431

Radiology Team

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Lecture 2: Radiology of Rheumatic Diseases

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◆Important ◆Doctor's notes ◆Team's notes

We thank 429 & 430 Team for their helpful notes

بسم الله الرحمن الرحيم

From Slides

Extra Images

MUSCULOSKELETAL PATHOLOGY:

- Congenital.
- Arthritis.
- Metabolic.
- Trauma.
- Infectious.
- Hematological.
- Neoplastic.

X-ray is the cornerstone modality to evaluate musculoskeletal disorders.

MUSCULOSKELETAL RADIOLOGICAL TRAUMA

❖TERMINOLOGY IN BONE TRAUMA:

1) DISLOCATION vs. SUBLAXATION

Something related to the joint, the articulation of two bones

DISLOCATION: If the alignment of the joint is disturbed in all positions: (flexion, adduction, abduction and extension) it means that there is **complete** malalignment between two bones.

SUBLUXATION: If there is **partial** malalignment which means in certain positions the two bone will be separated from each other while in other positions they return to the normal alignment.

-Subluxation is usually related to laxity not rupture or injury of the capsule and ligament responsible of maintaining normal alignment of the joint.

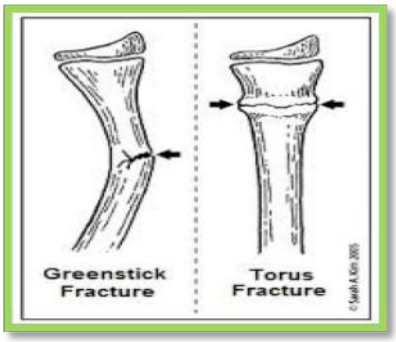
2) CLOSED vs. OPENED FRACTURES

OPENED: Disruption or injury of the overlying skin. (Risk for separated infection)

CLOSED: Overlying skin is still intact. (No risk for separated infection)

3) GREENSTICK vs. TORUS FRACTURES vs. PHYSEAL INJURIES.

These are the fractures or injuries that occur in pediatric age group. Because the bones (the cortex of the bones) are still not consolidated ⇒ leading to a specific pattern of injury.



4) STRESS vs. PATHOLOGICAL FRACTURES

-These fractures usually occur with **minor trauma** "Examples of major trauma: road traffic accident or being hit by a solid object".

-In stress and pathological fractures, the trauma is usually trivial even the patient does not notice these types of trauma, he will present with an absent traumatic insult to the area of the complaint.

- **The different between stress and pathological:**

STRESS: ◆ Occur from **repeated** type of **minor** trauma in under lying **normal bone.** It typically occurs in weight-bearing bones.

Examples of stress fractures: 1- Fractures seen in metatarsal bone from the repeated trauma to the foot. Soldiers usually have certain type of walking where they hit the foot on the floor, these type of repeated minor trauma -hitting the foot on the floor- can cause certain fractures in the shaft of the metatarsal bone which is perpendicular to the long axis of the shaft.

2- Runners who run long destines might have stress fractures in the tibial bone also the parachute jumper could have femoral bone fracture.

3- High heels

◆Symptom: pain in the forefoot. Image: affected shaft and fracture lines are vertical.

These types of fractures are usually thin and lucent line and it appears as a transverse line
- If you see an oblique line ⇒ it is less likely to be a stress fracture.
- Since it is a thin and lucent line ⇒ it is important that we look for it.

PATHOLOGICAL: Occur in **minor** trauma with **a diseased bone** such as patients with bone cancer and osteoporosis. It could occur from **one insult**.

❖Basic Principles In Radiology Of Bone Trauma:

1- Two perpendicular views: Frontal and lateral for examples. Why? Because we are taking about bone which is either cylindrical or tubular and you might have the fracture plane coming in face with the x-ray in one direction while it is in the other direction.

(It gives us the chance to visualize all the circumferential aspect of the bone)

2- The Paired bone concept "If one is fractured check the other": refer to the injury that occurs in an area where you have two bone. Example. Forearm. The radius and ulna both are fixed distally and proximally by the rest and elbow joint "almost similar length" If one of them is fractured, it will be shortened and the other bone will be exposed to more stress. Therefore, the second one will be either fractured or dislocated from one side.

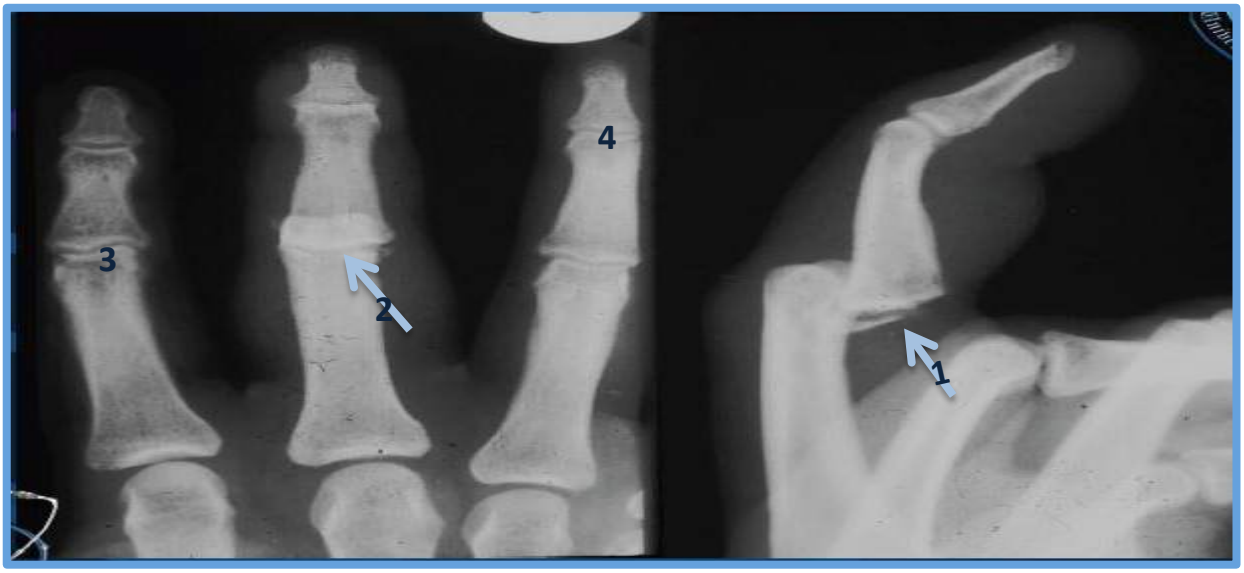
3- Weakest link concept: the weakest component in children is the bone. In adults it is the soft tissue (bone is more consolidated).

. Adults: The soft tissue structures (muscles/ ligaments/tendons)

(E.g. Football players usually have ligaments injury in either the cruciate ligaments or collateral ligaments more than bone fracture)

. Children: The physeal plate (growth plate) "The opposite, the bone is not consolidated there for they are more prone to be fractured than injury to the soft tissue"

Case 1: A Man presented to the ER with injury to the finger

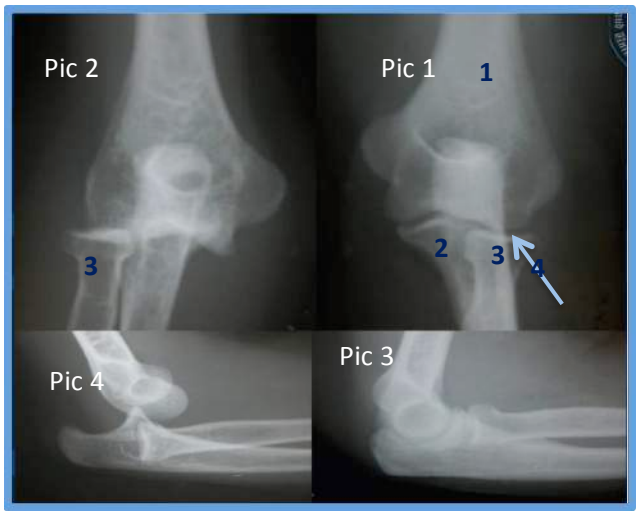


Frontal view:
In middle finger → loss of joint articulation→indicating that there is a dislocation → in order to clarify this dislocation → you need a lateral view.

