

432
Radiology
Team



(#): Imaging to the Musculoskeletal System



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Objectives

- Learn the Normal radiological anatomic landmarks.
- Learn the system of analyzing findings “Where to look & What to look for”.
- Recognize features of certain disease entity.

• Imaging to Musculoskeletal System

Metabolic and Endocrine Disorders:

- Osteoporosis
- Osteomalacia
- Renal Osteodystrophy
- Hyperparathyroidism
- Acromegaly

Arthritis

- Rheumatoid Arthritis
- Osteoarthritis
- Psoriaticarthritis
- Gouty Arthritis

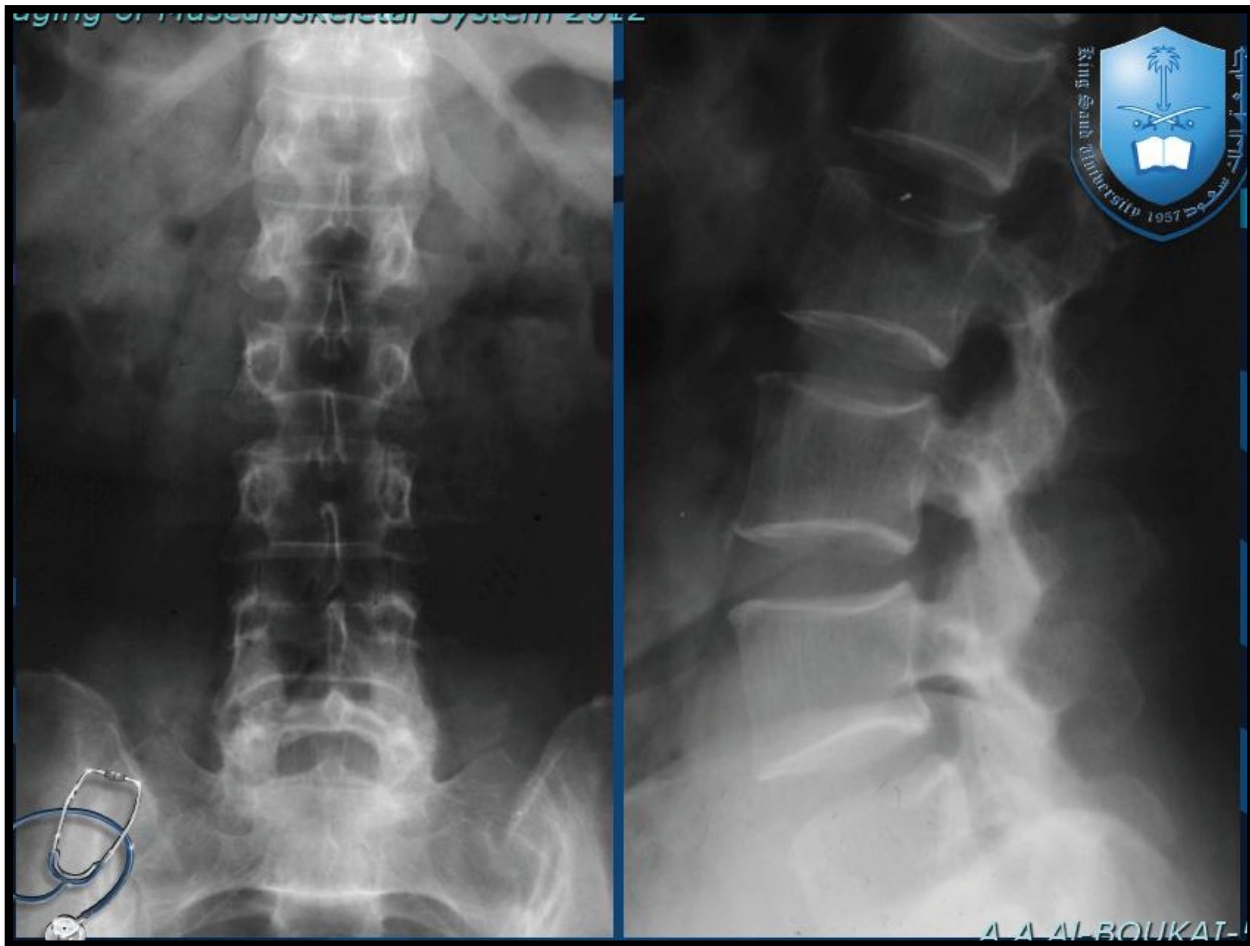
Musculoskeletal Tumors

- Osseus, chondral, fibrous, soft tissue

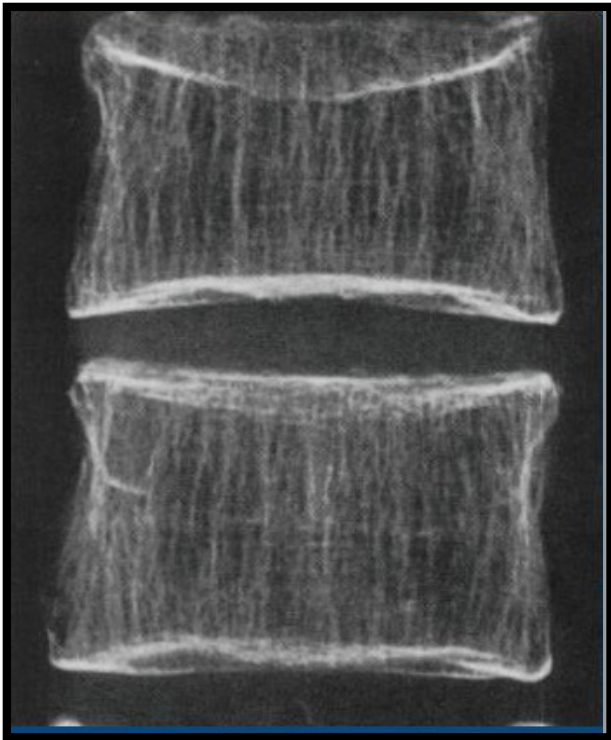
Metabolic and endocrine bone disorders

Case NO.1

54 years old female with low back pain x-ray of Lumbo sacral spine requested.



An X-ray of lumbosacral spine that shows a decreased bone density of the vertebra. Which is obvious by looking at the margins which is markedly increased when compared to the body of vertebra. Also, Trabeculae are seen , which are vertical lines on the vertebral bodies, due to reduction of the matrix “bone density” and the horizontally trabeculae will be lost and vertical ones will be obvious.(team431)



- The abnormal bodies are more black (Uneven density) than the normal ones because of the reduction of the bone matrix
