

Lecture (11)

Metabolic & Endocrine Bone Disorders + Musculoskeletal Tumors

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Resources:

- Lecture by dr.AlBoukai
- 429 rad team notes
- Diagnostic imaging book

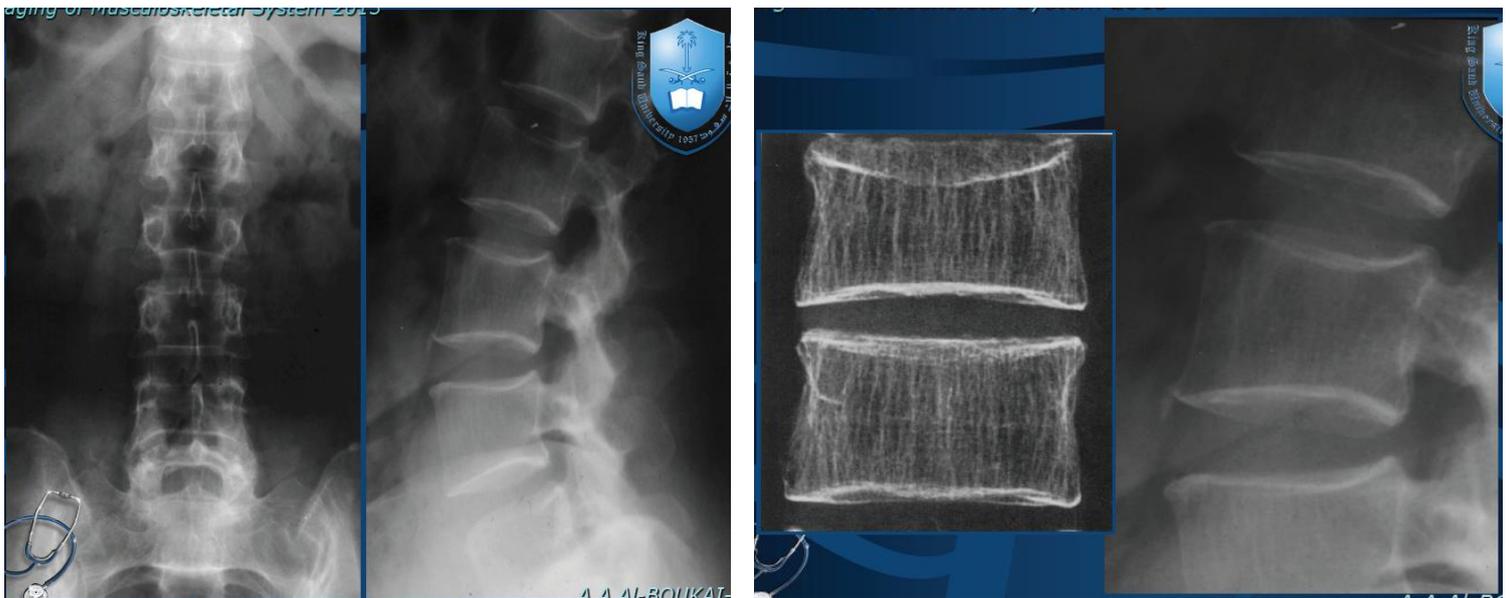
Disorders include:

- Metabolic and Endocrine Disorders:
 - Osteoporosis
 - Osteomalacia
 - Renal Osteodystrophy
 - Hyperparathyroidism
 - Acromegaly
- Arthritis
 - Rheumatoid Arthritis
 - Osteoarthritis
 - Psoriaticarthritis
 - Gouty Arthritis
- Musculoskeletal Tumors
 - Osseus, chondral, fibrous, soft tissue