Lateral view:
There is a clear dislocation and fracture of the middle finger more than frontal.

1-Associated fracture is not seen in frontal view
2- Overlapping between the middle phalanx and proximal phalanx at the level of proximal joint
3- Proximal interphalangeal joint
4- Distal interphalangeal joint

Case 2: Trauma of the elbow joint [Patient with both dislocation of radius and ulna]



1-Humerus bone 2- Ulnar 3- Radius 4-Joint space between - ulnar and trochlea - radius and capitulum

Pic 1 ⇒ normal articulation of elbow joints in the frontal view.
Pic 2 ⇒ the radius has been displaced laterally ⇒ so there is a dislocation of the radius. Also, the joint is not seen here.
Pic 3 ⇒ normal elbow joint in the lateral view.
Pic 4 ⇒ the proximal part of ulna has been displaced posteriorly and dislocated.
- So, in the frontal view we could only visualize the dislocation of radius but in the lateral view we were able to visualize the ulna dislocation.

Case 3: A child presented ER with history of trauma, swelling of elbow joint

- This is elbow joint for a pediatric patient → because the epiphyseal plate is seen here.

- This is not fracture this is the growth plate of the Capitulum which usually articulate with the radius

Frontal view →it looks normal elbow joint.

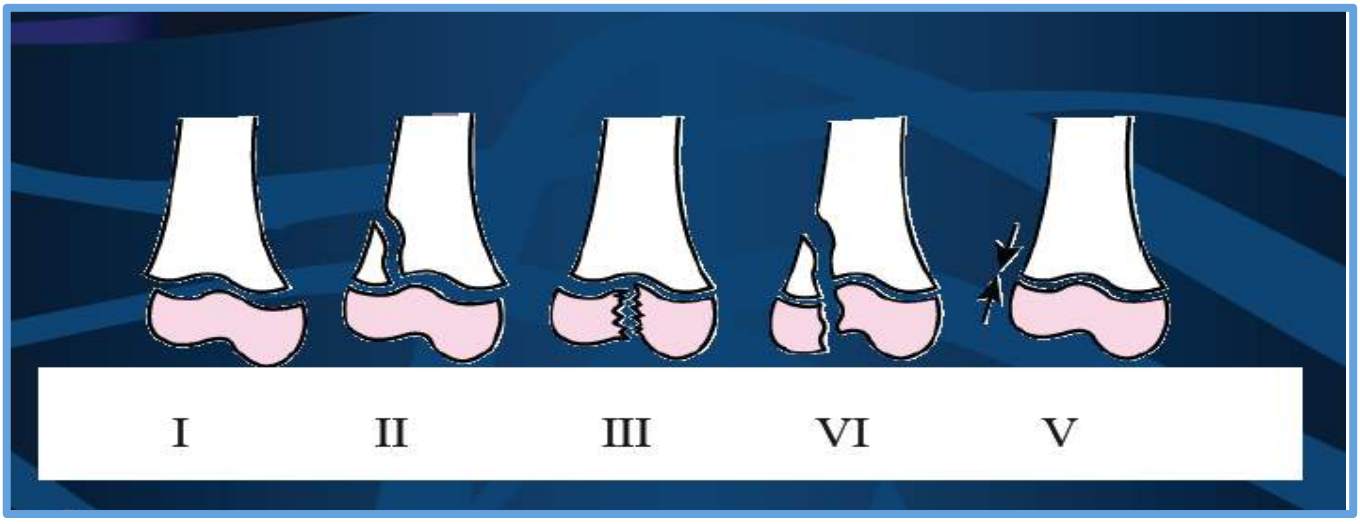
Lateral view→ there is a fracture within the distal part of the humerus **1**

This fracture might be completely missed in the frontal view.

Physeal Injuries **"physeal plate fractures or growth plate fractures"**

(Salter-Harris Injuries) **"Names of the first orthopedic and radiologist who describe this type of facture"**

(It is a pediatric age group fracture ⇒ occurs at the epiphyseal plate level ⇒ it has 5 subtypes depending on the type of insult to the growth plate)



1. SH I: This fracture typically traverses through the hypertrophic zone of the cartilaginous physis, splitting it longitudinally and separating the epiphysis from the metaphysis.
2. 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.

3. 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 .
4. SH IV: This fracture runs obliquely through the metaphysis, traverses the physis and epiphysis, and enters the joint .
5. 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

Type 1: only separation of the 2 bones at the epiphyseal plate.
Type 2: separation of the 2 bones with metaphysical corner fracture. (Most frequent type).
Type 3: separation with fracture involving the epiphysis.
Type 4: separation with fracture at the metaphysical corner and epiphysis. "Both"
Type 5: the 2 bones are impacted ⇒ due to vertical force ⇒ leading to retardation of the growth ⇒ because it's leads to premature closure of the growth plate. (It is the worst type). Most likely to affect the growth of the limbs.

What is the importance of type 5 fracture?

The growth, because the growth plate is the plate where the growing of the tubular bone occur so if we have injury in the growth plate its mean you might have disturbance of the growth of the limb or the part that is involve in this injury

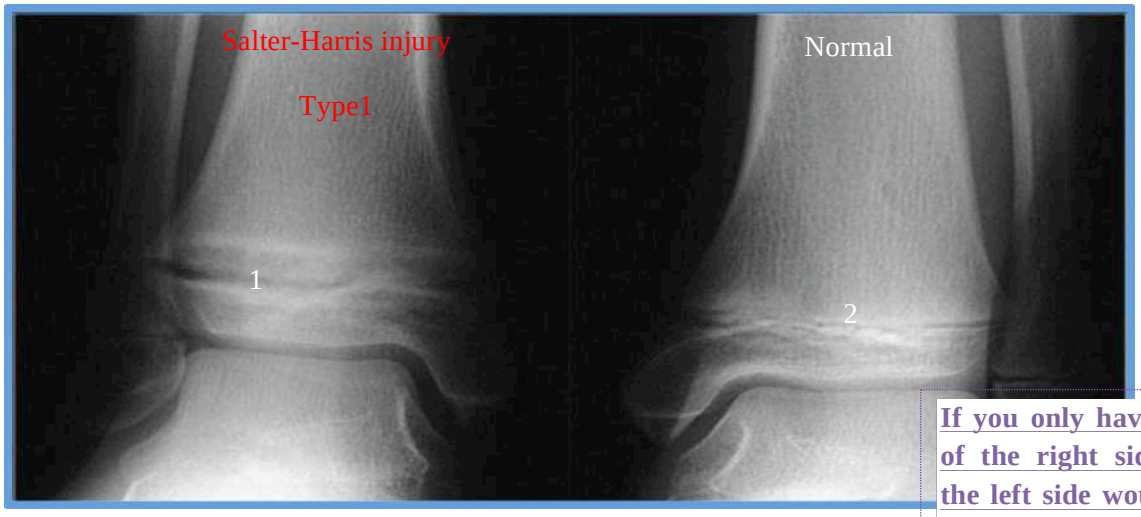
What is the most likely type that affects the growth?

