Musculoskeletal Radiology

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Objectives

1. Discuss the localisation of disease processes (bone, cartilage, synovium, soft tissue) as identified by the plain radiograph and demonstrate a systematic approach to the interpretation of the plain radiograph
2. Recognise and describe the principal radiographic features of the major arthropathies including osteoarthritis, rheumatoid arthritis, seronegative spondarthropathies and septic arthritis and osteomyelitis
3. Recognise and describe the radiographic features of common adult fractures including:
   - Colles
   - Scaphoid
   - Femoral neck
   - Vertebral
   - Tibial
   - Ankle
4. Recognise and describe the radiographic features of major bone disease including primary and secondary malignancy, Paget's disease, osteomalacia and osteonecrosis
5. Discuss the most appropriate further investigations following the plain radiograph including the indications for other bone imaging techniques such as technetium bone scanning, ultrasound and MR imaging
6. Interpret the results of DEXA assessment of bone density in the assessment of osteoporosis

Systematic Approach to the Musculoskeletal Radiograph

- Alignment
- Bones
- Cartilage
- Soft tissues

Alignment

- Compare the alignment of each bone relative to the remaining structures
- Position of adjacent articular surfaces is
- Normally should be 100% apposition between the two surfaces
- Partial apposition = subluxation
- No apposition = dislocation

Subluxation / Dislocation

Bones

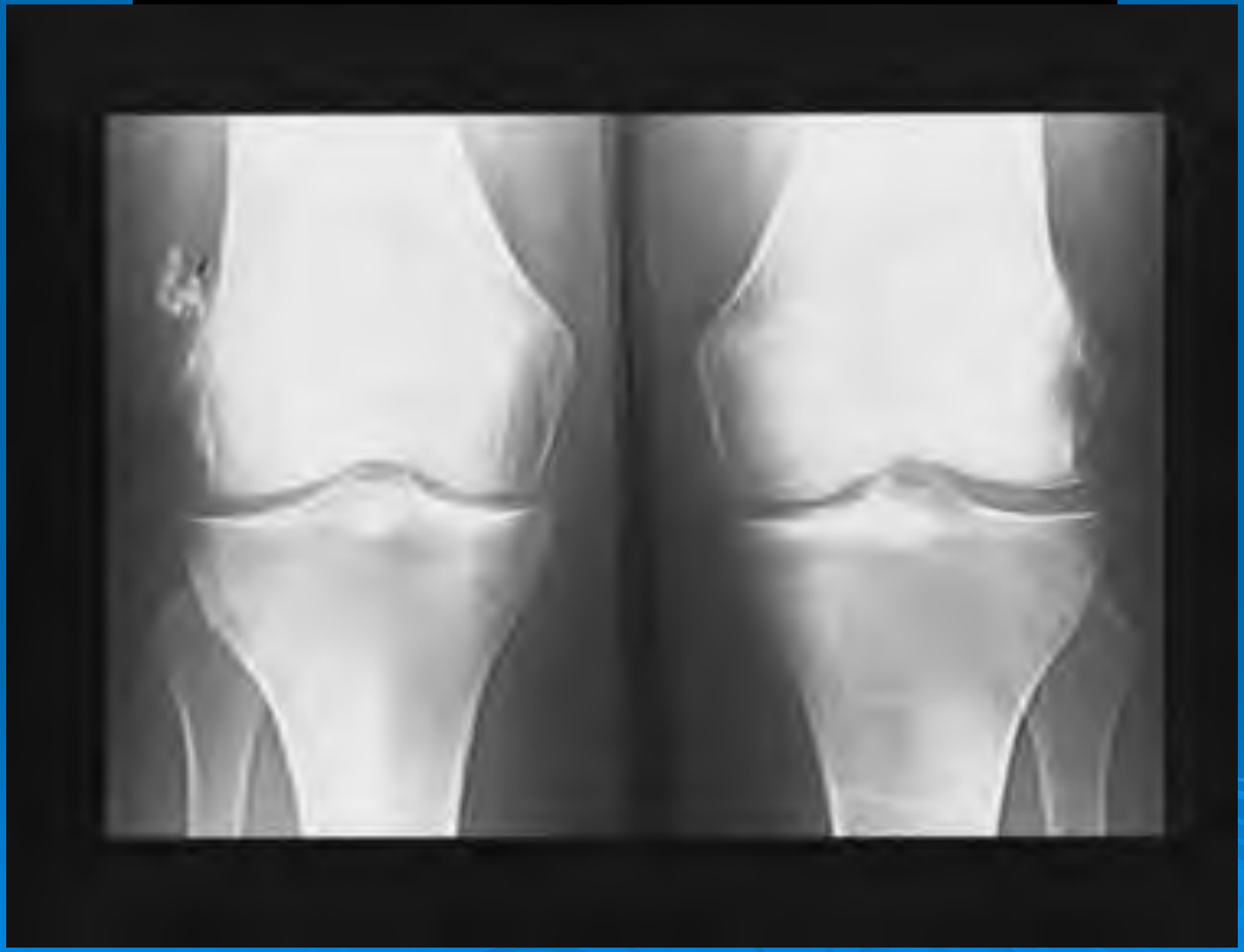
Assess for variations or abnormality of:

- Shape and size of each bone
- Lucency and opacity
- Cortical continuity
- Growth & Growth Plate

Cartilage

- Decreased joint space
- Increased joint space
- Chondrocalcinosis

Chondrocalcinosis



Soft Tissues

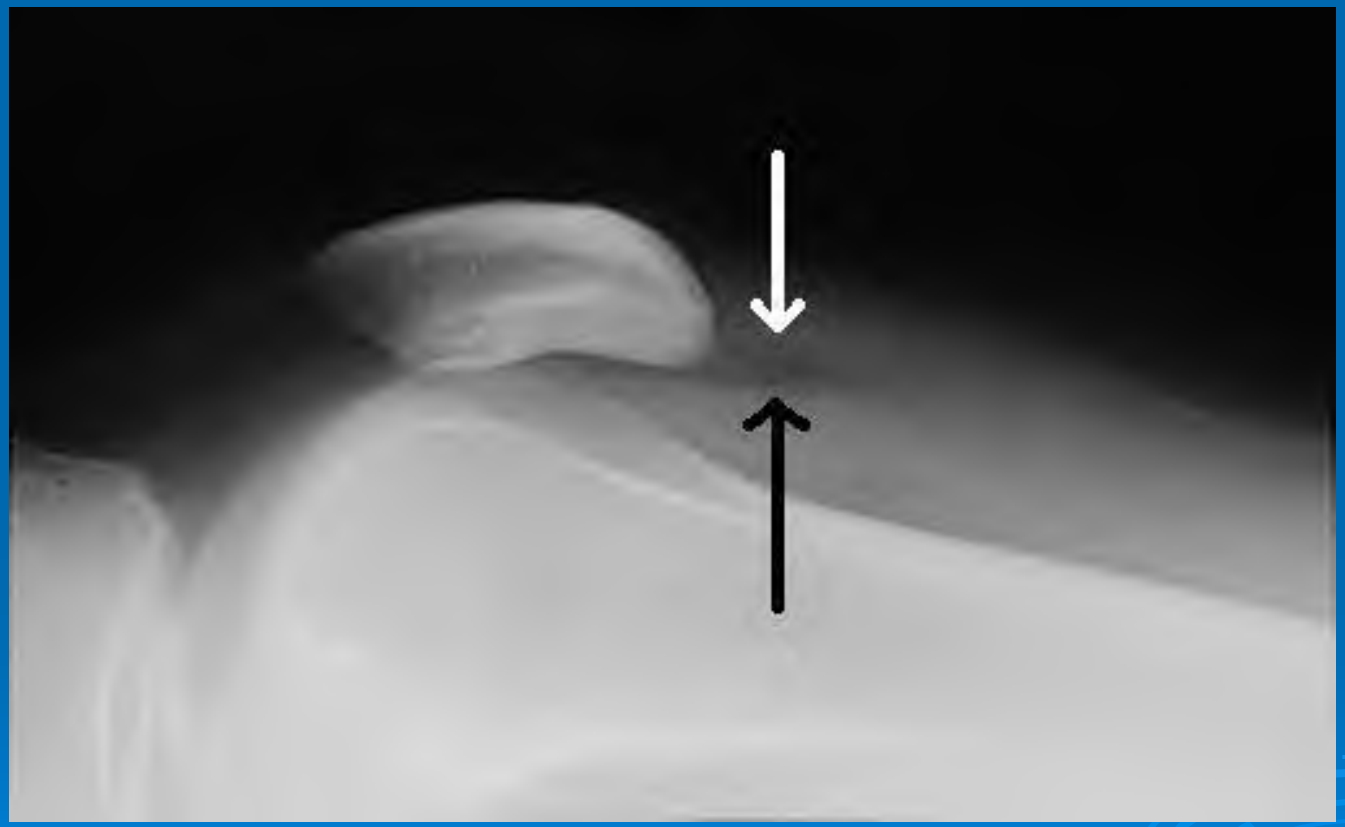
- Joint effusion
- Free fat within ioint capsule - lipohaemarthrosis
- Gas
- Calcification
- Mass
- Laceration/foreign body

Fat Pad Sign

Normal

Posterior Fat Pad

Lipohaemarthrosis



Describing Fractures

- By the **number of fragments**
- By **communication of the fracture with the outside atmosphere**
- By their **relationship to the joint**
- By the **direction of the fracture line**
- By the **relationship of the fragments** to each other

Describing Fractures

- **Describing fractures by the number of fracture fragments**
  - **Two fragments simple**
  - **More than two fragments comminuted**
- **Describing fractures by the presence or absence of communication of the fracture with outside atmosphere (best evaluated clinically)**
  - Closed - No communication
  - Open - Communication
- **Describing fractures by their relationship to the joint**
  - Not involving the joint - extra articular
  - Involving the joint - intra articular
- **Describing fractures by the direction of the fracture line**
- **Transverse** the fracture line is perpendicular to the long axis of the bone
  - Transverse fractures are caused by a force directed perpendicular to shaft
- **Diagonal or oblique** the fracture line is diagonal in orientation relative to the normal axis of the bone
  - Diagonal or oblique fractures are caused by a force usually applied in the same direction as the long axis of the bone
- **Spiral** a twisting fracture caused by a torque injury, such as might be caused by planting the foot in a hole while running
  - Spiral fractures are often associated with soft tissue injuries such as tears in ligaments or tendons

