



# Imaging the Musculoskeletal System

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PART 2 - 2012**



# 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*



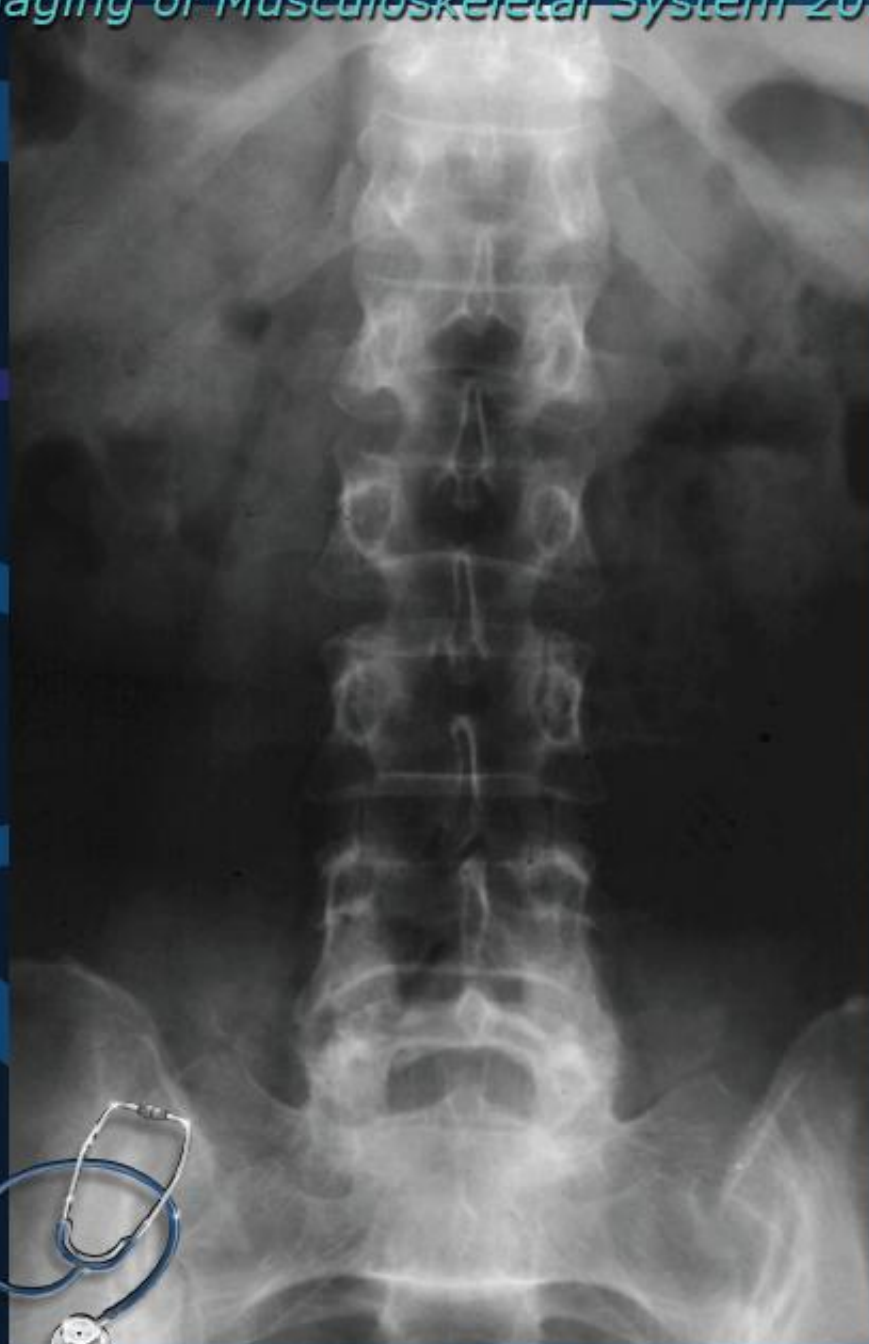




## CASE NO. 1

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

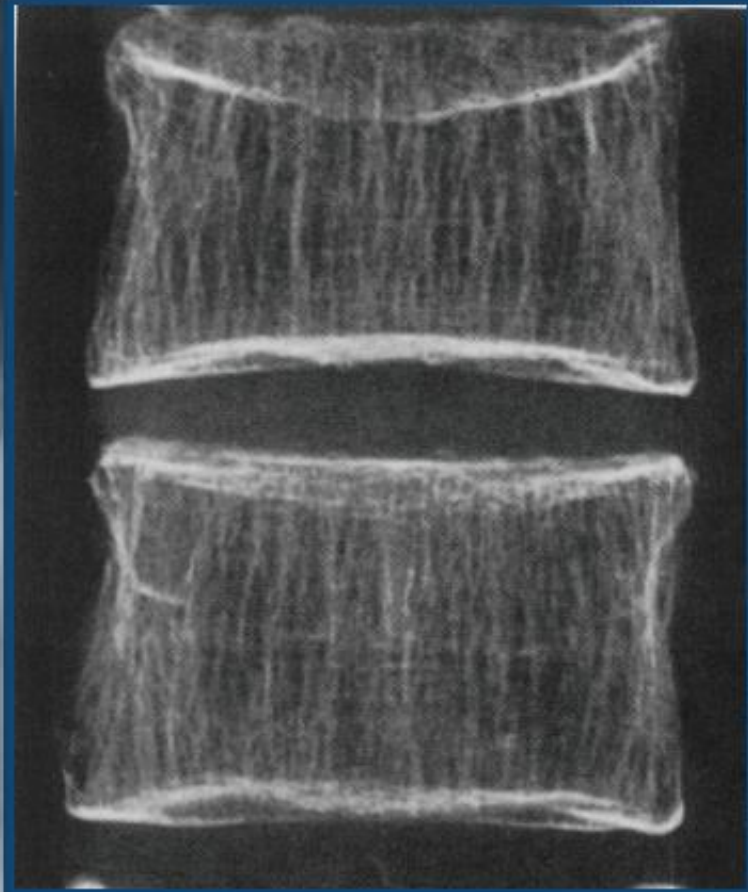
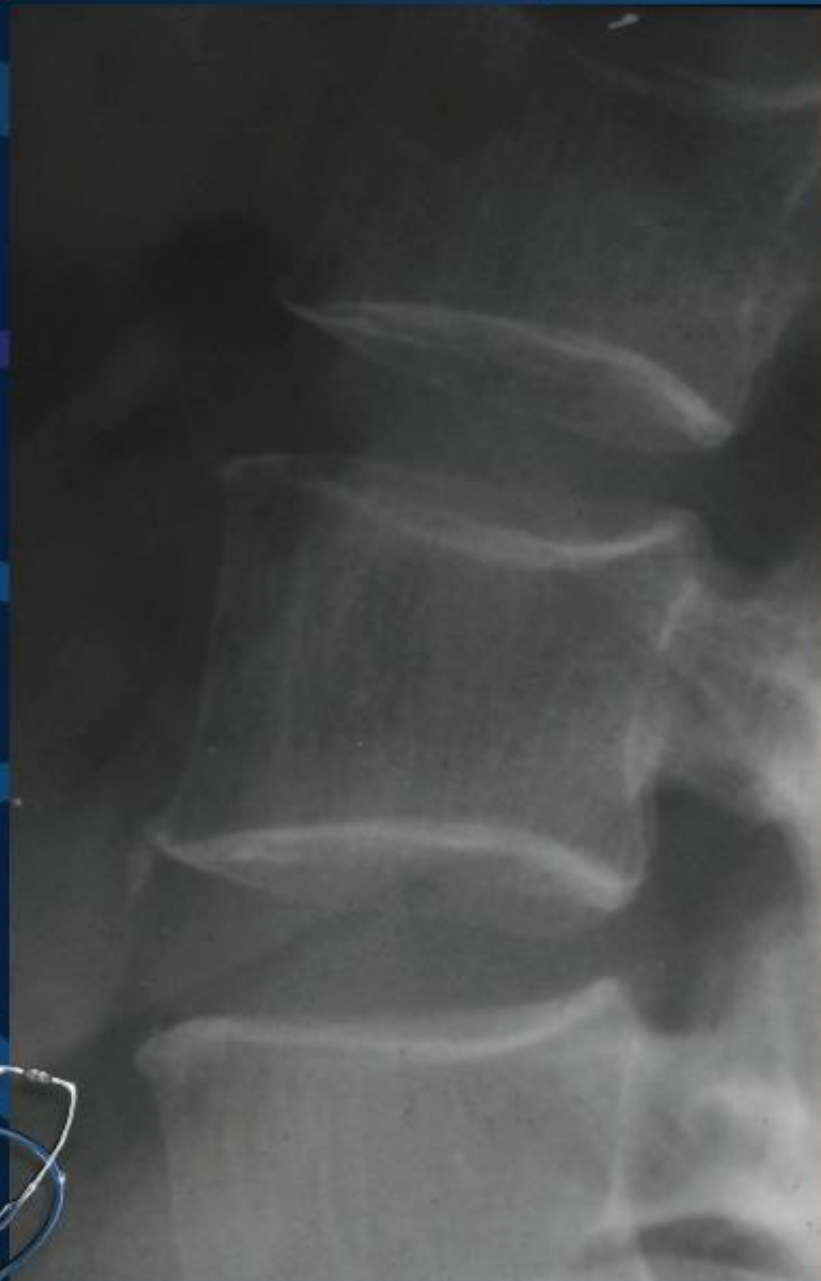


