



# Imaging the Musculoskeletal System

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# Radiology Team 429

**In this team we used the outlines from the:**

**Doctor's slides**

**Lecture notes are in red boxes**

**427 Radiology team**

**Diagnostic Imaging –PETER  
ARMSTRONG – 6<sup>Th</sup> Edition**

**Sorry we don't hold responsibility for any missing information or perhaps – perhaps -wrong material.**

**We tried our best to present this lecture in the best way, and we hope what we wrote is enough to cover the subjects.**

**Team Leaders:**

Abdulmajeed Al-Sadhan, Ibrahim Al-Sadhan, Sarah Mahasin

**Team Members:**

Mashail Al Towariqi, Abdullah Alessa

**Best Wishes : )**



# OBJECTIVES

The main focus and objective of this lecture is to help student to be competent 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



# Imaging to the Musculoskeletal System

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



# *METABOLIC & ENDOCRINE BONE DISORDERS*

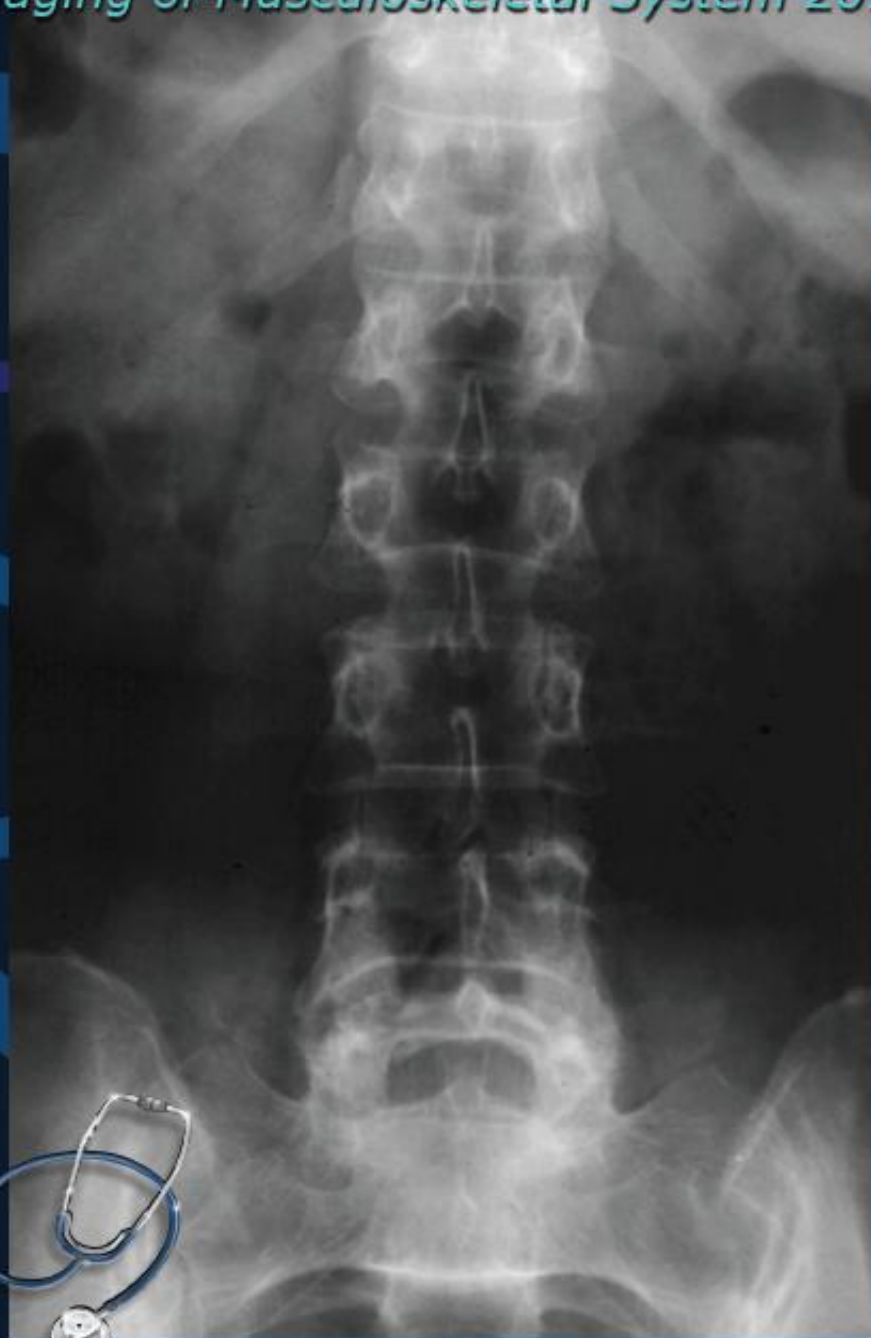




## CASE NO. 1

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



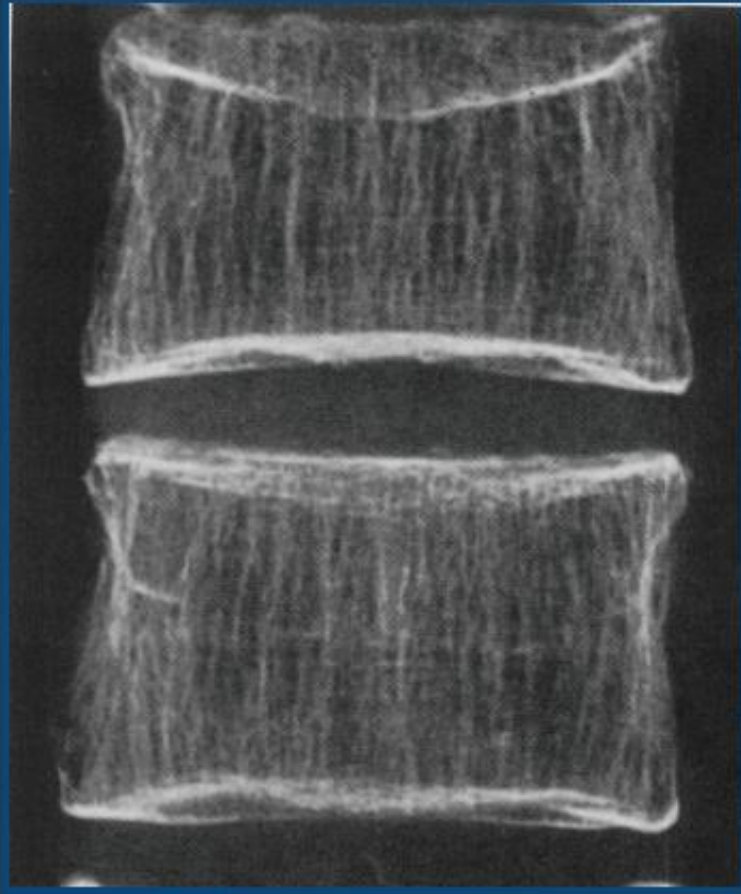
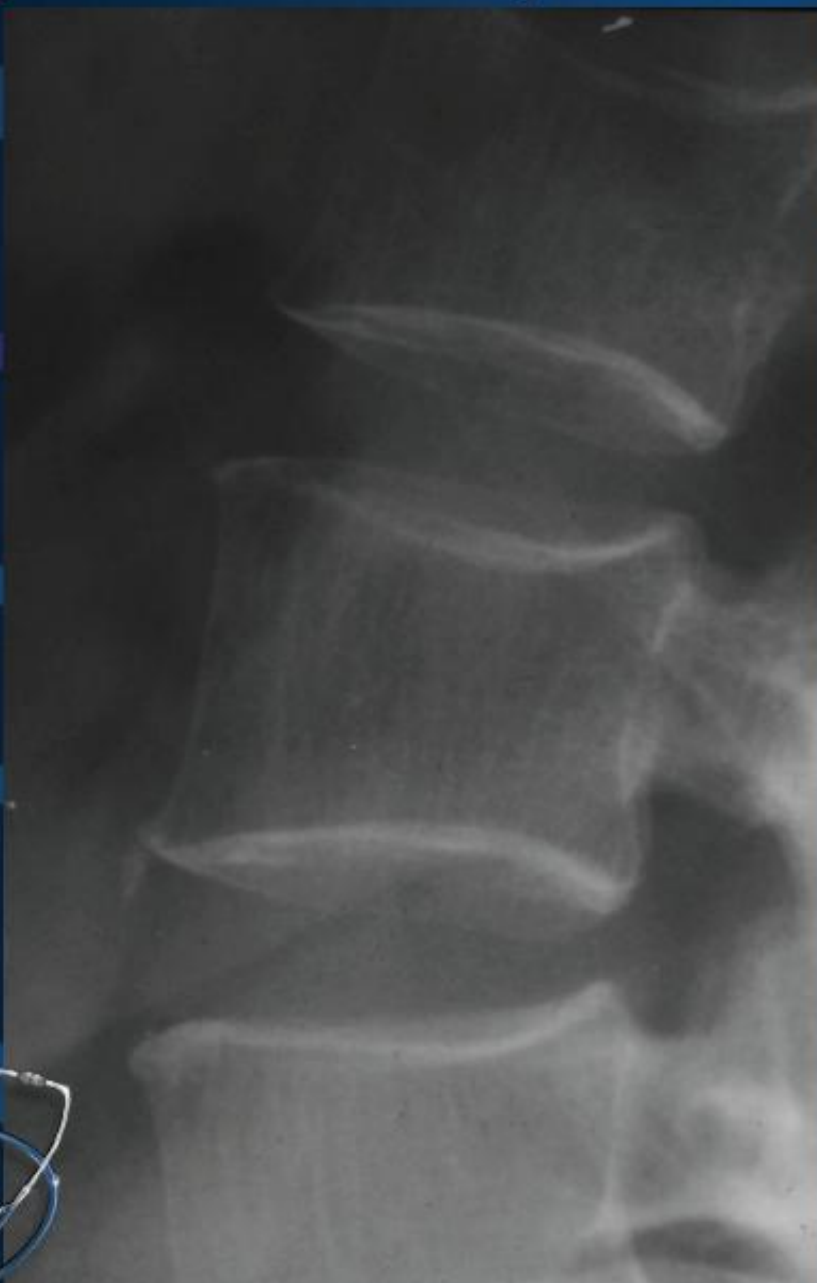