Describing Fractures

- Describing fractures by the **relationship of the fragments** to each other
- Four parameters
- Described in terms of the relationship of the distal fracture fragment relative to the proximal fragment.
- **Displacement**
  - Describes the amount by which the distal fragment is offset, from to back and side to side, from the proximal fragment
- **Angulation**
  - Describes the angle between the distal and proximal fragments as a function of the degree to which the distal fragment is deviated from its normal position
- **Shortening**
  - Describes how much, if any, overlap there is of the ends of the fracture fragments, which translates into how much shorter the fractured bone is than it would be had it not been fractured
- **Rotation**
  - Almost always involves the long bones, such as the femur or humerus, which describes the orientation of the joint at one end of the fractured bone relative to the orientation of the joint at the other end of the same bone. To appreciate rotation, both the joint above and the joint below a fracture must be visualized, preferably on the same radiograph.

Tibial Fractures

- Shaft
- Plateau - Intra articular at the knee
- Plafond - Intra articular at the ankle
- Use the general rules for describing fractures
- If in doubt, management will be:
  - Reduce
  - Immobilise
  - Rehabilitate

Colles Fractures

- Colles fracture, frontal (A) and lateral (B) views.
  - Displacement ("Dinner Fork" Deformity)
  - Dorsal Angulation
  - Shortening
  - Radial Deviation of hand
- Ulnar styloid Injury often associated (60%)
- Ulnar collateral ligament injury often associated

Scaphoid Fractures

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- Suspected clinically if there is tenderness in the anatomic snuff box after a fall on an outstretched hand
- Look for hairline, thin radiolucencies on special angled views of the scaphoid (closed white arrow)
- Fractures across the waist of the scaphoid can lead to avascular necrosis of proximal pole of that bone

Femoral Neck Fractures

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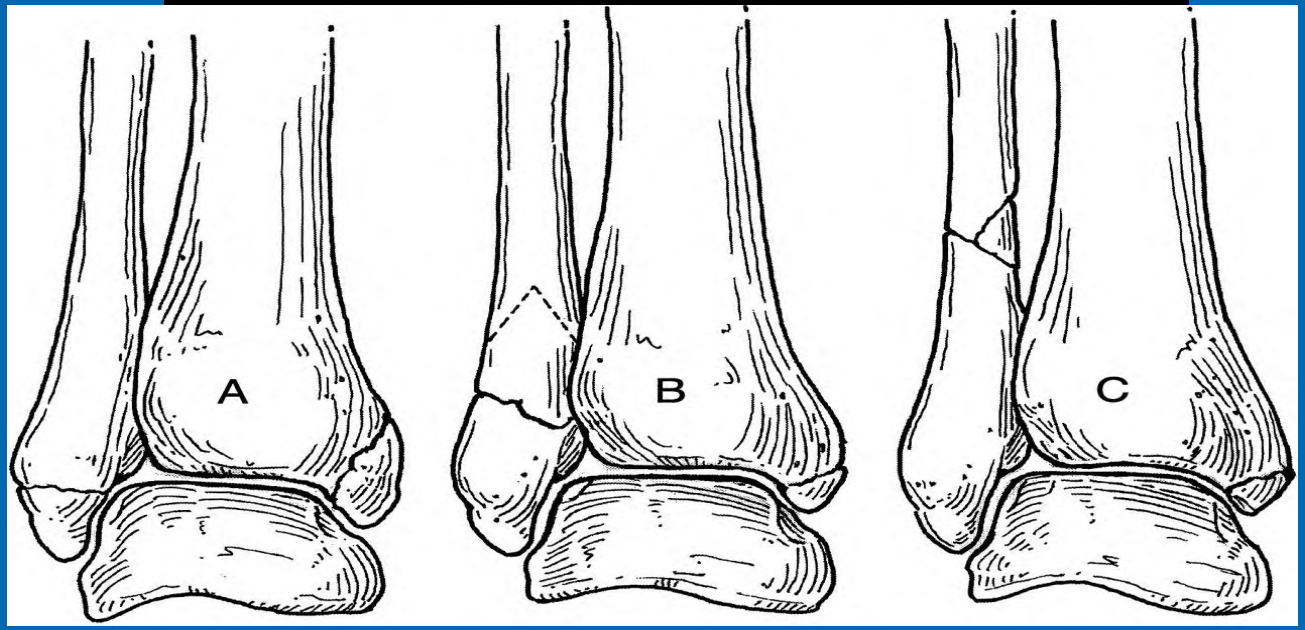
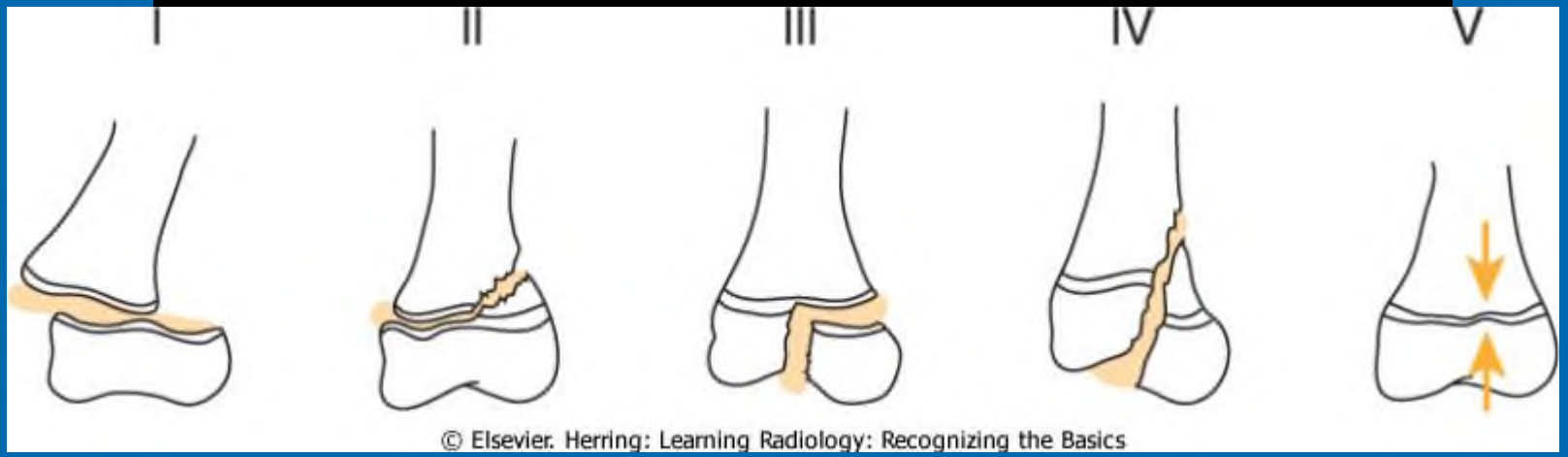
- Hip fractures can be very subtle and sometimes require additional imaging such as bone scan or MRI for their diagnosis
- Look for angulation of the cortex and zones of increased density (closed white arrows) indicating impaction.
- Conventional radiographs of the femoral neck should be obtained with the patient's leg in internal rotation so as to display the neck in profile.