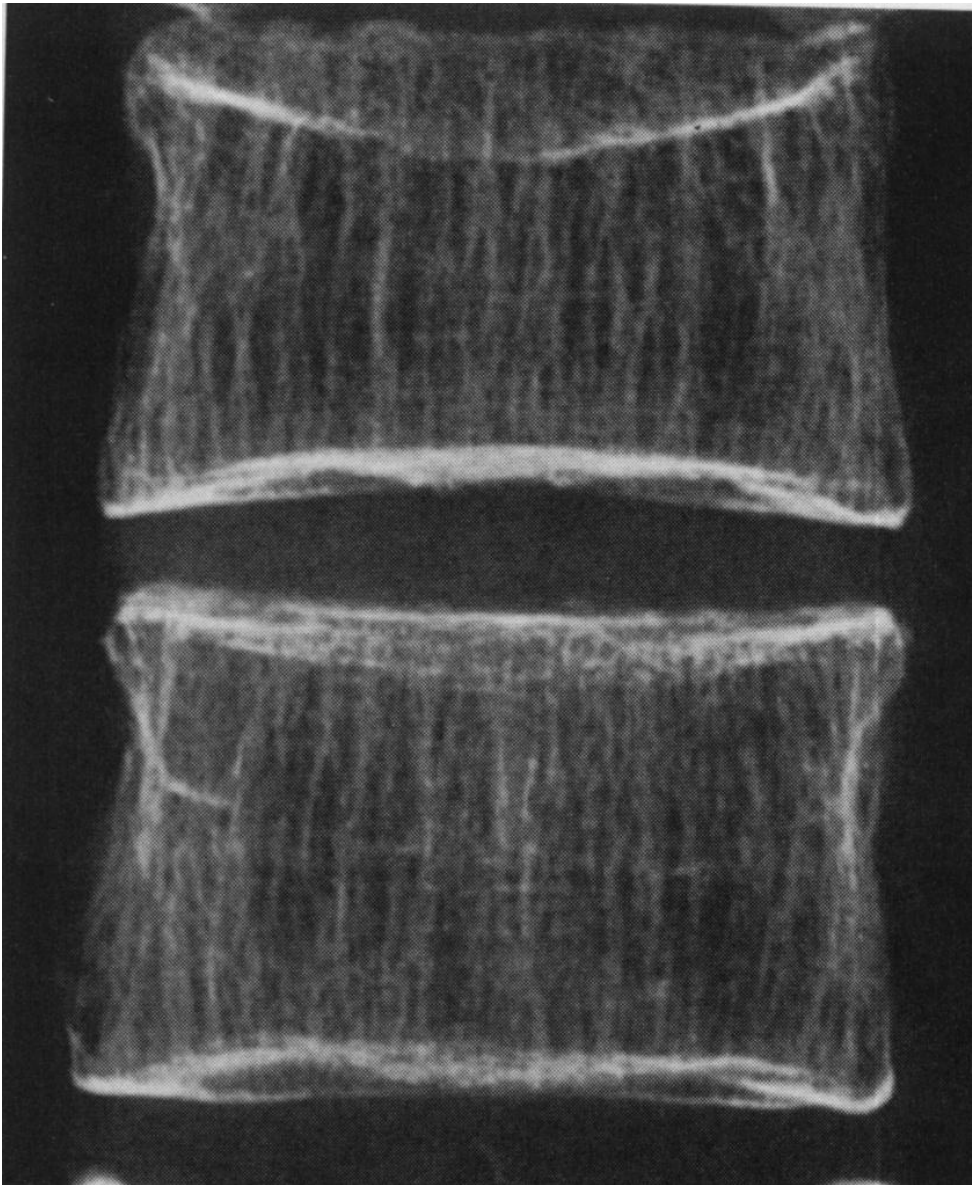


Case no.1:

An X-ray of lumbosacral spine that shows  
Decreased bone density of the vertebra.  
Thin sharp pencil-like cortex “margins of vertebra”.  
Course trabeculae (vertical lines) are seen.



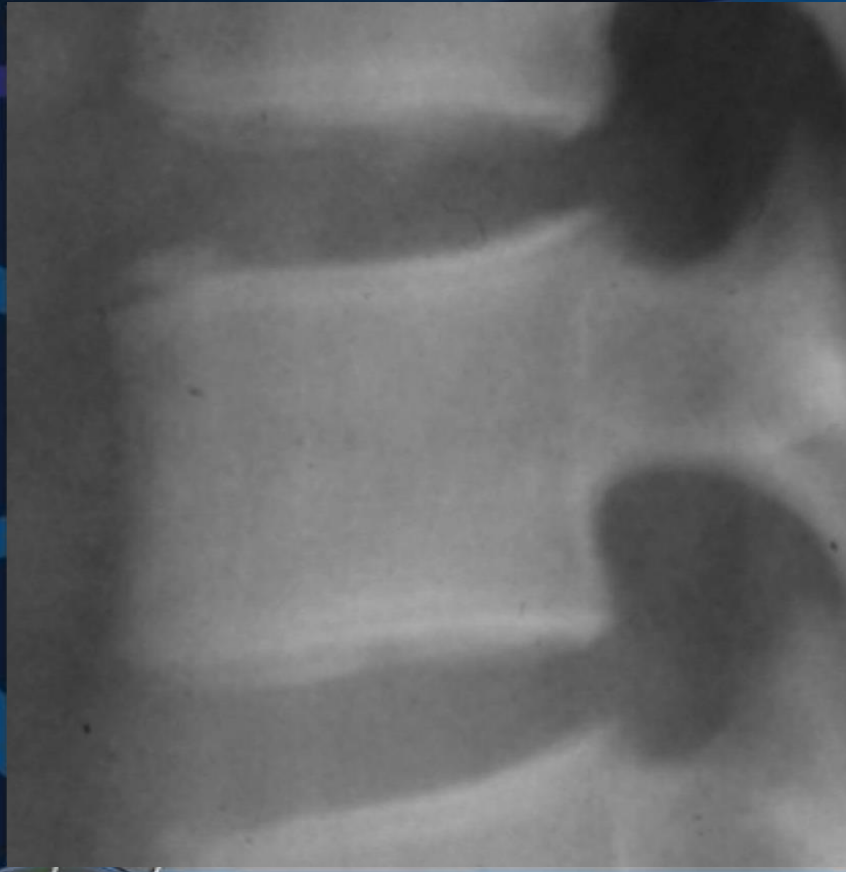




- Reduction of the bone matrix
- Concave end plates
- Trabeculae are clear and vertical, (lines inside the vertebrae)
- Uneven density
- Cortex is thin and sharp
- Margins are sharp and sclerotic
- Reduction in the height of the vertebrae

## Patient A

## Patient B



**Osteomalacia**



**Osteoporosis**

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Patient (A): Osteomalacia "Rickets in children"