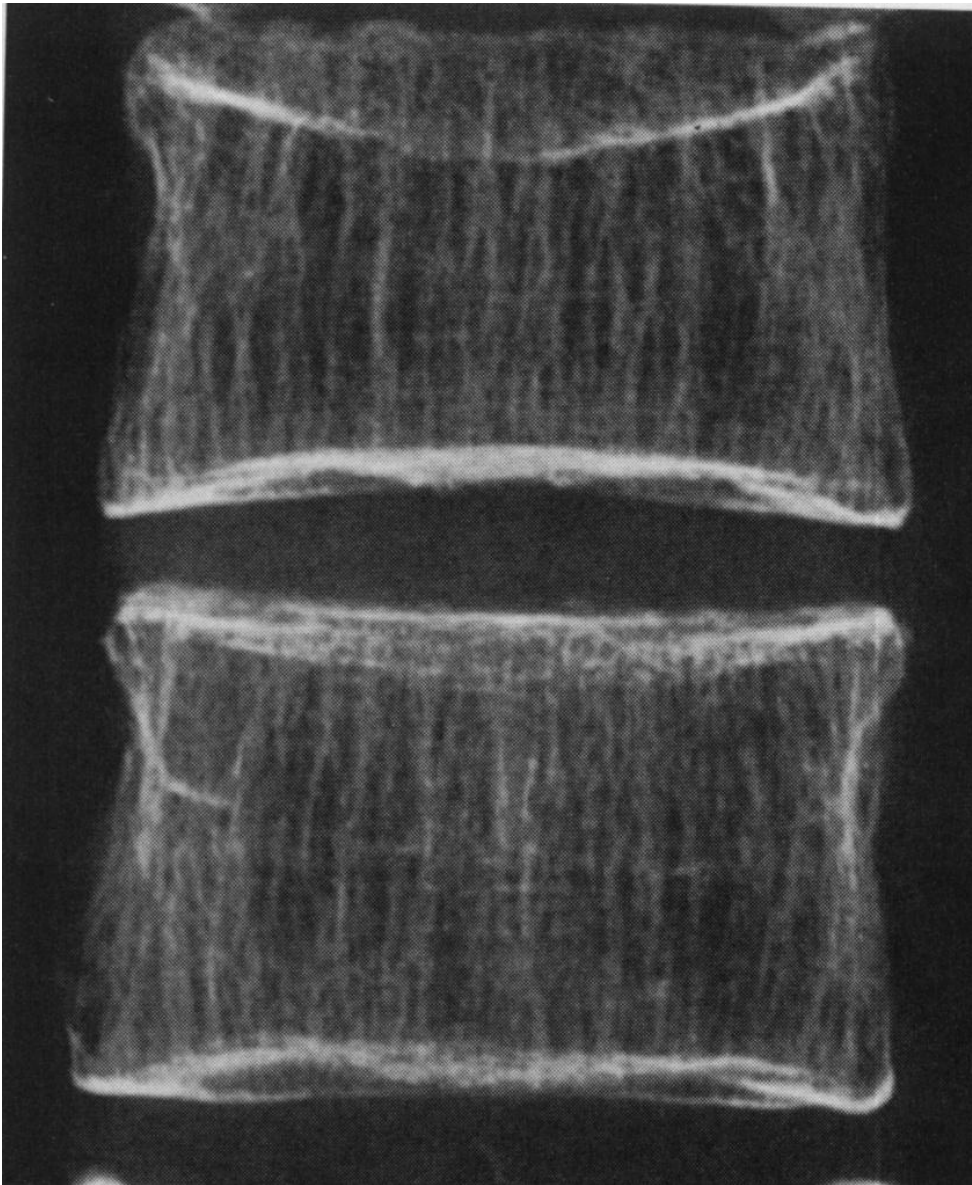
Case no.1:

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.



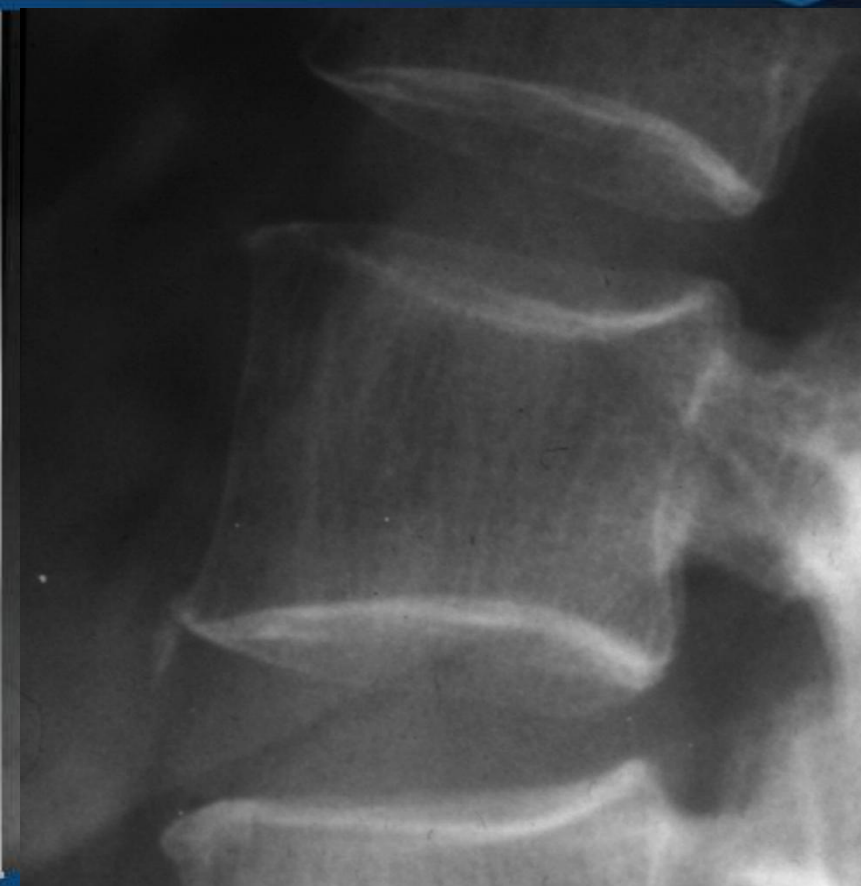
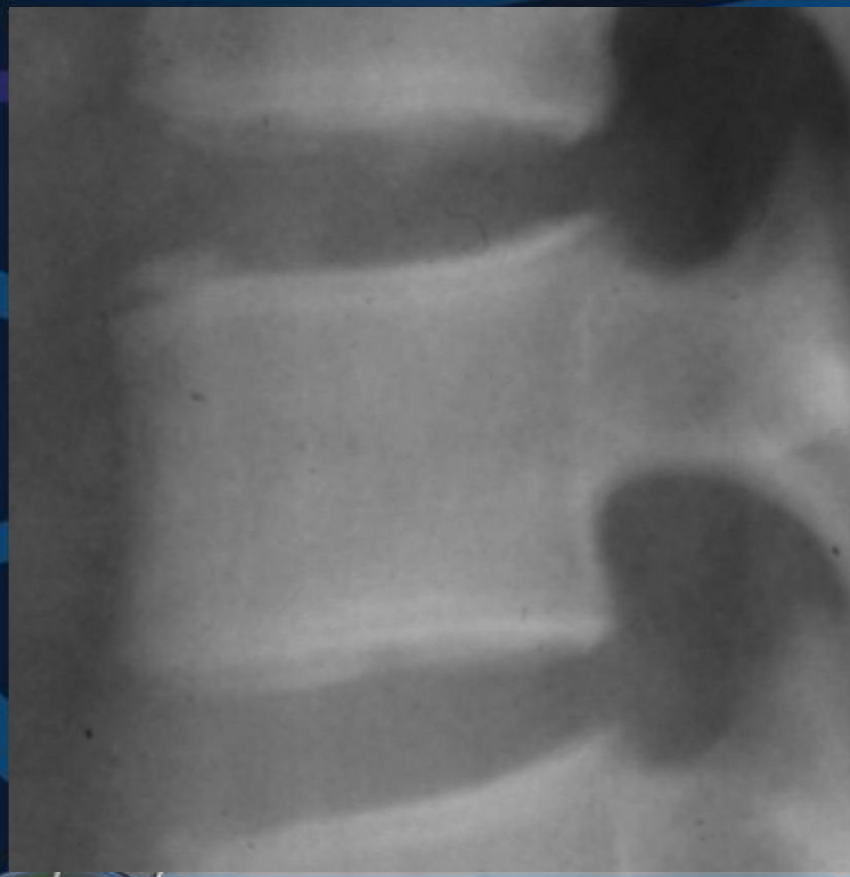




- Reduction of the bone matrix
- Concave end plates
- Trabeculae are clear and vertical, (lines inside the vertebrae)
- Uneven density
- Cortex is thin and sharp
- Margins are sharp and sclerotic
- Reduction in the height of the vertebrae

# Patient A

# Patient B



**Osteomalacia**

**Osteoporosis**

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Patient (A): Osteomalacia "Rickets in children"

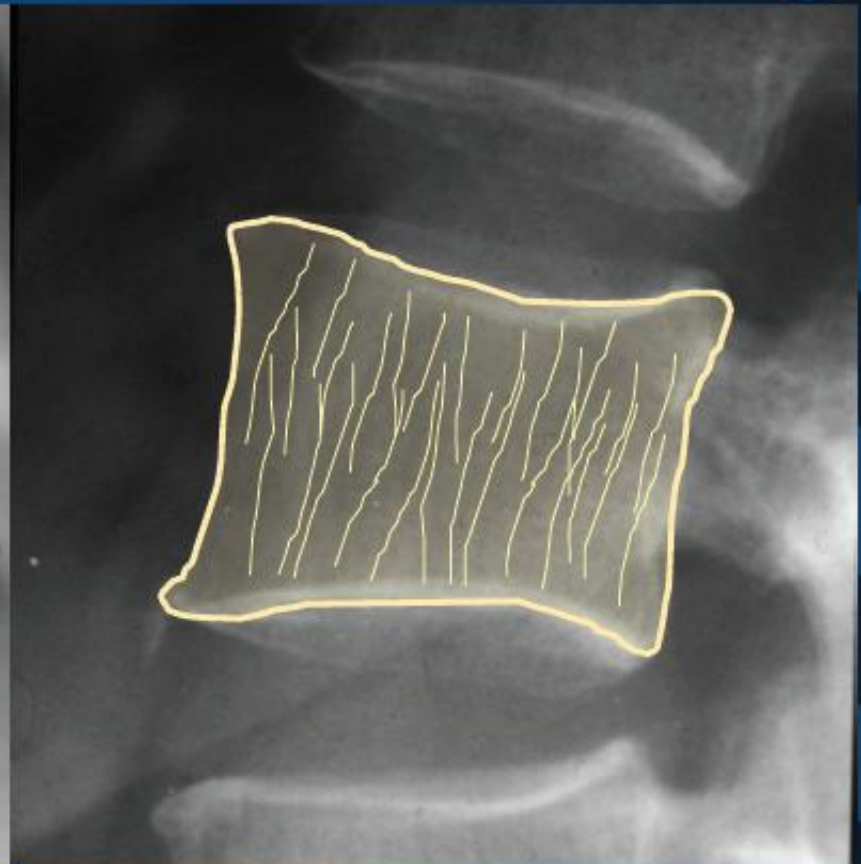
Bone density may be normal but bone is soft and there is a defect in mineralization and ill defined margins with no vertically oriented trabeculae.