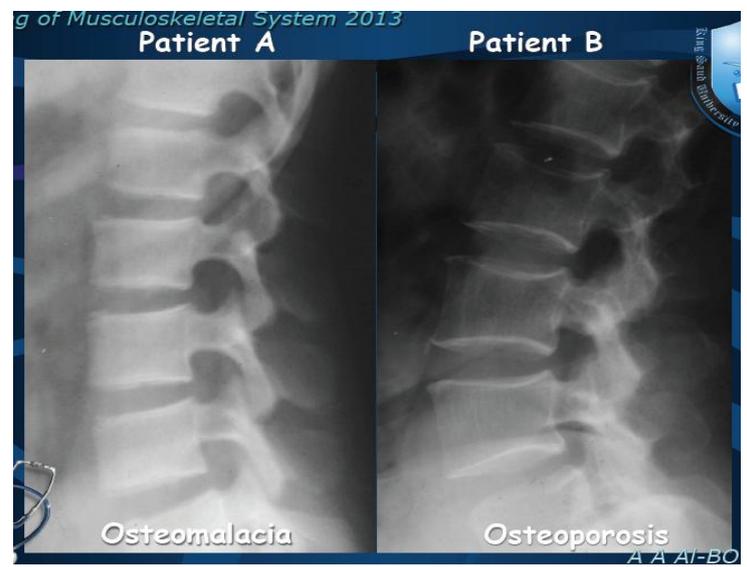
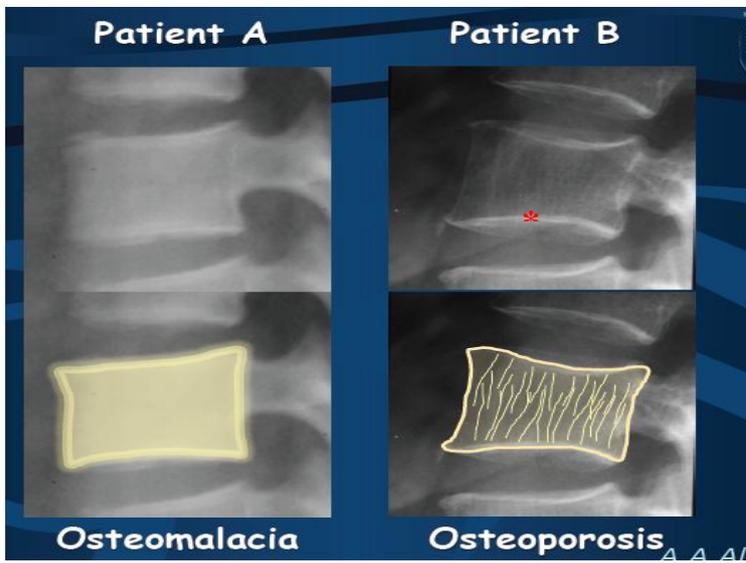
Metabolic & endocrine disorders

Case 1:

- 54 years- old female with low back pain X-ray of lumbosacral spine requested



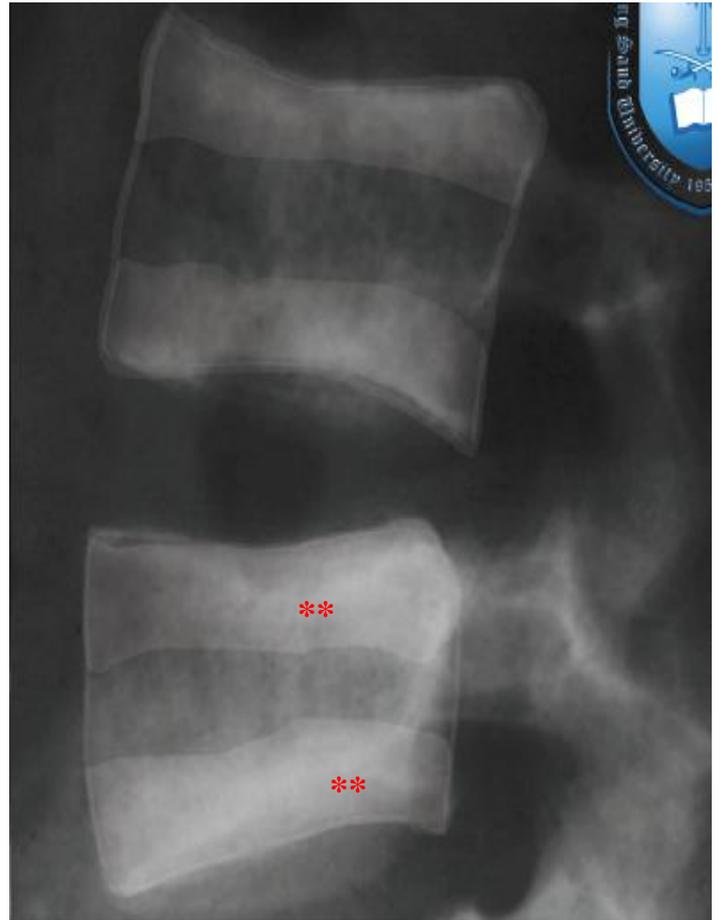
- **Bone density** of the vertebra is decreased. Which is obvious by looking at the margins which is markedly increased when compared to the body of vertebra
- **Texture:** to assess the texture we look at the trabeculae, in this case due to reduction of the matrix "bone density" horizontal trabeculae are lost and vertical ones still obvious to bear the vertical forces of gravity and weight of the patient. This can be seen in osteopenia and osteoporosis.
- **Cortical outline:** thin sclerotic white line. which is called "**picture frame appearance or pencil line cortex***" --> as seen in patient B
- **Soft tissue outline** of adjacent tissue to the bone. (the doctor did not say anything about it)



- **Patient (A):** --> Osteomalacia” rickets in pediatric age group” Bone density may be normal but bone is soft with thick hazy ill-defined cortical outline with "ground glass density or soft tissue density" of the central portion.
(Bone matrix is normal but there is a defect in mineralization and it is usually related to nutrition, common in pediatrics, or certain diseases such as kidney failure or hyper parathyroid)
- **Patient (B):** bone density is reduced, thin white sclerotic cortical outline of the vertebral body with obvious vertically oriented trabeculae.
(Bone matrix reduced with normal mineralization)
- In between osteoporosis and Osteomalacia there is **Osteopenia** --> which means reduction in bone density so it is a descriptive of both Osteomalacia and osteoporosis

Case 2:

- 27 years- old male with long standing history of renal failure. X-ray of lumbosacral spine requested.