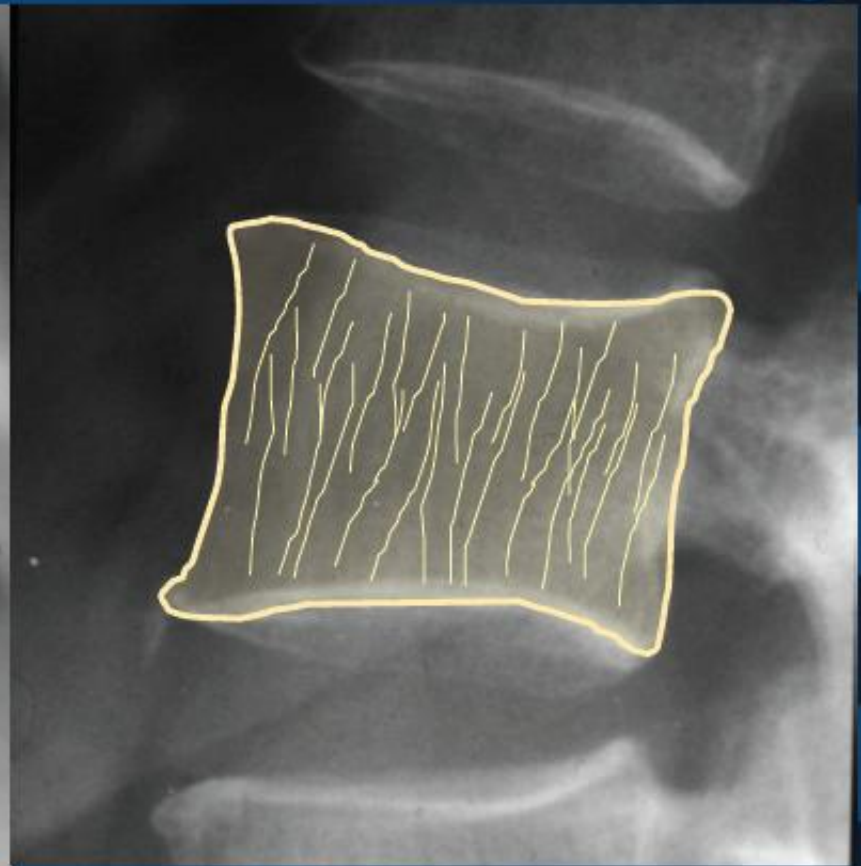
Bone density may be normal but bone is soft and there is a defect in mineralization and ill defined margins with no vertically oriented trabeculae.

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

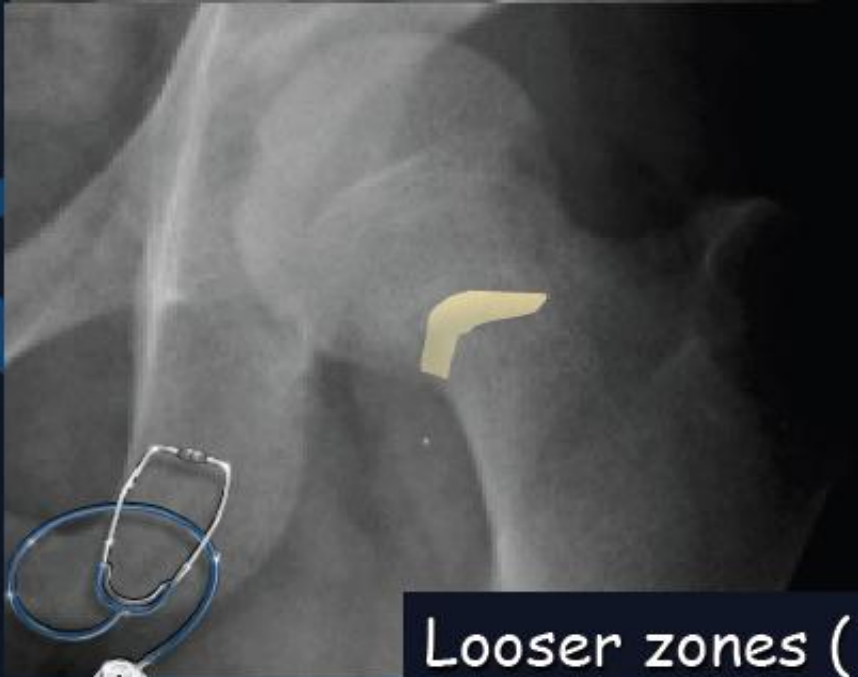
Osteosclerosis



20 years old lady, weakness and lower limbs pain



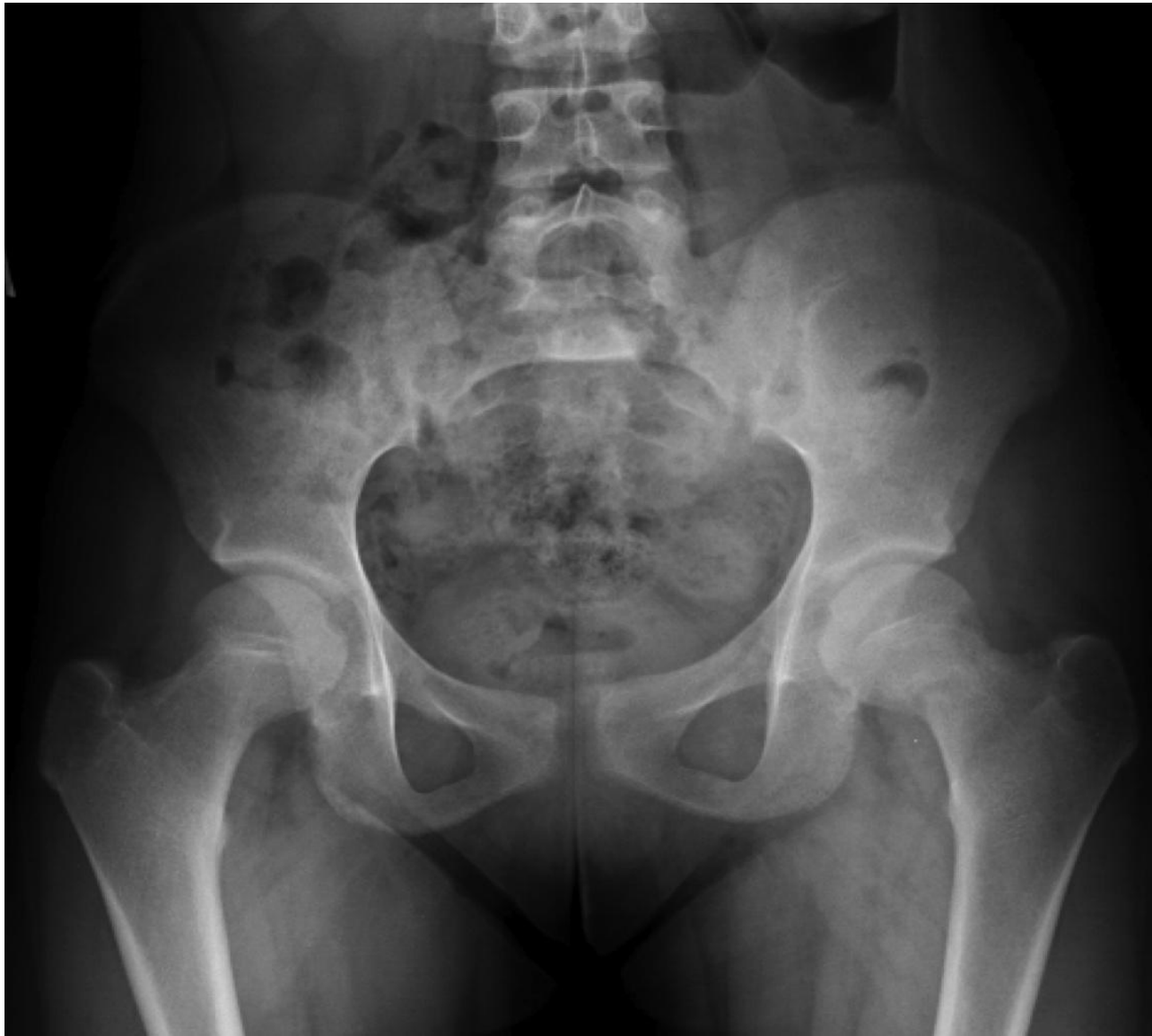
RT



Looser zones ( OSTEOMALACIA)

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- 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.  
Theses 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

