

# Imaging the Musculoskeletal System

## (Part Three)

**AHMAD AMER AI-BOUKAI**

*Clinical Associate Professor & Senior Consultant Radiologist*  
Radiology & Medical Imaging Department  
King Saud University Medical city

# OBJECTIVE

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

IMPORTANT SITES

BONE DENSITY & TEXTURE  
BONE MARROW  
ARTICULAR CORTICES  
SOFT TISSUE

# OUTLINES

- ✓ Introduce Imaging approach to skeletal metabolic disorders and Identify important findings including sequelae and complications
- ✓ Introduce Imaging approach to skeletal neoplastic disorders and Identify important findings including sequelae and complications

# IMAGING OF MUSCULOSKELETAL SYSTEM PATHOLOGY

CONGENITAL

ARTHRITIS

METABOLIC

NEOPLASTIC

**METABOLIC**

TRAUMA

INFECTIOUS

HEMATOLOGICAL

# IMAGING OF MUSCULOSKELETAL METABOLIC DISORDERS

## TERMINOLOGY IN METABOLIC BONE DISORDERS

### FEATURES

#### Describe Bone Density

Decreased  
Increased

Osteoporosis  
Osteomalacia  
Osteopenia  
Osteosclerosis

#### Describe Texture

Corticomedullary differentiation  
Trabeculae

Sharp  
Hazy

#### Describe Soft tissue changes

Density (swelling, increased,..)  
Calcification (Heterotopic, Chondral, vascular,...)

## IMAGING OF MUSCULOSKELETAL METABOLIC DISORDERS

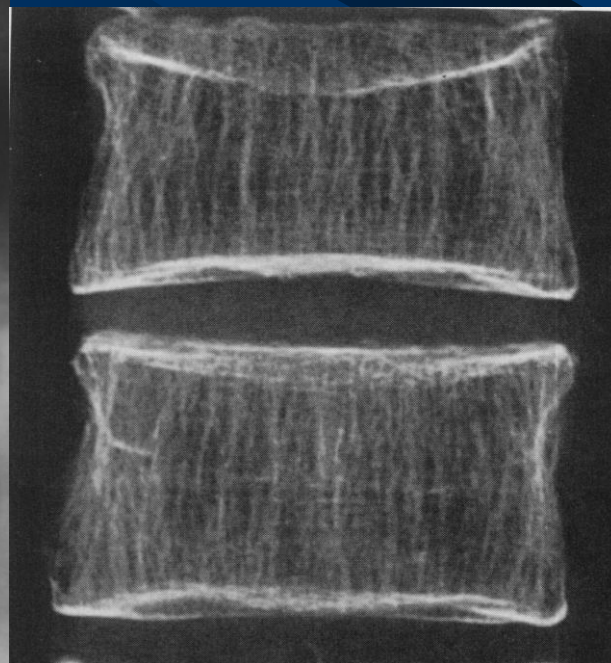
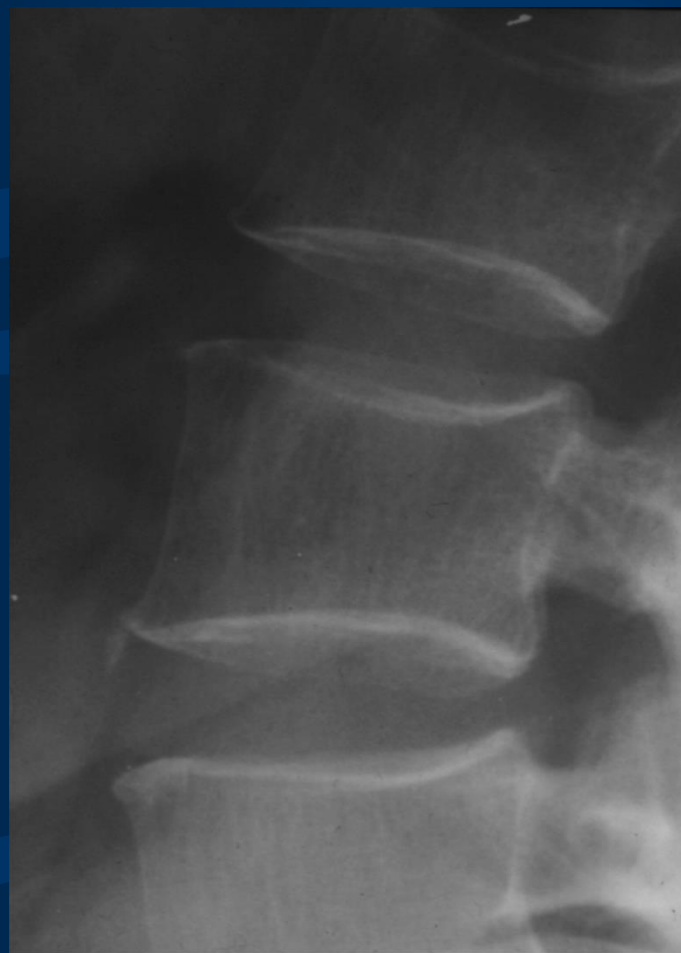
### ✓ Osteoporosis