- You can see lines of the residual trabeculae very clear and vertically shaped inside the vertebral bodies
- concaved end plates (cupp) but it's significant in osteomalacia
- Reduction in the height of the vertebrae
- you can draw the lines of the cortex because they are very sharp and thin and the margins are sclerotic (white)
- **Patient has osteoporosis**

Osteomalacia: excessive mineralization of the bone that isn't functional.

Osteomalacia "Rickets in children"
Bone density may be normal but bone is soft and there is a defect in mineralization and ill defined margins with no vertically oriented trabeculae

Unlike in **osteoporosis** there is reduction in bone density, sharp margins of the vertebral body with obvious vertically oriented trabeculae.



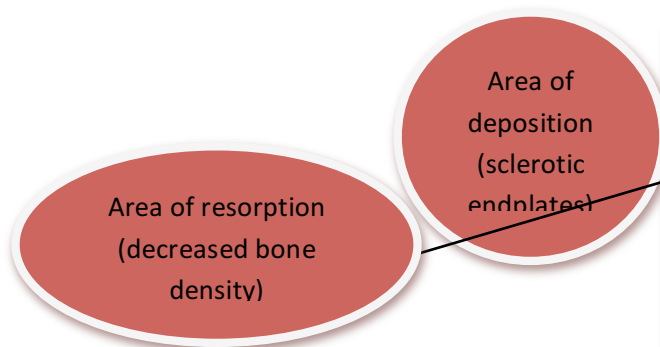
Case NO.2

27 years old male with long-standing history of renal failure
x-ray of lumbar sacral spine was requested.

We see 2 white margins because of Excessive deposition in the end plates and central lucent area (black) with vertically lined trabeculae inside the body of the vertebrae (osteosclerosis)

It's called **"Rugger jersey spine"**

Due to renal osteodystrophy which is secondary to hyperparathyroidism



Renal osteodystrophy presents with:

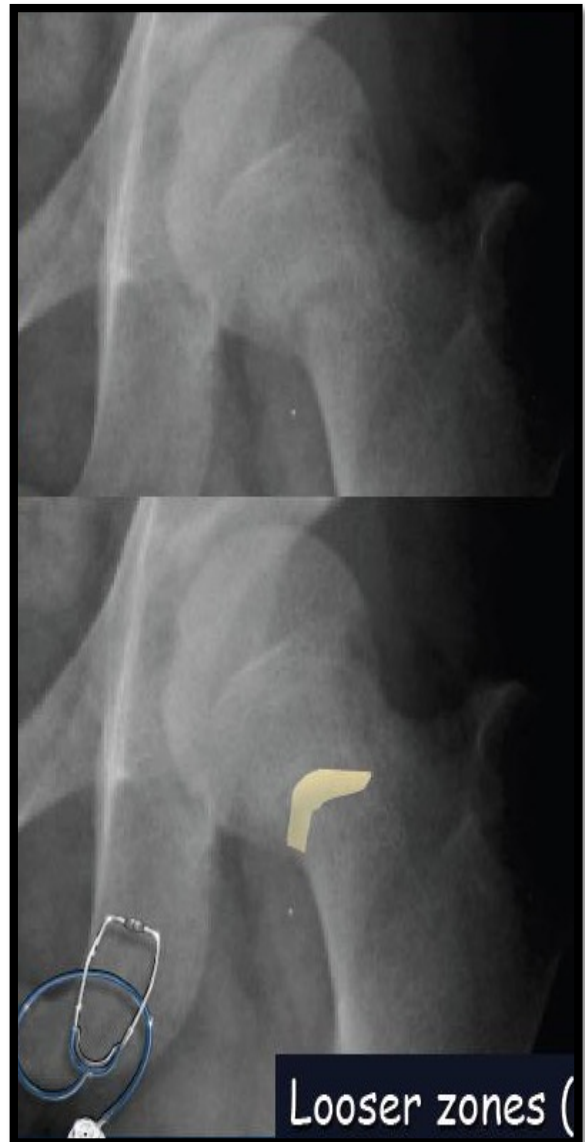
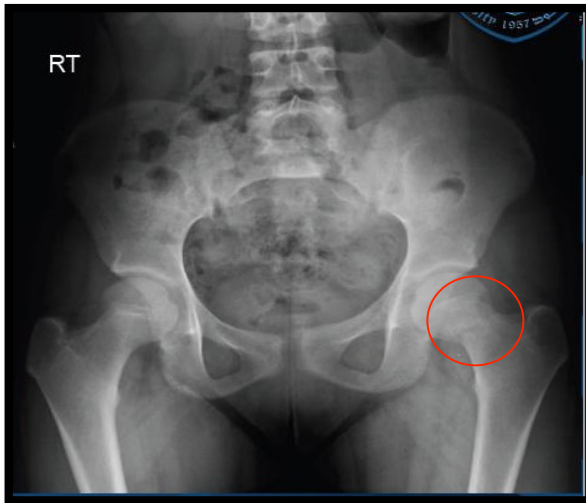
Osteoporosis