Patient (B): Osteoporosis

There is reduction in bone density, sharp margins of the vertebral body with obvious vertically oriented trabeculae.



**Osteomalacia**



**Osteoporosis**

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## CASE NO. 2

27 years- old male with long standing history  
of renal failure

X-ray of lumbosacral spine requested





Osteosclerosis

"Rugger Jersey Spine"





Case no.2: Patient with renal failure  
→ No absorption & metabolism of vitamin D.

On x-ray, **2 White margins** with **lucent central** and vertical trabeculae which is called (**Rugger jersey spine**), these changes are due to renal dystrophy. The rugger-jersey sign is diagnostic of osteosclerosis.

- Decreased bone density of the central portions (black area)
- Sclerotic vertebral end plates
- Caused by reabsorption of the minerals, but increased activity of the



# *METABOLIC & ENDOCRINE BONE DISORDERS*

Renal Osteodystrophy

**Presents with**

Osteoporosis

Osteomalacia

Secondary Hyperparathyroidism

Osteosclerosis

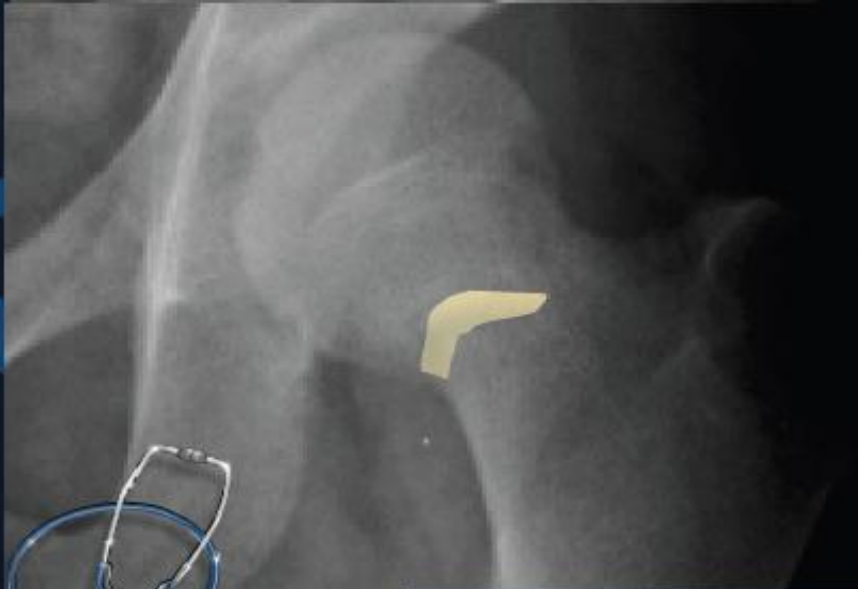




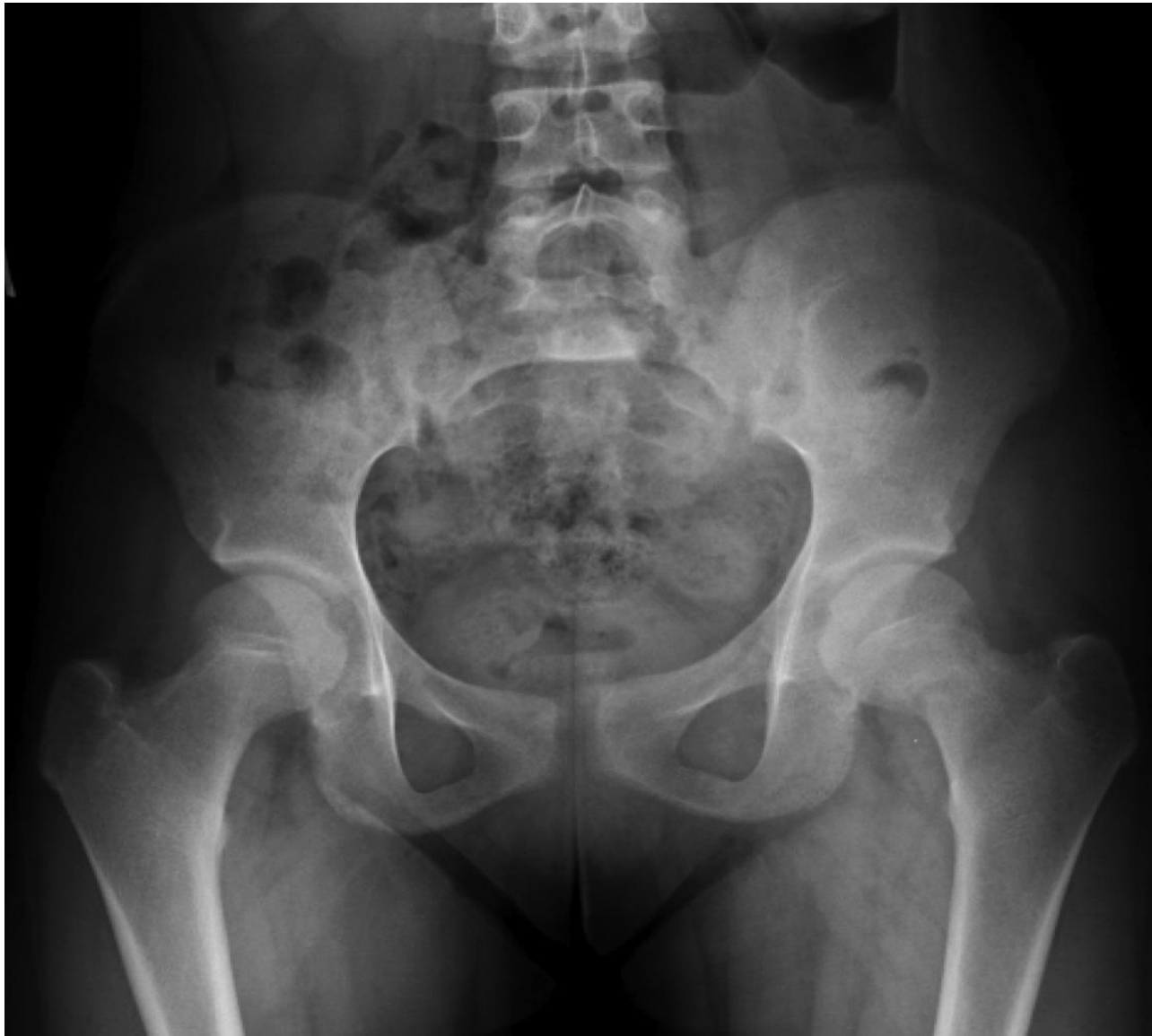
# 20 years old lady, weakness and lower limbs pain



RT



**Looser zones ( OSTEOMALACIA)**



- 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



# HYPERPARATHYROIDISM

- ✓ Bone Resorption
- ✓ Bone Softening
- ✓ Brown Tumors
- ✓ Osteosclerosis
- ✓ Soft tissue calcifications





Hyperparathyroidism

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In hand, sub periosteal bone resorption in hyperparathyroidism.  
These changes usually happen in the middle phalanx, radial aspect in the 2<sup>nd</sup> or 3<sup>rd</sup> finger.