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

#### CASE NO. 1

#### FINDINGS

- Generalized Osteopenia
- Sharp, thinned out cortices
- Sharp trabeculae



## IMAGING OF MUSCULOSKELETAL METABOLIC DISORDERS

### ✓ Osteoporosis

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

#### CASE NO. 1

#### FINDINGS

- Generalized Osteopenia
- Sharp, thinned out cortices
- Sharp trabeculae



# IMAGING OF MUSCULOSKELETAL METABOLIC DISORDERS

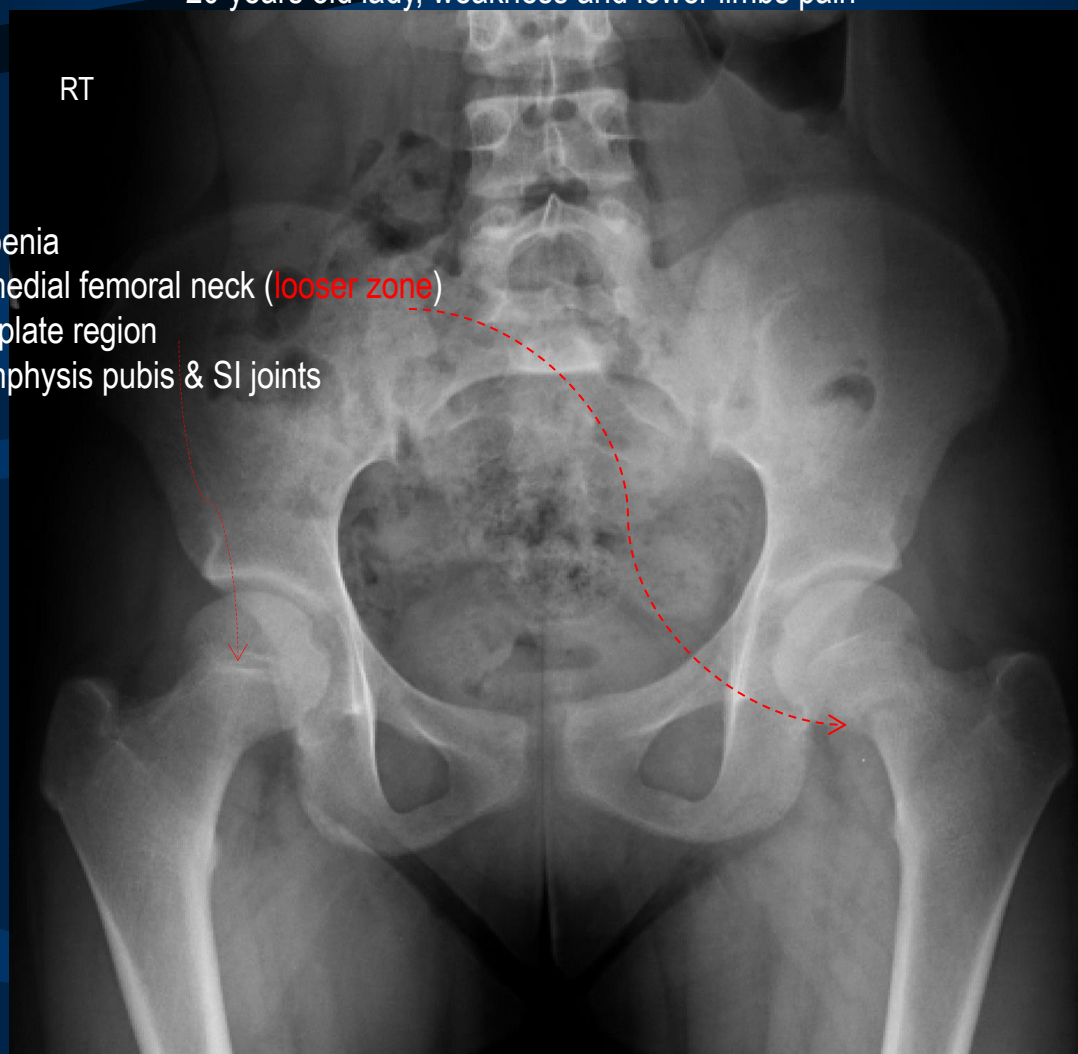
## ✓ Osteomalacia

20 years old lady, weakness and lower limbs pain

### CASE NO. 2

#### FINDINGS

- Generalized mild osteopenia
- Lucent area within the medial femoral neck (**looser zone**)
- Lucent band at physeal plate region
- Indistinct cortices at symphysis pubis & SI joints



