



Radiology of Rheumatic Diseases

Objectives

1. Understanding basics of image formation and anatomical landmarks.
2. Developing system of analyzing findings:
3. - Where to look "important site"
- What to look for "bone density & texture, bone marrow, articular cortices, soft tissue"
4. Recognizing imaging features axial spondyloarthritis.

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Color Coding

Important | Notes | Extra

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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 physal plate (growth plate) in children.**

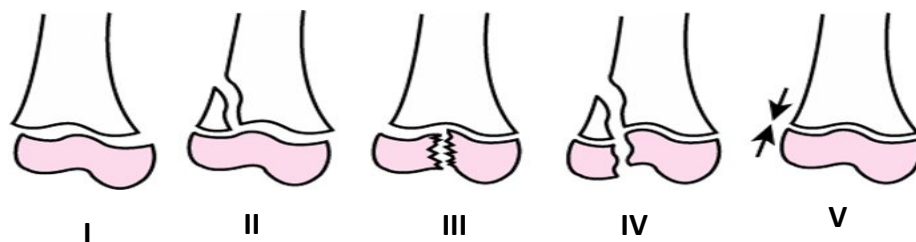
Two perpendicular views



A 6 year old boy with trauma



Physeal plate (growth plate) Injury



Traumatic Osteolysis of epiphyseal plate

a) **Salter-Harris injury type 1:**



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



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



Fractures

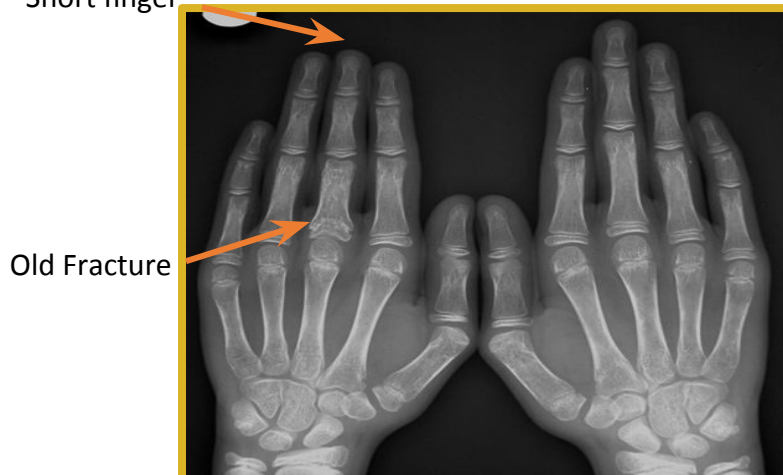
- d) **Salter-Harris injury type IV:** 12 year old girl fell down.



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

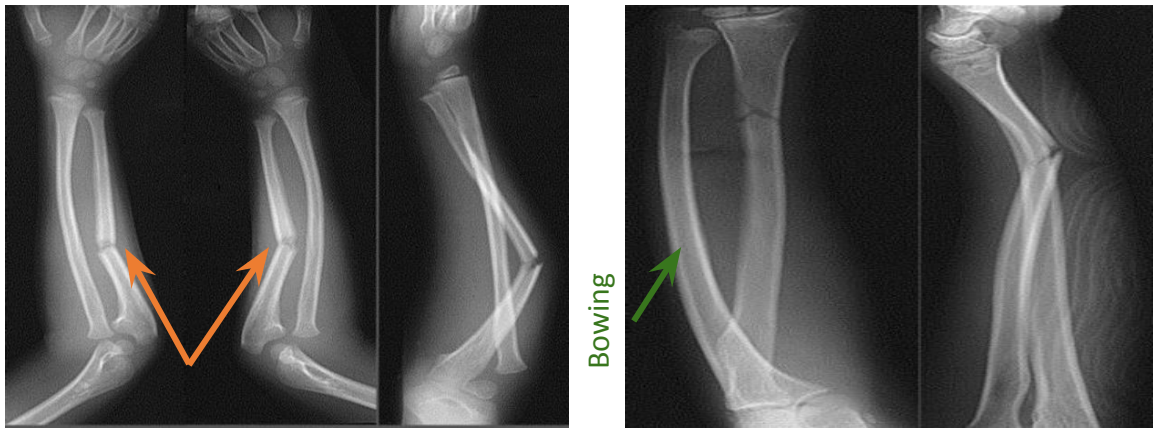


Old Fracture

Short middle finger because of:

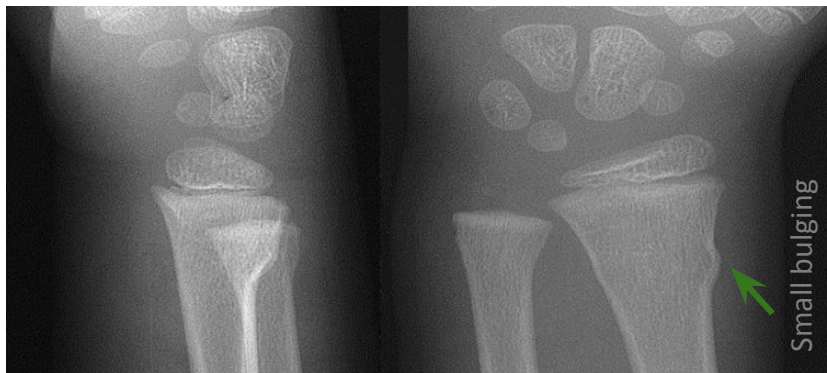
An old insult in the physal plate → premature closure of the physal plate (impaction) → shortening of the bone. So any fracture in growth plate (physal fracture) results in Salter-Harris injury type V.

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



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.



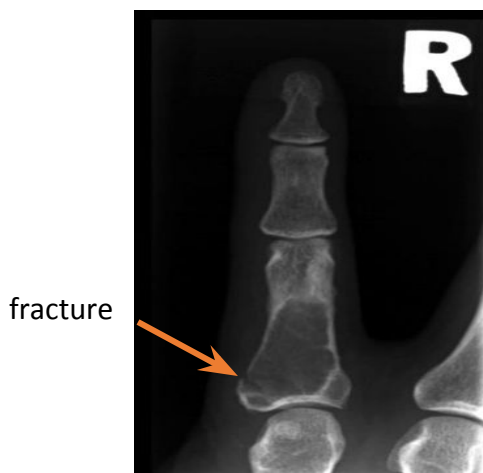
Greenstick Fractures

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.

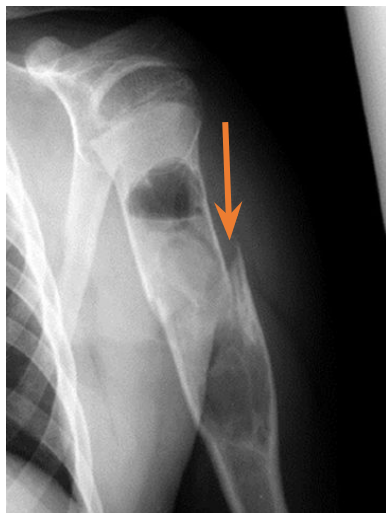
Pathological Fractures fracture occurs in a diseased bones (like bone cyst and osteosarcoma)

a) Pathological fracture secondary to enchondroma:

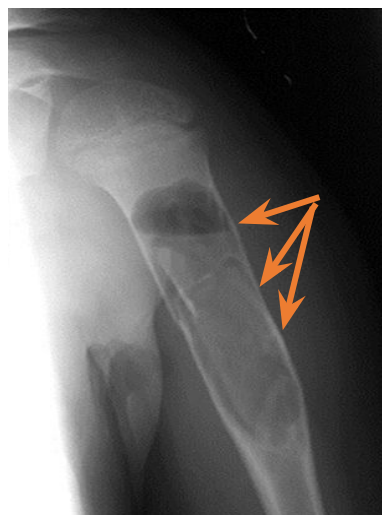


Enchondroma is a type of benign bone tumor that originates from cartilage. Most often it affects the cartilage that lines the inside of the bones. Notice the osteolytic (blackish) circular lesion, it led to the small fracture after the bone became weaker.

b) Pathological fracture secondary to Bone cyst:

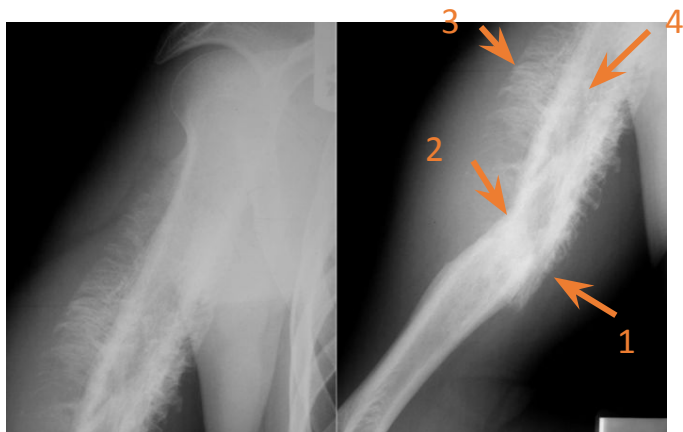


Fracture



Bone cysts

c) Pathological fracture secondary to osteosarcoma:



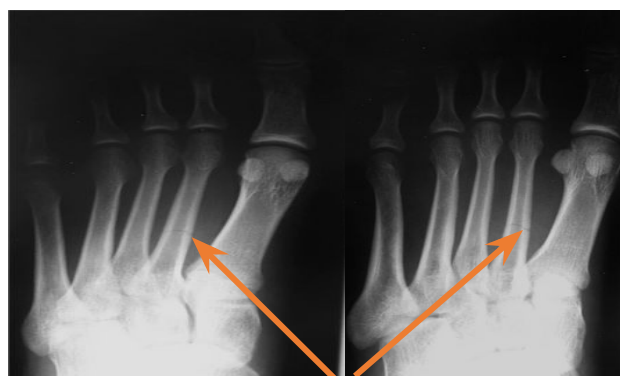
1&2- Fracture.
3- Periosteal reaction.
4- Heterogeneous bone texture.

Stress Fractures

Initial X-ray



Follow up X-ray after 10 days



fracture

Stress fracture is a fine (not obvious), minor, hair-like fracture that involves the shaft of the tubular bones.

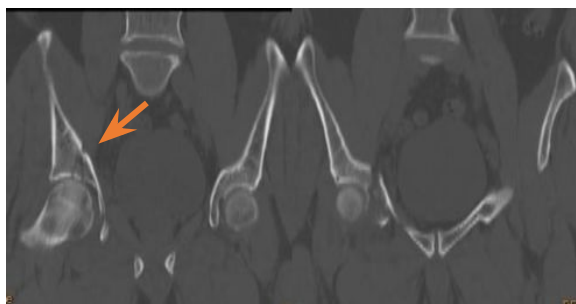
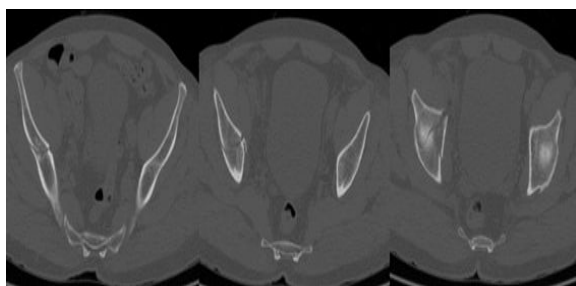
This type of fracture can happen in soldiers, athletics and patients who walk a lot (**chronic stress on bones**).

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.).



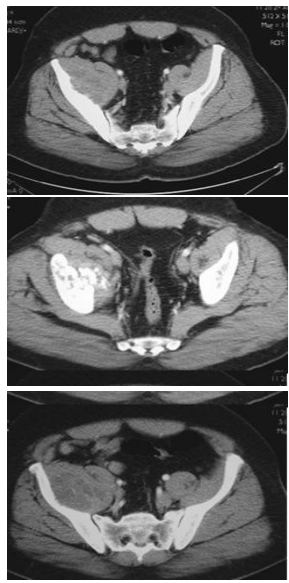
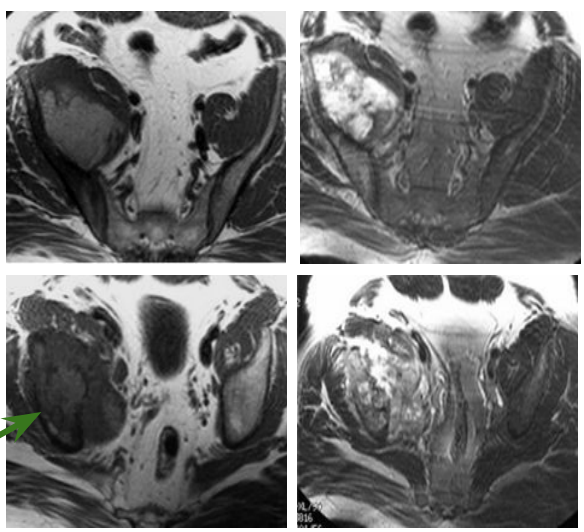
- b) A 55 year old man with hip pain and limping: Supra-acetabular fracture.**