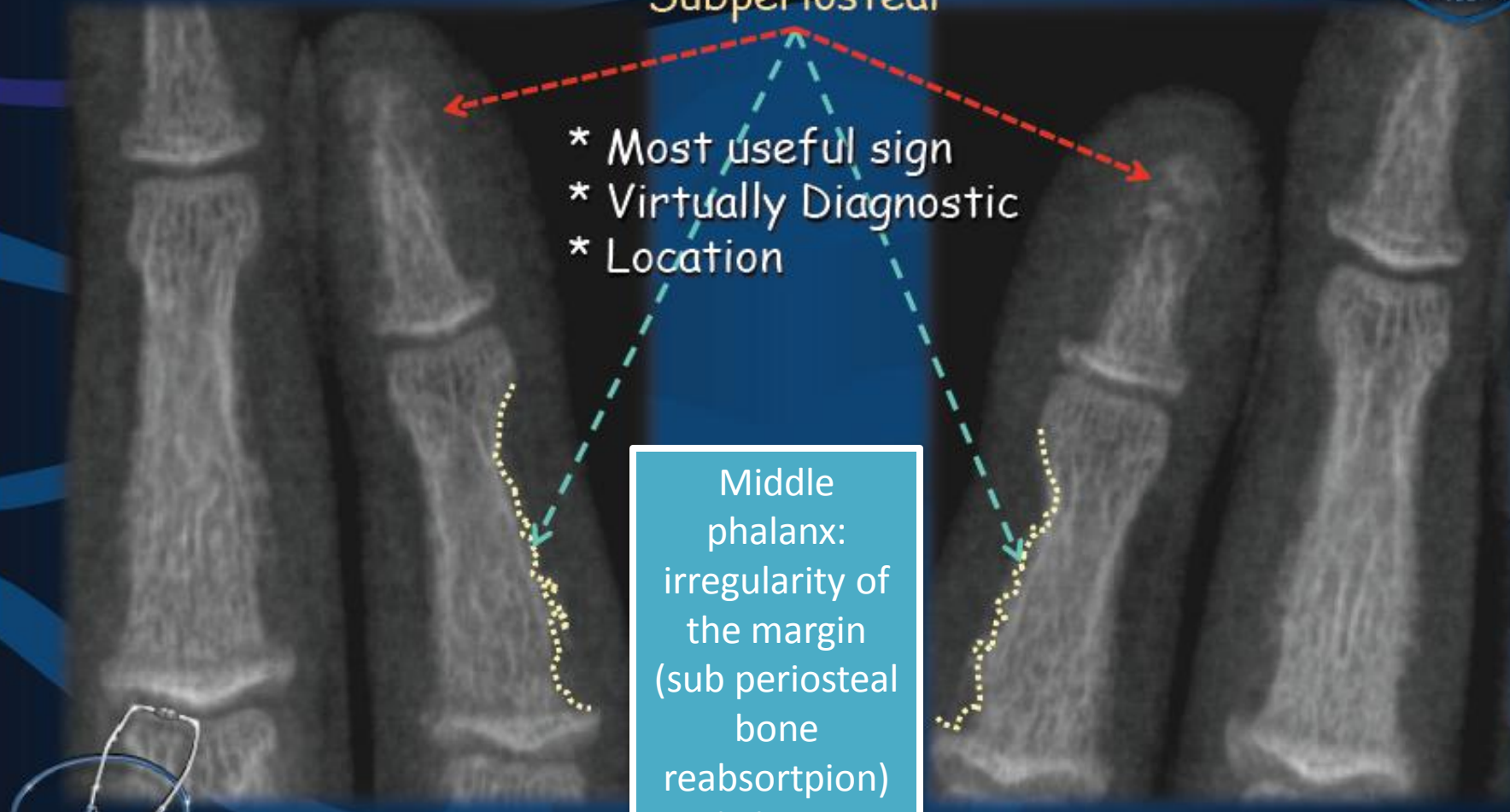
# Bone Resorption

## Subperiosteal



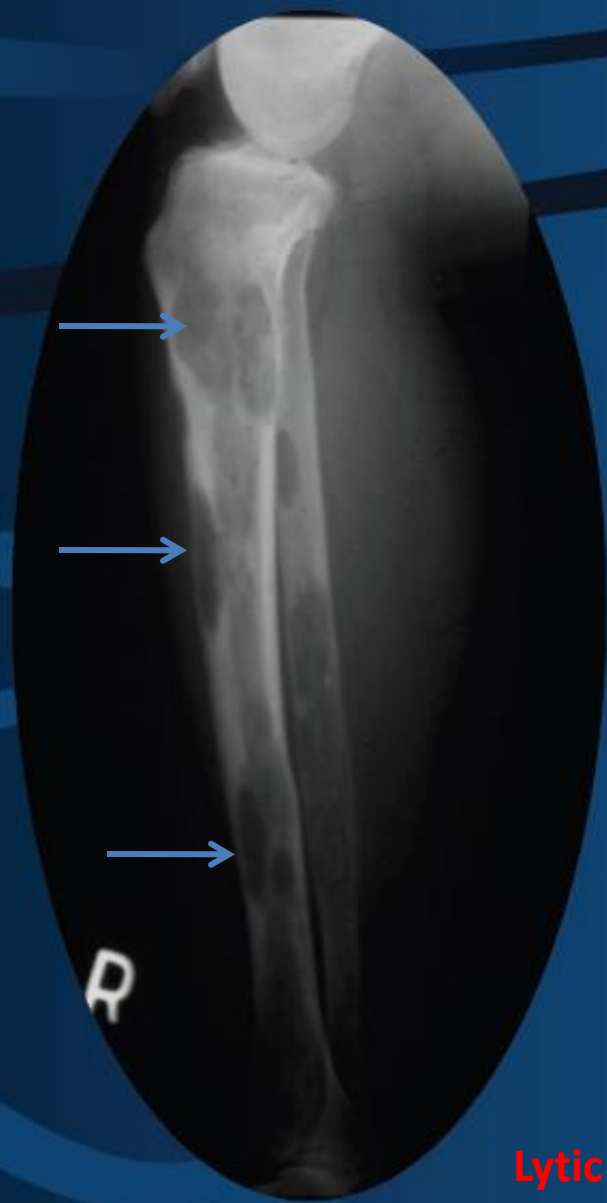
- \* Most useful sign
- \* Virtually Diagnostic
- \* Location

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



# Hyperparathyroidism

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



**Lytic Lesions**  
**Brown Tumors**



## CASE NO. 3

45 years- old male presented with history of  
bone enlargement

X-ray of skull and hand are requested

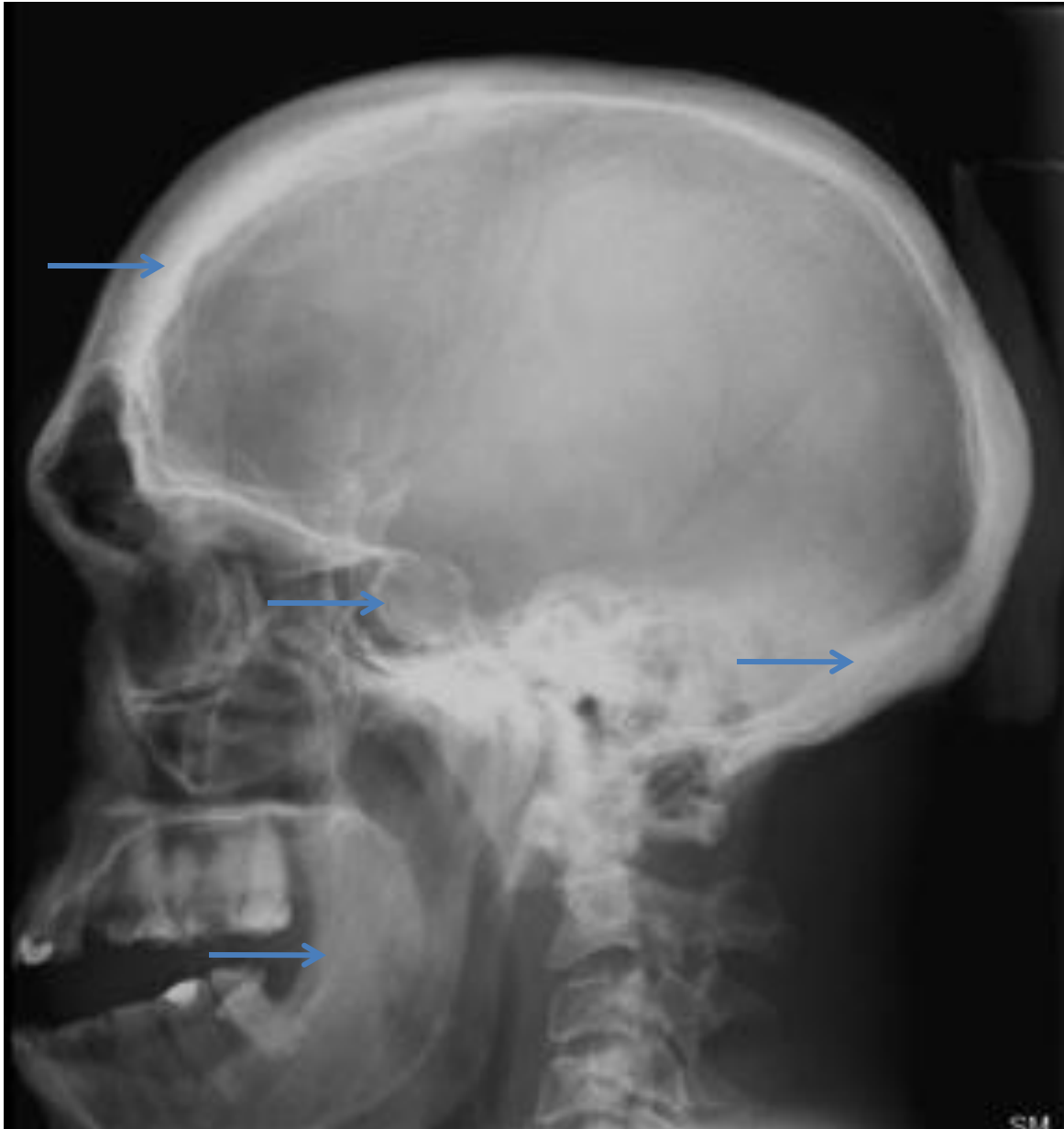




Acromegaly







- 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

## Acromegaly



Hands: Enlargement of the soft tissue, early osteoarthritis



ARRS



# *ARTHRITIS*





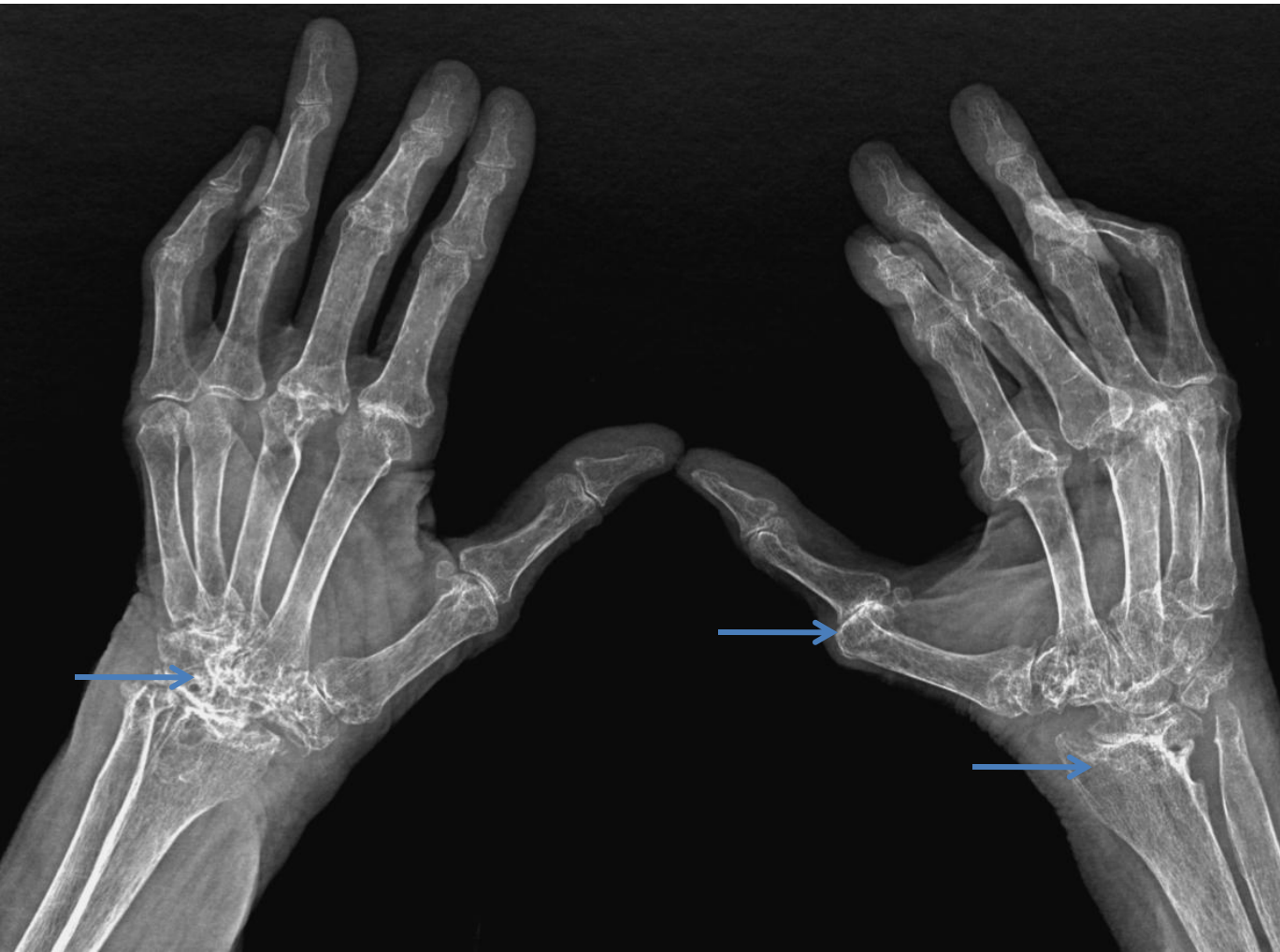
## CASE NO. 4

48 years- old female presented with joint  
pain of the hands & feet  
X-ray of hand requested





*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



*Rheumatoid Arthritis*







- Carpals aren't clear, 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: Periarticular erosions (periarticular osteopenia), loss of joint spaces.