Osteomalacia

Osteosclerosis

Secondary Hyperparathyroidism

20 years old lady weakness and lower limbs pain.



- **Lucent line in the left head of the femur in the Medial aspect of the femur neck**
- **CT: check texture of the cortex**
- **MRI: check changes in the bone marrow**
- **Insufficient fracture of the femur neck due to softening of the bone**
- **Looser zones: presents as pain during movement, lower limb weakness**
- **Specific fracture for osteomalacia (most common area) also can happen in the symphysis pubis and scapula**

Hyperparathyroidism presents**with:**

- Bone resorption
- Bone softening
- Brown Tumors
- Osteosclerosis
- Soft tissue calcification

In hyperparathyroidism:

- Trabeculation (bone loss)
- Distinctive cortical lines
- Classical hyperparathyroidism:
2nd/3rd finger , middle phalanx,
radial aspect bone resorption.



In hand, sub periosteal bone resorption in hyperparathyroidism.

These changes usually happen in the middle phalanx, radial aspect in the 2nd or 3rd finger.

Bone Resorption**Subperiosteal**

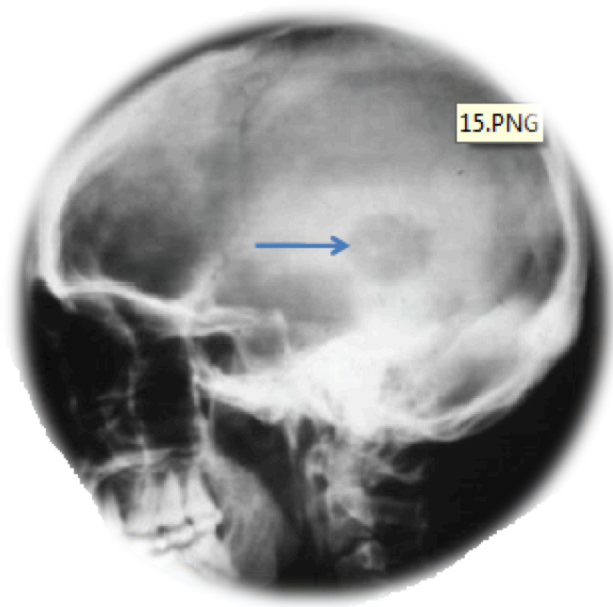
- * Most useful sign
- * Virtually Diagnostic
- * Location

Middle phalanx:
irregularity of the margin
(sub periosteal bone reabsorption)
radial aspect

14.PNG

Hyperparathyroidism

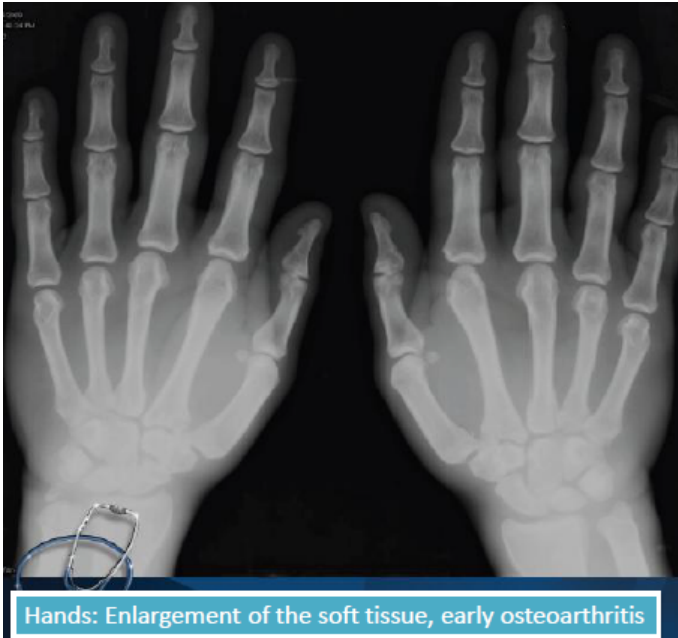
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- **Brown tumor** features:
- Affect long or flat bones 2)single or multiple 3)have a sharp outline but with no obvious margins.
- Lytic lesions most common place the skull.
- DDX: hyperparathyroidism,tumor,metastasis lymphoma.
- nothing van be diagnosed by x-ray