Weber Fractures



- Weber Classification
- Relates to fibular fracture position in relation to syndesmosis between tibia and fibula
- Weber A
  - Below syndesmosis
  - Usually stable
- Weber B –
  - Oblique fracture at level of syndesmosis
  - Variable stability
- Weber C –
  - Fracture above syndesmosis
  - Unstable

Salte Harris Fractures



- S - Straight (through physis)
- A - Above (only metaphysis)
- L - Lower (only epiphysis)
- T - Through (metaphysis & epiphysis)
- R - Ram (compression injury)

Bone Diseases

- Bone is undergoing continuous change from a combination of forces including biochemical and mechanical
- Increased osteoclastic activity can produce focal or generalized decrease in bone density, and increased osteoblastic activity can produce focal or diffuse increased bone density
- Osteoblastic metastases, especially from carcinoma of the prostate and breast, can produce focal or generalized increase in bony density
- Other diseases that can increase bone density include osteopetrosis, avascular necrosis of bone, and Paget's disease
- Osteolytic metastases, especially from lung, renal, thyroid, and breast cancer, can produce focal areas of decreased bone density, as can multiple myeloma, the most common primary tumor of bone
- There must be a reduction of bone mass of almost 50% to produce a recognizable abnormality on conventional radiographs
- Examples of diseases that can cause a generalized decrease in bone density include osteoporosis, hyperparathyroidism, rickets (in children), and osteomalacia (in adults)
- Pathologic fractures occur with minimal or no trauma in bones that had a preexisting abnormality.

Primary Bone Tumour

- A 26 year old male gave a history of pain in his forearm for two months. This AP radiograph of the forearm shows a destructive lytic lesion in the radius typical for a primary central chondrosarcoma.
- Staples are seen in place as a result of the biopsy which proved this to be a chondrosarcoma.

Lytic Bone Metastases

- Lateral radiograph of the lumbodorsal spine in a 54 year old female with metastatic breast carcinoma shows a pathological collapse of the vertebral body anteriorly associated with severe back pain but without paraplegia.