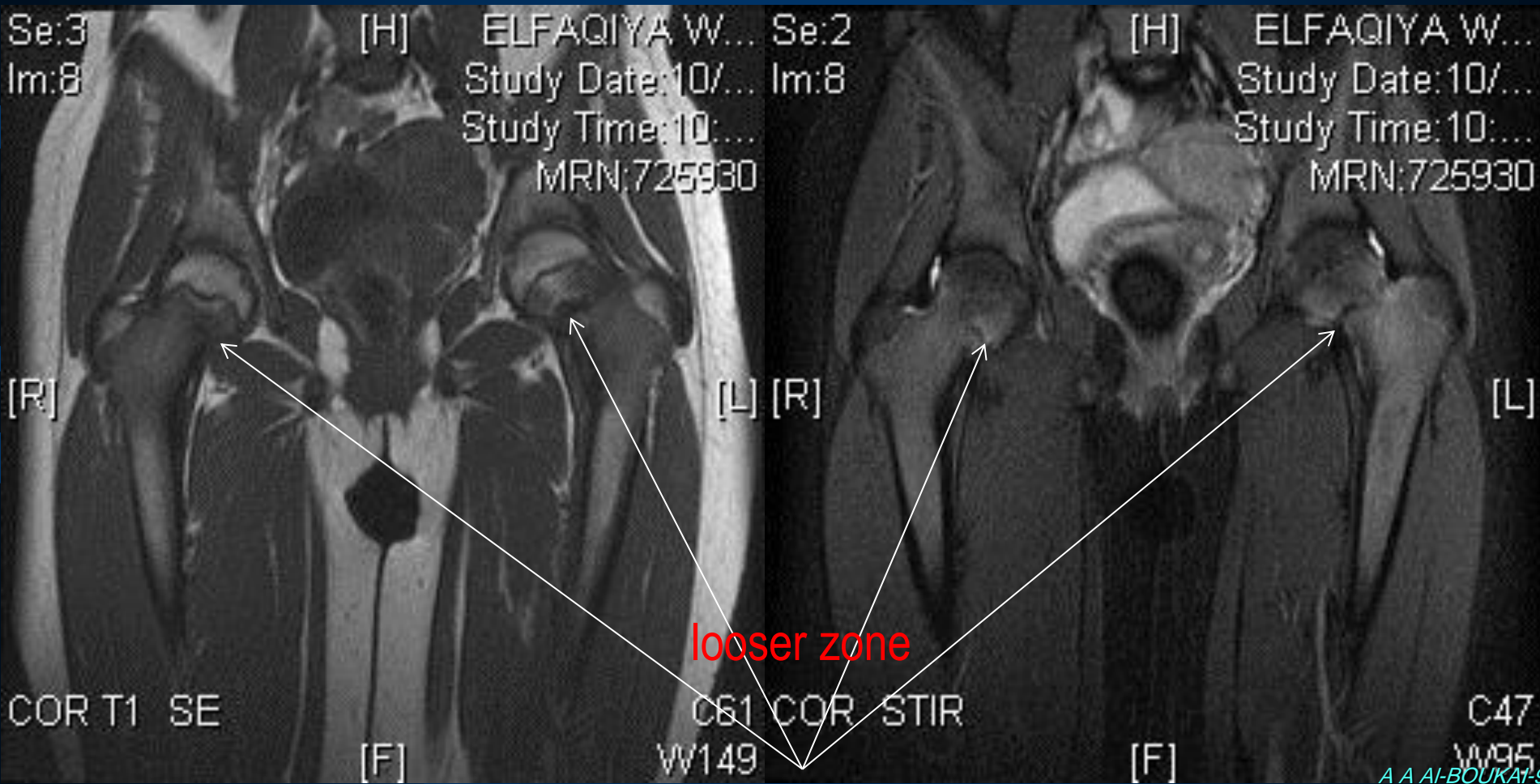


# IMAGING OF MUSCULOSKELETAL METABOLIC DISORDERS

✓ Osteomalacia      20 years old lady, weakness and lower limbs pain

CASE NO. 2

RT



Patient A

Patient B

## ***IMAGING OF MUSCULOSKELETAL METABOLIC DISORDERS***

✓ Osteoporosis vs. Osteomalacia



**Osteomalacia**



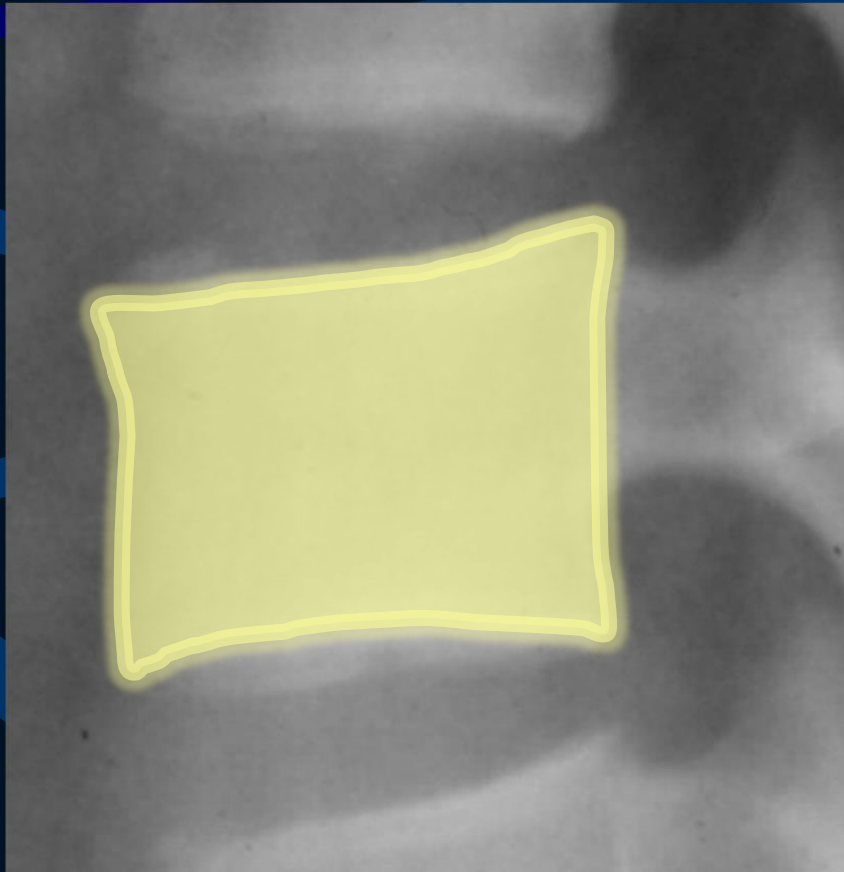