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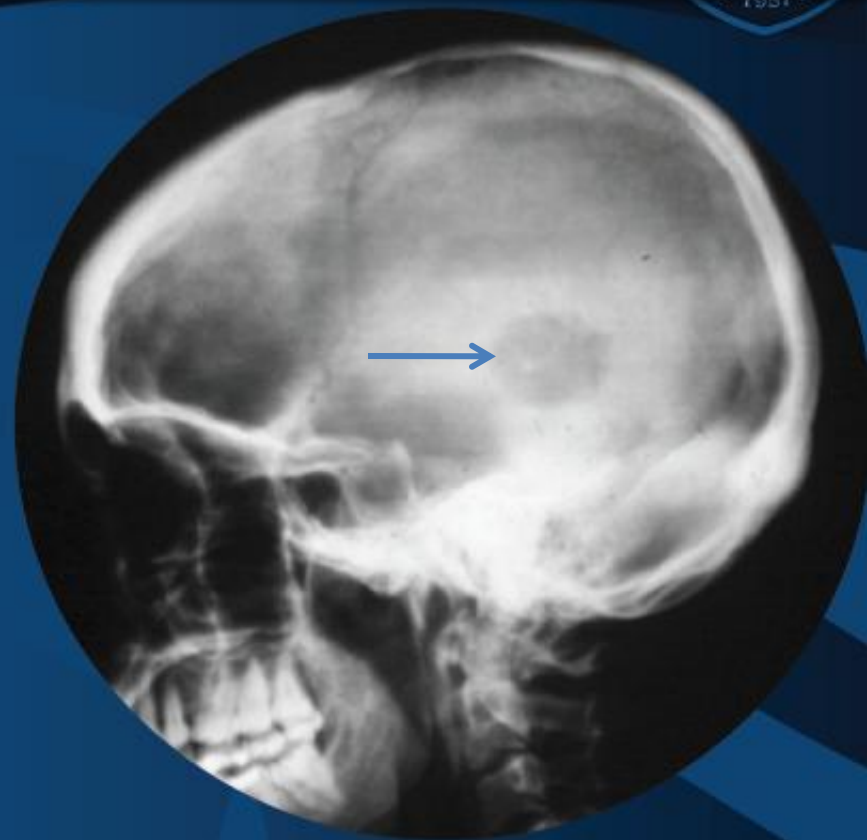
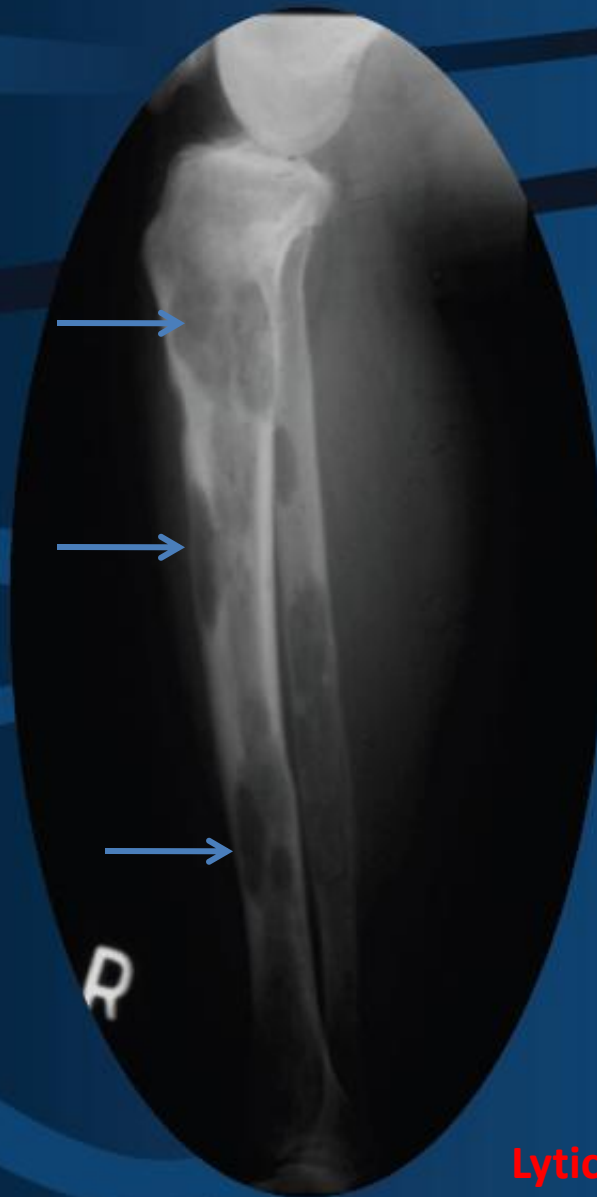


Brown tumors features:

Affect long or flat bones. .1

Single or multiple .2

Have a sharp outline but with no obvious margins .3



**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

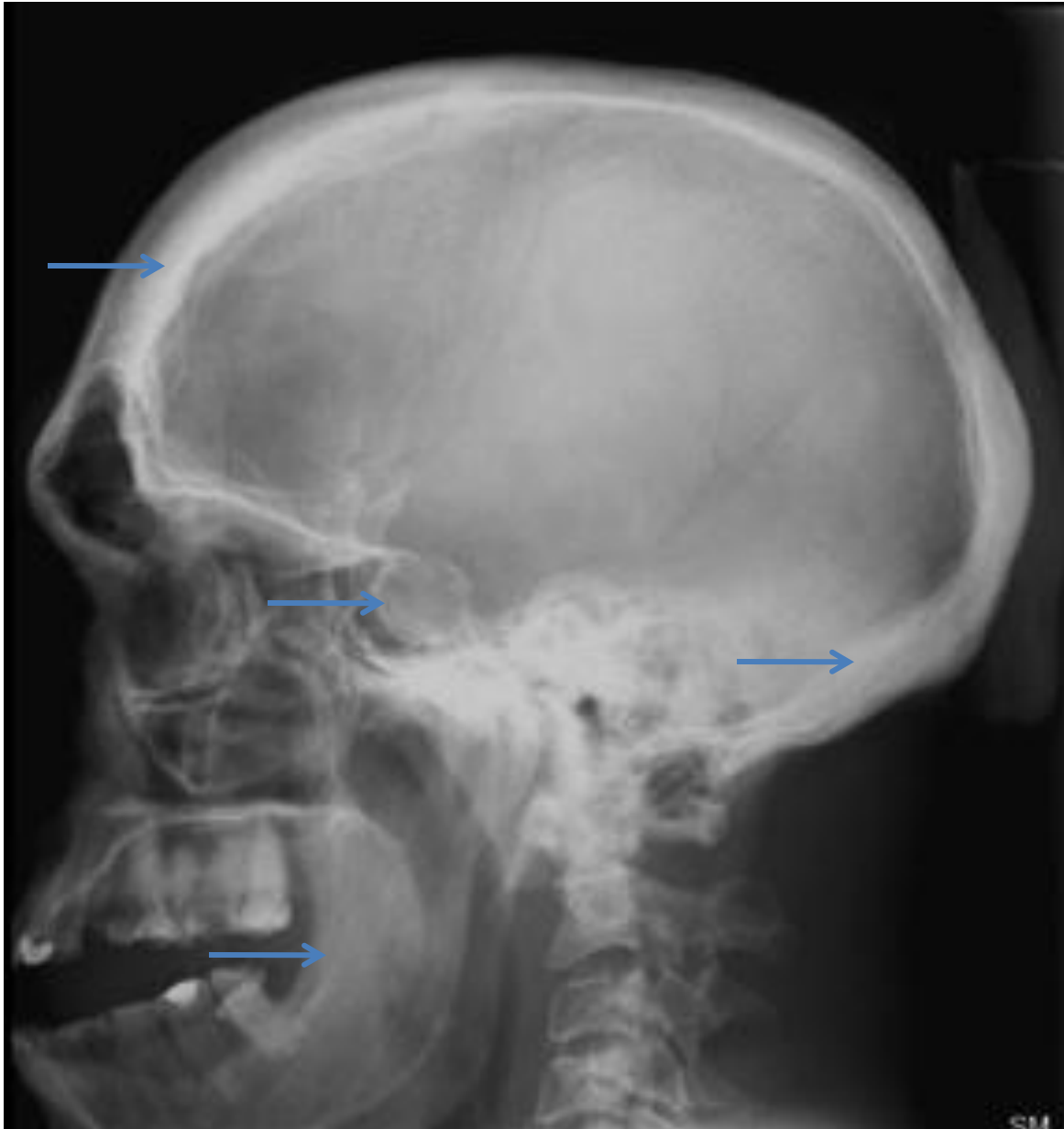






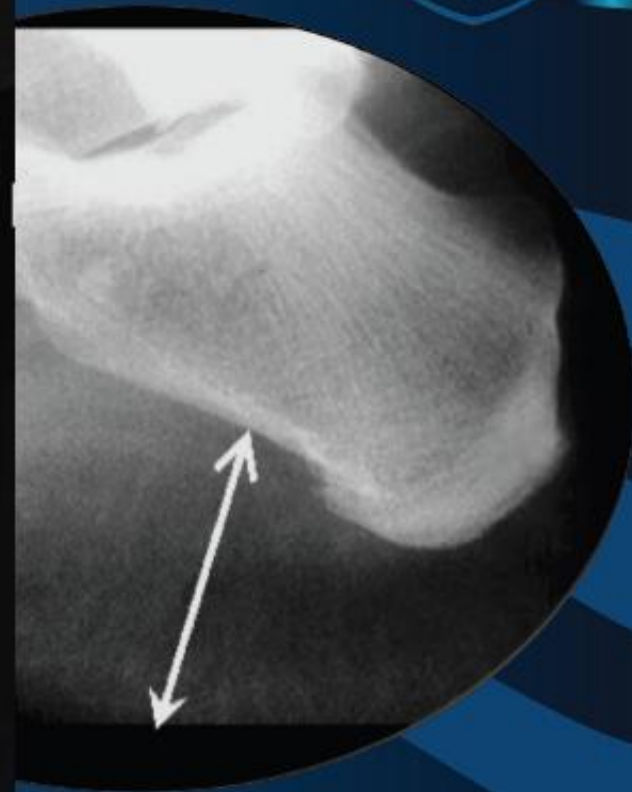
Acromegaly





- 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
- Sella of the pituitary is enlarged due to adenoma