Sclerotic Bone Metastases

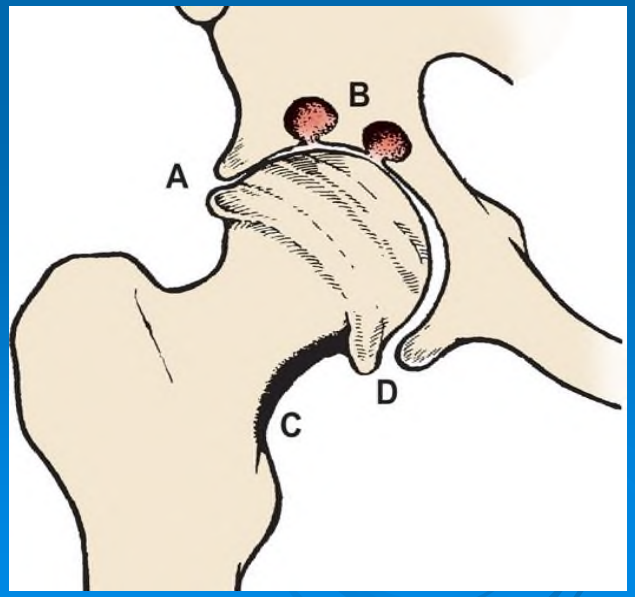
- This AP radiograph of the pelvis shows multiple sclerotic lesions throughout the entire pelvis as well as diffuse sclerotic changes in the L5 vertebra and the upper third of the sacrum, consistent with metastasis from prostate cancer.

Paget’s Disease

- This is an AP radiograph of the pelvis showing thickening of the femoral neck and diffuse sclerosis of bone, consistent with Paget's disease.

Osteoarthritis

- These are all radiographic changes consistent with a diagnosis of degenerative disease, either primary or secondary osteoarthritis.
- This is an AP radiograph of the left hip, showing:
  - Narrowing of joint space (A)
  - Subchondral cysts (B)
  - Subchondral sclerosis (C)
  - Marginal osteophyte formation (D)



Rheumatoid Arthritis

- In the hand **(A)**, the erosions tend to involve the proximal joints: the carpal-metacarpal, metacarpophalangeal (closed white arrows), and proximal interphalangeal joints, with periarticular osteopenia.
- In the wrist **(B)**, erosions of the carpals (dotted black arrow), ulnar styloid (closed black arrow), and narrowing of the radiocarpal joint space (open black arrow) are frequently seen. Late findings in the hands include deformities such as ulnar deviation of the fingers at the MCP joints, subluxation of the MCP joints, and ligamentous laxity leading to deformities of the fingers (all present in this case).

Psoriatic Arthritis

- A. Psoriatic arthritis typically involves the small joints of the hands, especially the distal interphalangeal (DIP) joints (closed white arrows) and resorption of the terminal phalanges or the DIP joints with telescoping of one phalanx into another (penci ir cup deformity) (closed white arrows).
- B. There is ankylosis of the second toe (open white arrow) and more penci ir cup deformities (closed white arrows).

Seronegative Spondarthropathies

- This is an AP radiograph of the upper pelvis and lumbar spine.
- Both sacroiliac joints (large arrows) are fused
- There are bilateral, symmetric syndesmophytes (small arrow), resulting in the typical "bamboo spine" appearance of ankylosing spondylitis.

Septic Arthritis

- This plain radiograph of part of the right foot shows destruction of the articular cartilage and the adjacent articular cortex (closed black arrow) from proteolytic enzymes released by the inflamed synovium.
- There is associated osteopenia from the hyperemia of inflammation (open white arrow).
- Small bubbles of gas (closed white arrow) are present in the soft tissues from gas forming bacterial cellulitis.

Progression of Septic Arthritis

Early in the disease and radiographic changes are limited to concentric joint space loss.

Later, subchondral erosions and sclerosis of the femoral head are present.

8 months after the initial examination, osteonecrosis and complete collapse of the femoral head are present.

- **Osteoarthritis**
- *Loss of joint space*
- *Subchondral bone cysts*
- *Subchondral sclerosis*
- *Osteophyte formation*

What other conditions is sacroileitis a feature of?

Sacroileitis is a feature of all seronegative spondyarthritides: psoriasis, inflammatory bowel disease, Reiter's syndrome.