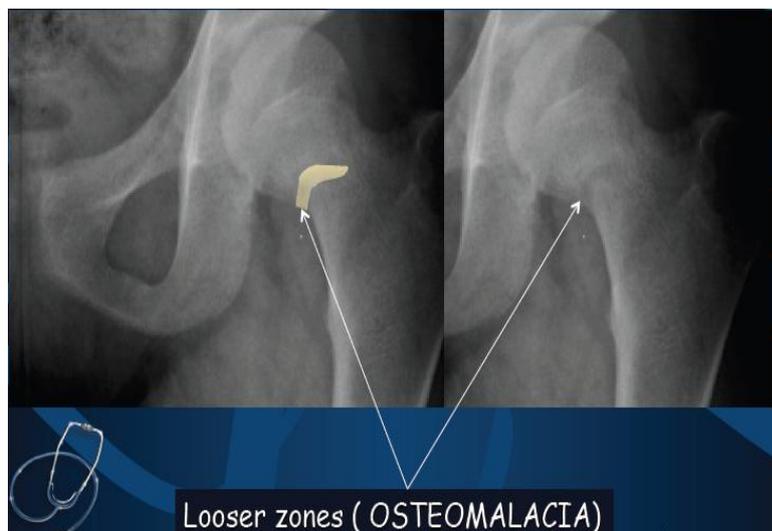


- Renal failure can lead to disturbance of the metabolism of vitamin D and parathyroid hormone consequently can lead to changes in the bone.
- Bone density is decreased within the central portion (**osteopenic**) when you compare it with the end plate of the vertebral body (margins) which are **whitish, sclerotic thick margins**.
- Soft bone + hazy margins -- > means Osteomalacia
- Soft bone + sharp margins -- > means Osteoporosis.
- Trabeculae present -- > means Osteoporosis.
- There is alternating bands within the vertebral bodies called "**Rugger Jersey Spine****" which diagnostic of osteosclerosis.
- Here we can see soft bone + hazy margins and also there is vertical trabeculae -- > so, it is a combination of Osteoporosis and Osteomalacia. In addition to osteosclerosis.
- Final diagnosis is -- > renal dystrophy.

❖ Renal Dystrophy:

- **Components of Renal Osteodystrophy:**
 1. Osteomalacia
 2. Osteoporosis
 3. osteosclerosis
 4. Changes that result from secondary hyperparathyroidism .