Type 5

In normal physiology the growth plate will be diffused in puberty. From this concept, type five is the most common type that can affect the growth of the limb, because it is an impaction of the growth plate. Type 1 (Separation) will still has space for the growth to occur while in the impaction you are accelerating the diffusion of growth plate.

Case 4: Traumatic Osteolysis of epiphyseal plate

Salter-Harris injury Type 1 (A child presented to the ER with a trauma to the right ankle joint)



- Pediatric right and left ankle joints ⇒ because the epiphyseal plate is seen in the normal left ankle joint.
- Widening of the growth plate in the right ankle joint ⇒ the epiphyseal plate is separated **1** (So this is type 1 physeal injury)

Why don't we say there is an impacted injury on the left side?

1-We need to know the normal appearance of the growth plate in certain age groups.

2- You need to correlate the findings with the clinical history.

If you only have an x-ray of the right side without the left side would you be able to say that this is defiantly physeal fracture of the growth plate?

It depends on your experience and knowing the normal anatomy. But if you have a doubt, do the x-ray of the opposite side and compare the normal with the side that patient is complaining with.

Lateral view of the ankle joints for the previous pediatric patient.

- The growth plate **1** of the left ankle joint.
- Widening of the growth plate **2** of the right abnormal joint.
- The history will help you to differentiate between the normal joint and the type 5 fracture.
- In this case the patient came complaining of an injury of the right joint so, when we took the left joint image, it can't be type 5 fracture because the patient dose not complain of it.
- We took an image for both the right and left joint to compare between them.

Case 5: An 11-year-old boy with swelling of wrist join

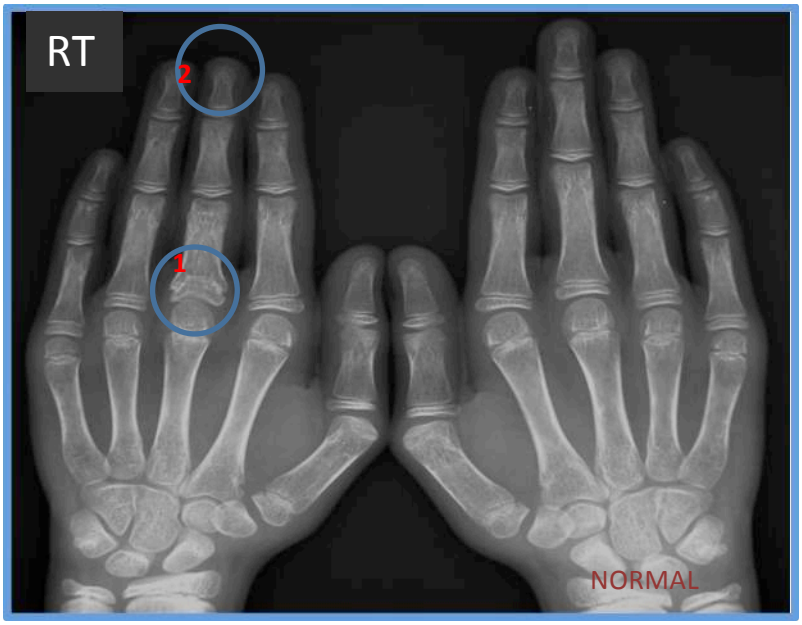
- Irregular outline **1** in the epiphyseal plate and slightly separated. (Type 2 injury)

-**To confirm this widening what should we do?** Take the opposite side and compare it with the injured side

- In the lateral view → there is a soft tissue swelling **2** → indicating that there was a trauma to the wrist joint.

- Separation at the metaphysic level.

Case 6: A 9-year-old boy with right hand pain



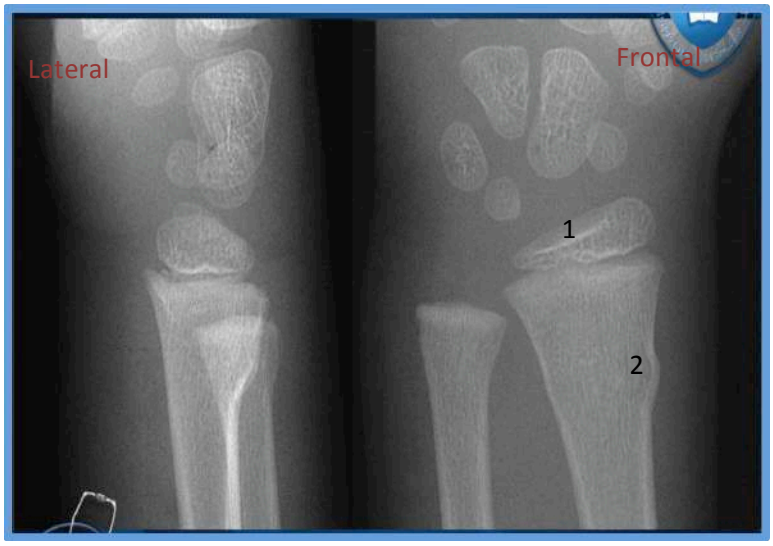
- By comparing the length of the fingers between the two hands, we will see that the middle right finger is shortened **2**.

- The growth plate **1** (at the base of proximal phalanges of the right middle finger) is not seen here.

- Type 5 fracture.

- If this injury has been discovered earlier, the management will prevent the shortening of the finger.

Case 7: A child who had sustained trauma to the right joint. Torus Fracture



-Pediatric wrist joint → because we can see the growth plate **1**

- Buckling of the cortex **2** → this is called a torus fracture.

- We call it torus fracture because the lesion is all over the circumferential surface of the cylindrical bone.

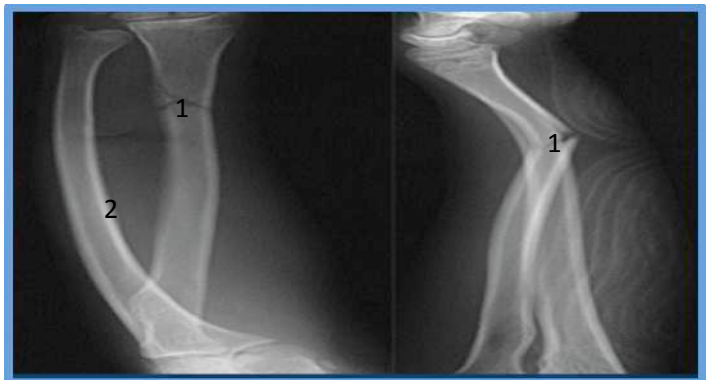
Case 8: Greenstick fracture

Greenstick **1** fracture is a pending fracture.

