



RADIOLOGY

TEAM 435

Radiology of rheumatic diseases and bone infection and tumors

[Color index: **Important** ★ | **Notes** | Extra | [Editing file](#)]

● Objectives:

The main focus and objective of this lecture is to help student to be familiar in looking at MSK images and interpreting findings, by learning:

- Normal radiological anatomic landmarks System of analyzing findings "Where to look & What to look for"
- Recognize features of certain disease entity

● Resources:

- 435 slides
- 434 team

● Done by:

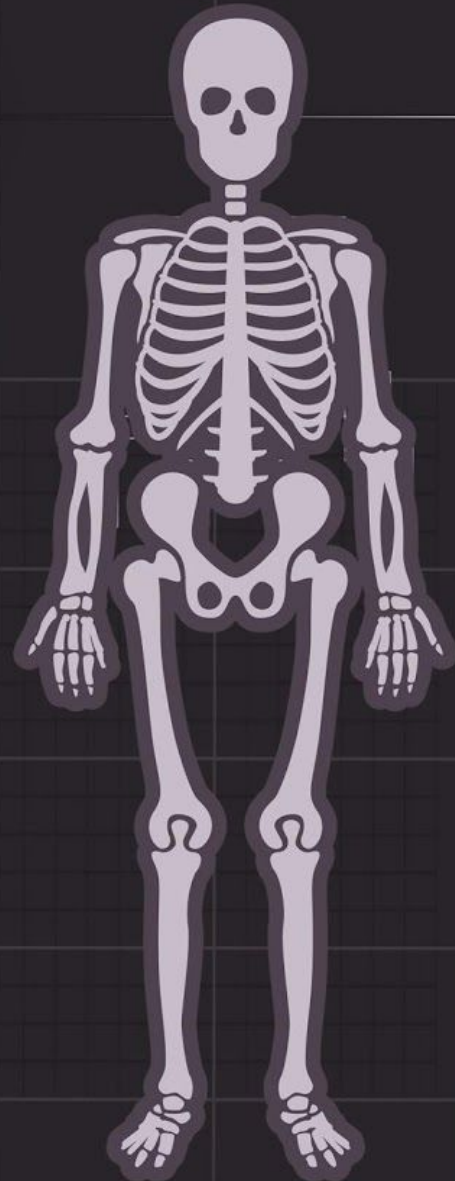
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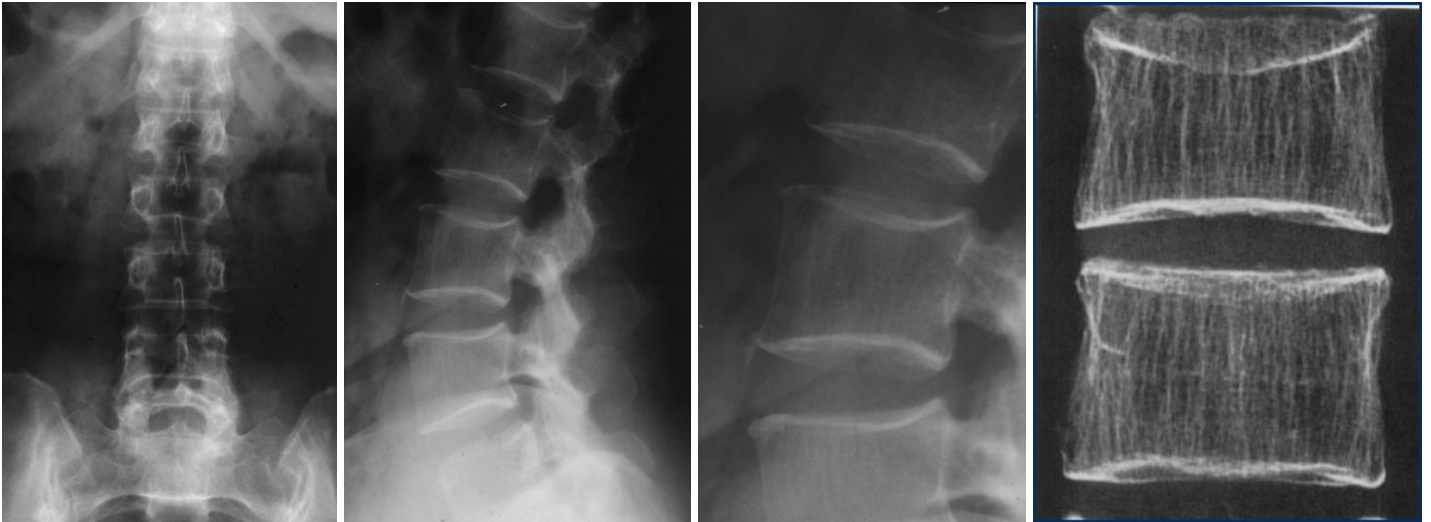
- Revised by:

- Ahmed Al Yahya



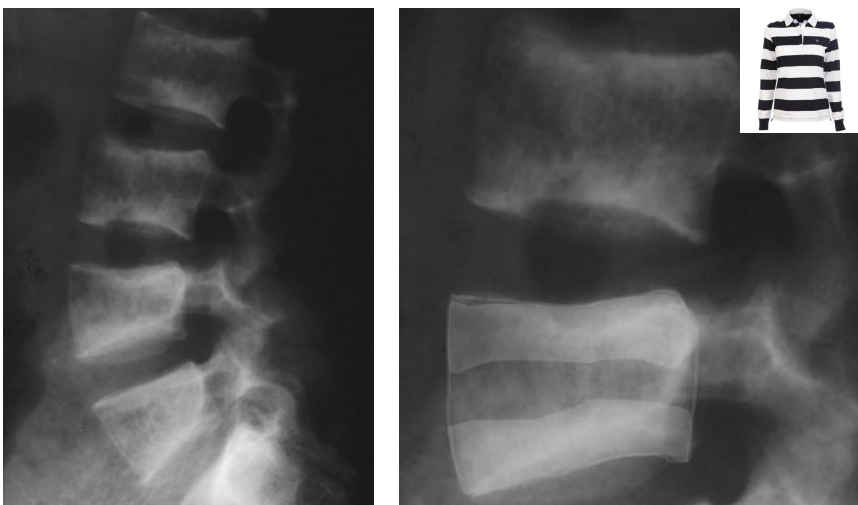
Bone diseases

Case 1: 54-year-old female with low back pain. X-ray of lumbosacral spine requested *not important for the exam



- 1st picture: 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
- Osteoporosis is the most common metabolic disease in the world
- X-ray is not very sensitive for osteoporosis
- The only way for diagnosis is **DEXA** scan
- 4th picture: very severe osteoporosis in cadaver
 - Osteopenia (bone is darker).
 - Black lines are loss of trabeculations (loss of white lines). You normally don't see trabeculations unless some of them are lost.
 - Borders of the spine are white

★ **CASE 2: 27 year-old male with long standing history of renal failure¹. X-ray of lumbosacral spine is requested.**



Osteosclerosis "Rugger Jersey Spine"

Findings:

- Rugger jersey spine *specific finding for renal osteodystrophy (lucent with White margins)

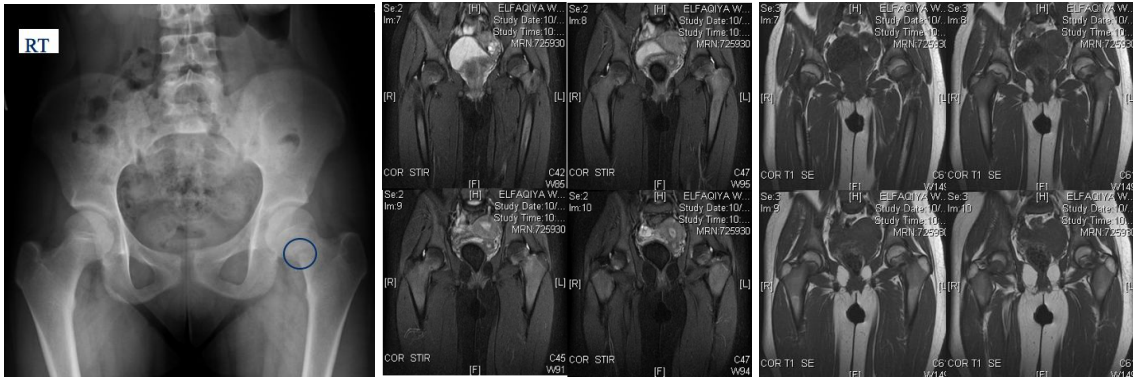
Renal osteodystrophy:

- Osteoporosis (darker bones)
- Osteomalacia (bones are softer)
- Secondary Hyperparathyroidism
- Osteosclerosis

None of those are specific for renal osteodystrophy except for jersey spine.