- A young lady, presented with back pain

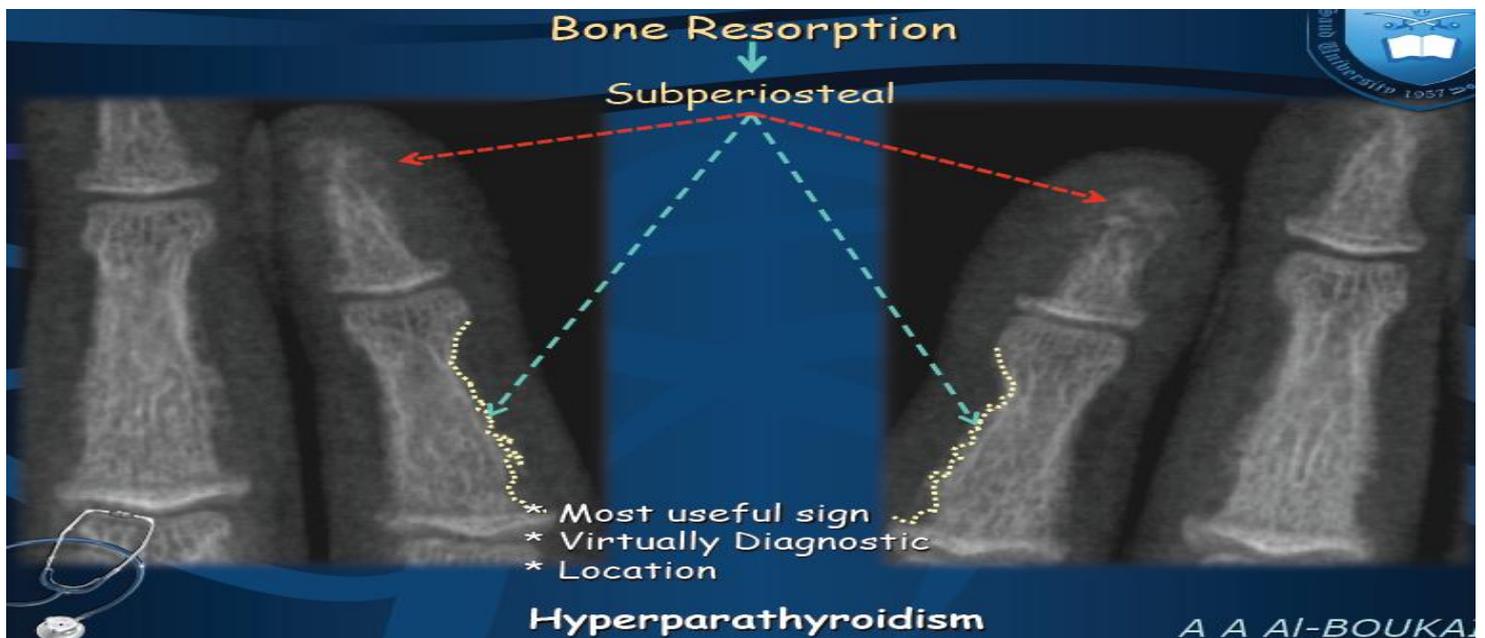


- Looser zones: presents as pain during movement, lower limb weakness.
- Osteomalacia --> hazy thick margins + soft bone + looser zones.
- MRI is the best to check changes in the bone marrow.

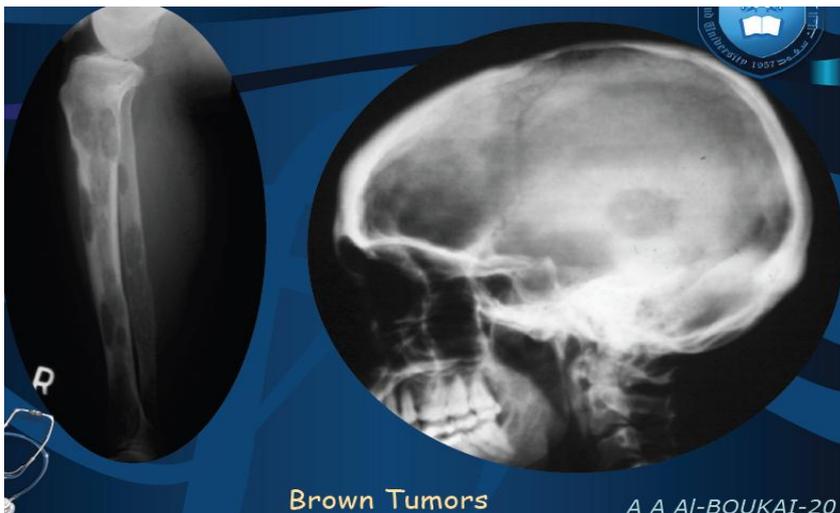
❖ Hyperparathyroidism:

- Hyperparathyroidism Changes:

1. Bone Resorption (erosions or erased trabeculae in certain area)
 2. Bone Softening (the bone in total is being soften)
 3. Brown Tumors
 4. Osteosclerosis
 5. Soft tissue calcifications
- You might see only one of them not all should be present).



- **Irregularity of the cortical outline at the middle and distal phalanges** --> usually in the lateral aspect (radial side) --> and it is often in the middle and distal phalanges.
- Loss of corticomedullary differentiation
- Bone outline is asymmetrical and irregular in the radial side
- Disturbed bone density with coarse trabeculation due to bone resorption caused by hyperparathyroidism



- These are the lucent (**lytic**) areas within the bone which are Brown tumors.

Case 3:

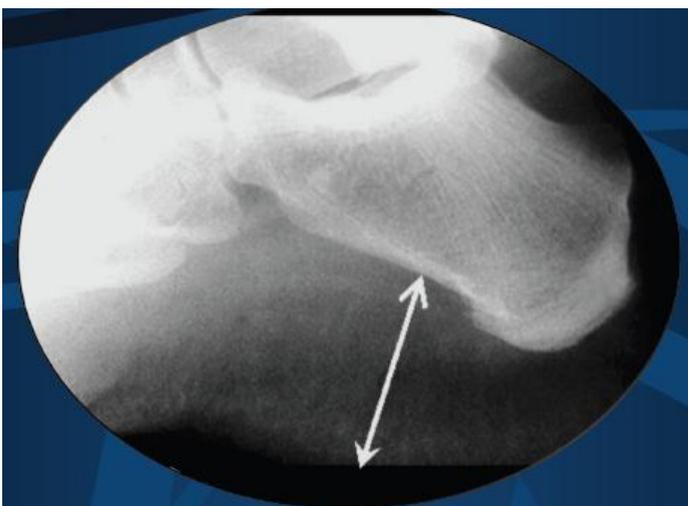
- 45 year old male presented with a history of bone enlargement. X-ray of the skull and hand requested



- **Sella turcica enlarged** due to pituitary gland adenoma.
- **Mandible is enlarged** and out of proportion to the maxilla, you can see the discrepancy between upper and lower jaw.
- There is **bony bridge** or tubercle at the area of **Frontal sinus**.