**Osteoporosis**

Patient A

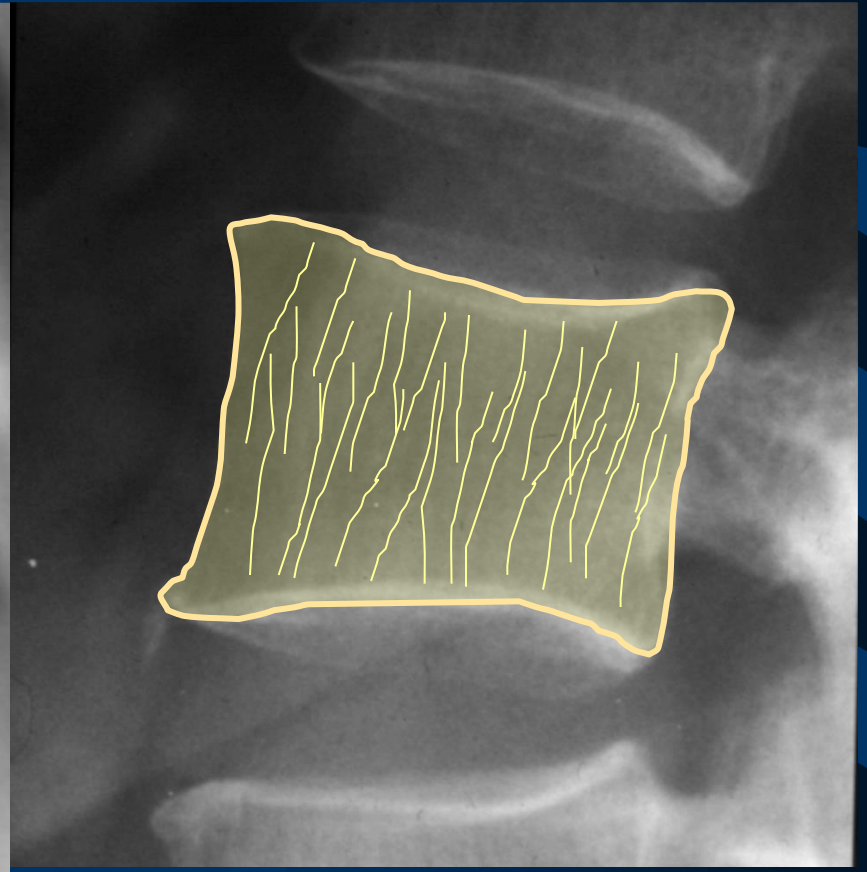
Patient B

## IMAGING OF MUSCULOSKELETAL METABOLIC DISORDERS

### ✓ Osteoporosis vs. Osteomalacia



Osteomalacia



Osteoporosis

# IMAGING OF MUSCULOSKELETAL METABOLIC DISORDERS

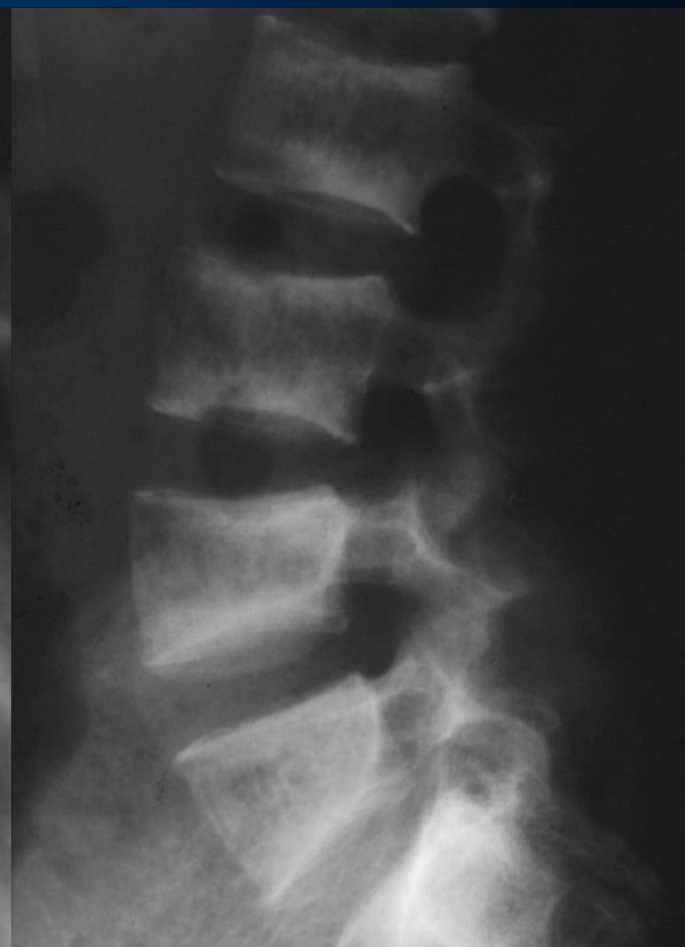
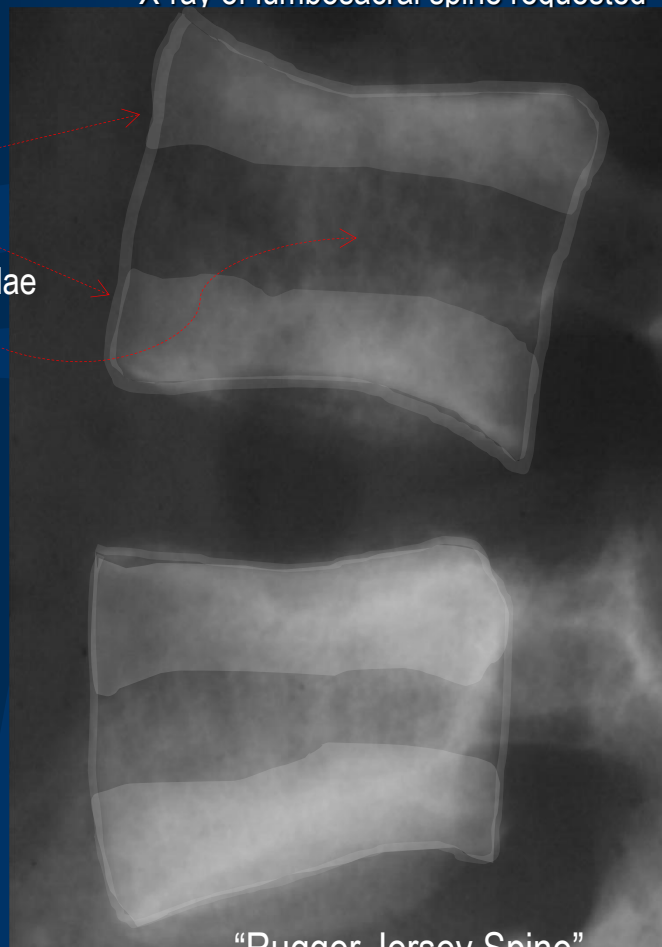
## ✓ Renal Osteodystrophy