- Psoriatic Arthritis

- Septic arthritis

Sclerotic Bony Metastases

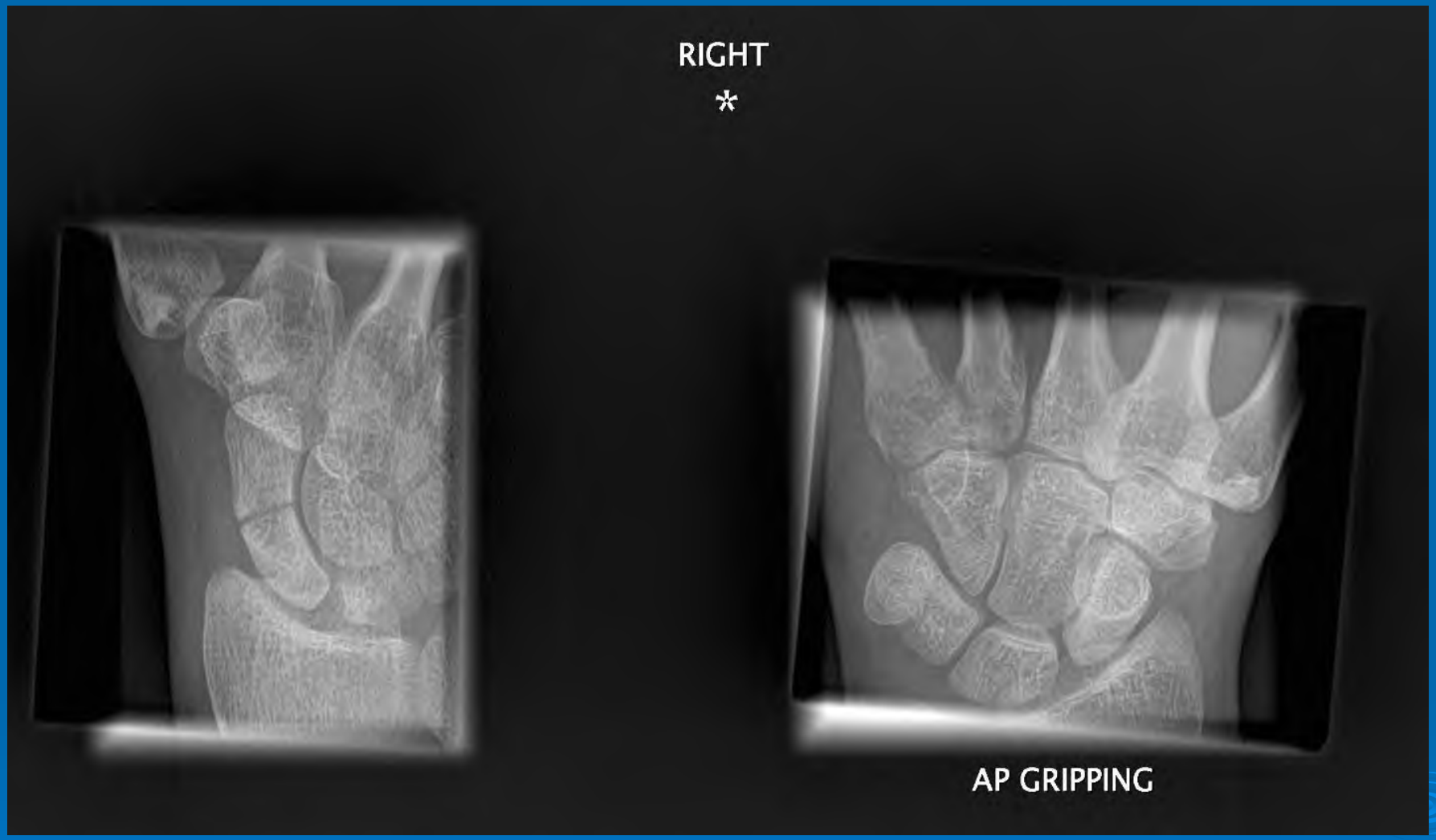
Subcapital Femoral neck fracture

Hip osteoarthritis

Weber B Fracture