- **Widening of the joint space** between metacarpophalangeal and interphalangeal joints due to enlargement of interphalangeal cartilage in between.
- **Enlargement of the soft tissues** of the hand



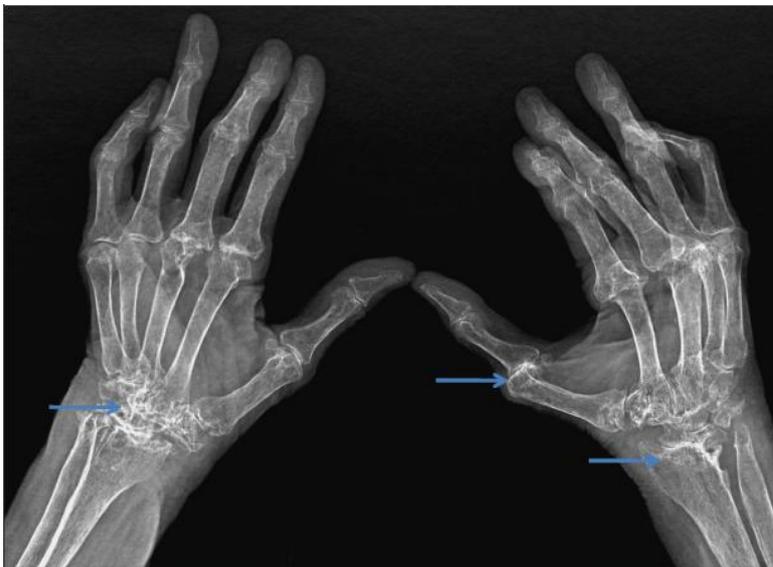
- This is the **Heel pad sign**, one of acromegaly signs
- It is an increase of the thickness of the heel pad. normally not more than 26 mm.

Arthritis

- It is important to differentiate between **Erosive** and **Non erosive arthropathy**.

- **Erosive arthropathy: e.g. rheumatoid arthritis.**

- There is periarticular osteopenia or osteoporosis localized around the joint. In addition, bone will be eroded.
- Such as in this patient
- There is **destruction** of the **carpal bone** and **metacarpophalangeal joint (A)**
- Periarticular erosion of **V shaped** defect at the metacarpal head (B)
- **Changes are more destructive at the proximal parts** than distal ones.



- Decreased bone density
- Oblique view: alignment is disturbed (first metacarpal)
- Carpal bones are destroyed and eroded
- Reduced distance between radius and carpal bones



- Extensive rheumatic arthritis changes including dislocation of the joints.

- **Non erosive arthropathy: e.g. osteoarthritis**
 - Changes are more **destructive at the distal parts.**

Case 5:

- Elderly male patient presented with joint pain of the hands X-ray of hand request



- Preserved cortical outline of metacarpal heads
- While **Distal bones are more whitish*** and extending from the margins around the joints "**Osteophytes**" --> Osteophytes means bone protrusions
- Changes are **more distal** which is the opposite from rheumatoid arthritis .



❖ Special Disease Patterns:



- Changes are more distal than proximal in an Osteoarthritis patient with no erosive changes



- Erosive changes in the bone affecting carpel, metacarpal and distal portions



- Extensive changes --> made the fingers looks like one piece of bone. This is usually seen in patients with psoriasis
- This is erosive osteoarthritis.

Case 6: (gout)

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



- Erosions.
- Misalignment.
- Around the erosion there is a swelling "Rounded soft tissue enlargement" (white areas).
- Erosive arthropathy with soft tissue component, seen in Gout



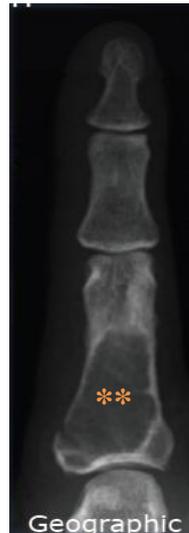
Musculoskeletal tumors

- 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**

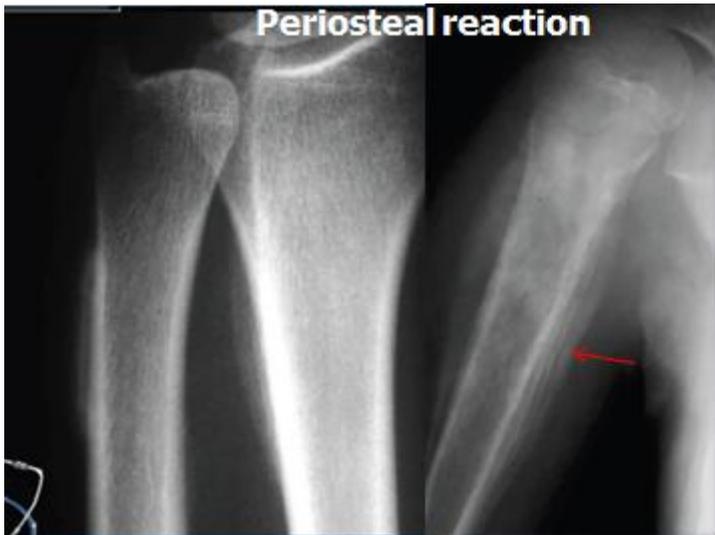


- **Permeative**** lesion
- It permeate through the bone (that's why it is called Permeative lesion)
- Margins of the lesion is hazy
- **Transition zone:** transition between the lesion and the normal bone
- A sharp margin means narrow transition zone which indicates benign lesion
- Hazy margin means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

- 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 such as hematological disorder, leukemia, lymphoma or a **malignant process**.