c) A 50 year old man with hip pain and limping

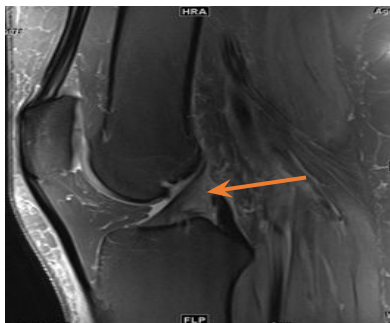


- Pathological fracture secondary to sarcoma:



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

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:

- Inflammatory (like Rheumatoid arthritis and seronegative arthritis).
- Degenerative (like osteoarthritis).
- Metabolic (like gouty arthritis).
- Infectious.

Features to look for:

1- Bone density:

- Osteopenia vs. Osteosclerosis.
- Periarticular / Generalized.

2- Bone cortex:

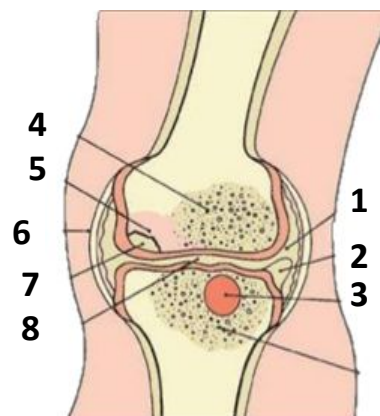
- Osteolytic vs. Osteoproliferation.
- Erosive / Osteophyte.

3- Bone alignment:

- Distribution / Deformities.

4- 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.

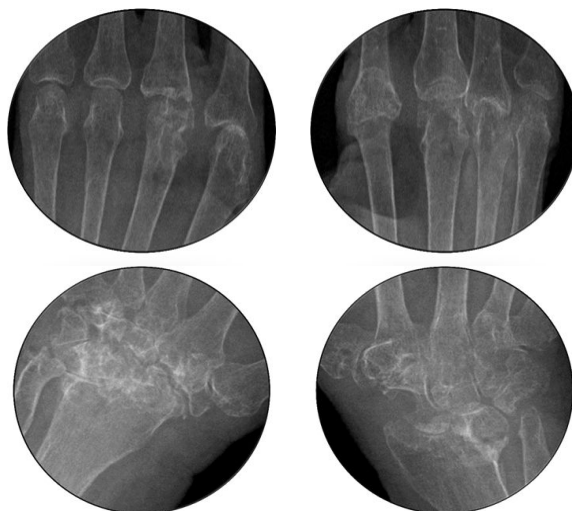
a) 48 year old female presented with joint pain of the hands & feet. X-ray of hand was requested.



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.



b) 40 year old woman with joint pain.



Normal

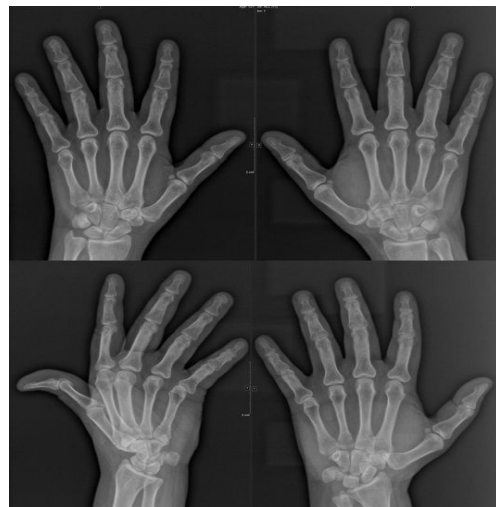


Diffuse Osteopenia

c) 53 year old man with small joint pain.