Case NO.3

45 years old male presents with history of bone enlargement x-Ray of skull and hand are requested



- Sella turcica is rounded & enlarged which may indicate pituitary pathology that caused the acromegaly
- Jaw and frontal sinus are enlarged
- Occipital protuberance
- Thickening of the calvarium
- Sellae of the pituitary is enlarged due to adenoma



Arthritis

Rheumatoid arthritis (age
very imp)

Gouty arthritis

Osteoarthritis

Psoriasis

Case NO.4

48 years old female presents with joint pain of the hands and feet x-ray of hand requested



- Decreased bone density
- Oblique view: alignment is disturbed (first metacarpal)
- Carpal bones are destroyed and eroded
- Reduced distance between radius and carpal bones (narrowed spaces between the joints)
- Subluxation at the thumb
- Ulnar deviation
- Lucent areas (early erosions of RA)
- Patient has Rheumatoid Arthritis





- Carpals aren't clear (**RA is a proximal disease**)
- Changes involve the head of the metacarpal, metacarpal pharyngeal joints
- Rheumatoid arthritis: Look → Bone density, texture & outline.
- Some of the signs of rheumatoid arthritis are: Peri-articular erosions (peri-articular osteopenia), loss of joint spaces.

Around joint:
periarticular osteopenia/osteoporosis

- Erosive changes
- Erosive arthropathy: caused by the rheumatoid arthritis
- Changes more to the **proximal joints than distal**
- Dislocation of the joints, swan neck deformity of the neck, extensive erosive
- Early radiological sign: **decreased density around the joint**
- Mal-alignment of the fingers , ulnar deviation of left hand & dislocation of the thumb of the left hand.



Case NO.5

Elderly male patient presented with joint pain of the hands.

X-ray of hand requested

Osteoarthritis is a distal disease

- Carpals are clear
 - Metacarpopharyngeal joints : no defect or erosive changes
 - Proximal inter pharyngeal space
- Distal: osteosclerosis at the margins of the bone and osteospikes are found (osteophytes)
- Reduction of the joint space distally
 - You can see new bone formation (osteophytes)
 - Sclerosis seen at the articulations



Sclerosis and narrowing of the joint

- First carpal metacarpal joint (thumb)

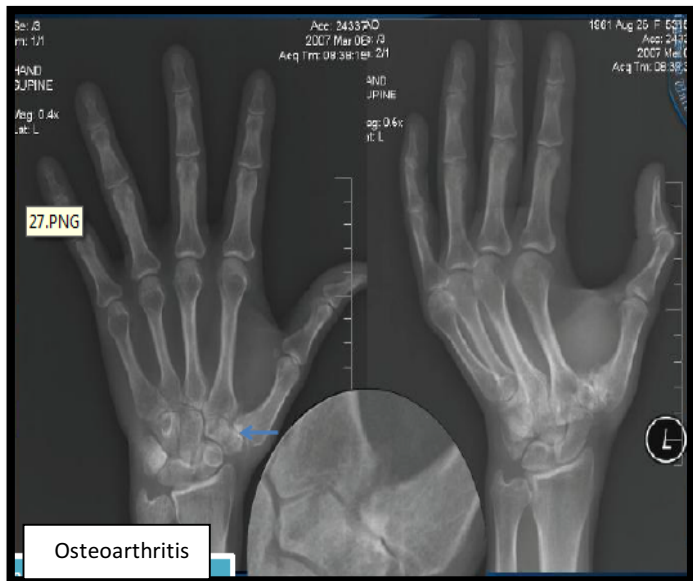
If an arthritis is:

- **Non erosive** (osteoarthritis, large joints)
- **Erosive** (rheumatoid, small joints)
- synovial joints

osteoarthritis:

- Distal interphalangeal joint osteoporosis.
- Non-erosive but there can be an erosive type
- Distal rather than proximal