- When there is pending force over the bone, the fibers of the cortex will disrupt form one side and preserved from the other side and the opposite side is still intact

Involve only one side of the bone

Case 9: Bowing Fracture

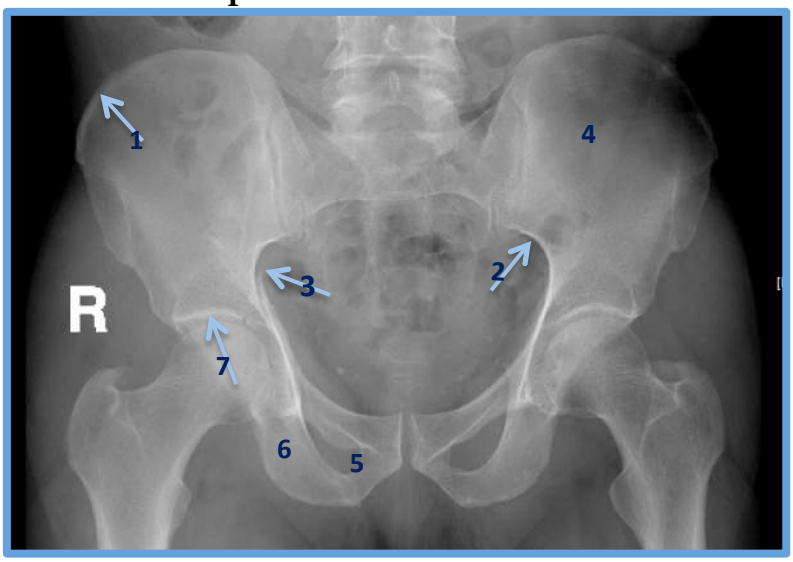


- Angulated radius **1** fracture ⇒ leading to shortening of the fractured bone and curving **2** of the other bone.
- The curvature is called bowing fracture.
- It is a pediatric age group fracture.
- This case applies the concept of paired bones

- Angulated fracture of the ulnar.
- The radius is bowing and dislocated **3**

Case 10: A 55-year-old patient limping with right hip pain after a road traffic accident

Supra-acetabular fracture



1-The iliac crest is intact 2- Normal cortical outline "continuous" 3-Abnormal cortical outline "discontinuous" fracture. 4- Iliac plate 5- Pubic ramus 6- Ischium ramus 7- supra acetabulum 8- Fracture of the right iliac bone → we can see whit dense disrupted line in the right iliac bone

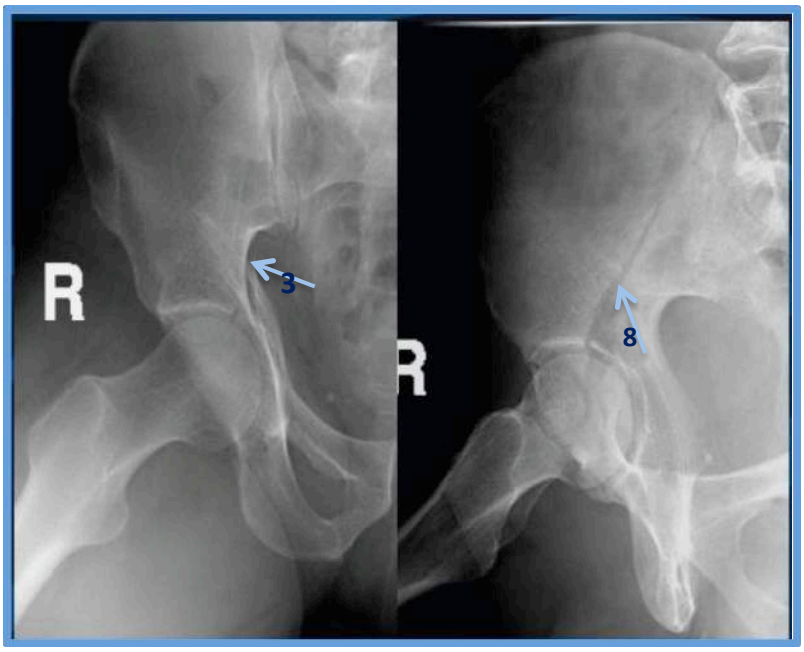
When you look at the bone there are 4 things that we look at: Bone density, Bone texture, Alignment, Cortical outlin

Q-Which part of the bone is the fracture involving ?

Iliac bone.

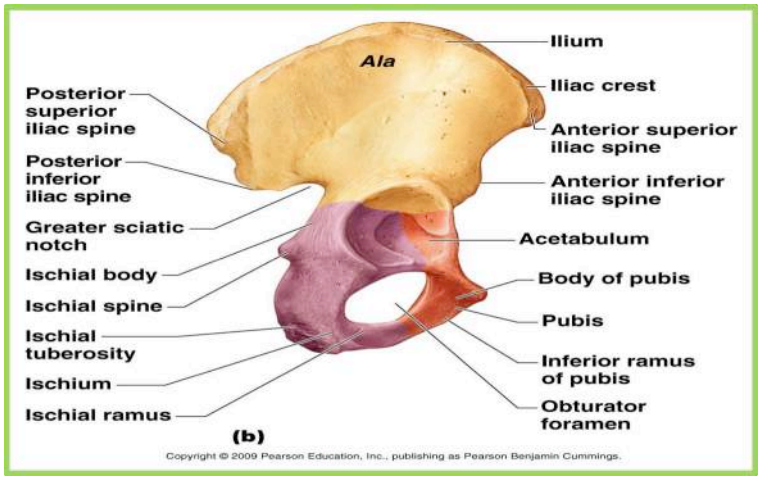
Q-Which part of the iliac bone?

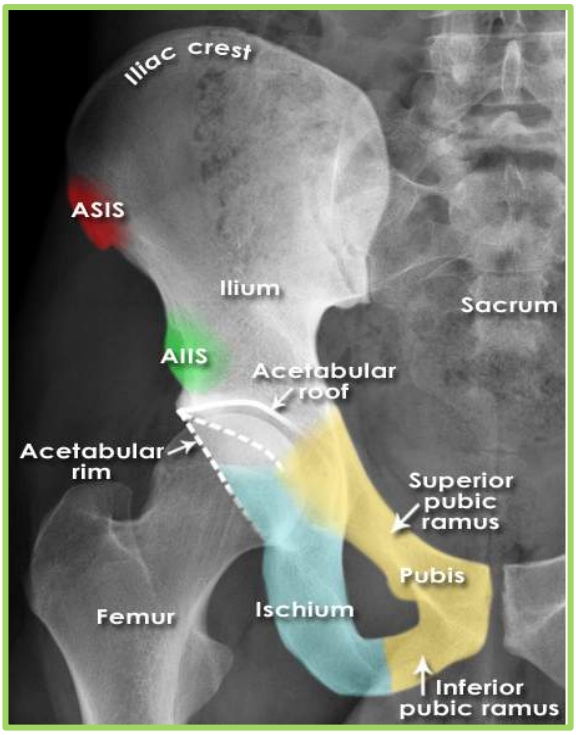
Supra acetabulum.