CASE NO. 3

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

### FINDINGS

- Generalized Osteopenia
- Sclerotic end plates
- Hazy, indistinct cortices
- Hazy (Fuzzy) coarsened trabeculae



“Rugger Jersey Spine”

# IMAGING OF MUSCULOSKELETAL METABOLIC DISORDERS

## ✓ Renal Osteodystrophy

- *Osteoporosis*
- *Osteomalacia*
- *Secondary Hyperparathyroidism*
- *Osteosclerosis*

Bone Resorption

Bone Softening

Brown Tumors

Osteosclerosis

Soft tissue calcifications

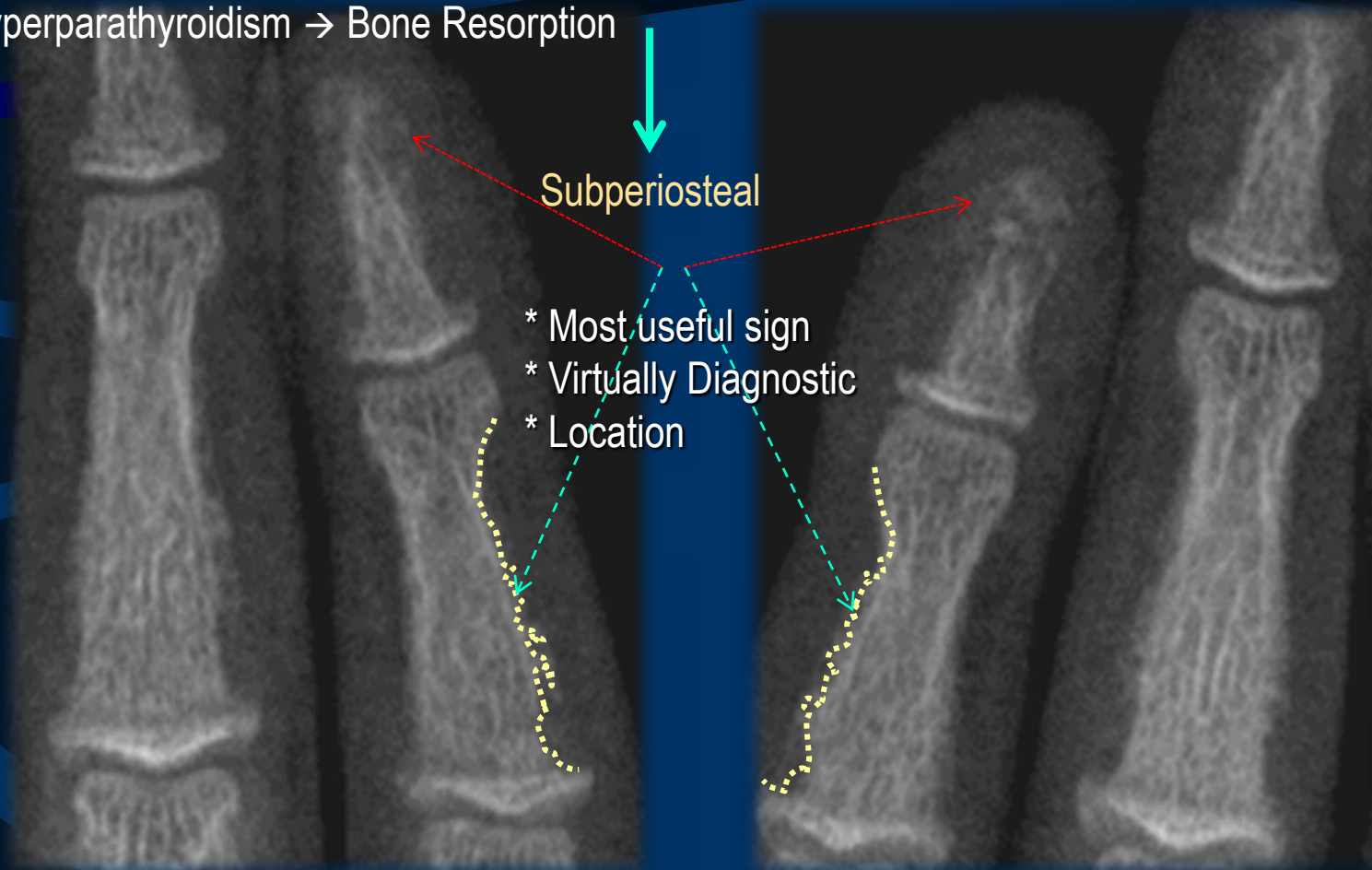
## IMAGING OF MUSCULOSKELETAL METABOLIC DISORDERS

- ✓ Hyperparathyroidism → Bone Resorption



## IMAGING OF MUSCULOSKELETAL METABOLIC DISORDERS

✓ Hyperparathyroidism → Bone Resorption

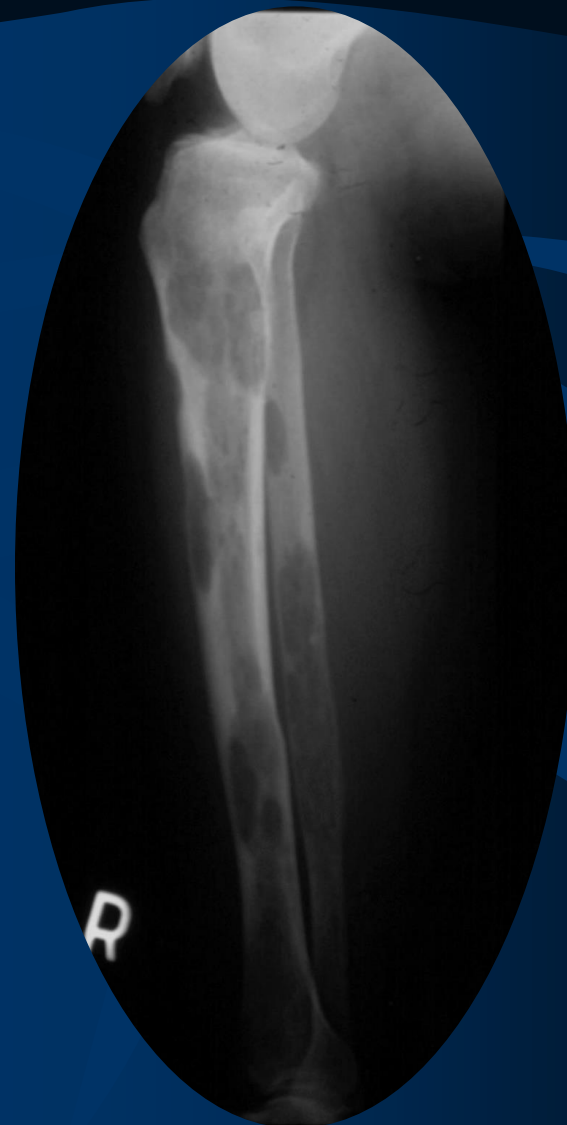
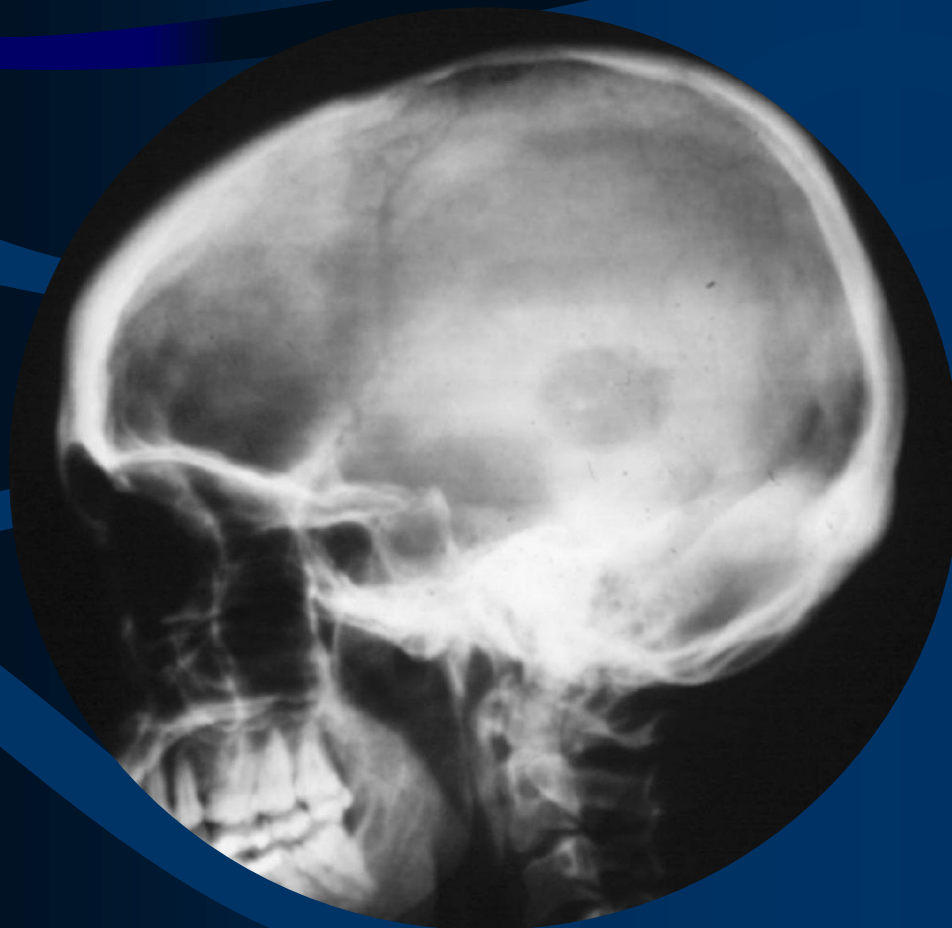


Subperiosteal

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

## IMAGING OF MUSCULOSKELETAL METABOLIC DISORDERS

- ✓ Hyperparathyroidism → Brown Tumors





## IMAGING OF MUSCULOSKELETAL METABOLIC DISORDERS

### ✓ Osteomalacia

45 years- old male presented with history of bone enlargement  
X-ray of skull and hand are requested

#### CASE NO. 2

#### FINDINGS

- Calvarial thickening
- Enlargement of the sinuses (bossing of glabella)
- Enlargement of mandible
- Enlarged sella turcica (pituitary fossa)
- Prominent digits
- Increased heel pad thickness



# IMAGING OF MUSCULOSKELETAL SYSTEM PATHOLOGY

## NEOPLASTIC

### TYPES

✓ OSSEOUS

Osteoma -- Osteosarcoma

✓ CHONDRAL

Enchondroma -- Chondrosarcoma

✓ FIBROUS

Osseous Fibroma -- Fibrosarcoma

✓ SOFT TISSUE

Lipoma -- Liposarcoma

# IMAGING OF MUSCULOSKELETAL NEOPLASTIC DISORDERS

## KEY FEATURES

**Morphology**

**Behavior of lesion**

**Age of patient**

**Site (Location)**

**Osteolytic**

**Osteosclerotic**

**Mixed**

**Soft tissue**

# IMAGING OF MUSCULOSKELETAL NEOPLASTIC DISORDERS

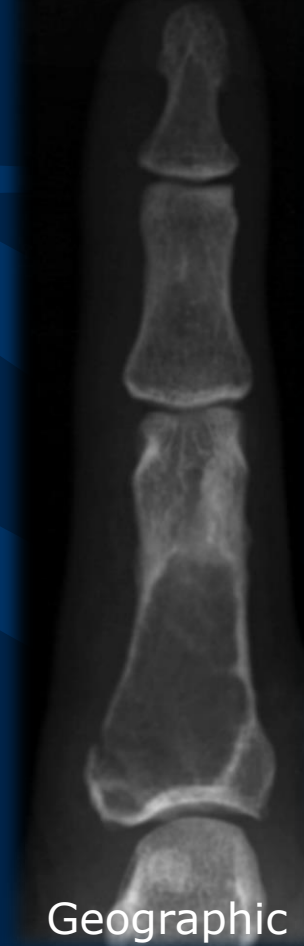
## KEY FEATURES

### Morphology

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

### Behavior of lesion

- Slow grow
- Rapid grow (Aggressive)



# IMAGING OF MUSCULOSKELETAL NEOPLASTIC DISORDERS

## KEY FEATURES

### Morphology

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

### Behavior of lesion

- Slow grow
- Rapid grow (Aggressive)