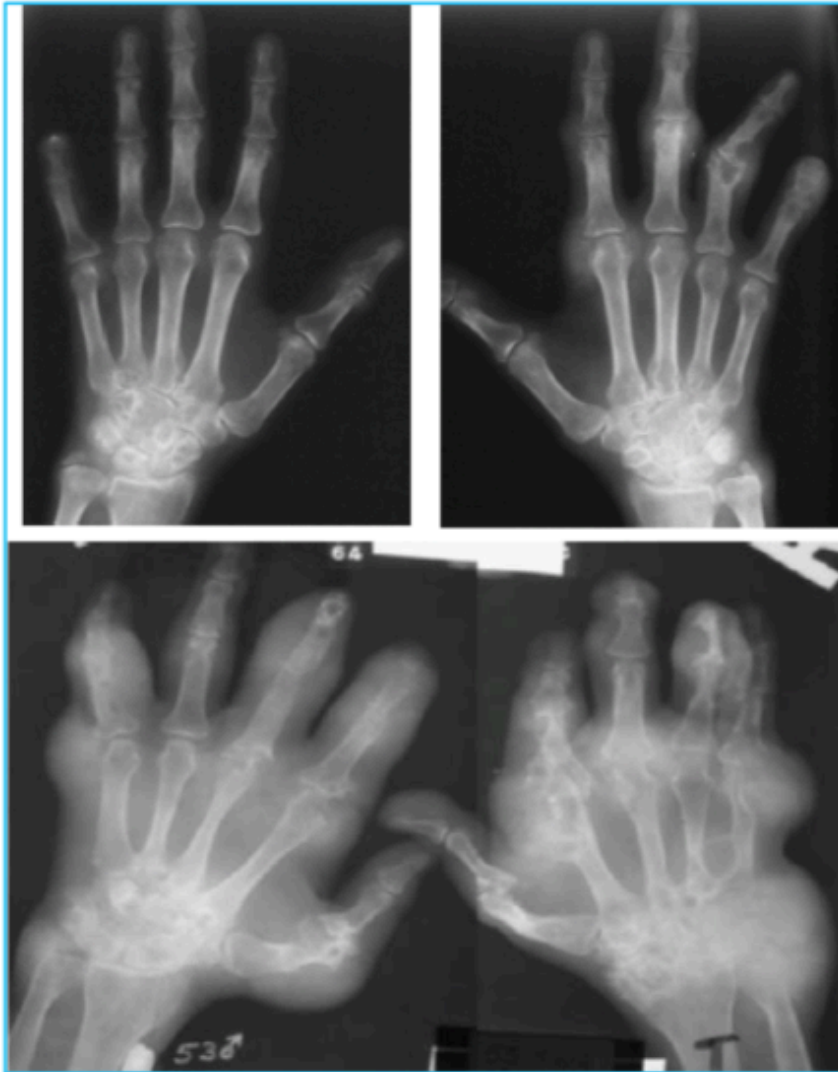




- Destruction of the head of the metacarpal
- Ossified joints
- Psoriasis:
 - can be similar but more severe, affect proximal to distal of one finger (usually the middle finger like in the pic on the right) , ankylosis of the bone
 - Distal arthropathy is more common in psoriasis
 - asymmetric/ lots of soft tissue swelling
 - increase bone density (esp at PIP and DIP area)

Case NO.6

43 year-old male patient presented with hands and feet pain and swelling, X-ray of hand requested.



- Erosions.
- Misalignment.
- Around the joints there is a swelling "crystals deposition or tophi gout" (white areas).

Musculoskeletal Tumors

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Tumors can arise from any of these components:

- Osseous -- > e.g. Osteosarcoma
- Chondral -- > e.g. Chondroma
- Fibrous -- > e.g. Fibroma, Fibrosarcoma
- Soft tissue -- > Tumors of soft tissue structures such as muscles, tendons

KEY FEATURES:

- Morphology (**geographic, Moth-eaten, Permeative**)
- Pattern of bone destruction
- Size, shape, margin of the lesion
- Texture of lesion matrix
- Cortex and periosteal reaction
- **Behavior of lesion** · Age of patient · Site (Location)



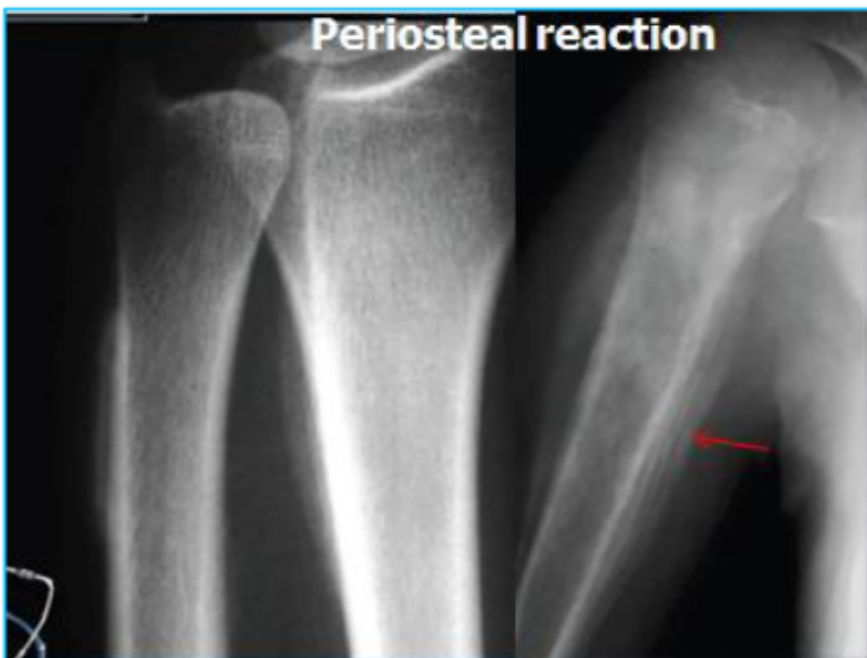
- Lucent osteolytic lesion **, Eaten bone
- **Sharply demarcated margins** (the margin of the lesion)
- **we call it geographic** (because it occurs at certain locations in the body)
- geographic lesions are usually **benign**