## Acromegaly



Hands: Enlargement of the soft tissue, early osteoarthritis





# *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

•Note that changes within the joints are more in proximal than distal  
“metacarpophalangeal more than distal interphalangeal”





*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 (early sign)
- Erosive changes “Erosive arthropathy”
- Changes more to the proximal joints than distal
- Mal-alignment of the fingers or dislocation of the joints, swan neck deformity of fingers (result hyperextension of proximal interphalangeal joint and flexion of distal interphalangeal joints).
- 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







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Osteoarthritis

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- Carpals are clear
- Metacarpopharyngeal: no defect or erosive changes
- Proximal interpharyngeal 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







Se: /3  
Im: 1/1

HAND  
SUPINE

Mag: 0.4x  
Lat: L

Acc: 2433 AD  
2007 Mar 08: /3  
Acq Tm: 08:38:15: 2/1

HAND  
UPINE

Mag: 0.5x  
Lat: L

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Acc: 2433  
2007 Mar 08  
Acq Tm: 08:38:15: 2/1



## Osteoarthritis

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- 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





Erosive Osteoarthritis



RT



## Psoriatic Arthritis

Involvement of middle finger and fusion

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## 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

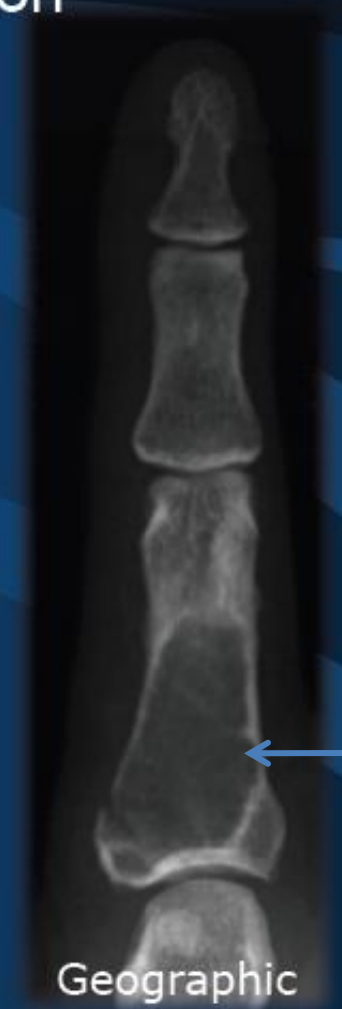




# Musculoskeletal Tumors

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



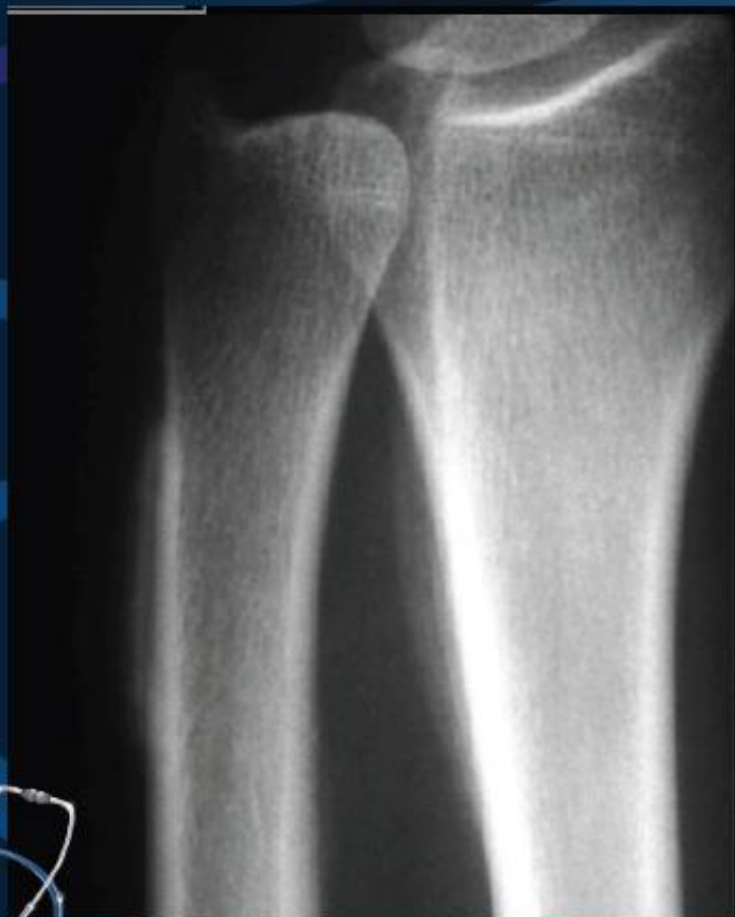
Permeative:

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



# Musculoskeletal Tumors

## Periosteal reaction



An anteroposterior radiograph of a humerus. A blue arrow points to a well-defined, thickened periosteal reaction along the shaft of the bone, which is a characteristic finding in certain bone tumors.

### 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 periosteom
- slow growing tumors allow the periosteum to grow
- periosteom 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

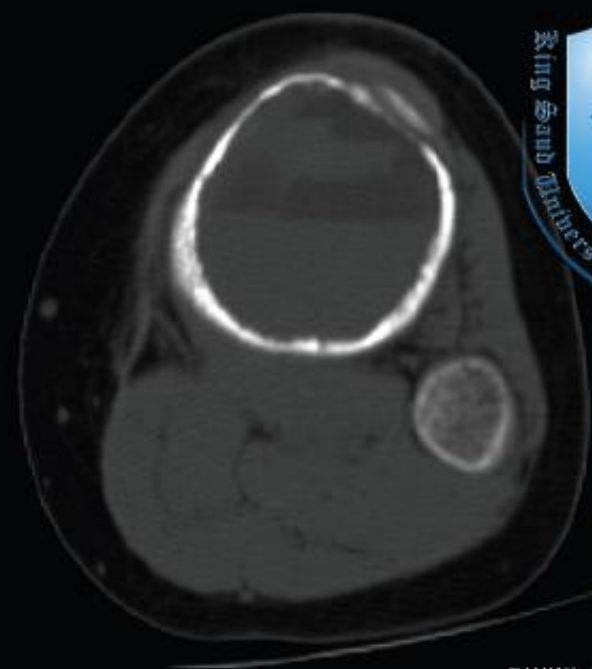
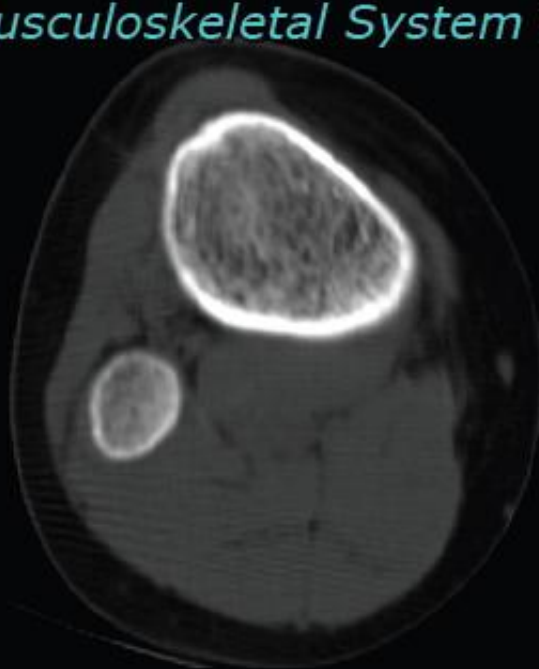
CT or MRI might be done to check the texture of the lesion.