Moth-eaten

Permeative

# IMAGING OF MUSCULOSKELETAL NEOPLASTIC DISORDERS

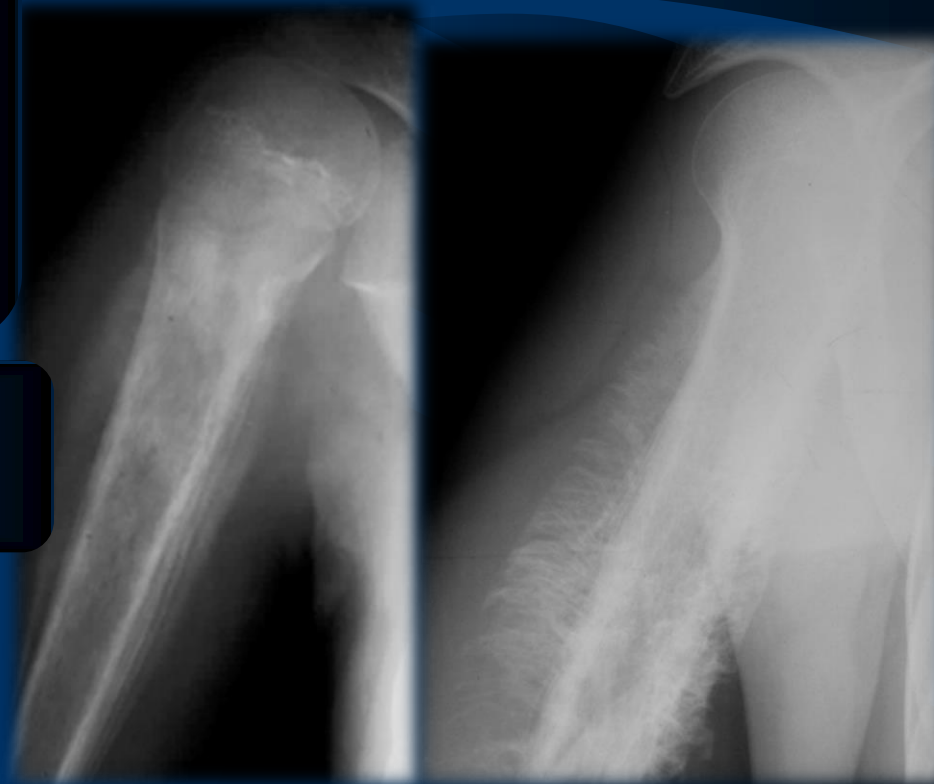
## KEY FEATURES

### Morphology

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

### Behavior of lesion

- Slow grow
- Rapid grow (Aggressive)



# IMAGING OF MUSCULOSKELETAL NEOPLASTIC DISORDERS

## KEY FEATURES

Age of patient

Pediatric, Adult, Elderly

Site (Location)

Diaphyseal, metaphyseal or epiphyseal  
Cortical vs. Medullary (eccentric vs. concentric)



# IMAGING OF MUSCULOSKELETAL NEOPLASTIC DISORDERS

✓ Osteolytic / Benign / Pediatric

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

CASE NO. 1

## FINDINGS

- Expansile lytic lesion
- Metaphyseal
- Homogeneous, no calcification
- No cortical destruction and no periosteal reaction
- No soft tissue swelling





# IMAGING OF MUSCULOSKELETAL NEOPLASTIC DISORDERS

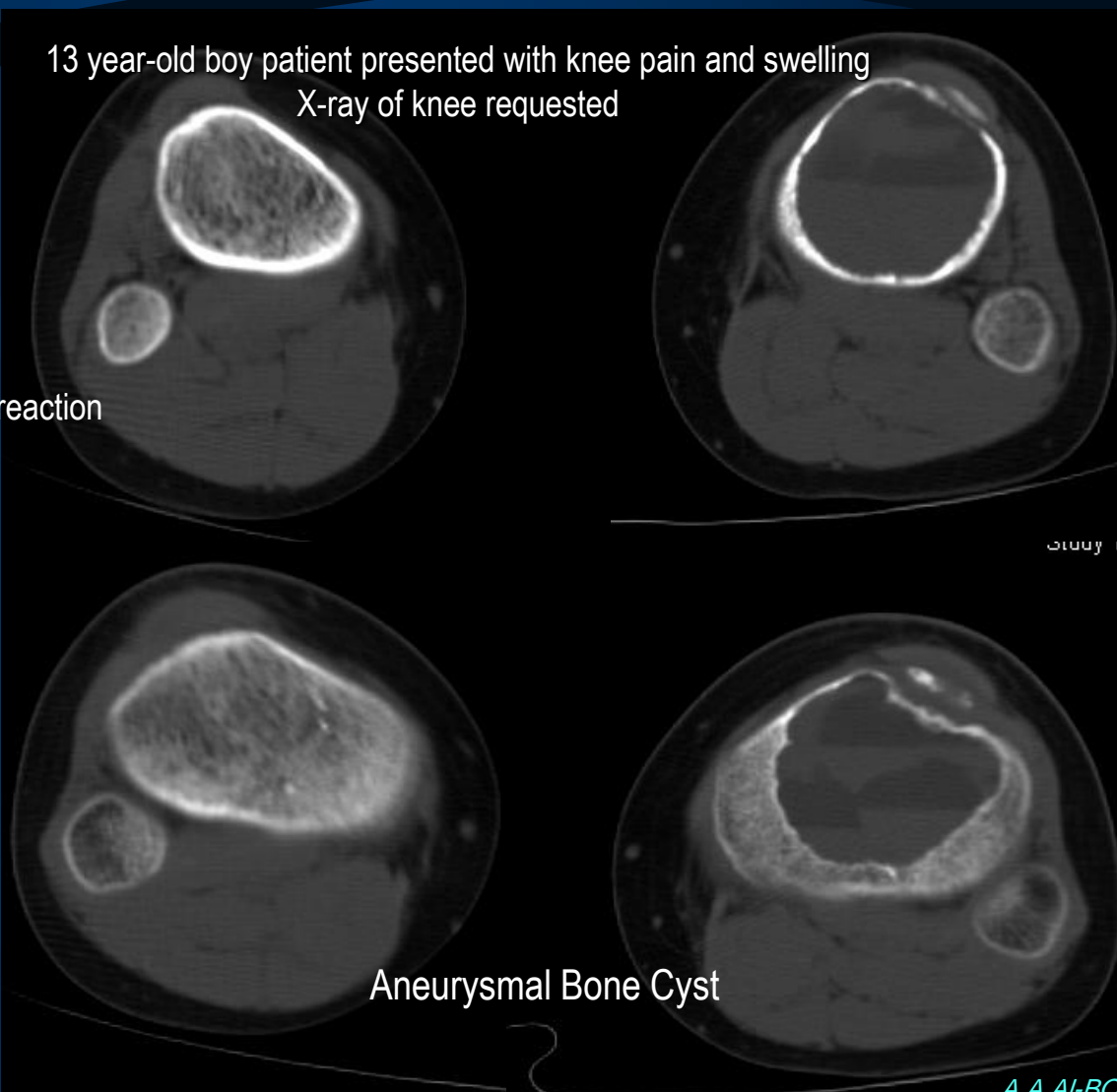
✓ Osteolytic / Benign / Pediatric

CASE NO. 1

## FINDINGS

- Expansile lytic lesion
- Metaphyseal
- Homogeneous, no calcification
- No cortical destruction and no periosteal reaction
- No soft tissue swelling

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



Aneurysmal Bone Cyst

# IMAGING OF MUSCULOSKELETAL NEOPLASTIC DISORDERS

✓ Osteolytic / Benign / Adult

Adult man with knee pain and swelling

## CASE NO. 2

### FINDINGS

- Expansile lytic lesion
- Metaphyseal / Subarticular
- Homogeneous, no calcification
- Cortical destruction and periosteal reaction
- Soft tissue swelling



