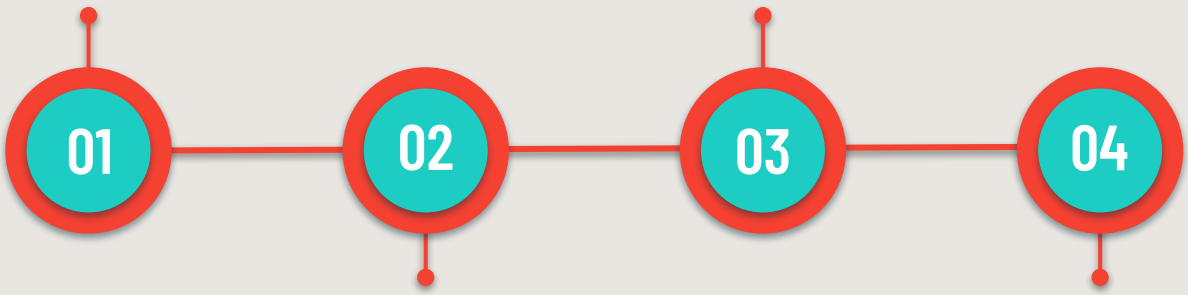
Metabolic
(like gouty arthritis).

Degenerative
(like osteoarthritis).

Features to look for:

Bone density:
Osteopenia vs. Osteosclerosis.
Periarticular / Generalized.

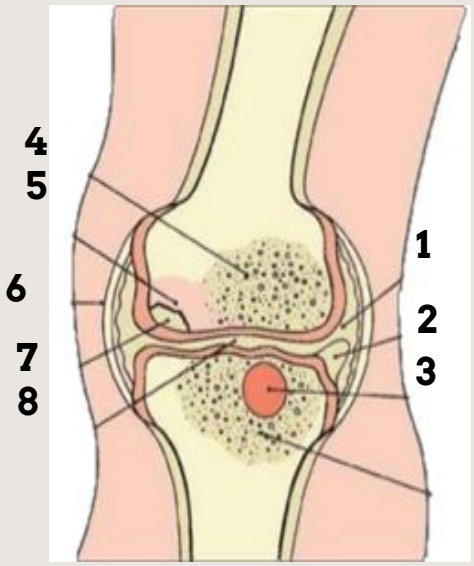
Bone alignment:
Distribution / Deformities.



Bone cortex:
Osteolytic vs. Osteoproliferation.
Erosive / Osteophyte.

Soft tissue changes:
Effusion / Density / Calcification.

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

Palmar view

Dorsal view

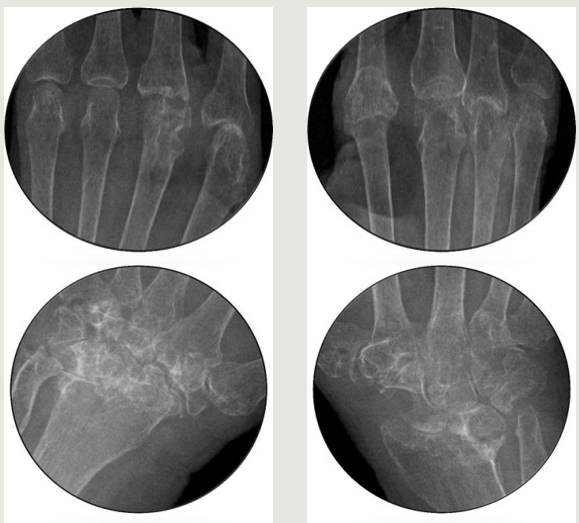
Normally:

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

a) 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.



Note: Whenever you have a reduction in bone density this indicates inflammatory rather than degenerative.

Rheumatoid Arthritis

b) 40 year old woman with joint pain.

Normal

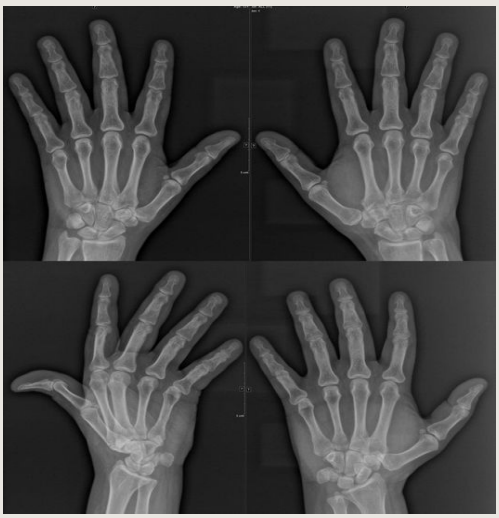
Diffuse Osteopenia

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

c) 53 year old man with small joint pain.

Findings:

- Periarticular osteopenia (radiolucent areas).
- Preserved joint space.
- No erosions.
- Normal alignment.
- Normal soft tissue.

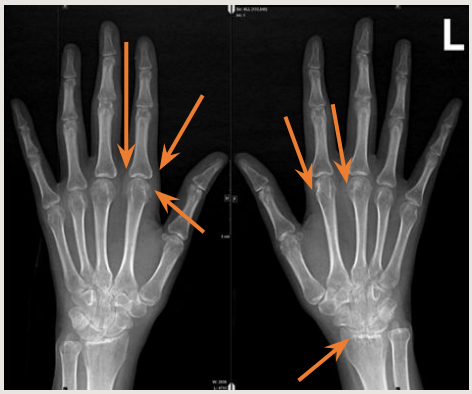


Diffuse osteopenia on top of periarticular / no erosions

Rheumatoid Arthritis

d) 29 year old women with arthralgia.

Palmar view



Dorsal view

Findings:

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

e) Rheumatoid arthritis & deformities

- 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.

Erosive Osteoarthritis

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.