Fractured 5th Metatarsal

Colles Fracture

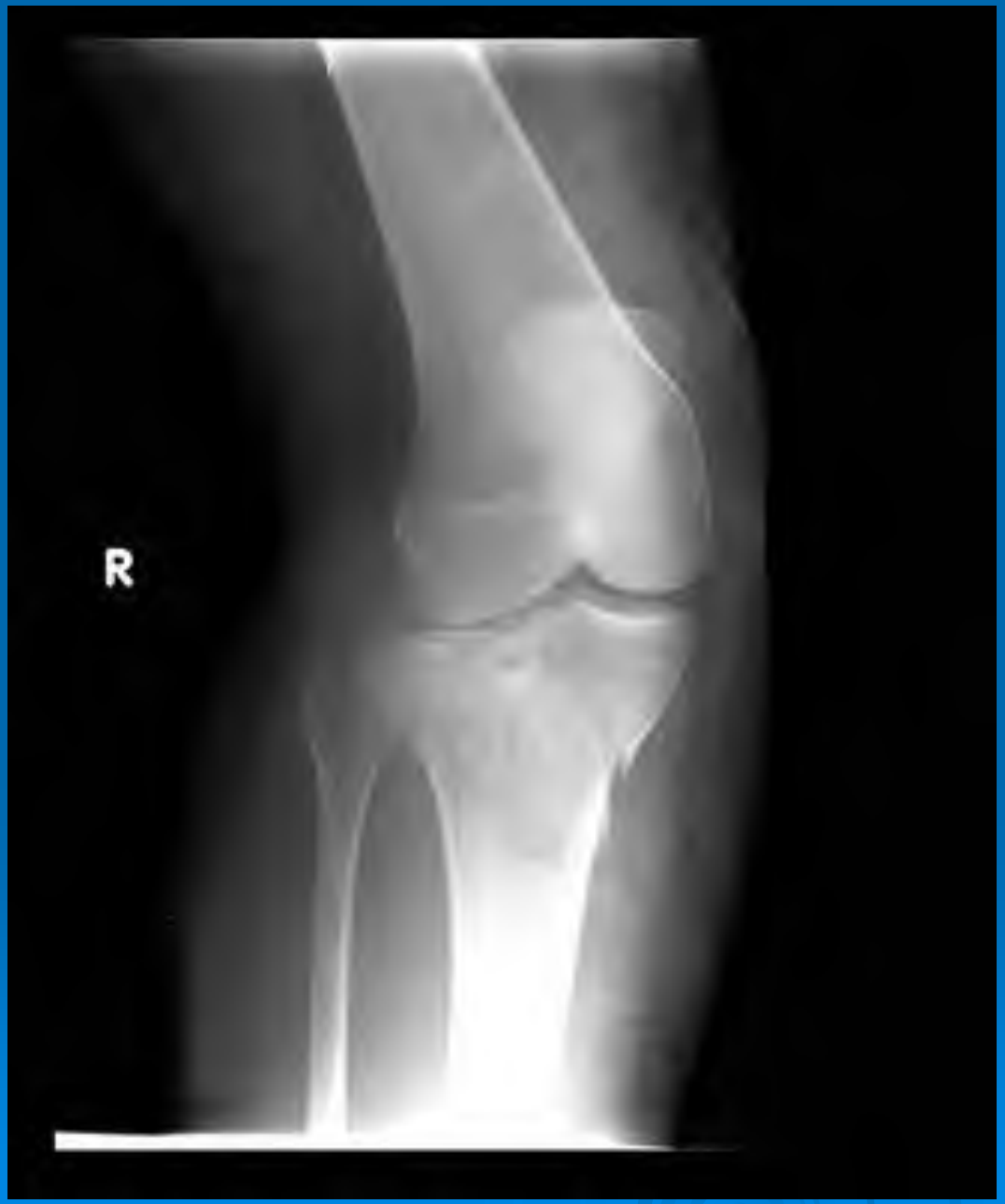


Fracture of scaphoid waist

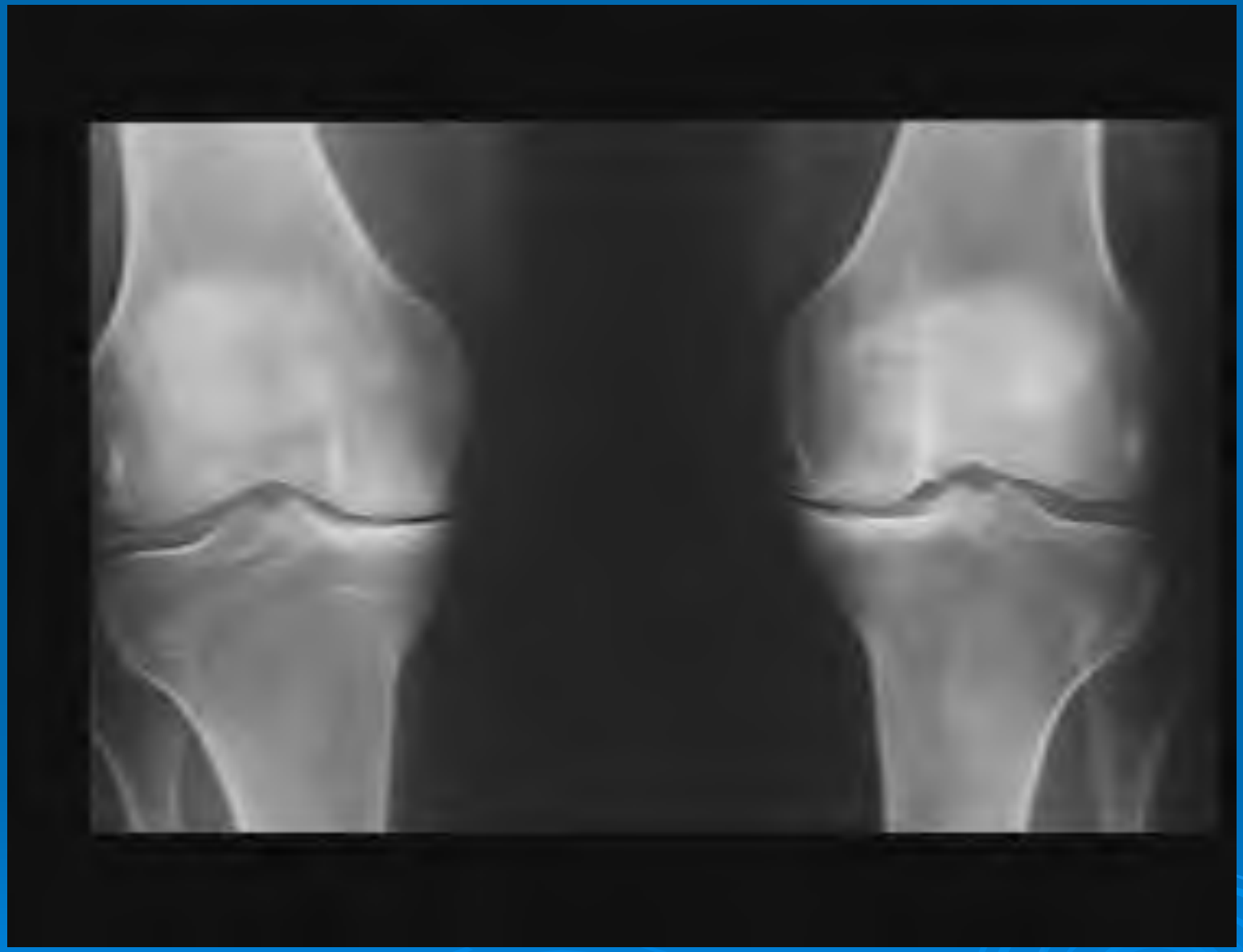
Intra articular fracture middle phalanx index finger