Giant Cell Tumor

# IMAGING OF MUSCULOSKELETAL NEOPLASTIC DISORDERS

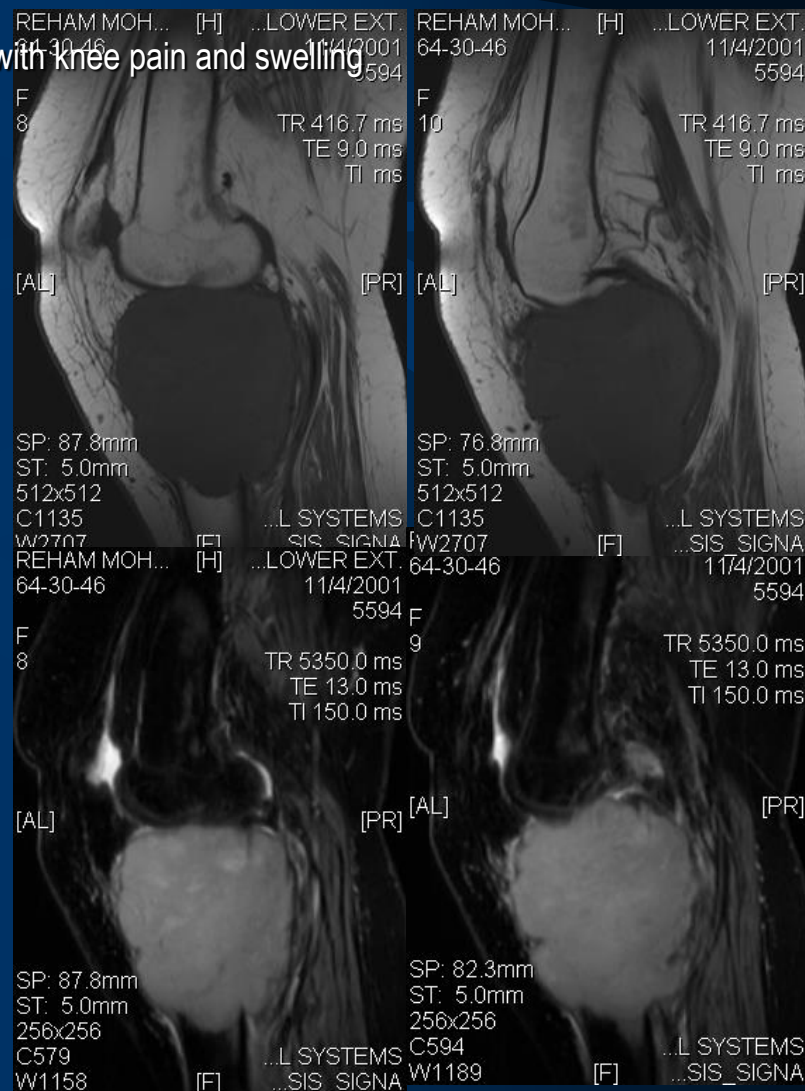
## ✓ Osteolytic / Benign / Adult

### CASE NO. 2

#### FINDINGS

- Expansile lytic lesion
- Metaphyseal / Subarticular
- Homogeneous, no calcification
- Cortical destruction and periosteal reaction
- Soft tissue swelling

Adult man with knee pain and swelling



Giant Cell Tumor

# IMAGING OF MUSCULOSKELETAL NEOPLASTIC DISORDERS

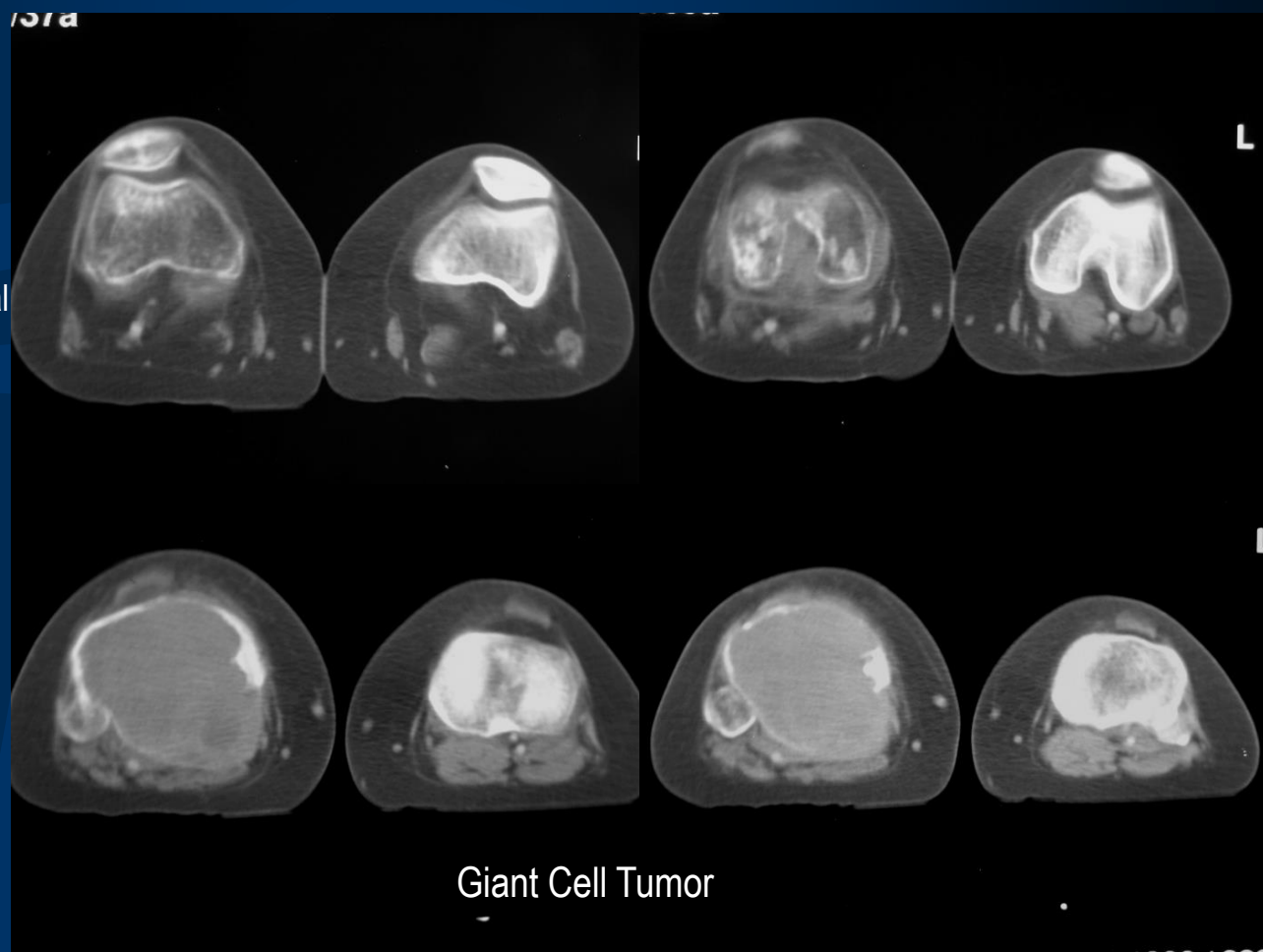
✓ Osteolytic / Benign / Adult

Adult man with knee pain and swelling

CASE NO. 2

## FINDINGS

- Expansile lytic lesion
- Metaphyseal / Subarticular
- Homogeneous, no calcification
- Cortical destruction and periosteal
- Soft tissue swelling



# IMAGING OF MUSCULOSKELETAL NEOPLASTIC DISORDERS

✓ Osteolytic / Aggressive / Adult

Adult man with knee pain

CASE NO. 3

## FINDINGS

- Eccentric osteolytic lesion
- Metaphyseal / Subarticular
- Heterogeneous texture
- Cortical destruction and periosteal reaction
- Localized soft tissue extension