- If you suspected a malignant lesion (Permeative or moth-eaten) --> you will **need more investigations** --> **investigate the bone marrow using MRI.**

- 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**" (not shown here)



- Age of the patient and site of lesion can tell the type of the tumor

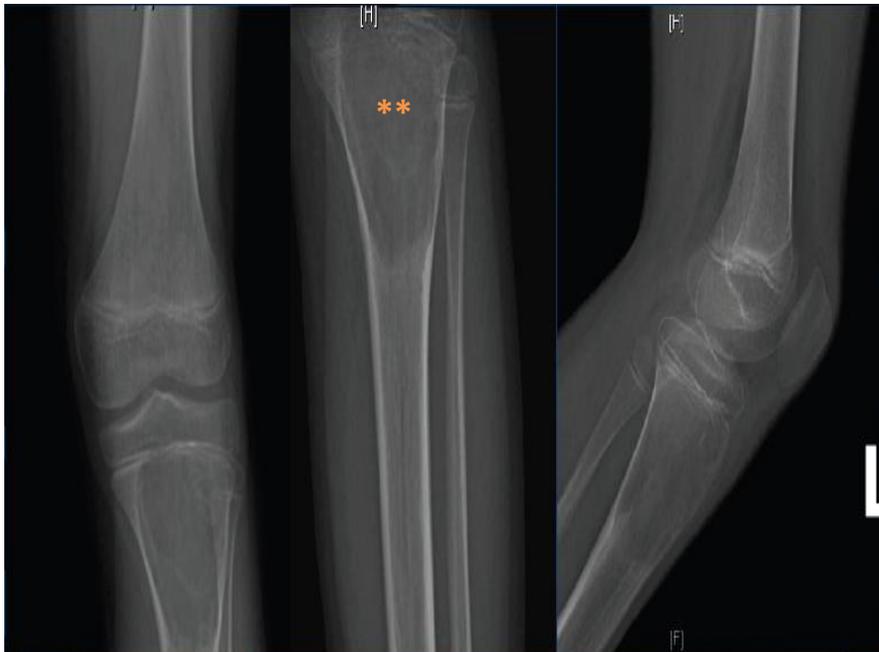
- **Chondroblastoma** --> occurs before the closure of growth plate --> pediatric age group --> it occurs in the epiphyseal center --> it is benign process.
- **Giant cell tumor** --> adult age group (20 -40) --> in epiphyseal plate (subarticular surface) --> it is osteolytic lesion
- Fibrous dysplasia --> seen only in the shaft --> if you see lesion looks like fibrous dysplasia in the epiphysis --> it is **NOT** fibrous dysplasia.

❖ Osseous Lesions either :

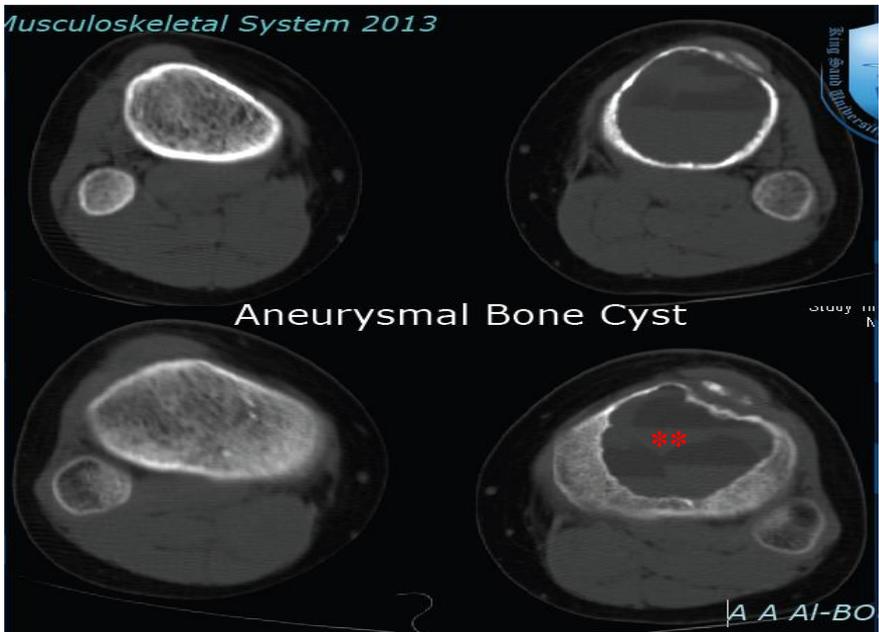
- Sclerotic (osteoplastic activity -- > activate osteoplastic -- > appears whit in the X-ray)
 - Osteolytic (lytic) (destructive of the bone -- > appears locent in the X-ray)
 - Mixed
- Usually, metastasis from other organs of the body appears either sclerotic or osteolytic according to the origin e.g.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