- **Lucent osteolytic lesion with ill-defined margin**
- It has **tiny black dots**** in between.
- It is called **Moth-eaten** appearance
- **Moth-eaten appearance means Infiltrative type of pathology** (aggressive) but it **doesn't mean cancer**, it could be infection

- **Permeative** lesion**, It permeate through the bone (that's why it is called Permeative lesion)
- Margins of the lesion is hazy + **areas of destruction**
- **Transition zone: transition between the lesion and the normal bone**
- A sharp margin means narrow transition zone which indicates **benign lesion**
- Hazy margin means wide transition zone which indicates **malignant lesion** (aggressive) either malignant neoplastic or malignant infection e.g. osteomyelitis

Periosteum is a thin layer of a membrane to keep the bone intact. Any insult (trauma, neoplasm or inflammation) to the bone --> leads to --> Periosteal reaction which is excess bone produced by the Periosteum --> e.g. Periosteum reaction to fractures for example is attaching the two bones by a **callus** formation (bone bridging in between the bones) by osteoplastic activity. If it is a **slowly progressing process**, it will **allow time to periosteal reaction** to form and surround the pathology --> will lead to thickening of the cortex. If the lesion is **aggressive and fast** --> **periosteal reaction will not surround it completely** because of the ongoing destructive process so you will see multiple layers of bone due to the alteration between constructive and destructive effect of osteoplastic activity. This is called "**lamellated type**" of periosteal reaction. (red arrow)

In some cases the periosteum will form **perpendicular** to the lesion and it is called "**sunray appearance**"



✓ Morphology
✓ Behavior of lesion



✓ Age of patient
✓ Site (Location)
The younger the pt > more likely to be benign. Older > more likely to be malignant.

- **Osseous Lesions either:**

- **Sclerotic** (osteoplastic activity -- > activate osteoplastic -- > appears white in the X-ray).
- **Osteolytic (lytic)** (destructive of the bone -- > appears lucent in the X-ray).
- **Mixed** (usually the aggressive type)- Usually, metastasis from other organs of the body appears either sclerotic or osteolytic according to the origin e.g. skin -- > usually sclerotic and kidney -- > osteolytic.

Case NO.7

13 year-old boy patient presented with knee pain and swelling, X-ray of knee requested.



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- **Osteolytic, Geographic**** -- > because it is sharply demarcated -- > it is in the metaphyseal lesion -- > indicates a **benign** lesion

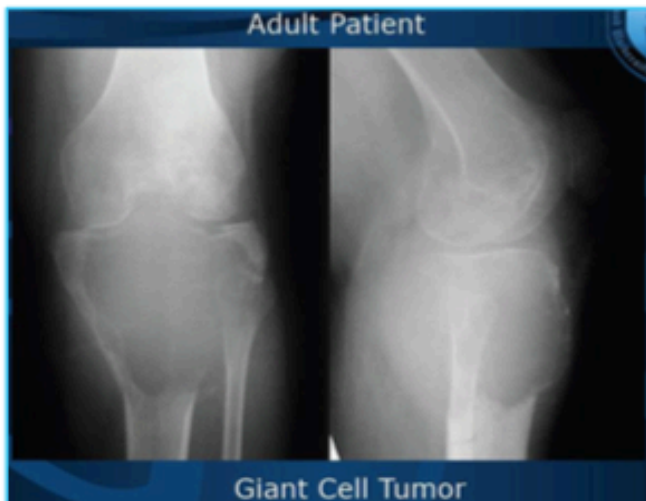
- DDX -- >

- Either **simple bone cyst** -- > which is simple content that involve the bone and it occur in pediatrics age group and it is in the metaphyseal portion of proximal humerus or tibia

- Or **aneurysmal bone cyst** (cyst that contain blood)