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.
- Erosions (proximal & distal).
- Marginal osteophytes.
- 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.

Milder form of soft tissue swelling and erosions

Advanced condition

Gouty arthritis is caused by the deposition of crystals of uric acid in a joint.

-(Over hanging sign): hook like erosive changes.
-increased density.

Findings:

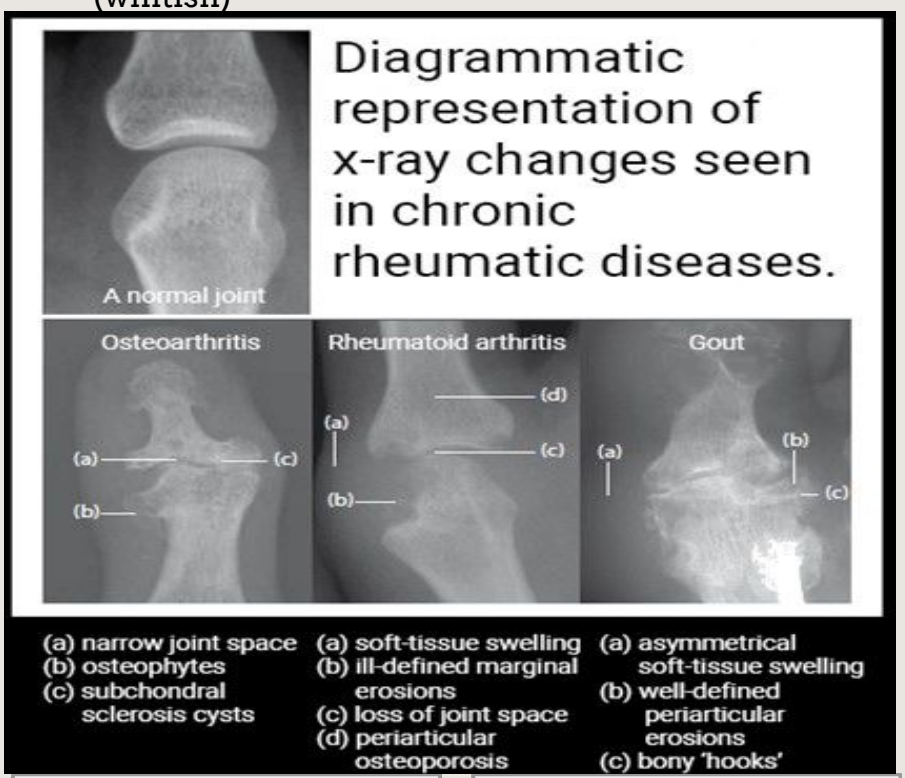
- Normal bone density.
- Preserved joint space.
- Dense periarticular soft tissue tophi.
- Erosions (periarticular & marginal overhanging sign).
- Periostitis & Marginal osteophytes.
- Deformities.

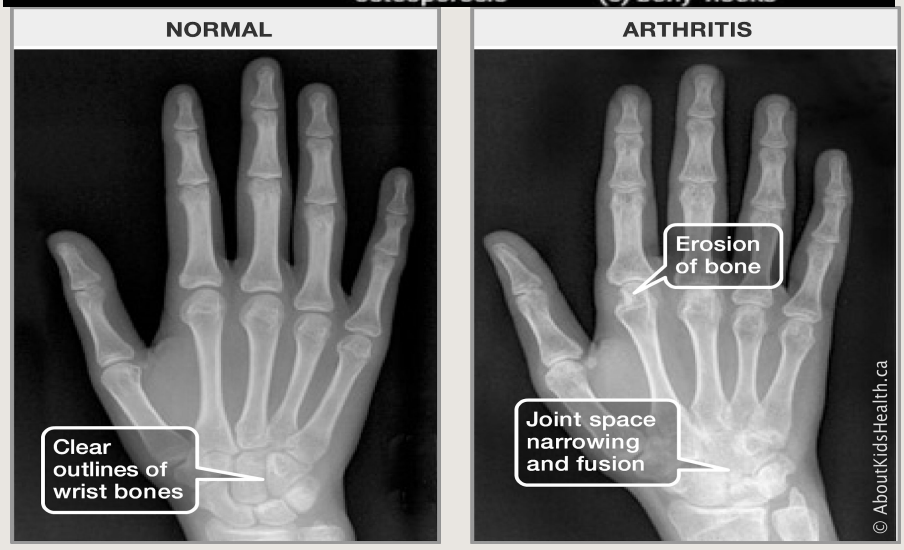
Extra pictures for better understanding

Osteoarthritis:

Subchondral sclerosis
thickening of subchondral bone (whitish)

Subchondral cyst
Empty space (Blackish)





Summary

Thanks to 436

Terminology in bone trauma

Pathological fracture	Describe Fracture Location	Describe Fracture Alignment	Describe Fracture Severity
- Green stick & Torus fractures. - Physeal injuries. - Stress fractures.	- Diaphyseal / Metaphyseal. - Peri-articular / Intra-articular.	- Displaced / Non-displaced. - Angulated / Depressed.	- Simple. - Comminute / Segmented.

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

a) Salter-Harris injury type 1.
b) Salter-Harris injury type II.
c) Salter-Harris injury type III.
d) Salter-Harris injury type IV.
e) Salter-Harris injury type V.

Arthritis

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

Questions

Thanks to 436

Q1: 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.

Q2: The abnormality seen in the following image is:

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

Q3: What is the best modality to assess the anterior cruciate ligament:

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

Q4: What is the weakest link in an adult musculoskeletal system?

a) Long bones.
b) Tendons.
c) Physeal plate.
d) Synovial joints.

Q5: Subchondral sclerosis is seen in:

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

Answers:

1- D.
2- C.
3- A.
4- B.
5- A.

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