¹ Patient with renal failure → No absorption & metabolism of vitamin D.

★ **CASE 3: 20 year-old lady presented with weakness and lower limb pain.**

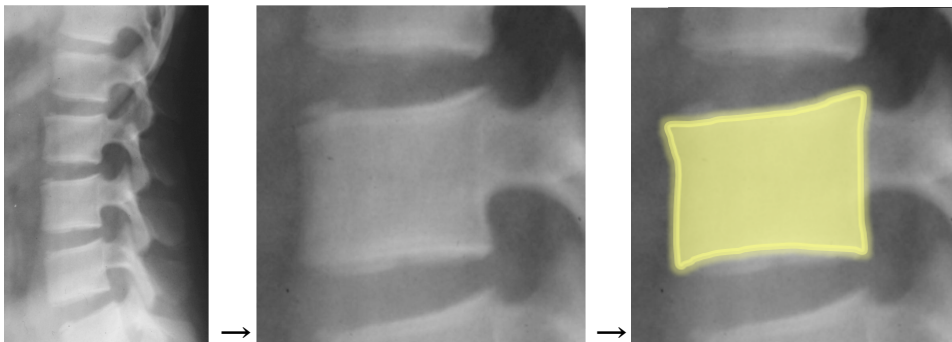


Looser zones² (osteomalacia)

- rule out infection first
- **X-ray:** Medial aspect of the femur neck
- **MRI:** check changes in the bone marrow → most important for diagnosis.
- **CT:** check texture of the cortex
- Insufficient fracture of the femur neck due to softening of the bone
- Looser zones: presents as pain during movement, lower limb weakness
- Can also happen in the scapula and ribs, but it occurs most commonly in the femur neck.

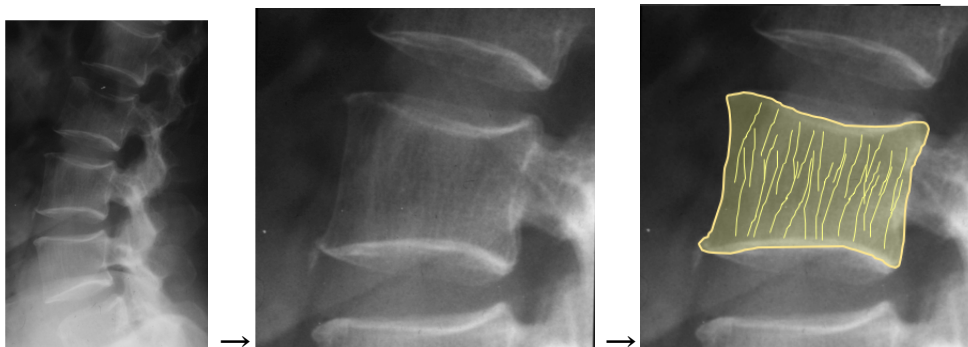
❖ **Differences between osteomalacia and osteoporosis:**

Patient A (Osteomalacia)



Patient (A): 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.

Patient B (Osteoporosis)



Patient (B): Osteoporosis There is reduction in bone density, sharp margins of the vertebral body with obvious vertically oriented trabeculae.

² (specific type of fracture that only happens in osteomalacia)

Hyperparathyroidism

1. Bone Resorption
2. Bone Softening
3. Brown Tumors
4. Osteosclerosis
5. Soft tissue calcifications

★ Bone Resorption



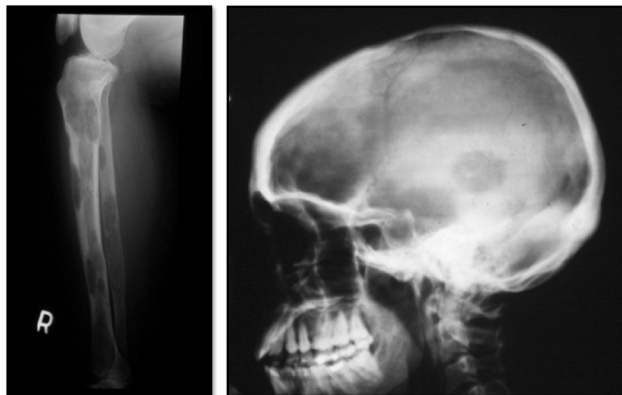
- **Subperiosteal resorption in hyperparathyroidism.**

- Finding: Middle phalanx: irregularity of the margin (subperiosteal bone resorption) **radial aspect**

These changes usually happen in the **middle phalanx**, radial aspect in the **2nd or 3rd finger**. (pathognomonic for hyperparathyroidism)

*The choices will be very similar in the exam. Memorise this well!