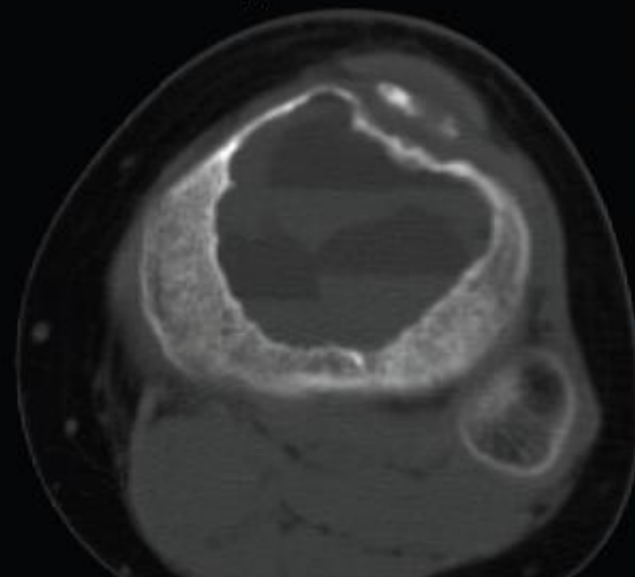
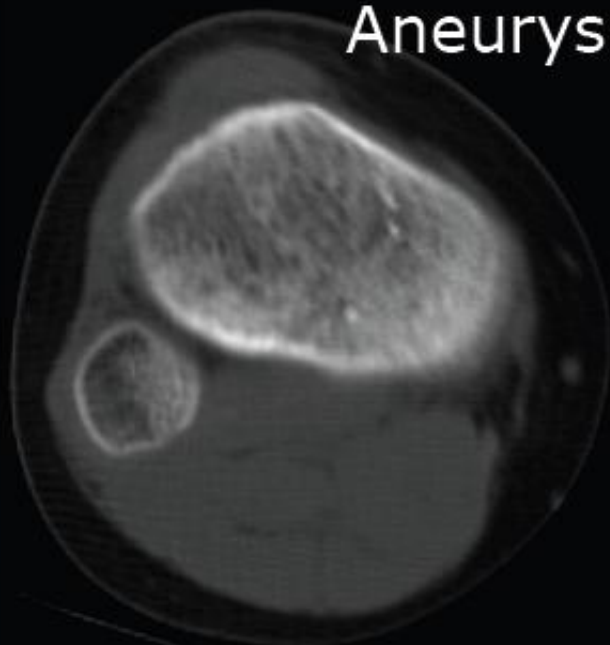




- Within the metaphysis, doesn't extent to the epiphysis
- Geographical
- X ray: expansile lytic lesion, cortex is thinned out
- CT: fluid level blood, vascular benign lesion
- Cause: aneurysm bone cyst (age, location, appearance)