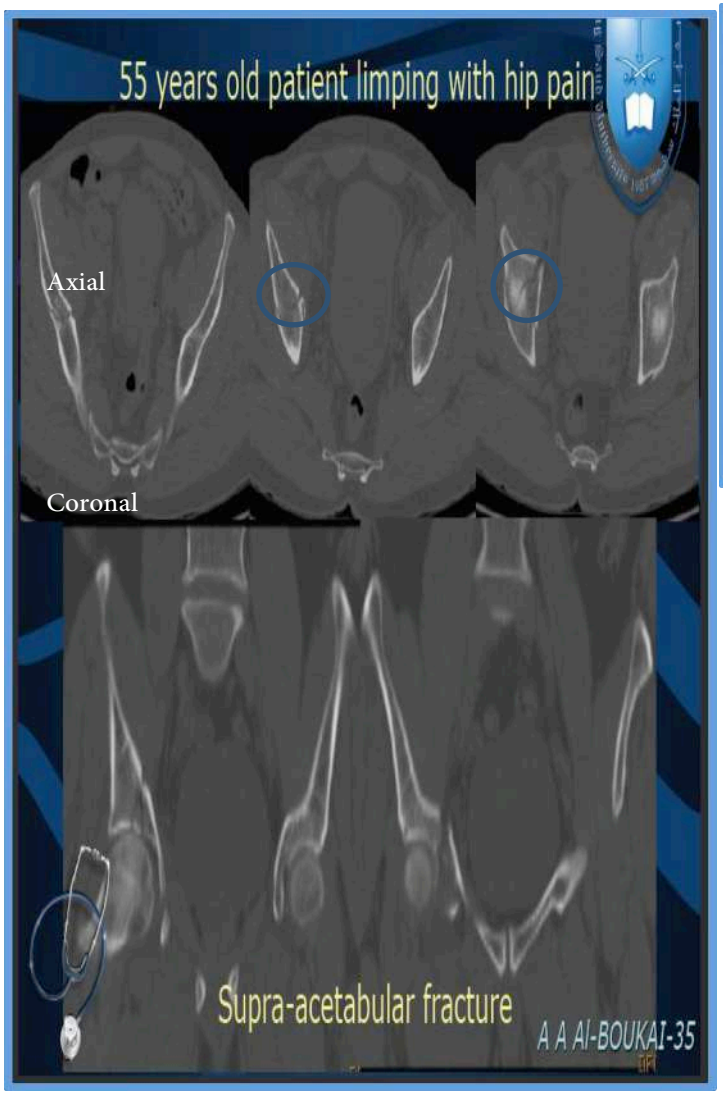


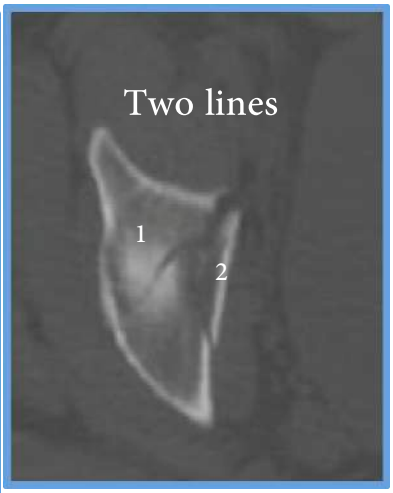
The frontal view shows the fracture only at the cortical surface.

Oblique view







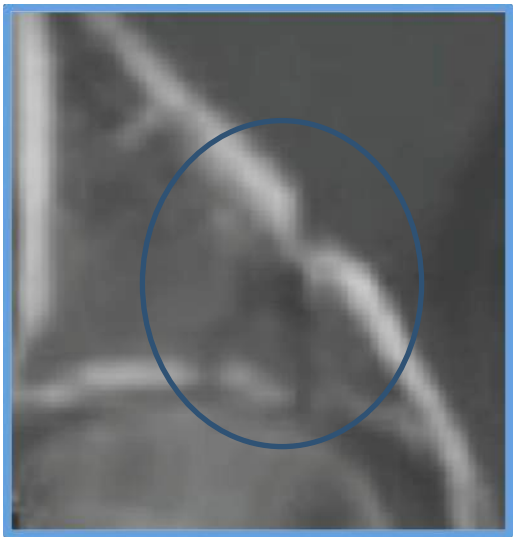


X-ray shows there is a fracture. However, CT shows there is a branching fracture.

Whenever we have trauma to complex area such as pelvis and shoulder and there is query underlying either:

- Loss fragment.
- Possible extension of the fracture in to the articular surface.

CT will be helpful in delineating the outline of the bone.

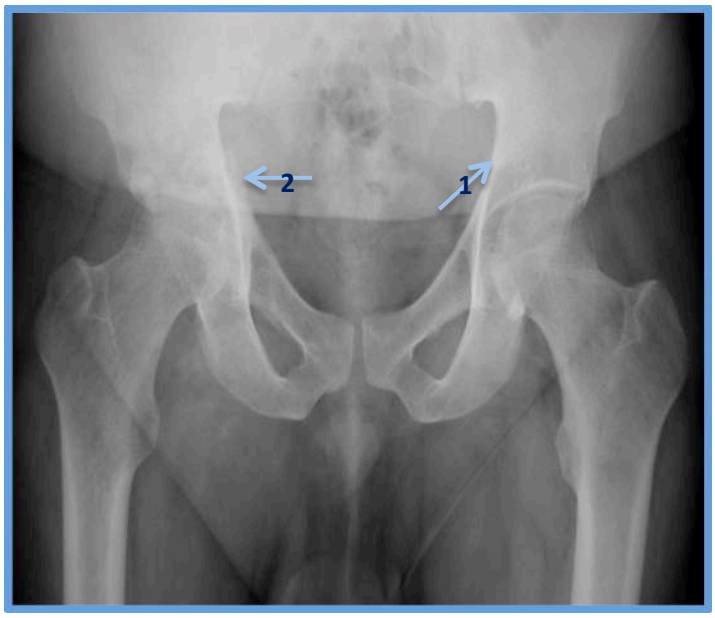


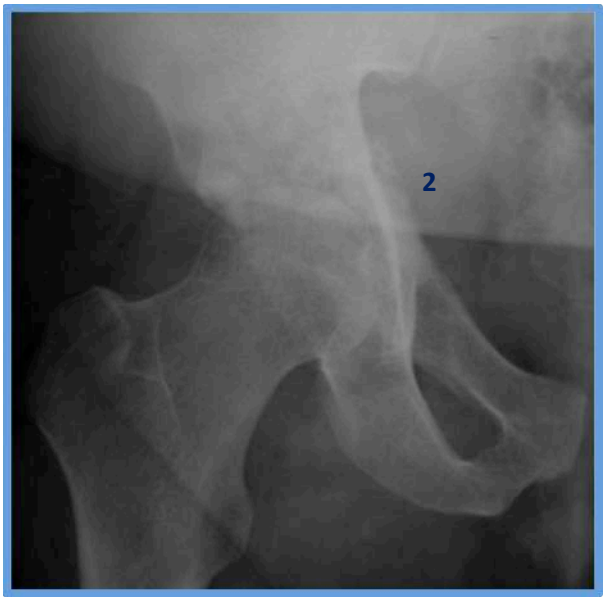
Coronal plain: you can see the triangular piece which indicate that this piece might be loss piece inside the joint and could interfere with the movement of the joint there for it is extending in to articular surface.

Orthopedic surgeons should know about it to fix or stabilize this fragment with the rest of the acetabulum

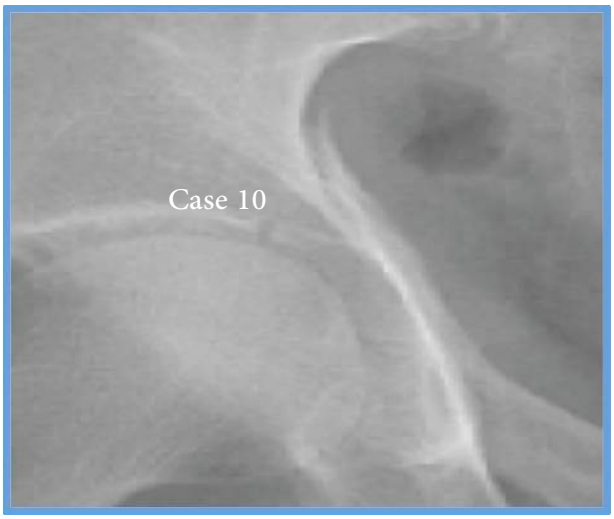
The important of CT here, is that there is a chance that there will be a piece of fracture inside the joint causing pain and limitation of the movement.