# IMAGING OF MUSCULOSKELETAL NEOPLASTIC DISORDERS

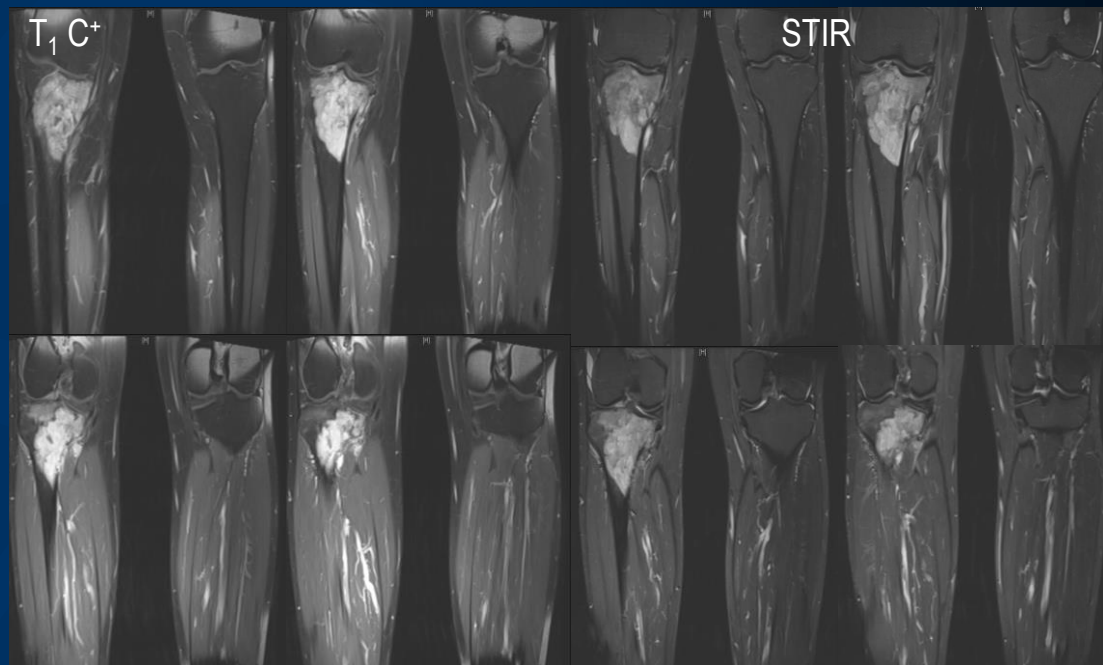
✓ Osteolytic / Aggressive / Adult

Adult man with knee pain

CASE NO. 3

## FINDINGS

- Eccentric osteolytic lesion
- Metaphyseal / Subarticular
- Heterogeneous texture
- Cortical destruction and periosteal reaction
- Localized soft tissue extension



Permeative Pattern

Osteosarcoma / Lymphoma

# IMAGING OF MUSCULOSKELETAL NEOPLASTIC DISORDERS

## ✓ Sclerotic Osseous Lesion

57 years old female patient presented with bone ache  
Had history of breast carcinoma

### CASE NO. 4

#### FINDINGS

- Preserved bone density in general
- Sclerotic foci of variable sizes (islands)
- No destructive lesion



# IMAGING OF MUSCULOSKELETAL NEOPLASTIC DISORDERS

## ✓ Soft tissue Mass

### CASE NO. 5

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

### FINDINGS

- Soft tissue swelling (relatively lucent)
- No calcification
- No osseous involvement





# IMAGING OF MUSCULOSKELETAL NEOPLASTIC DISORDERS

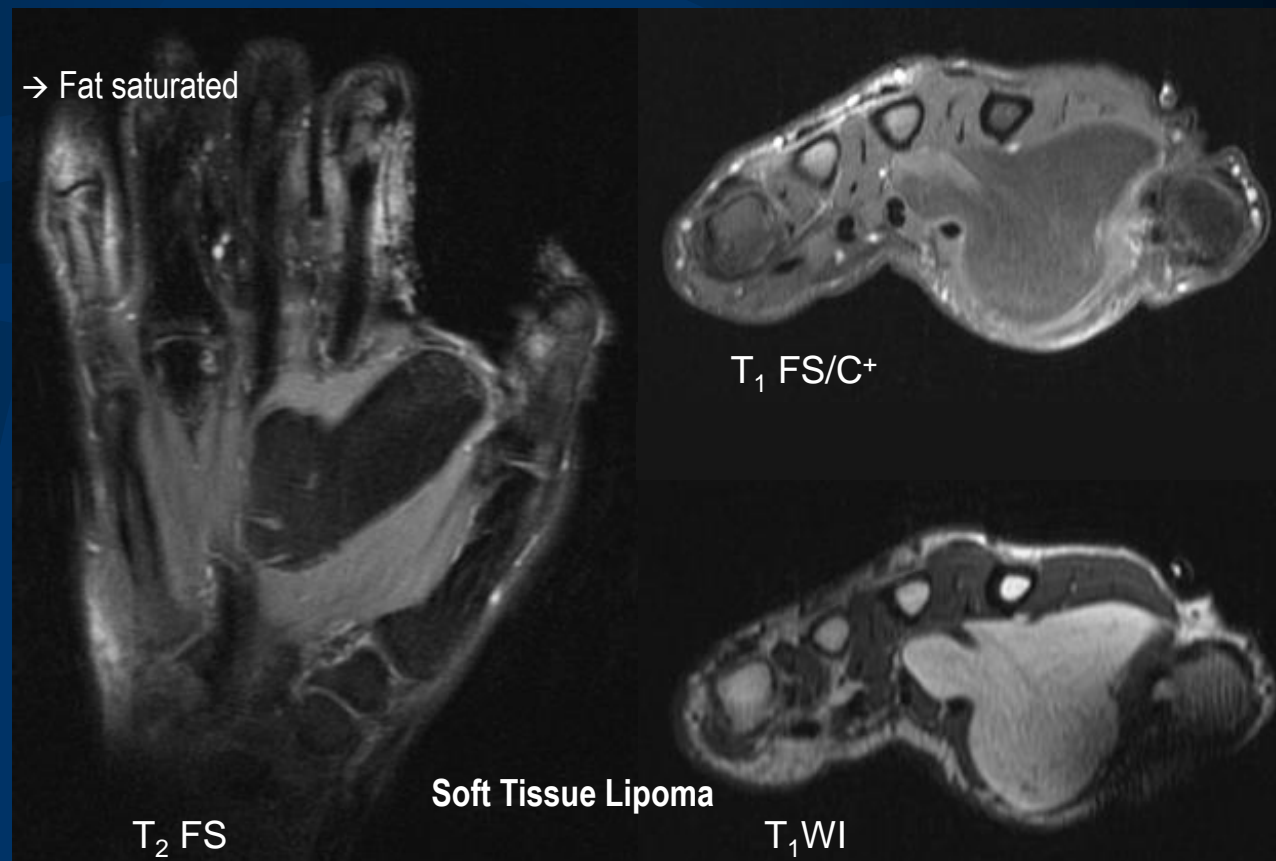
## ✓ Soft tissue Mass

### CASE NO. 5

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

### FINDINGS *mri*

- High signal on T<sub>1</sub>WI and low in T<sub>2</sub>FS → Fat saturated
- No enhancement





THANKS