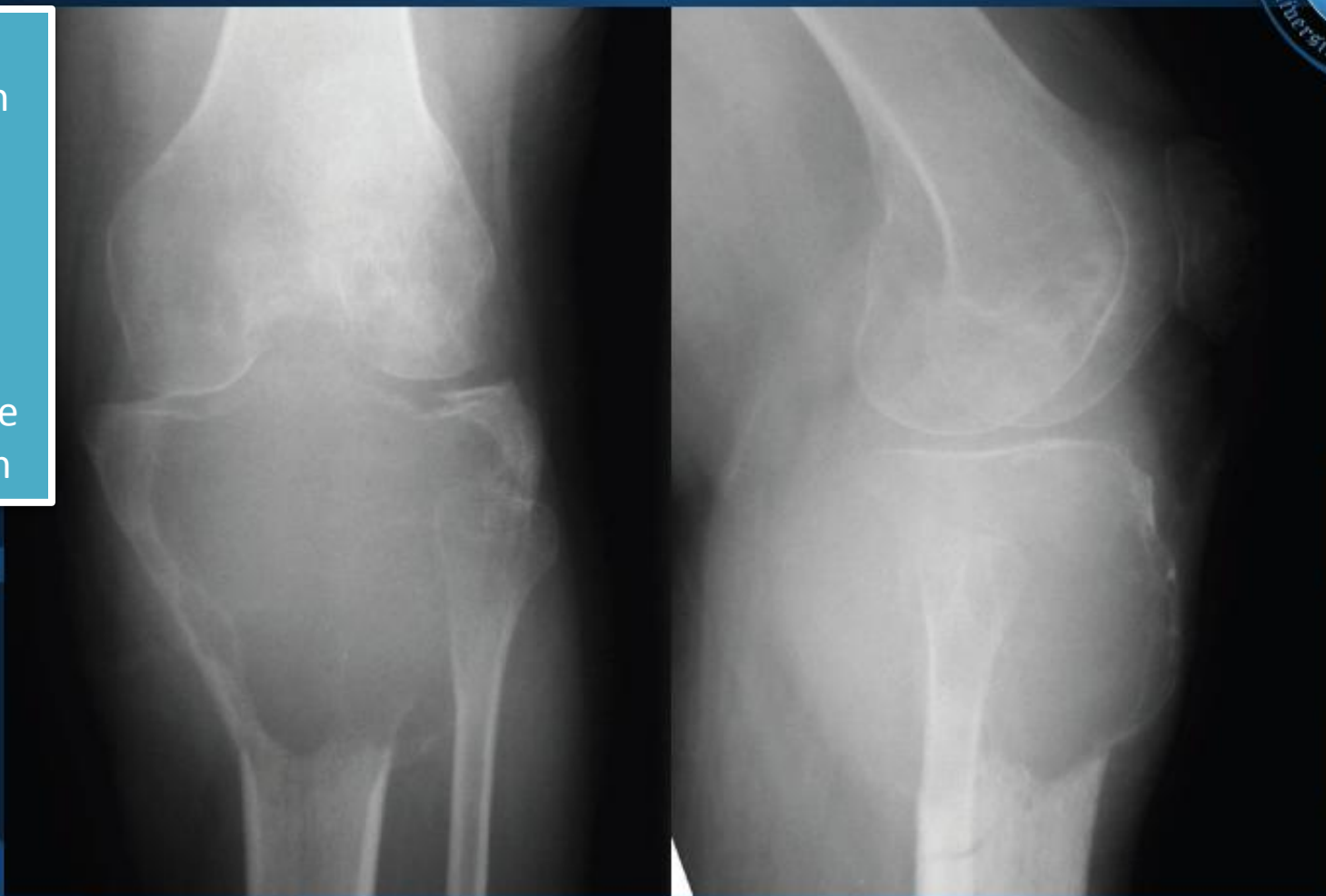
## Aneurysmal Bone Cyst



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

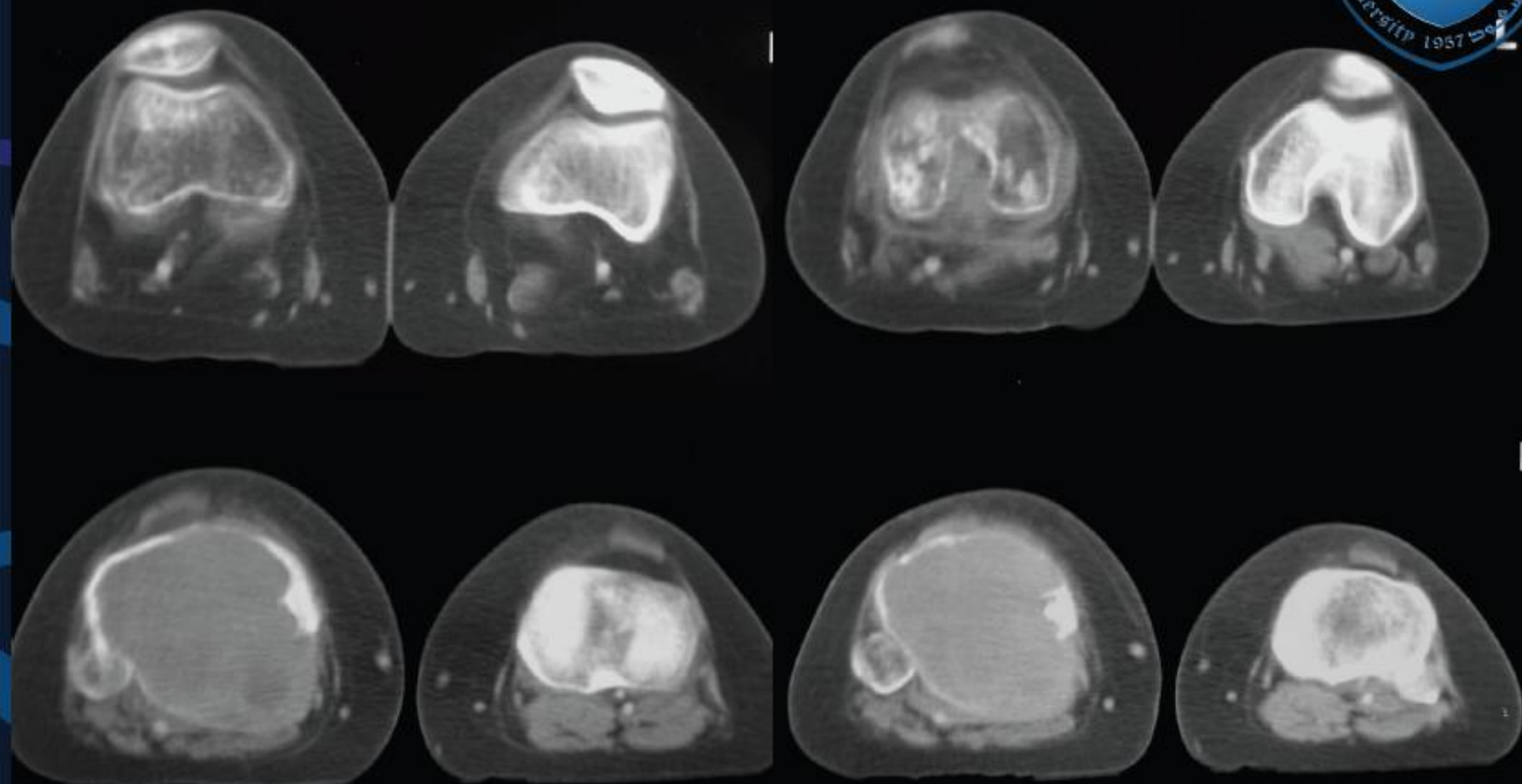
## Adult Patient

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



## Giant Cell Tumor





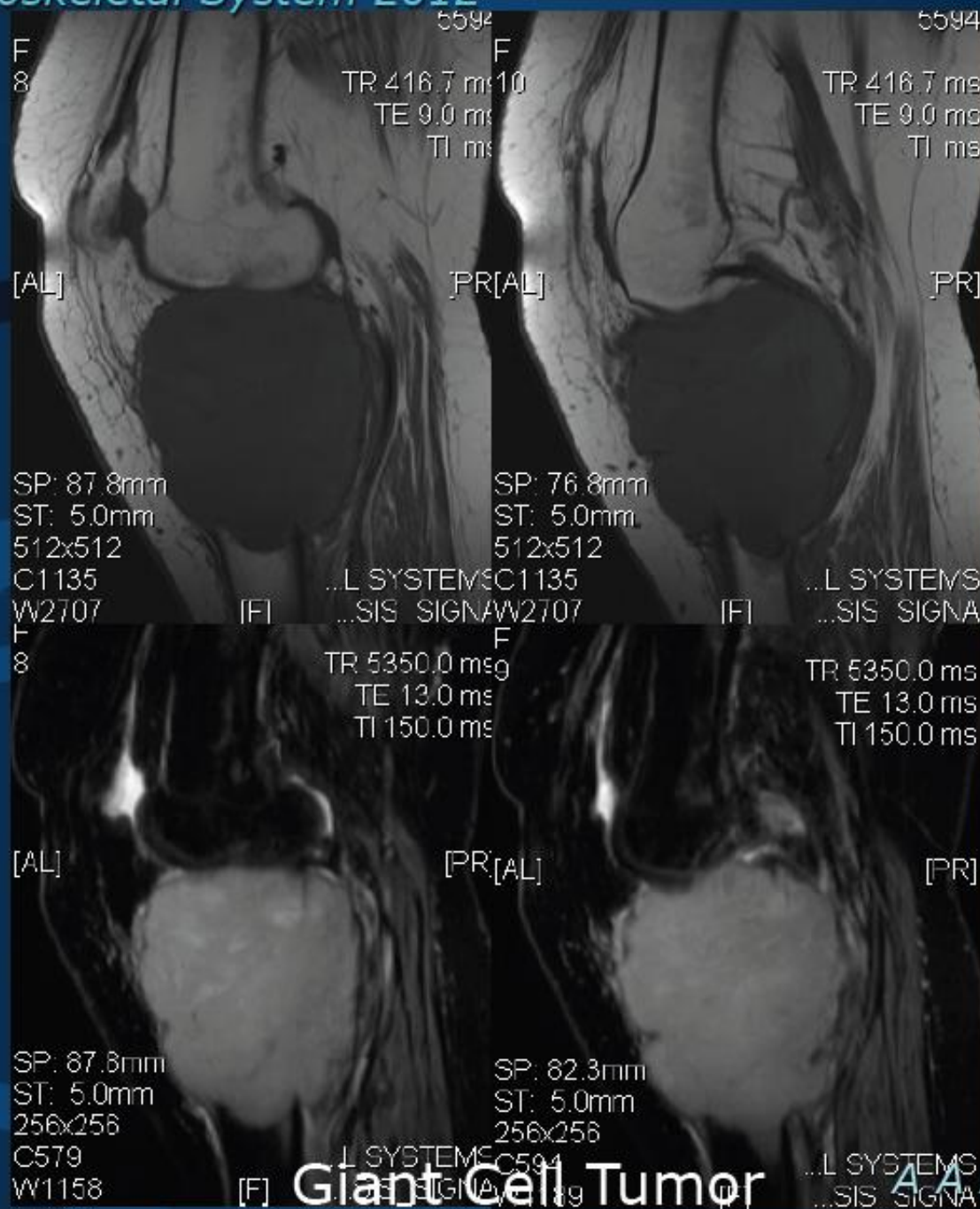
Giant Cell Tumor







**MRI**





## Permeative Pattern

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

**R**



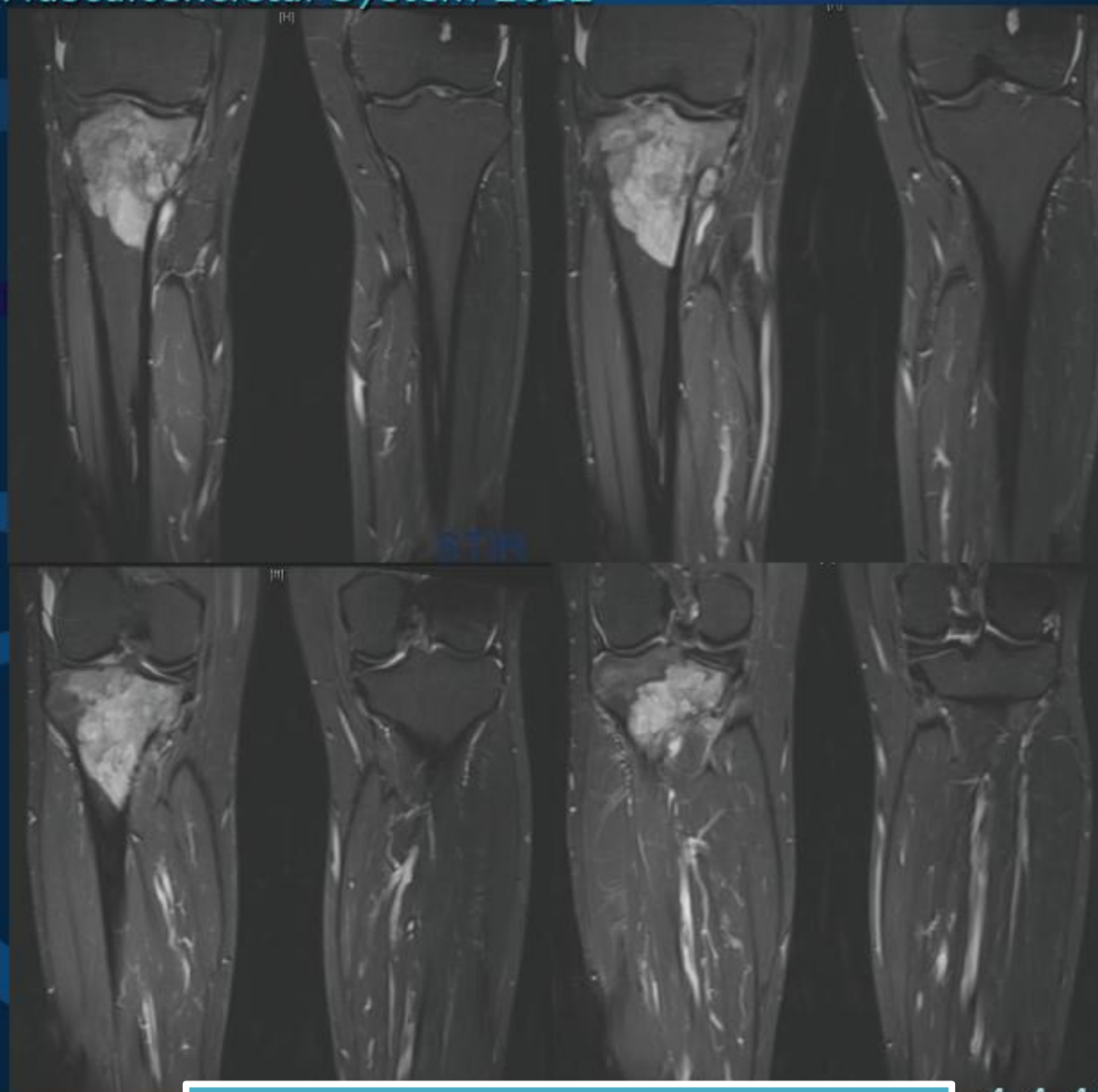
**R**



Osteosarcoma / Lymphoma

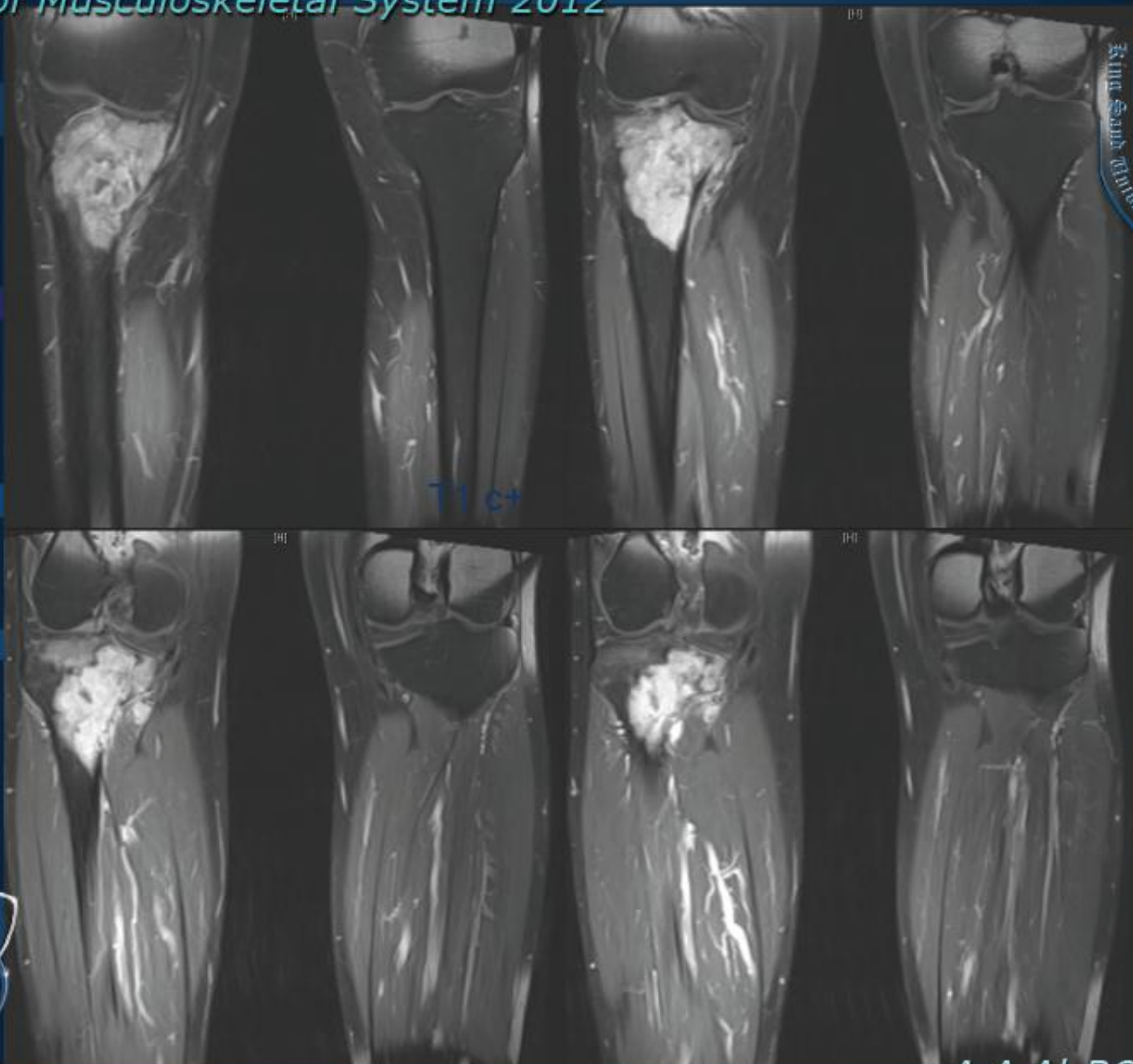