Findings:

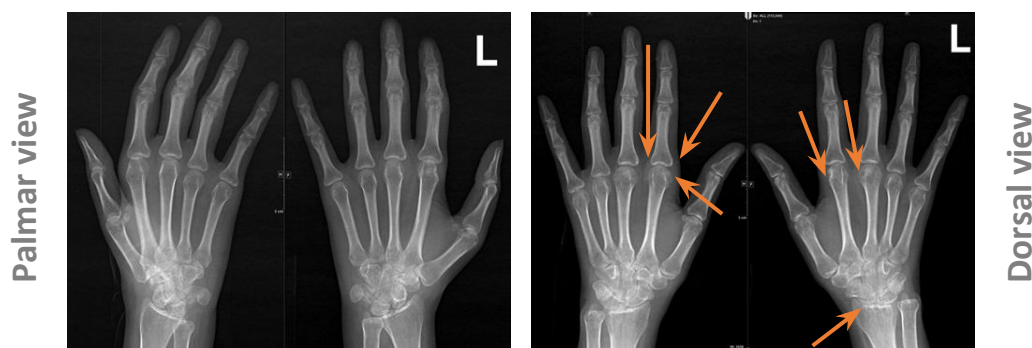
- Periarticular osteopenia (radiolucent areas).
- Preserved joint space.
- No erosions.
- Normal alignment.
- Normal soft tissue.





Diffuse osteopenia on top of periarticular / no erosions

d) 29 year old women with arthralgia.



Findings:

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

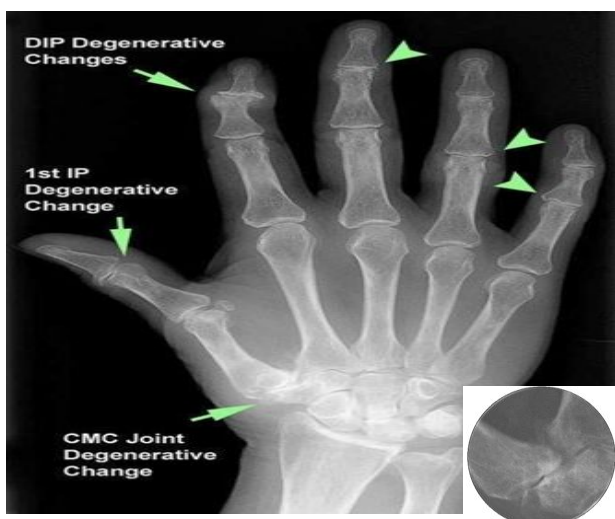
e) Rheumatoid arthritis & deformities.



- 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.



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

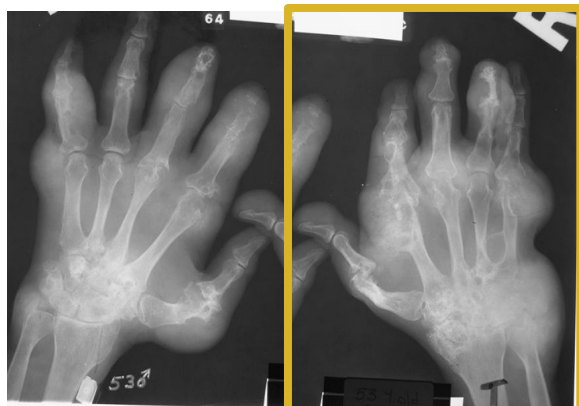
Gouty arthritis

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

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

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:



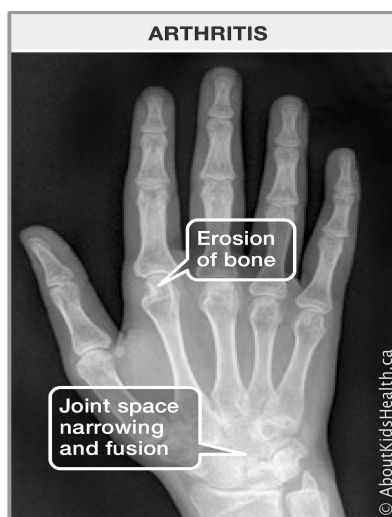
Subchondral sclerosis
thickening of subchondral bone
(whitish)



Subchondral cyst
Empty space (Blackish)

Diagrammatic representation of x-ray changes seen in chronic rheumatic diseases.

<p>A normal joint</p>		
<p>Osteoarthritis</p>	<p>Rheumatoid arthritis</p>	<p>Gout</p>
<p>(a) narrow joint space (b) osteophytes (c) subchondral sclerosis cysts</p>	<p>(a) soft-tissue swelling (b) ill-defined marginal erosions (c) loss of joint space (d) periarticular osteoporosis</p>	<p>(a) asymmetrical soft-tissue swelling (b) well-defined periarticular erosions (c) bony 'hooks'</p>





Summary

Terminology in bone trauma

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

- 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.

Questions

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.

WE NEED
YOUR
FEEDBACK