*Rheumatoid Arthritis*



- Around joint, periarticular osteopenia/osteoporosis
- Erosive changes
- Erosive arthropathy: caused by 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





AYAJAM YI

Osteoarthritis

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- Carpals are clear
- Metacarpophalangeal: no defect or erosive changes
- Proximal interphalangeal space
- Distal: osteosclerosis: margins of the bone and extends, osteospike
- Reduction of the joint space, sclerotic changes, osteo



- 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.  
Distal rather than proximal



## Osteoarthritis



Se: /3  
Im: 1/1

HAND  
SUPINE

Mag: 0.4x  
Lat: L

Acc: 2433AD  
2007 Mar 08: /3  
Acq Tm: 08:38:19: 2/1

HAND  
UPINE

Mag: 0.5x  
Lat: L

1961 Aug 25 F 531 E  
Acc: 2433  
2007 Mar 08  
Acq Tm: 08:38:19: 2/1



- Destruction of the head of the metacarpal
- Ossified joints
- Psoriasis can be similar but more severe, affect proximal to distal of one finger, ankylosis of the bone

## Osteoarthritis

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Erosive Osteoarthritis





RT



### Psoriatic Arthritis

Involvement of middle finger and fusion



## CASE NO. 6

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





Gouty Arthritis



Seen in the x-ray:

Erosions.

Malalignment

Around the erosion there is a swelling “ Rounded soft tissue enlargement”.

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

# Notes

- Matrix is chondroid tissue, deposited with phosphorous 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



# Musculoskeletal Tumors

- ✓ Osseous
- ✓ Chondral
- ✓ Fibrous
- ✓ Soft tissue





# Musculoskeletal Tumors

## KEY FEATURES

- ✓ Morphology
- ✓ Behavior of lesion
- ✓ Age of patient
- ✓ Site (Location)

Pattern of bone destruction  
Size, Shape & Margin of lesion  
Texture of lesion Matrix  
Cortex & Periosteal reaction





# Musculoskeletal Tumors

Geographic lesions:  
benign, sharp  
out line

## Pattern of bone destruction





# Musculoskeletal Tumors

## Pattern of bone destruction

### Moth eaten:

- non-homogenous
- wide margin
- transition zone is wider
- malignant



Moth-eaten



Permeative

### Permeative:

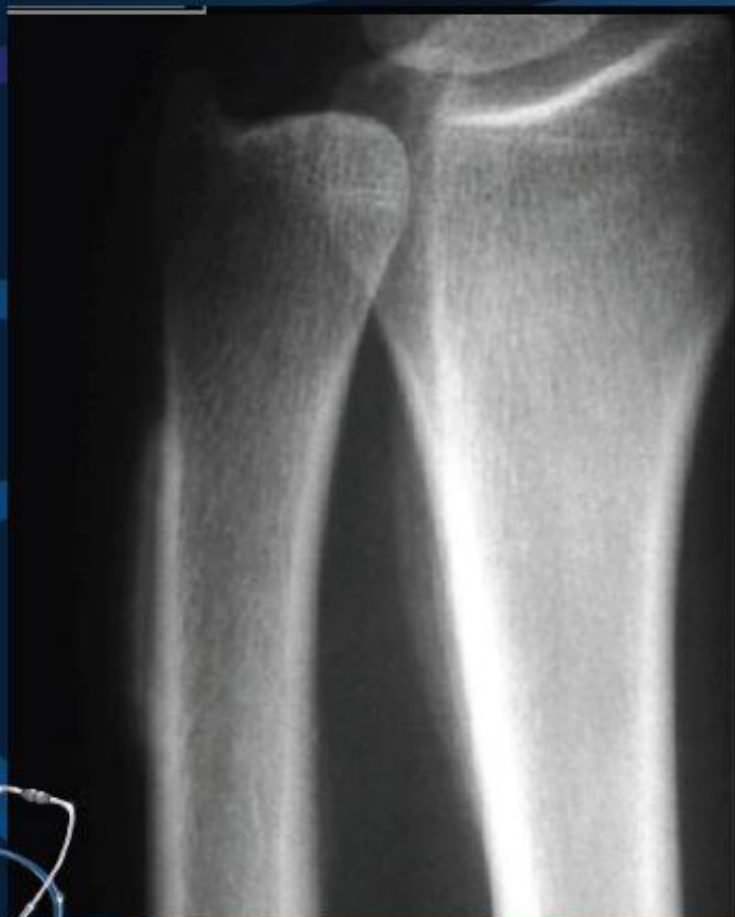
- ill defined margins
- aggressive lesion
- wide zone transition
- aggressive malignant process or non-malignant as infection





# Musculoskeletal Tumors

## Periosteal reaction





Periosteal reaction:

- 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 callous and periosteum
- slow growing tumors allow the periosteum to grow
- periosteum will be thick
- benign



# Musculoskeletal Tumors

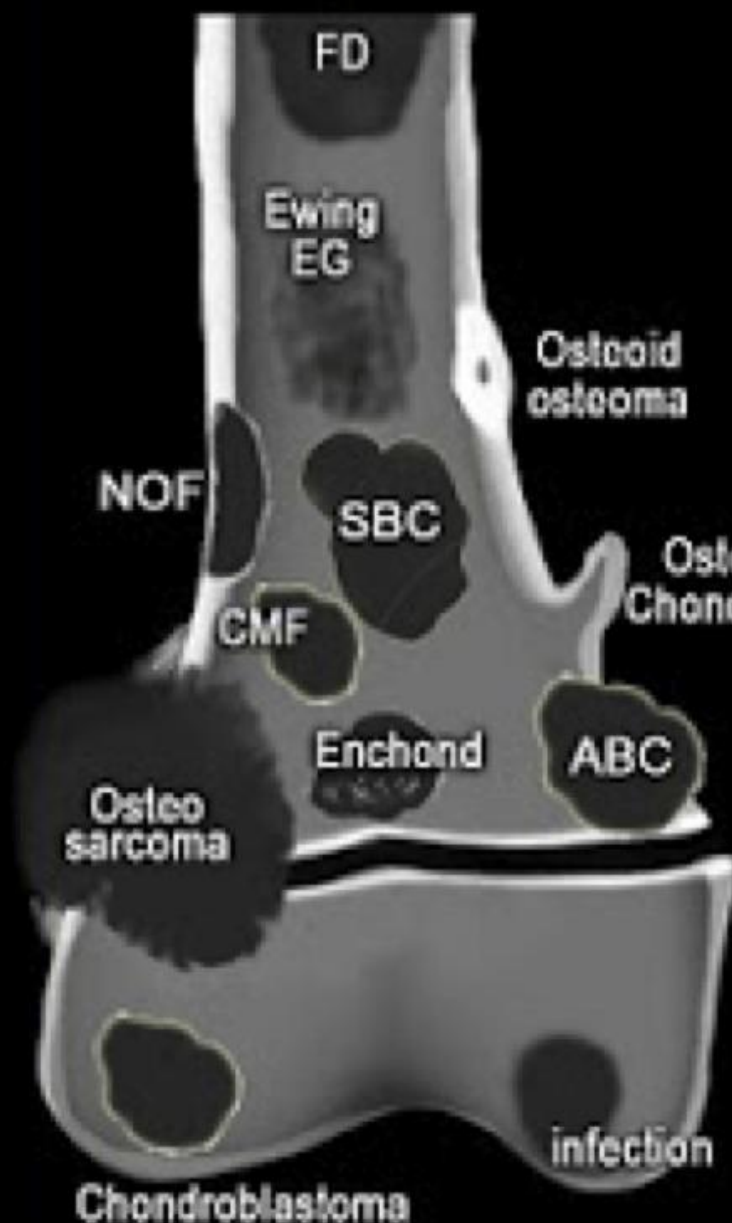
## KEY FEATURES

- ✓ Morphology
- ✓ Behavior of lesion
- ✓ Age of patient
- ✓ Site (Location)



< 30 years

> 30 years





## CASE NO. 7

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



Lytic expansile lesion located on the metaphysis (benign)



## Aneurysmal Bone Cyst

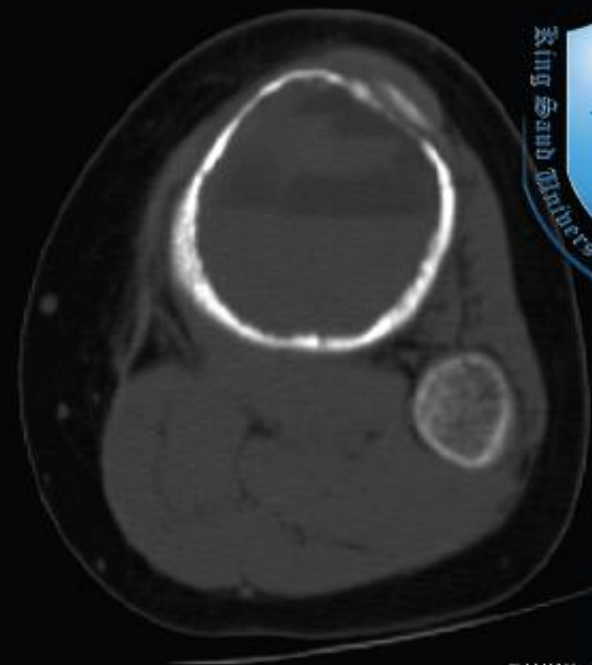
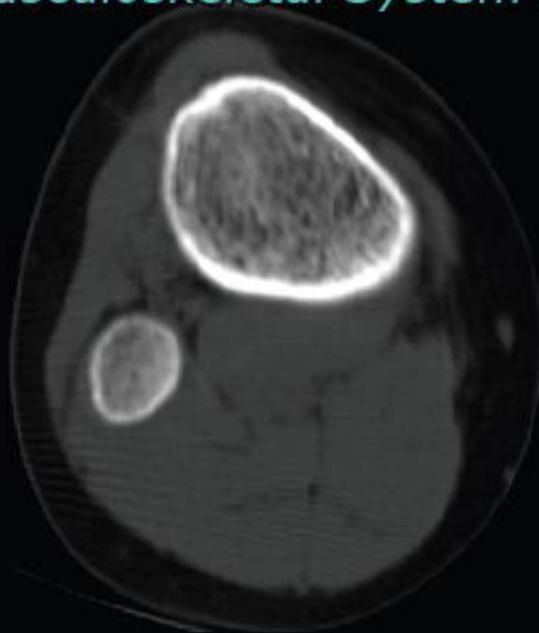
CT or MRI might be done to check the texture of the lesion.