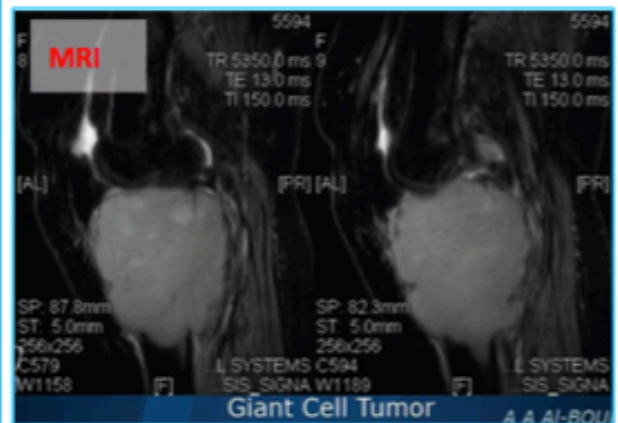
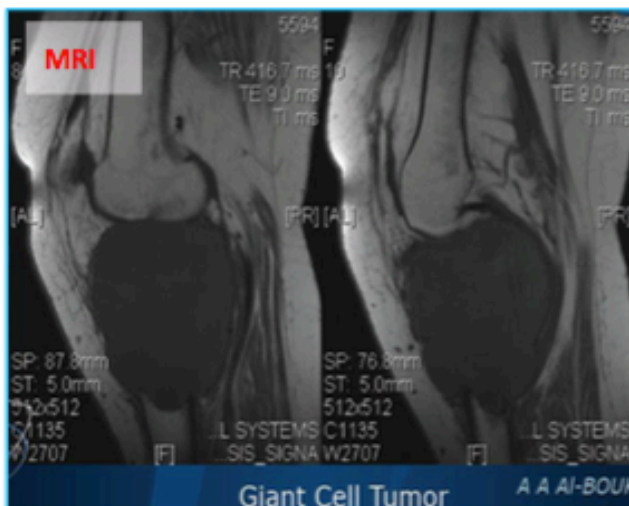
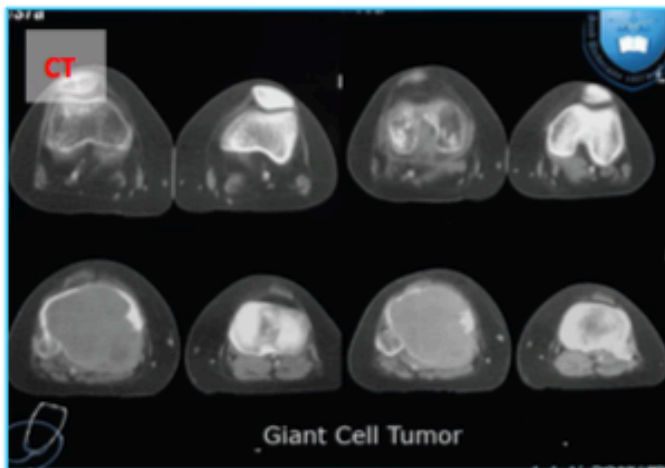
- The lesion was found in the X-ray but to get more details about tissue character we need CT and MRI.

- There is fluids with different densities we call it **fluid-fluid level**** -- > confirms that it is an **aneurysmal cyst**.



Appears osteolytic --> in some areas it is sharply demarcated and other it is not --> so, it is mixed margin --> it is aggressive behavior although it is osteolytic because the margins

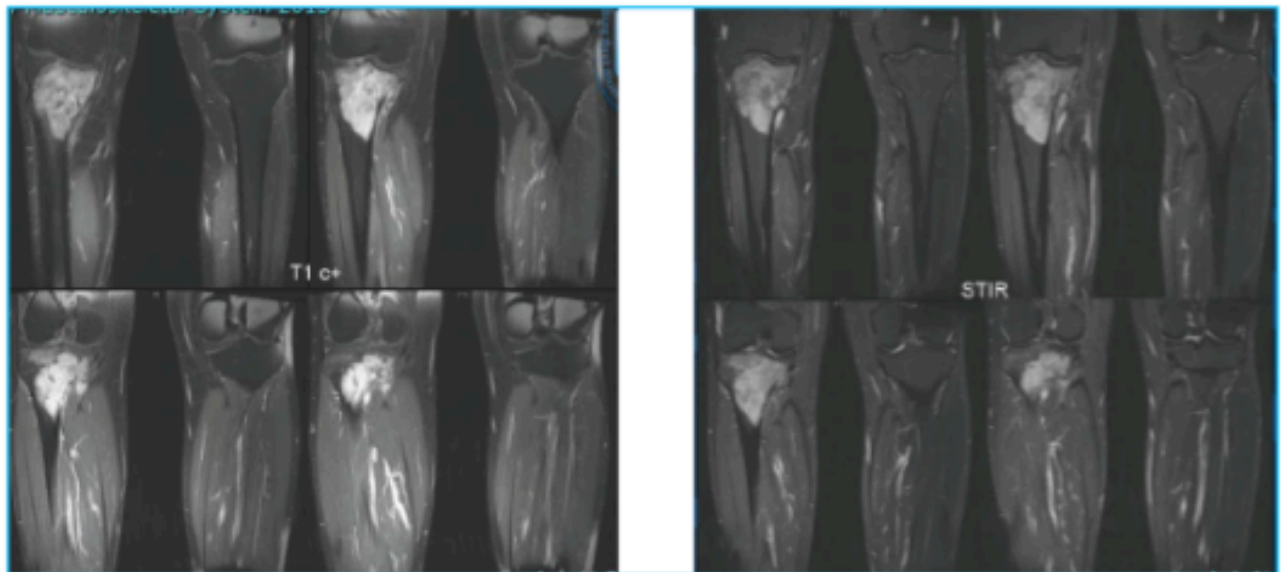
- The bone here looks like it is extending to the soft tissue plane behind the bone.
- You need more investigation --> either CT or MRI
- In CT--> two different densities
- In MRI --> lytic lesion
- The lesion after using enhancement in MRI --> this whitish appearance indicate that it is vascular lesion.