★ Brown Tumors



- There's **Lytic Lesions**, Brown tumors features:

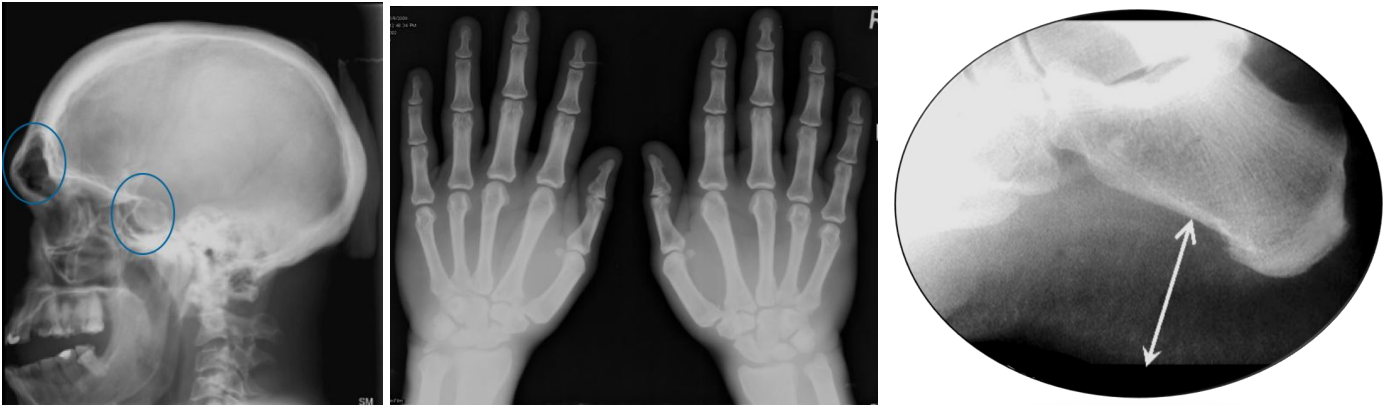
1. Affect long or flat bones.
2. Single or multiple
3. Have a sharp outline but with no obvious margins

- Whenever you see a bony lesion in a hyperparathyroid patient always think of brown tumors

- Always think of brown tumors in younger patients with multiple tumors

- It represents excessive metabolic (osteoclastic) activity in a certain area

★ **Case 4: 45 year old male presented with a history of bone enlargement. X-ray of skull and hand are requested.**



- Frontal bossing due to enlarged frontal sinus

- Enlarged mandible/jaw
- Occipital protuberance
- Rounded & enlarged sella turcica which may indicate pituitary pathology that caused the acromegaly (e.g. pituitary adenoma)
- Thickening of the calvarium (thick skull)
- Hands: Enlargement of the soft tissue, early osteoarthritis
- Foot x-ray: thickening of the heel fat pad

Arthritis

*In arthritis, the doctor only focused on theoretical findings. He said that we won't be asked about the diagnosis from the x-ray image.

❖ **Osteoarthritis:**

Case5: 48-year-old female presented with joint pain of the hands & feet. X-ray of hand requested.



- Carpals aren't clear, proximal disease
- Changes involve the head of the metacarpal, metacarpal phalangeal joints

Osteoarthritic classic changes in sequence: (seen in every joint)



1. Joint space narrowing
2. Sclerosis
3. Friction of the bone will cause a reaction
 - a. osteophytes
 - b. subchondral sclerosis could lead to subchondral cyst

*Note that the most common joint of the hand to be affected by osteoarthritis is the base of the thumb

❖ Rheumatoid arthritis



- Decreased bone density
- Oblique view: alignment is disturbed (first metacarpal)
- Carpal bones are destroyed and eroded
- Reduced distance between radius and carpal bones
- Some of the signs of rheumatoid arthritis are: **Periarticular Erosions (periarticular osteopenia)**, loss of joint spaces.