Case 11: A 50-year-old patient limping with hip pain





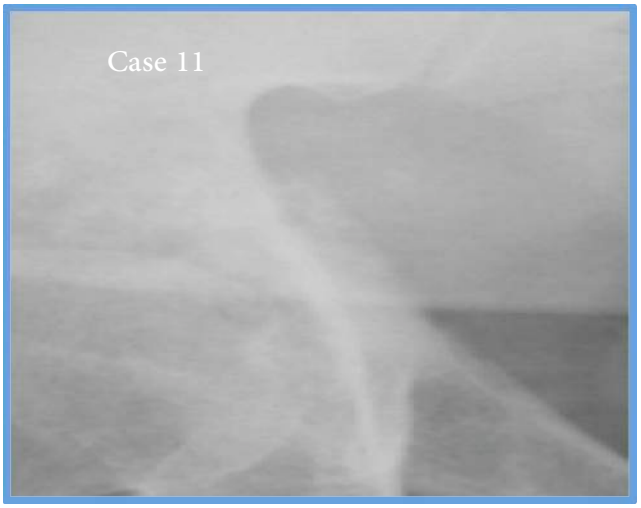
1- Normal cortical outline 2-Abnormal cortical outline "disruption" fracture.

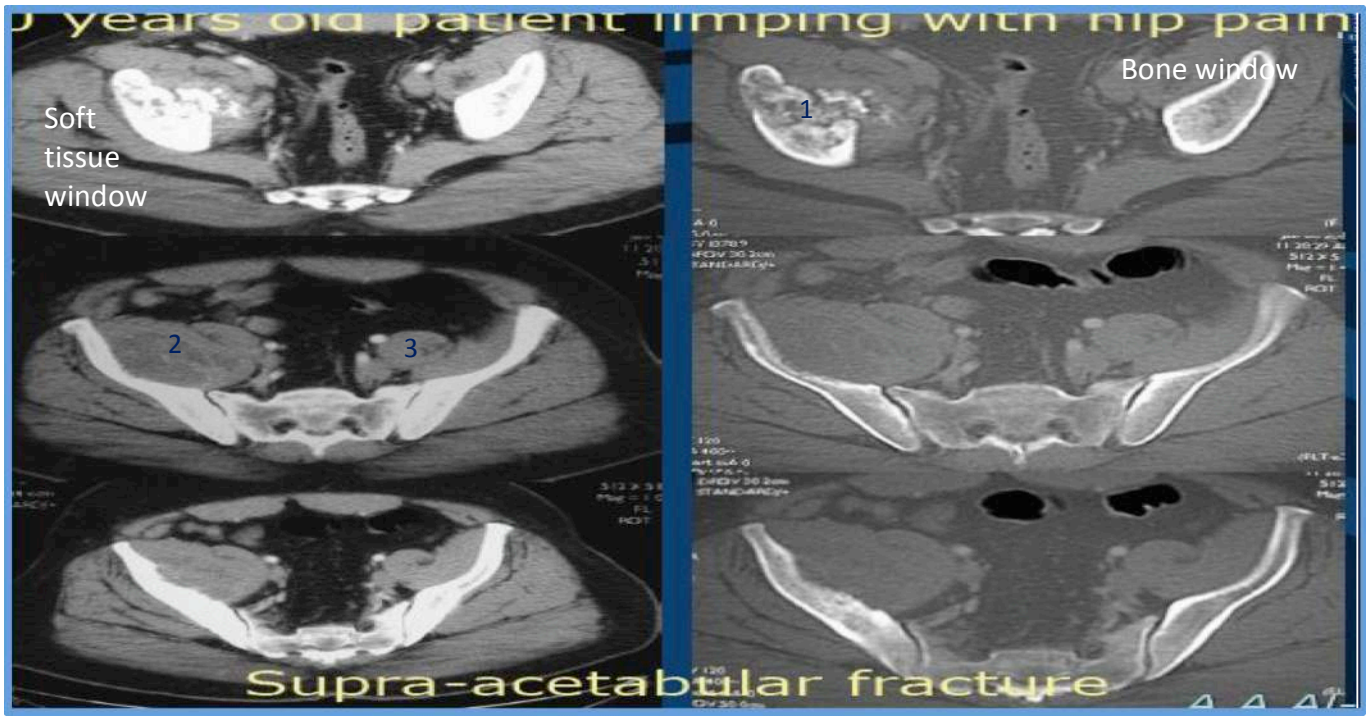


Q: What is the difference between this patient and patient in case 10?

Case 10: there is a very clear sharp fracture.

Case 11: the fracture is clear but the margin is not sharp.





When we did CT Instead of having sharp fracture we have fragmentation of the acetabulum (fragmented fracture of the acetabulum) **1**

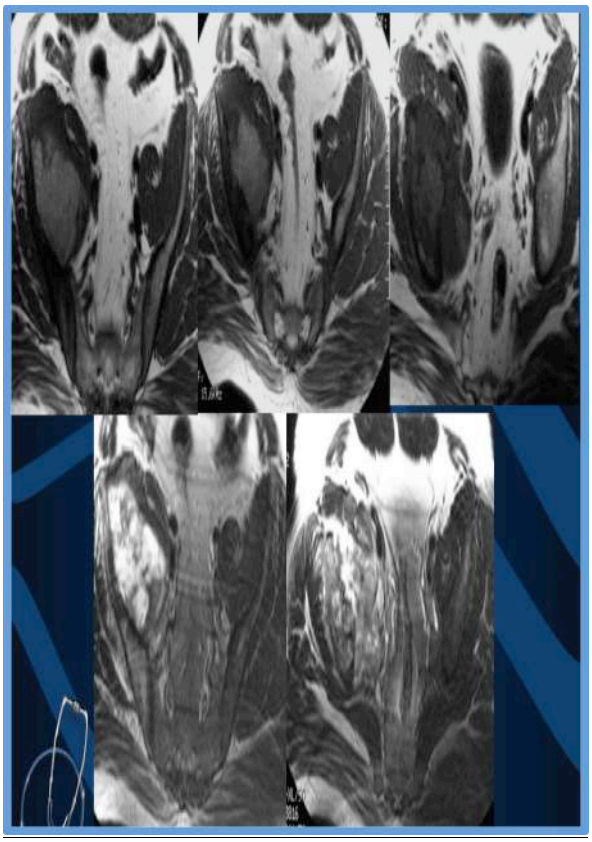
There is also soft tissue swelling **2**

If we compare the soft tissue in **2** and the soft tissue **3** there is swelling "almost amass"

-To visualize and now tissue characterization of this mass we should order MRI, because MRI has better resolution in differentiating tissue characterization.
(Whether it is an infection with fragmentation of the bone, or cancer with pathological fracture of the bone).