CASE 7:

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



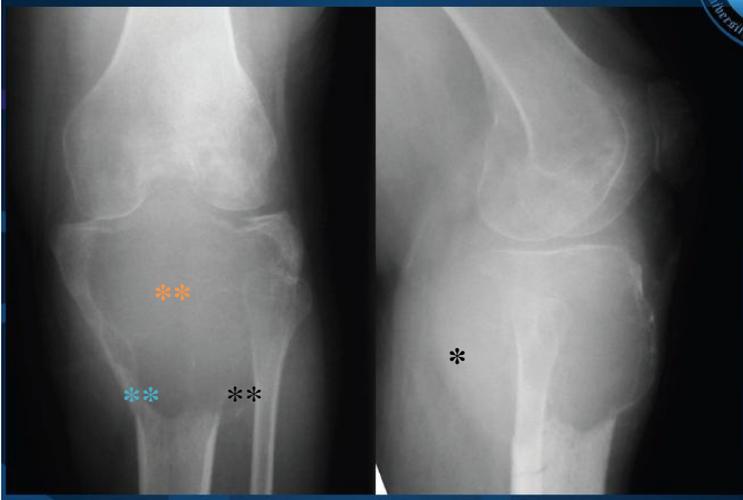
Aneurysmal Bone Cyst



Aneurysmal Bone Cyst

- **Osteolytic, Geographic**** -- > because it is sharply demarcated -- > it is in the metaphyseal lesion -- > indicates a benign lesion
- Differential diagnosis -- >
 - 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.
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Adult Patient



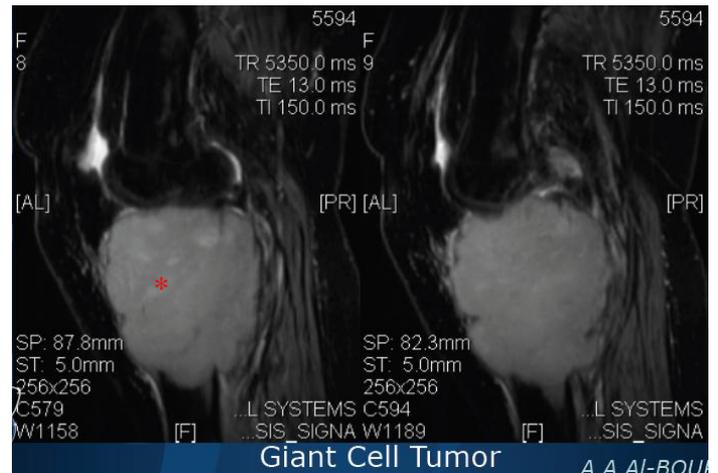
Giant Cell Tumor

- 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 MRI --> lytic lesion**
- The lesion* after using enhancement in MRI --> this whitish appearance indicate that it is vascular lesion.