Anterior shoulder dislocation

Spiral fracture femur



Tibial plateau fracture

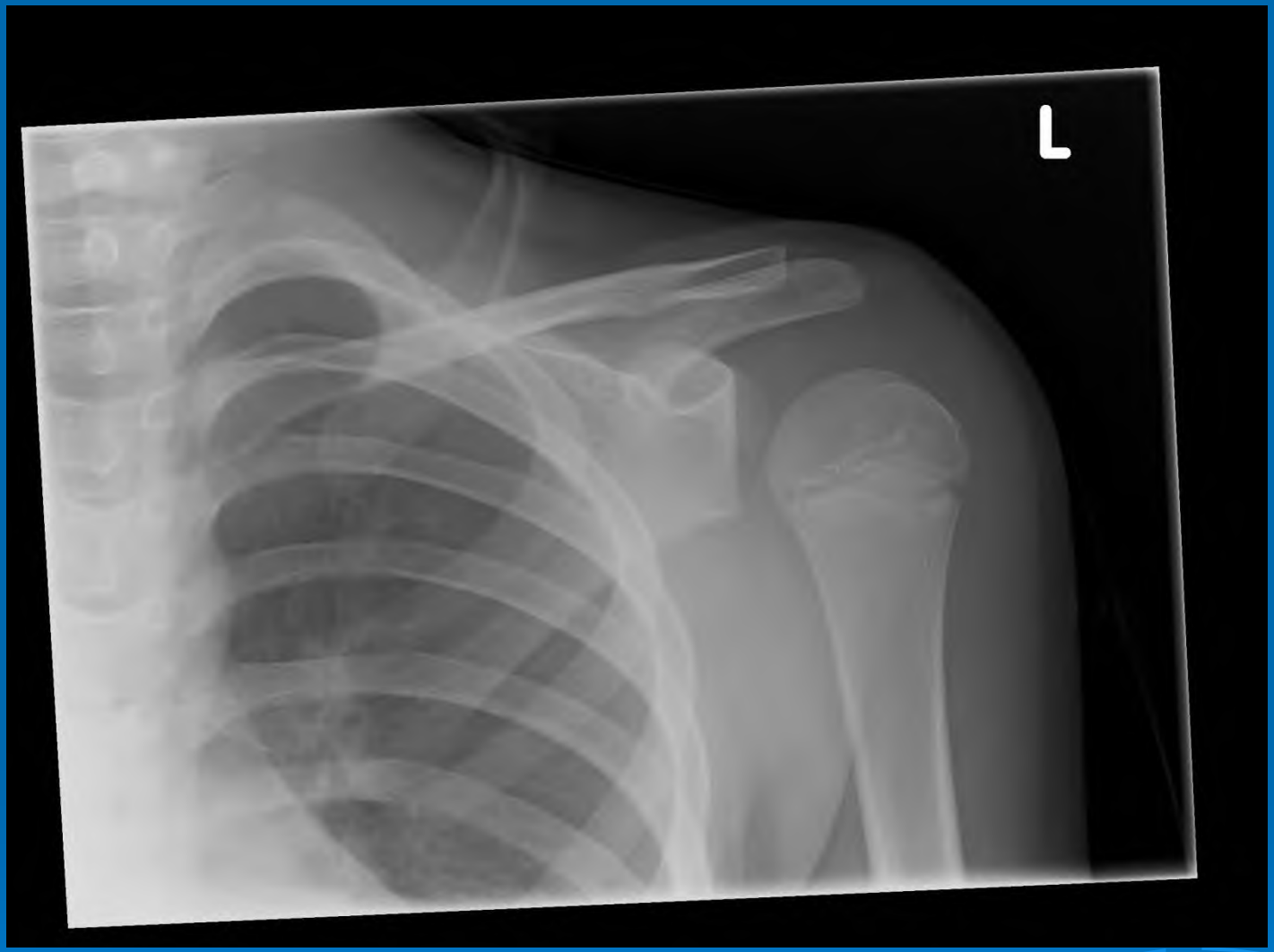


Chondrocalcinosis

Posterior Fat Pad

Lipohaemarthrosis

Sesamoid



Posterior dislocation with lightbulb sign

(don’t forget to mention the growth plate if it’s there!)

Inferior dislocation of the shoulder

The arm is abducted, elevated, and fixed. The humeral head is subcoracoid in position, with a parallel humeral shaft and a parallel scapular spine.

An associated greater tuberosity fracture is present.

Anterior dislocation (96%)
Posterior dislocation (2–4%)
Inferior dislocation (1–2%)
Superior dislocation (<1%)