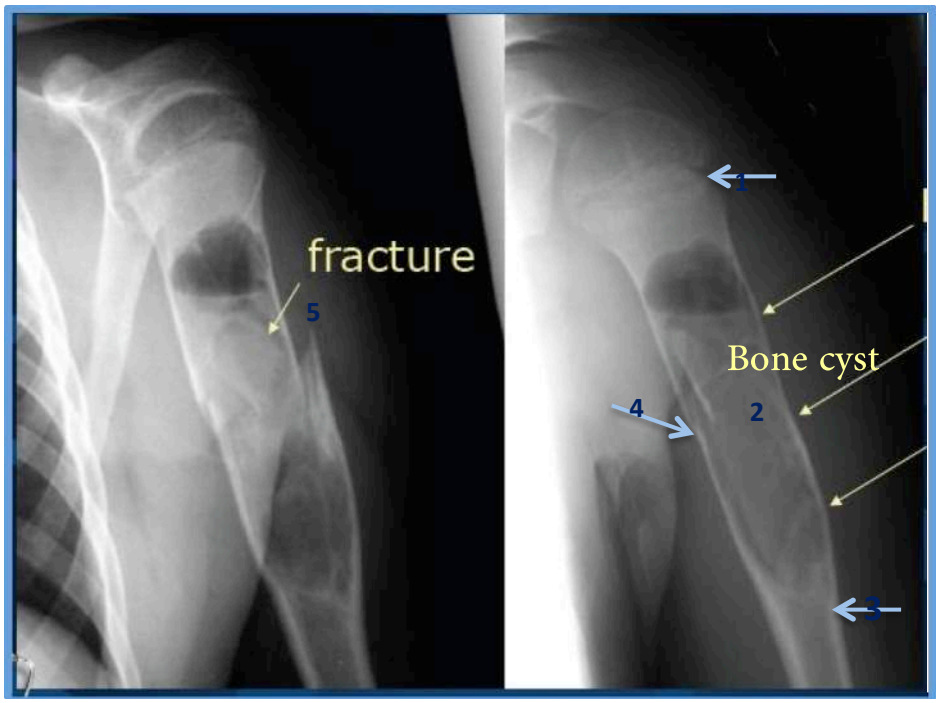
-MRI shows that this fracture is related to a mass lesion which is involving the muscle plane adjacent to iliac bone and the bone was fractured secondary to the underlying neoplastic process, sarcoma "pathological fracture".

-Tumor was in soft tissue adjacent to the bone so it infiltrates the bone and led to bone fragmentation



- If there is blood without history of trauma → suspect malignancy
- If there is pus → suspect infection
- This case, it is blood due to sarcoma.

Case 12: Young patient



- The fracture here is sharp because of the cyst.
- But if there is malignancy → the fracture will be fuzzy.

1- Growth plate "Young patient"
2- Large cystic legion in the medullary portion of the bone
3- Normal cortex.
4- Thinned out cortex.
5-Fracture "Pathological fracture secondary to bone cyst"

Case 13: A 20-Year-old lady finger pain

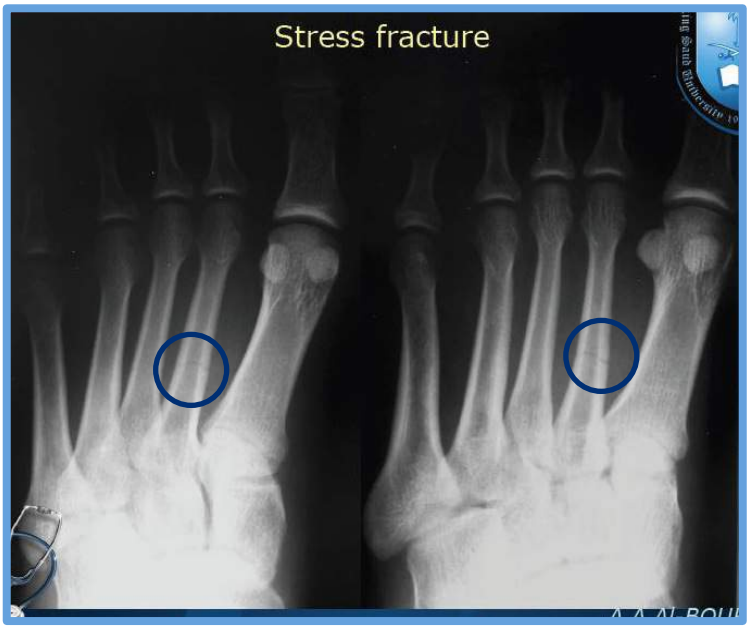
1- Cyst within the finger 2- fracture "disruption of cortex" Pathological fracture

Case 14: A soldier complaining of pain of the forefoot

Forefoot = metatarsal and toes.

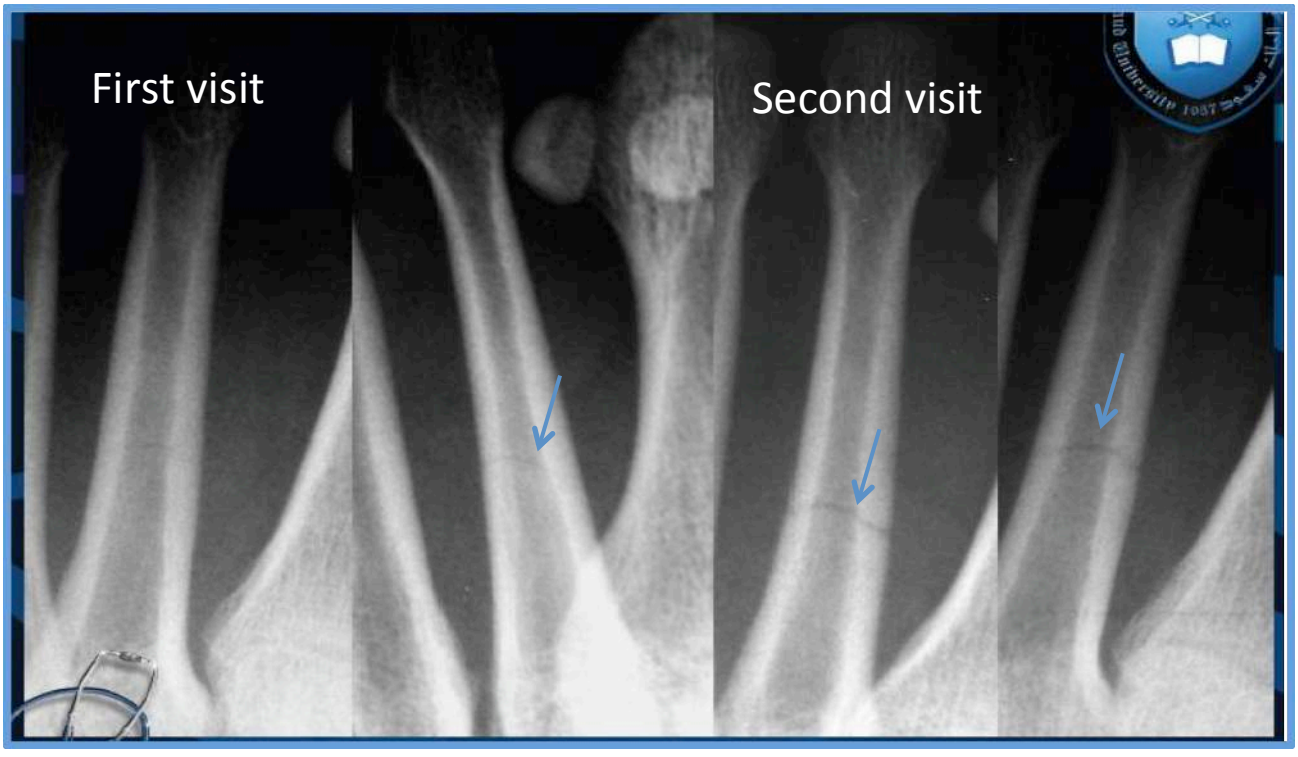
Hint foot = ankle and tarsal bones.