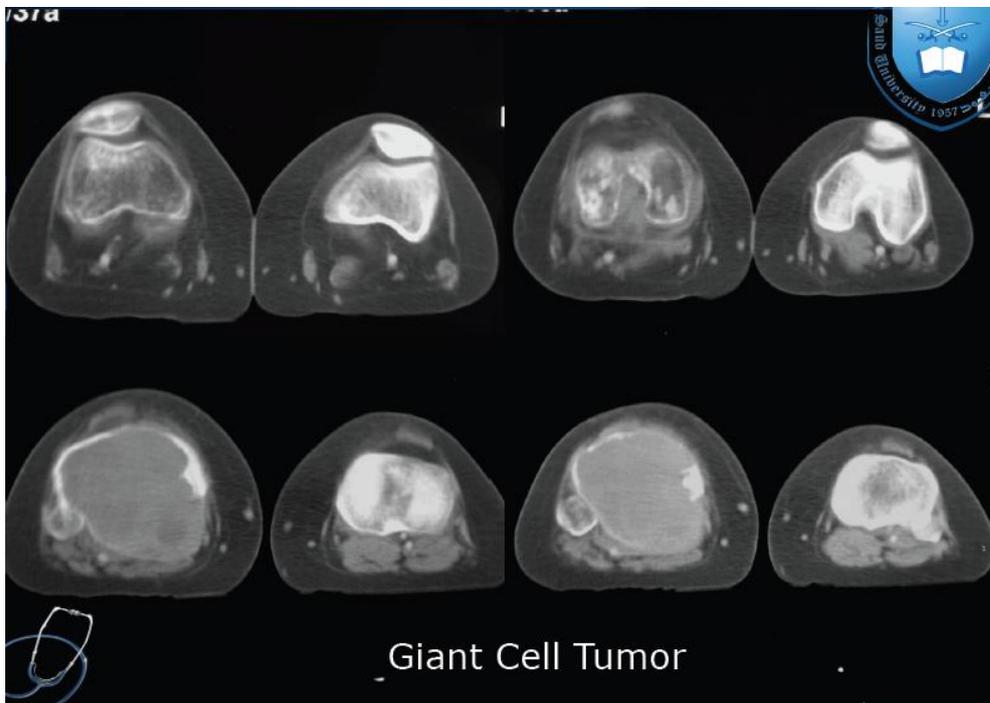
Giant Cell Tumor

A A Al-BOUK



Giant Cell Tumor

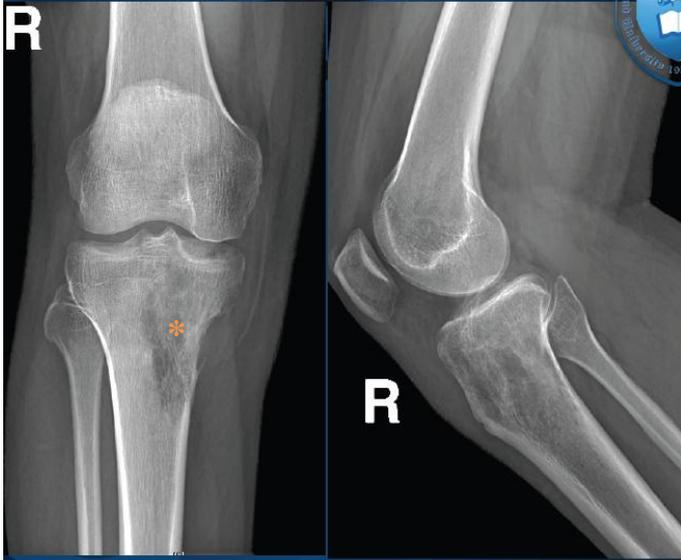
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Giant Cell Tumor

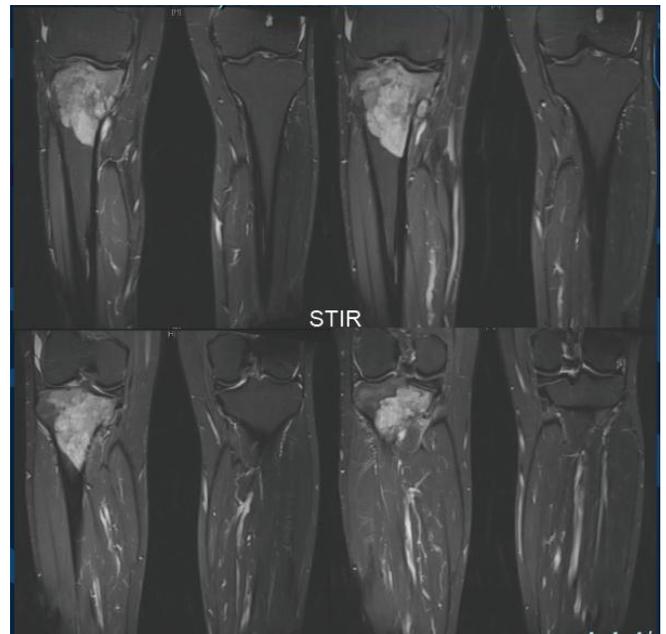
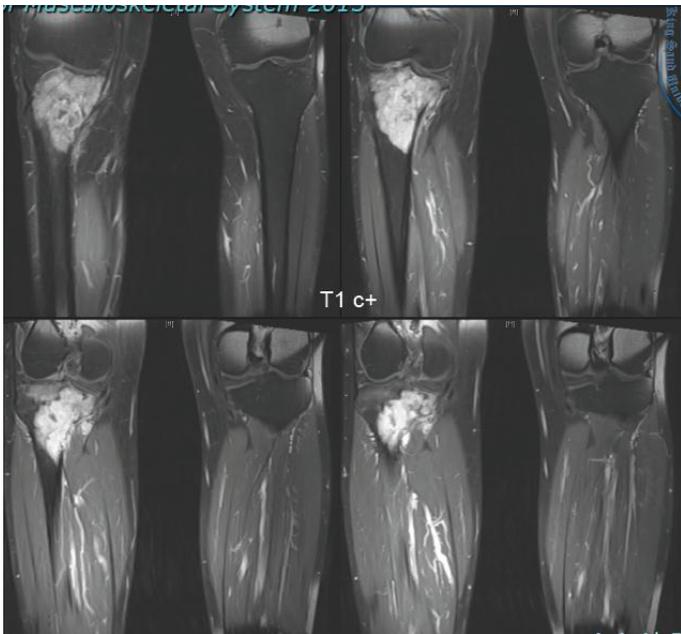
A A Al-BOUK

Permeative Pattern



Osteosarcoma / Lymphoma

- **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



CASE 8:

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



- Soft tissue 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 rhabdomyosarcoma.



- 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 9:

- 57 years old female patient presented with bone ache and had history 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**.
- 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.