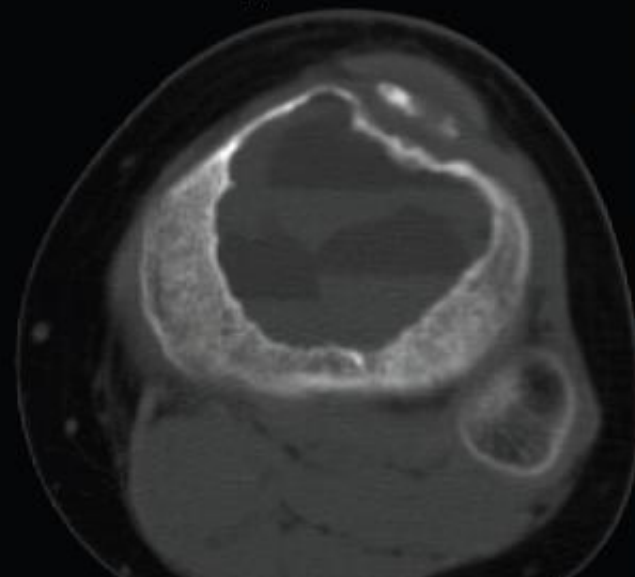
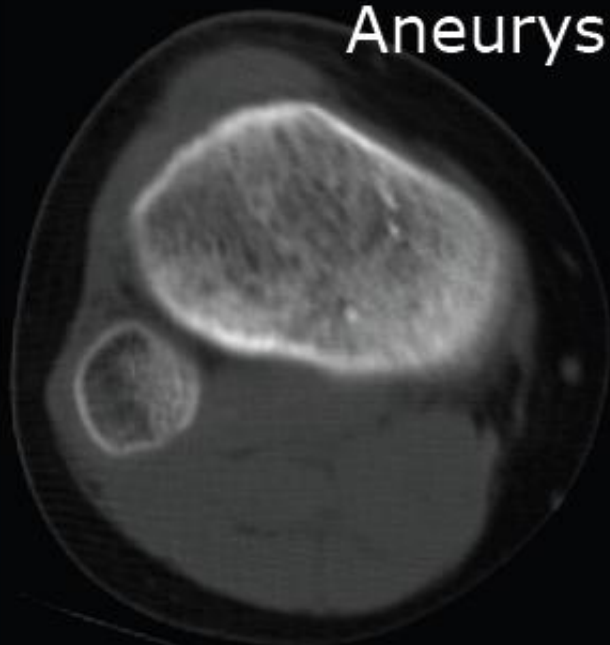




- Within the metaphysis, doesn't extent to the epiphysis
- Geographical
- X ray: expansile lytic lesion, cortex is thinned out
- CT: fluid level blood, vascular benign lesion
- Cause: aneurysm bone cyst (age, location, appearance)