The x-ray does not show any abnormality.



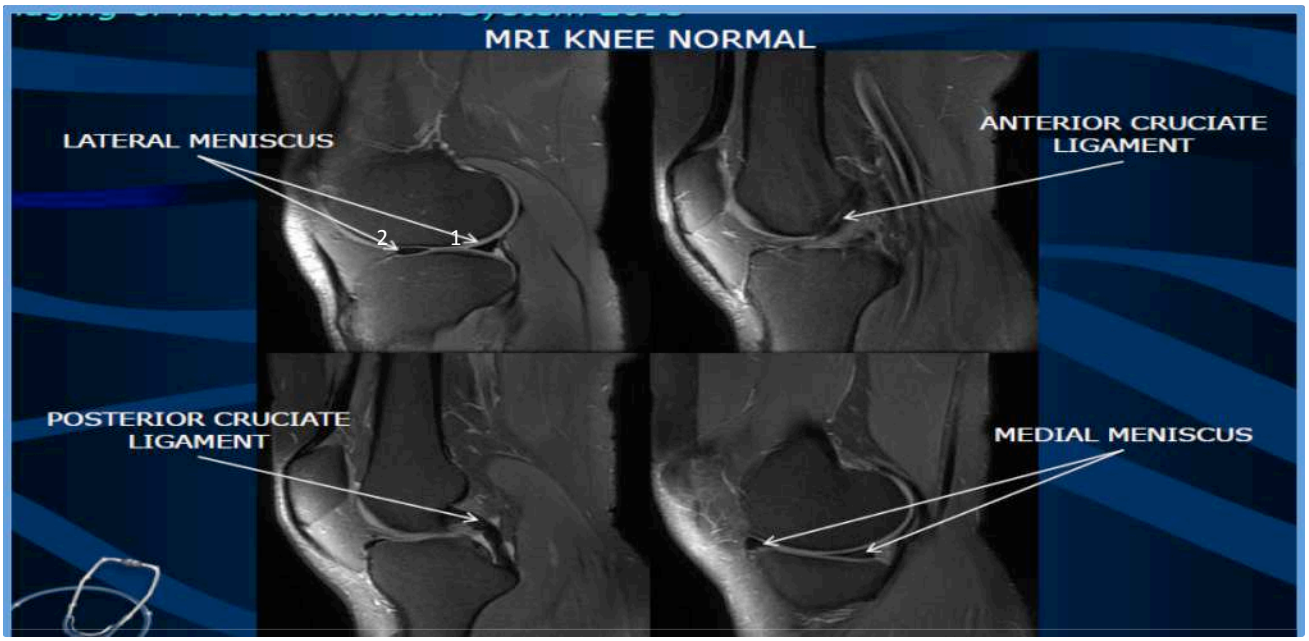
Because of persistent of the pain the x-ray was repeated. It shows lucent line 'very thin hair line' and this is usually related to stress fracture due to repeated type of trauma.

So, if you have patient with persistent pain → repeat the X-ray

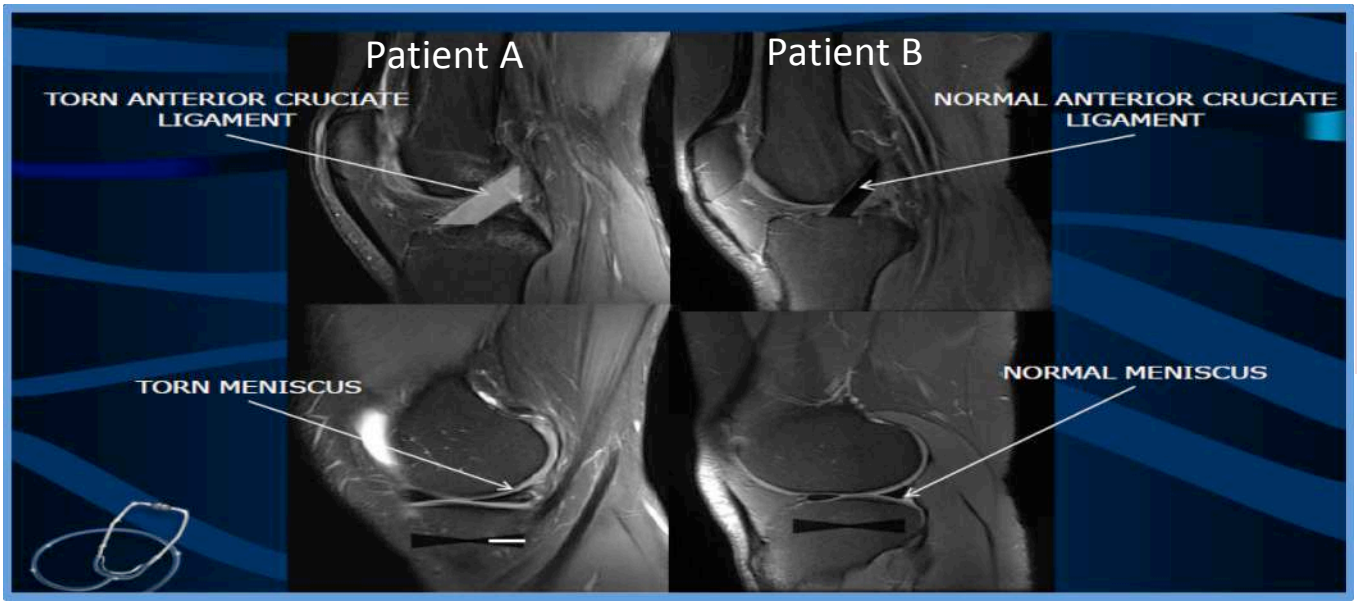


Importance of the MRI

MRI is the best modality for the evaluation of the soft tissue (bone marrow, tendon, ligament and muscle)



- This is an example of sagittal MRI taken at the knee joint
- There are two triangular black shadow (1,2) both of them will resample bow tie appearance usually refer to the menisci.



- Anterior cruciate ligament in patient B is black while in patient A is white which indicate tear of cruciate ligament (Normal = black / Tear = white)
- Normal black triangular meniscus seen in patient B while in patient A there is white line inside which represent tear or rupture (Normal meniscus = triangular black shadow / abnormal = white line inside the triangular black shaow)

Summary

- DISLOCATION: the alignment of the joint is disturbed in all positions.
- SUBLUXATION there is partial malalignment.
- OPENED: Disruption or injury of the over lining skin.
- CLOSED: Over lying skin is still intact.
- Basic Principles In Radiology Of Bone Trauma:
  - Two perpendicular views
  - The Paired bone concept
  - Weakest link concept
- GREENSTICK, TORUS FRACTURES and PHYSEAL INJURIES are the fractures or injuries that occur in pediatric age.
- STRESS: Occur from repeated type of minor trauma in under lying normal bone.
  PATHOLOGICAL: Occur in minor trauma could be from one insult and the under lying bone is diseased
- Type 5 is the most likely to affect the growth of the limbs.
- Type 2 is the most common seen type.
- MRI is the best modality for the evaluation of the soft tissue (bone marrow, tendon, ligament and muscle)

Questions

What is the most likely type of fracture that affects the growth?

a) 4
b) 5
c) 3
d) 2

What is the most common type of fractures among soldiers?

a) Stress fractures
b) Pathological fractures
c) Torus fractures
d) Physeal fractures

B, A

Good luck!