- Permeative pattern* --> because the margins are not clear --> which indicates an aggressive lesion like neoplastic or infectious lesion but it is more likely a malignant process because if it is infectious, the lesion will be all around the bone not skipped lesion like here.

- Here it is osteosarcoma and one of the differential is lymphoma, leukemia, infection or sarcoma in younger pts.



MRI: heterogeneous, extends beyond cortex

Case NO.8

- Adult female patient presented with hand swelling. X-ray of hand requested.



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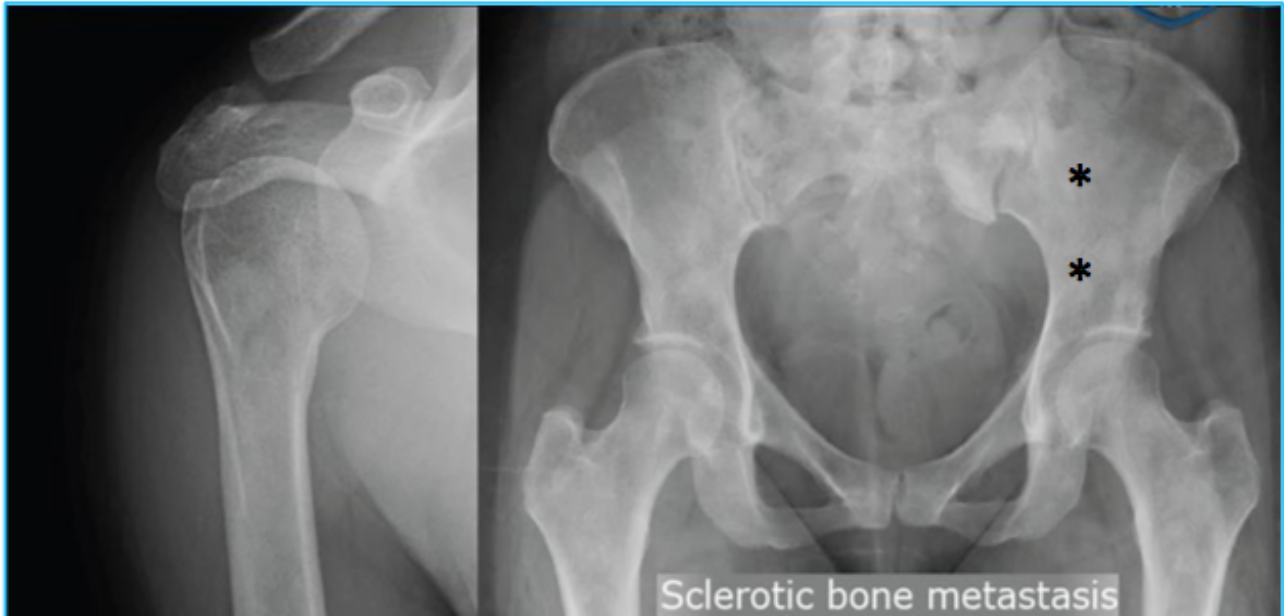
- **Soft tissue swelling*** but no bone is disrupted, so it is only a swelling.
- This mass lesion can arise from any soft tissue structure from skin to the bone including skin, **fat***, vascular structures or nerves
- Differential diagnosis -- > **lipoma**, angioma, Schwannomas, neuromas or

After determining the differential diagnosis we come to tissue characterization in CT scan or even better in **MRI** as in this image.

- In the usual MRI which is T1 -- > subcutaneous fat appears white similarly the lesion is white. We suppressed the Fat signal in T1FS/C+ with contrast and the lesion got suppressed as well -- >this indicates that the lesion is composed of fat.
- **Soft tissue lipoma was the diagnosis**

Case NO.9

57 years old female patient presented with bone ache and had history of **of breast carcinoma**.



There are **patches of white areas*** (Osteosclerosis) which are involving the whole bone.- Whenever there are multiple bone lesions (with sclerotic or lytic), it is more suggestive of a systemic disorder rather than a localized lesion.- **Breast metastasis -- > sclerotic lesion. " and prostate cancer as well"**- If you have a Patient above 50 with multiple bone lesions, you should think of metastasis or multiple myeloma (lytic) as a differential diagnosis in particular of lytic **or lung or thyroid tumor**.

Questions

- 1) 50 years old female patient came with hand joint pain, x-ray showed decreased bone density, loss of joint space and erosive arthropathy. What's the most likely diagnosis?
 - a. Psoriatic Arthritis.
 - b. Gouty Arthritis.
 - c. Rheumatoid Arthritis.
 - d. Osteoarthritis.

- 2) 49 years old male patient came with hands and feet swelling. X-ray showed swelling around the joint (white areas) and erosive arthropathy. What's the most likely diagnosis?
 - a. Psoriatic Arthritis.
 - b. Gouty Arthritis.
 - c. Rheumatoid Arthritis.
 - d. Osteoarthritis.

432 Radiology Team Leaders

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Answers:

1st Questions: C

2nd Questions: B