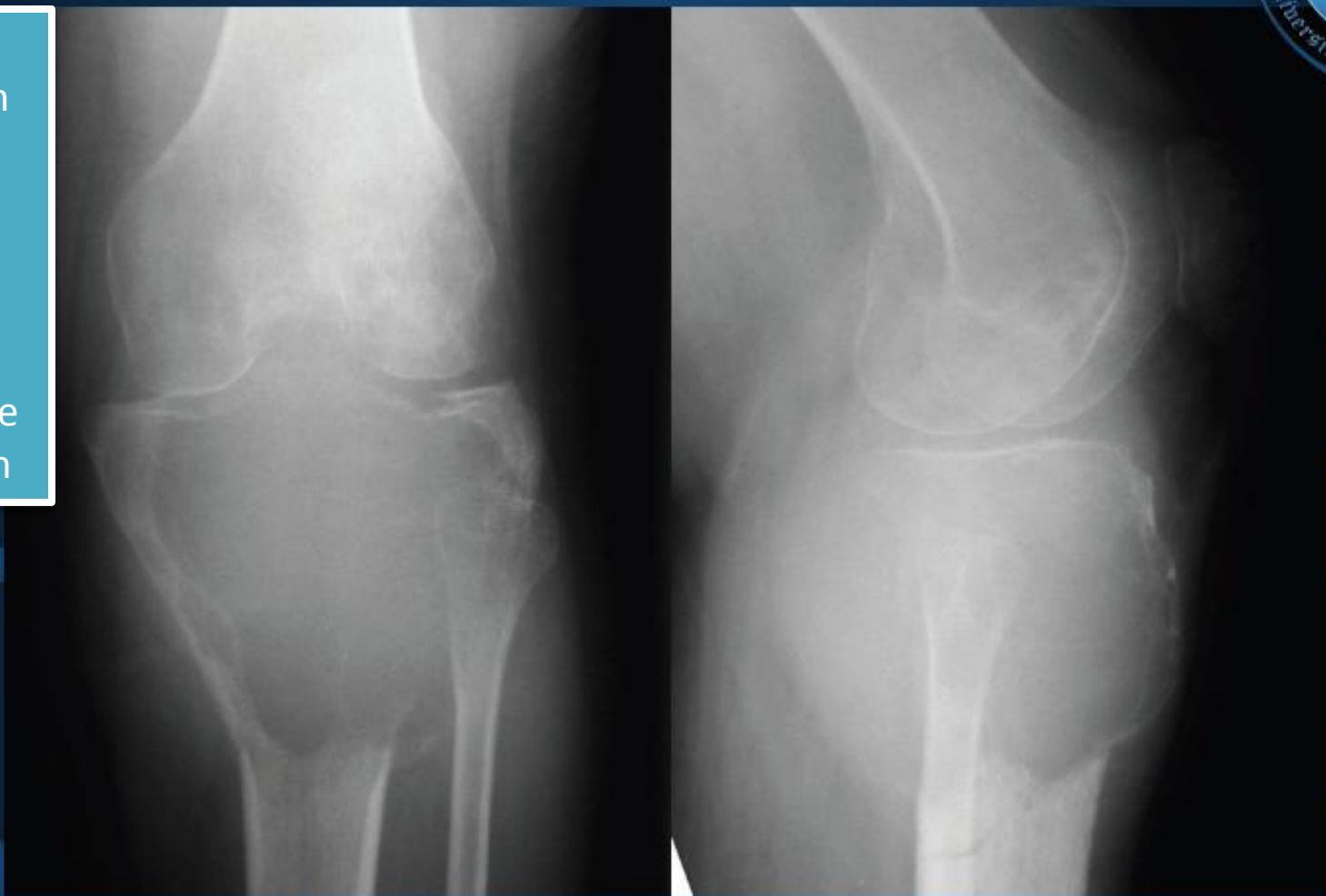
## Aneurysmal Bone Cyst



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

## Adult Patient

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



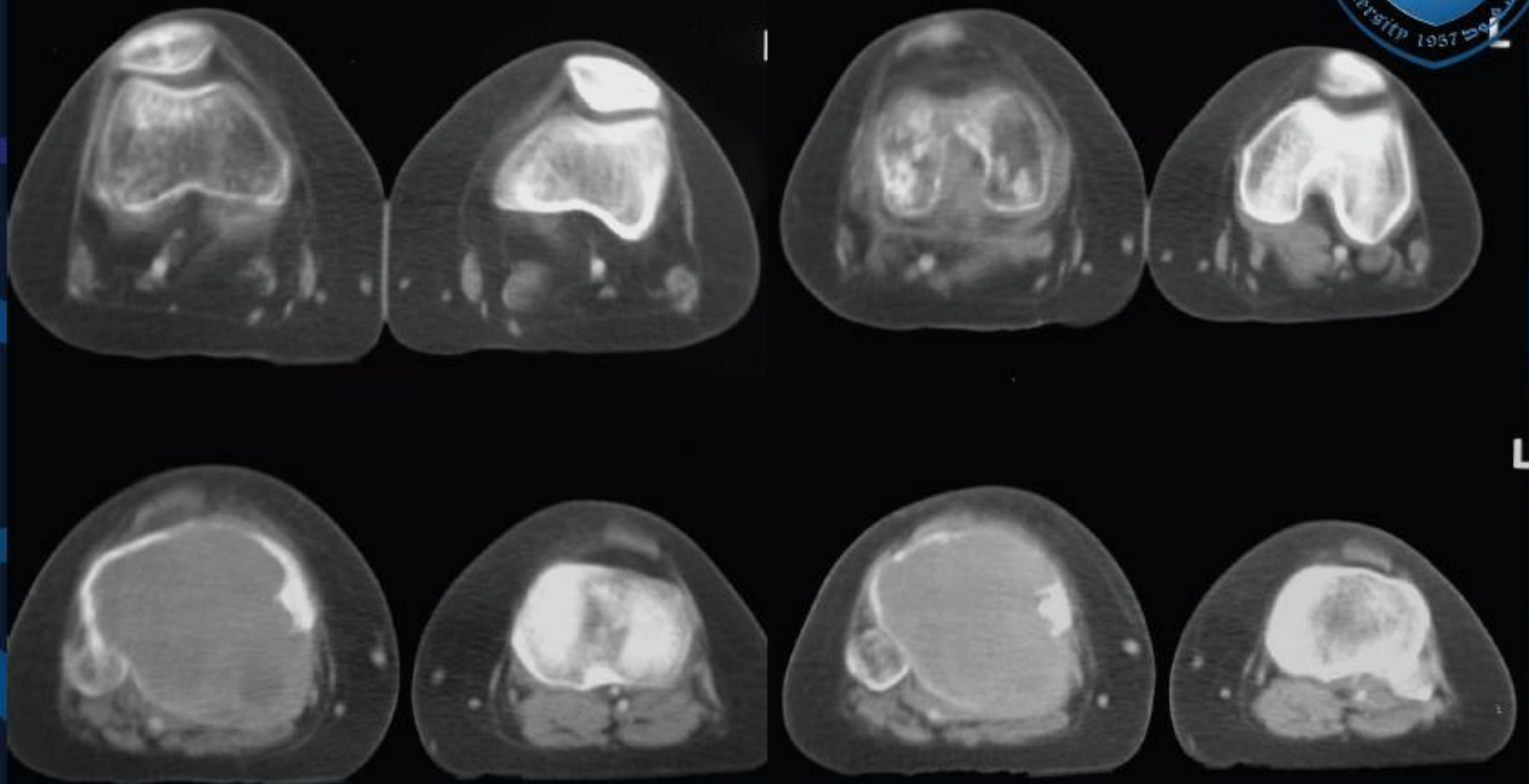
## Giant Cell Tumor



two different densities

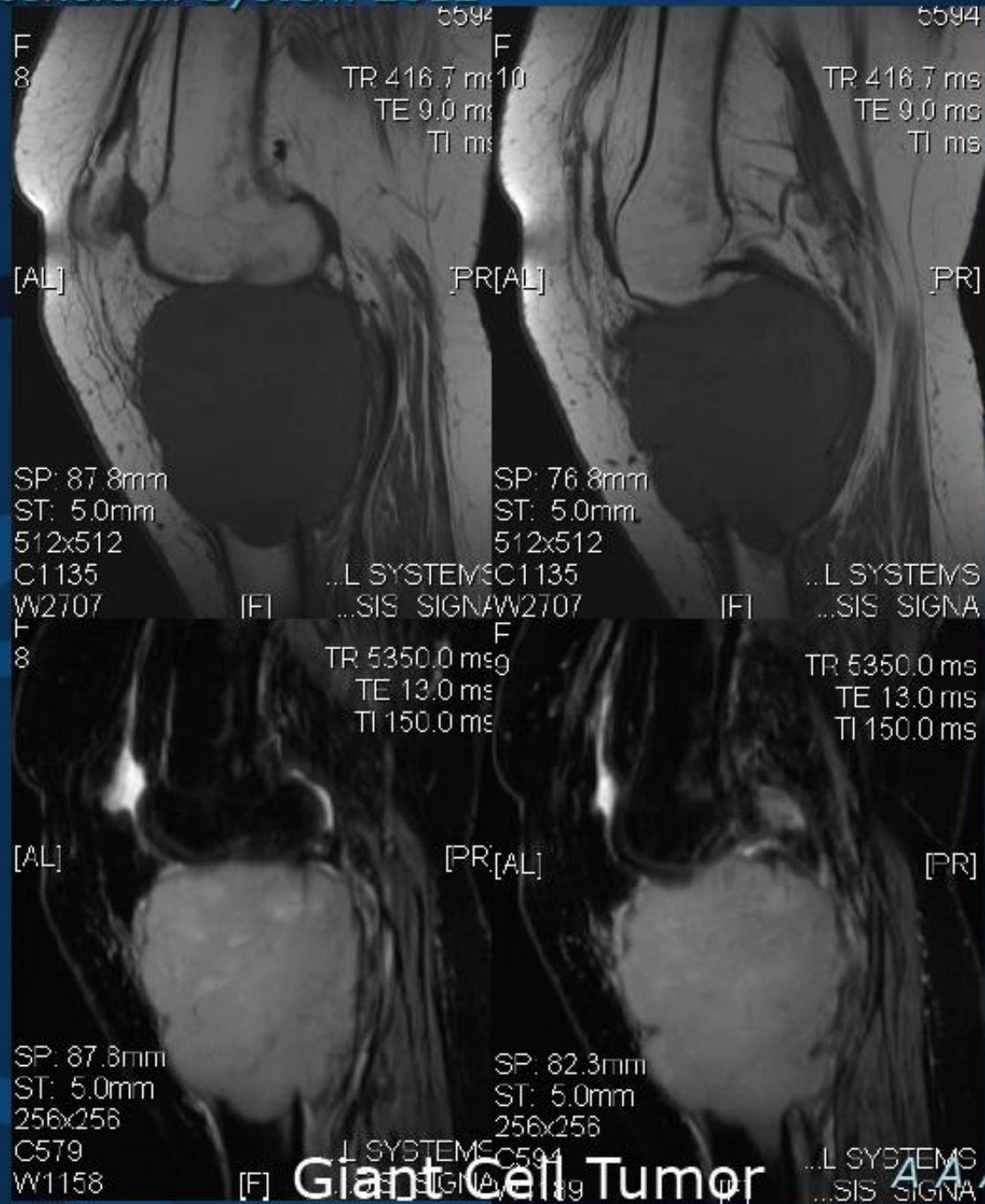


131a



Giant Cell Tumor





**MRI**



**Giant Cell Tumor**

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## Permeative Pattern

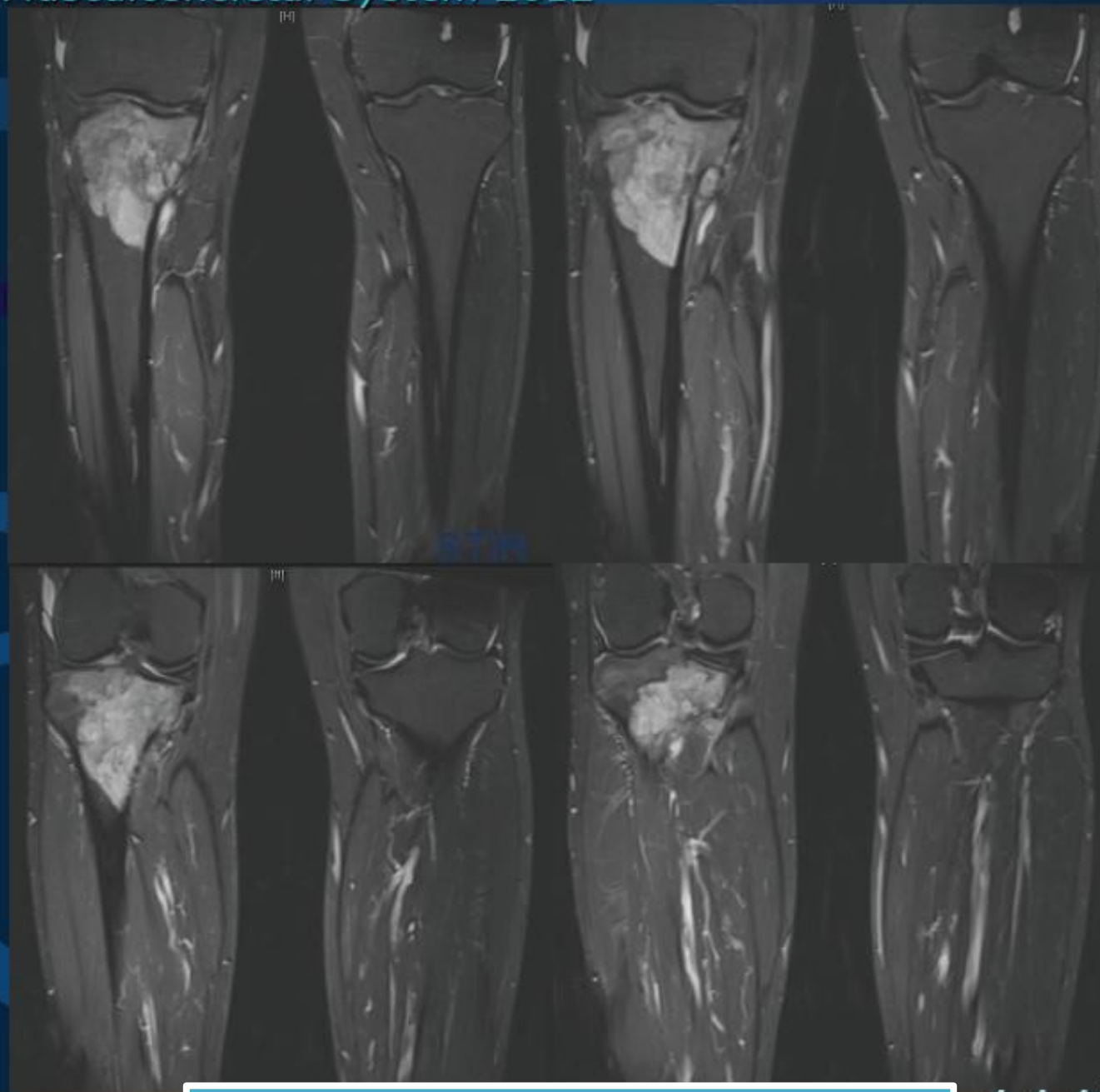
- Moth eaten, permeated (no margins)
- Violating the cortex
- Leukemia, lymphoma, sarcoma