Rheumatoid Arthritis	Psoriatic Arthritis ★
	
<ul style="list-style-type: none"> ● Proximal joints more affected than distal ● Loss of joint space ● Carpal bones not clear (eaten up and collapsed) ● Erosions ● Subluxation and dislocation ● Periarticular osteopenia ● Erosive arthropathy: caused by the rheumatoid arthritis ● Swan neck deformity of the neck, extensive erosive ● Early radiological sign: decreased density around the joint ● Malalignment of the fingers, ulnar deviation of left hand & dislocation of the thumb of the left hand. 	<ul style="list-style-type: none"> ● Distal affected more than proximal ● Swelling of fingers “sausage digits” ● Ivory phalanx (circle): one finger is whiter than the others ● You could argue that this patient has a Z deformity but it doesn’t necessarily mean that this patient has RA it could mean that the joint is destroyed

❖ Gouty arthritis: ★



Findings:

- Erosions (no specific distribution)
- Swelling around fingers (Gouty tophi) which give a characteristic “**Lumpy Bumpy**” appearance

*Note that gouty arthritis most commonly involves the big toe

- Erosive changes ring finger
- Soft tissue swelling (white area means it is dense)
- Erosive arthropathy with soft tissue component, seen in Gout

In summary:

Osteoarthritis → joint space narrowing, sclerosis, osteophytes, and subchondral cyst

Psoriasis → distal involvement and sausage digits

RA → proximal involvement and ulnar deviation

Gout → no specific distribution and lumpy bumpy appearance

Acromegaly → thick skull, frontal bossing, enlarged mandible and sella turcica, thickened heel fat pad

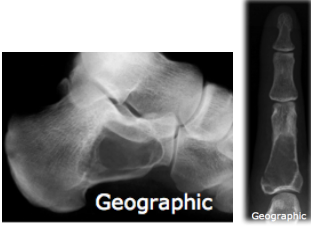


Tumors

- Osseous
 - Types: 1-Sclerotic 2-Mixed 3-Lytic
- Chondral
- Fibrous
- Soft tissue

Key Features: This is what you need to know about each tumor

- Morphology
- Behavior of lesion (Benign or aggressive)
- Age of patient
- Site (location)

Morphology ★

Geographic	Moth eaten	Permeative
 <p>Geographic</p>	 <p>Moth-eaten</p>	 <p>Permeative</p>
<ul style="list-style-type: none"> ● Outlined lesion ● Benign lesion ● Causes: bone cyst, benign fibrous tumor ● Geographic lesions: sharp outline 	<ul style="list-style-type: none"> ● Fuzzy edges ● Aggressive lesion ● Causes: infection, tumor ● non-homogenous ● widen margin ● transition zone is wider ● malignant 	<ul style="list-style-type: none"> ● Aggressive ● Worst type ● ill defined margins ● wide zone transition ● aggressive malignant process or non-malignant as infection

Behavior ★

Periosteal reaction



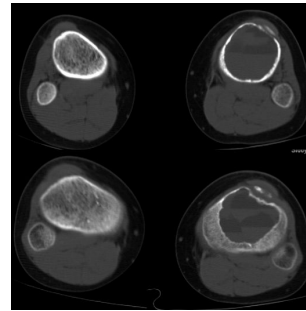
- It means that the body is trying to heal
- If there is a fracture the normal reaction would be periostitis and it would heal
- In cases of tumors there is continuous inflammation so the body tries to stop it by forming a layer of periosteal reaction (white line around bone). Then the infection/tumor becomes more aggressive and it stops (black line). Then the body will react again (white line). All of this will give an "onion peel/lamellated" appearance
- the periosteum is intact with cortex
- looser in the pediatric
- any violation to the cortex and the bone will react to the tumor by forming callus and periosteum
- slow growing tumors allow the periosteum to grow
- periosteum will be thick
- benign

❖ Case 5:

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



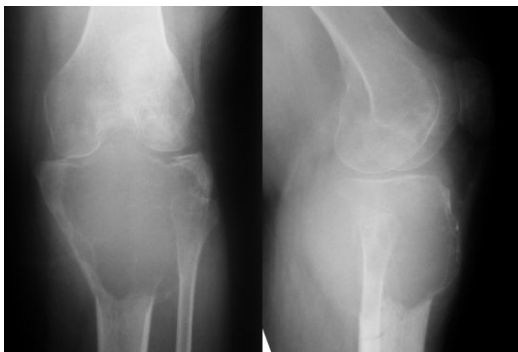
Pattern: Geographic
 Location: metaphyseal
 Diagnosis: Aneurysmal bone cyst. Do MRI or CT to know the extent
 Treatment: surgical or injection with sclerosing material
 Lytic expansile lesion located on the metaphysis(benign)



Fluid fluid level indicating a hemorrhagic component
 There are some spots that suggest presence of blood
 CT or MRI might be done to check the texture of the lesion.