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MRI: heterogeneous, extends beyond cortex









## CASE NO. 8

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



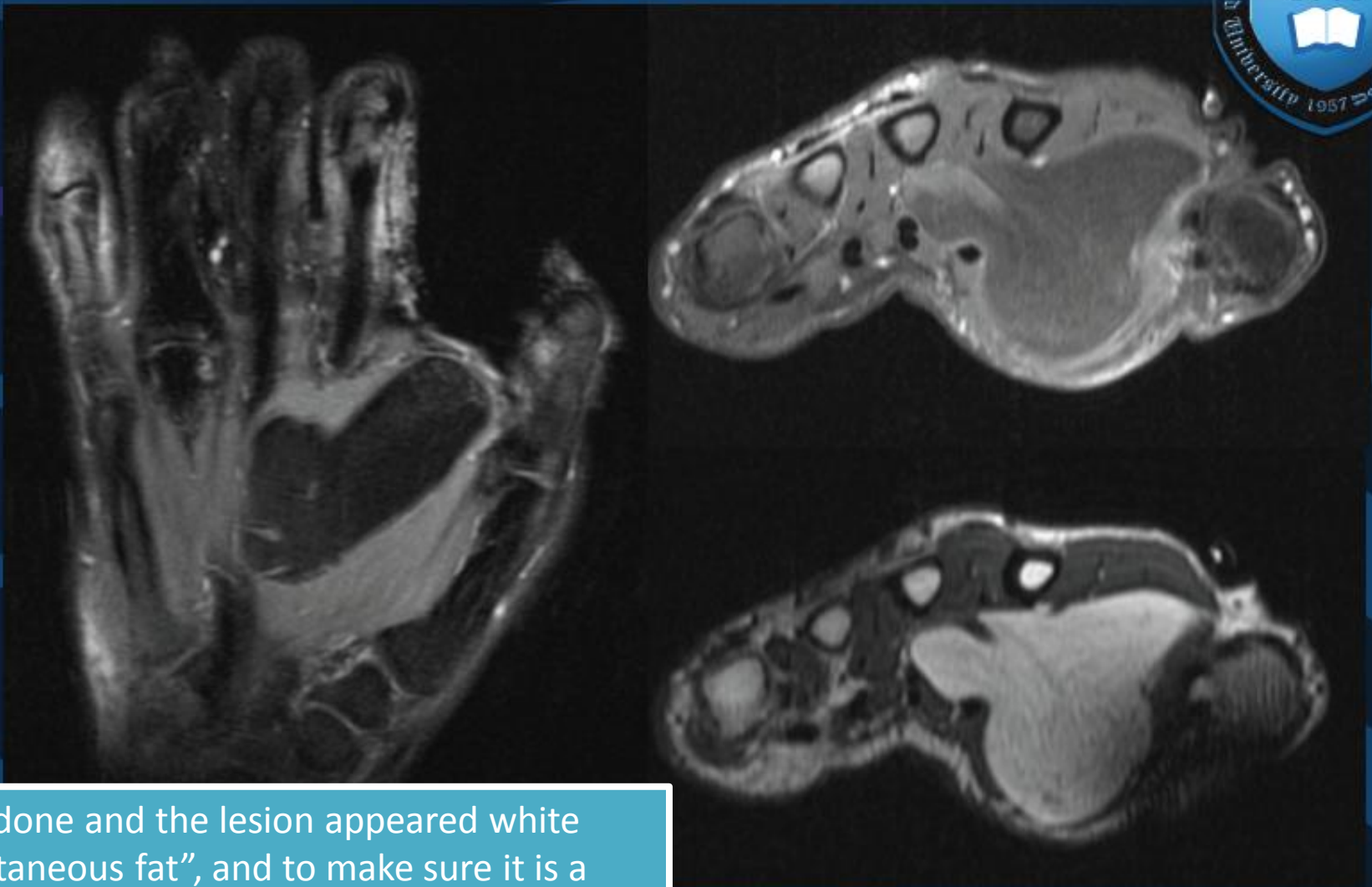


- soft tissue swelling of the hand, between thumb and finger
- no bone destruction
- Soft tissue swelling but no bone is disrupted, so it is only a swelling.



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?)

ie Lipoma

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**FINISH  
RADIOLOGY?**



**THANKS**

**CHALLENGE ACCEPTED.**

Good Luck!  
Radiology Team

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