Osteosarcoma / Lymphoma

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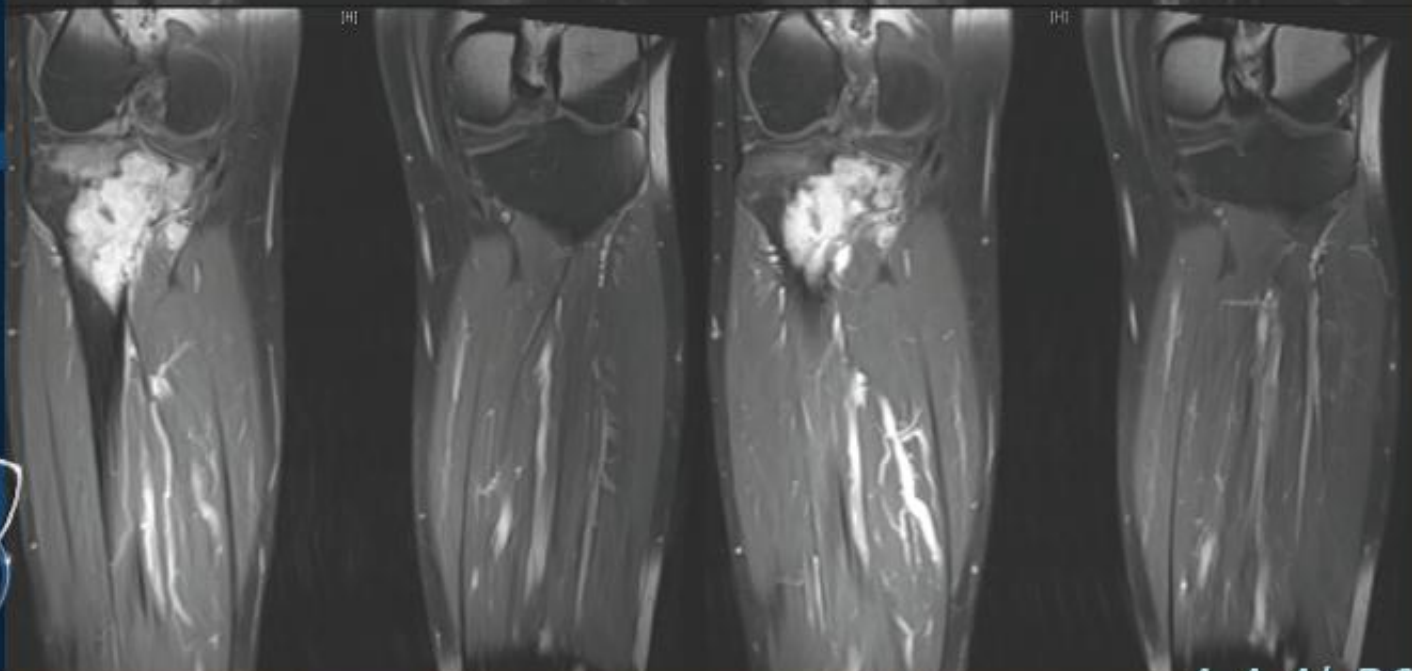
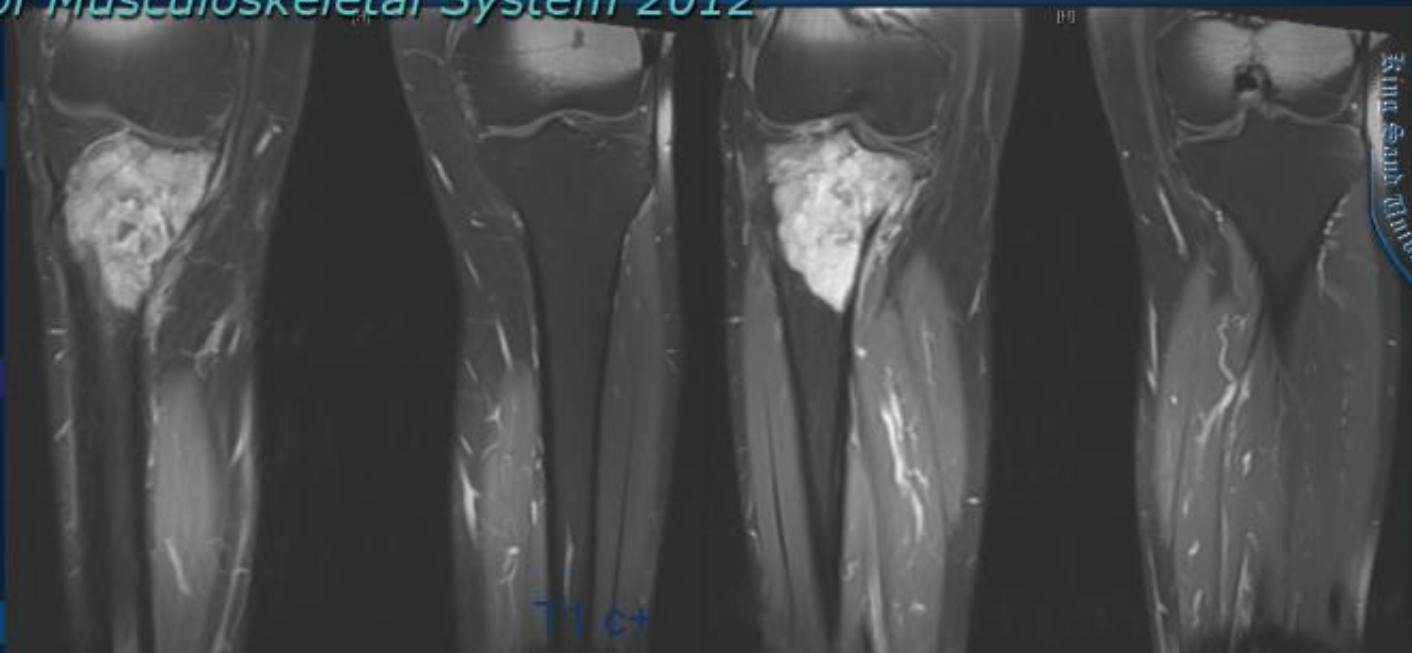




MRI: heterogeneous, extends beyond cortex

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## CASE NO. 8

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



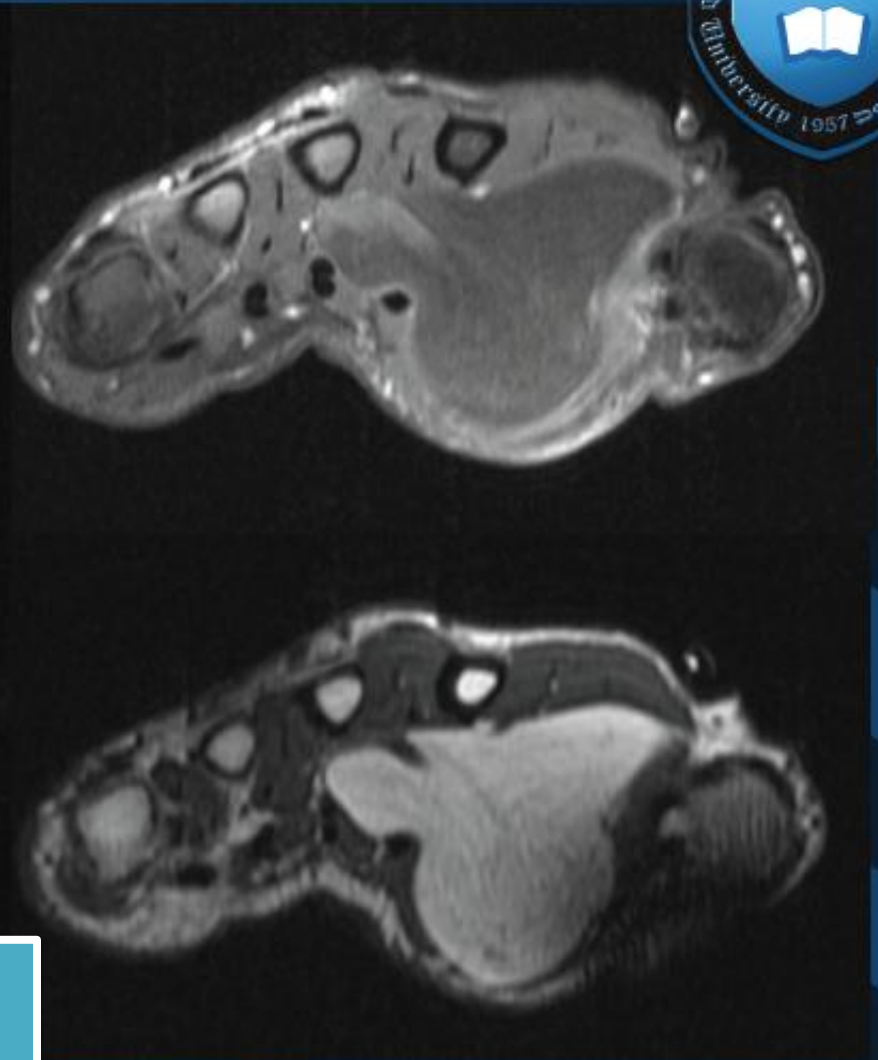
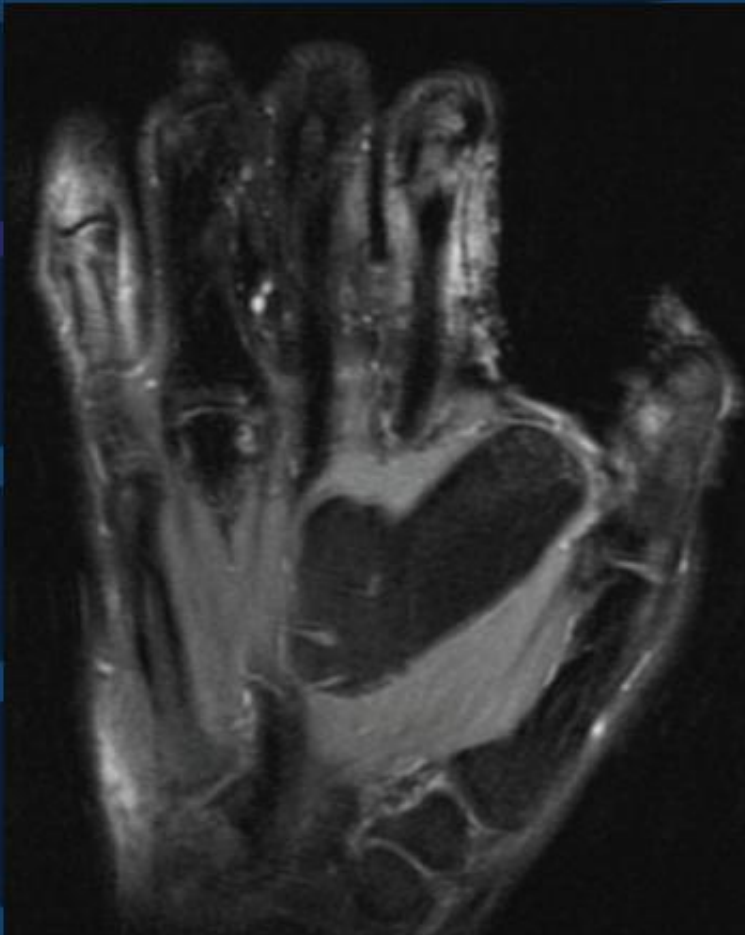


- soft tissue swelling of the hand, between thumb and finger
- no bone destruction
- Soft tissue swelling but no bone is disrupted, so it is only a swelling.



Soft Tissue Lipoma

- MRI: lesion is white
- Another image is adjusted to cancel the fat (black)
- Possible lesions: Lipoma, fibroma, rhabdomyoma, fibrous cystocytoma, hemangioma, neurofibroma



MRI is done and the lesion appeared white “subcutaneous fat”, and to make sure it is a fatty lesion we asked the machine to take off the fat and the lesion became black → supports our hypotheses (lipoma?)

the Lipoma

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**FINISH  
RADIOLOGY?**



**THANKS**

**CHALLENGE ACCEPTED.**

**Good Luck!**  
**Radiology Team**

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