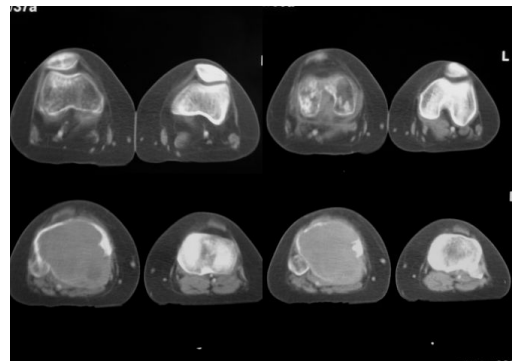
- Within the metaphysis, doesn't extend to the epiphysis
- Geographical
- X ray: expansile lytic lesion , cortex is thinned out
- CT: fluid level blood, vascular benign lesion
- Cause: aneurysm bone cyst (age, location, appearance)

On CT there are some spots that suggest that it contains blood Aneurysmal Bone cyst.



Frontal view: looks clear, lateral view: nothing is clear
 Diagnosis: Giant cell tumor (benign with aggressive behavior)

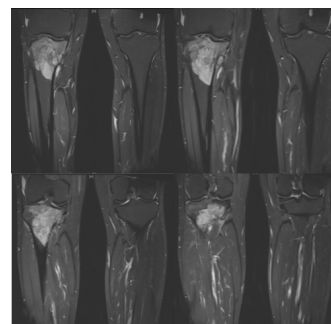
- Expansile
- lytic lesion
- sub-articular surface
- violated cortex
- Aggressive bone lesion



Lesion is pushing the bone (the bone is thinned out)
 Everything else is normal (if it were malignant it will be destroying everything)



- Moth eaten, permeated (no margins)
- Aggressive



- In these cases we depend more on X ray
- Moth eaten, permeated (no margins)
- Violating the cortex

- Leukemia, lymphoma, sarcoma

❖ Case 6: ★

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

	
<p>Findings:</p> <ul style="list-style-type: none"> • Swelling between thumb and index finger <p>In X ray:</p> <p>Black → fat (think of lipoma), air (think of bacterial infection)</p> <p>White → bone, calcification</p> <ul style="list-style-type: none"> •no bone destruction •Soft tissue swelling but no bone is disrupted, so it is only a swelling. 	<p>The image is adjusted to cancel out fat (black) to make sure it's a fatty lesion.</p> <p>Diagnosis: Lipoma</p> <ul style="list-style-type: none"> •MRI: lesion is white •Possible lesions: Lipoma, fibroma, rhabdomyoma, fibrous histiocytoma, hemangioma, neurofibroma <p>MRI is done and the lesion appeared white "subcutaneous fat".</p>

❖ Case 7:

57-year-old patient with a history of breast cancer presented with bone ache.



Findings:

Dots everywhere (metastasis)

Metastasis can be lytic or sclerotic (sclerotic in breast and prostate cancer)

Summary

- Metabolic & Endocrine Disorders:
 - Osteomalacia: looser zone
 - Osteoporosis: loss of trabeculations
 - HPT³: Brown tumors
 - ROD⁴: jersey spine
 - Acromegaly: 1-frontal bossing 2-protruding jaw 3-enlarged sella turcica 4-thickened heel pad
- Arthritis:
 - Rheumatoid Arthritis: proximal joint, periarticular osteopenia
 - Osteoarthritis: loss of joint space, osteophytes, and subchondral cyst.
 - Psoriatic Arthritis: distal joint
 - Gout: lumpy bumpy
- Musculoskeletal Tumors:
 - Benign (Non-aggressive)
 - Malignant (Aggressive)
- Matrix is chondroid tissue, deposited with phosphorus and calcium
- Osteopenia: is not a disease, but reduction in bone density
- Osteoporosis: can be secondary to trauma, immobilization, medicine such as heparin because the mass is reduced and not the minerals
- Osteomalacia: caused a by defect in minerals (inadequate amounts of available phosphorus and calcium, or because of overactive reabsorption of calcium from the bone as a result of hyperparathyroidism)
- Osteomalacia In children is called Rickets

³Hyperparathyroidism/

⁴Renal osteodystrophy