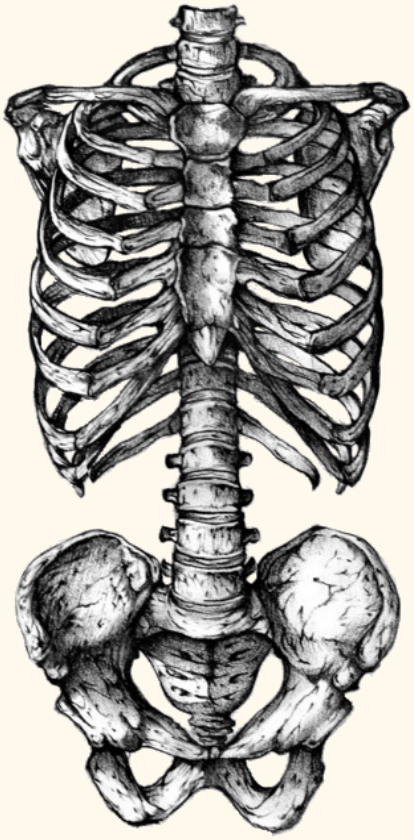
جامعة الملك سعود
King Saud University

434 Orthopedics Team

Lecture 2

Diagnostic imaging investigations



Objectives

1-Review a systematic approach to interpreting orthopedic x-rays.

2-Review the language of fracture description.

❖ **Medical decision making is a triad:**

1. History (from patient/Record).
2. Physical examination.
3. Confirming studies (Labs, imaging,...etc).
    - ➢ **Imaging includes:** X-ray, Ultrasound, CT Scan, MRI and nuclear medicine.
        - **<u>X-ray:</u>** (best for hard tissues and bones, often combined with other imaging)
        1. Radiation source.
        2. Patient exposed.
        3. Capture image (film or digital).
        4. Interpret image.
        5. Can be an ionizing radiation or radiation that damages the cell (as in radiotherapy).
        6. Patient blocks transmission of radiation resulting in the image:
            - Bones blocks more (white).
            - Soft tissues block less(grey/black).
        7. Images are interpreted by **radiologists** or **orthopedics**.

❖<u>ABCs Approach:</u>

➔ Pre-ABCs: Identify the patient and have a full history.

➔ **Apply this approach to every orthopedic film you evaluate.**

<u>A</u>	**Adequacy**
	Alignment
<u>B</u>	**Bone**
<u>C</u>	**Cartilage**
<u>S</u>	**Soft tissues**

❖Adequacy:

1. All x-rays should have an adequate number of views.
- **2 views minimum** (3 prefered) "Orthogonal views ex: AP + Lateral "
- If targeting a bone **shaft** we must have **joint above + joint below.**
- If targeting a **joint** we must have **mid-shaft above + mid-shaft below.**

2. All x-rays should have adequate penetration.

❖Alignment:

1. Anatomic relationship between bones on x-ray.
- Bone alignment Vs. other side
- Bone alignment relative to proximal and distal bones.

2. Normal x-rays should have normal alignment.

3. Fractures and dislocations may affect the alignment on x-rays.

4. **In alignment you describe the distal part in reference to the proximal part.**

❖Bones:

1. Identify the bone.
2. Examine the whole bone for:
- Discontinuity (i.e. Fractures).
- Change in bone consistency (i.e. density).

3. If there's abnormality, describe:

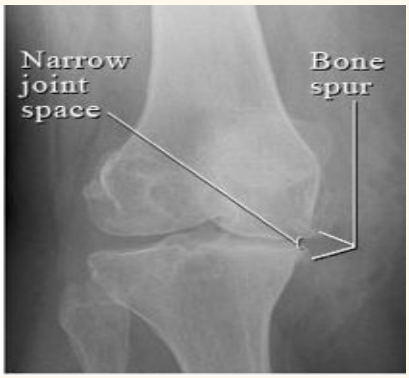
- Location (Right/left? ,shaft/ metaphysis/epiphysis? .... etc).
- Shape.

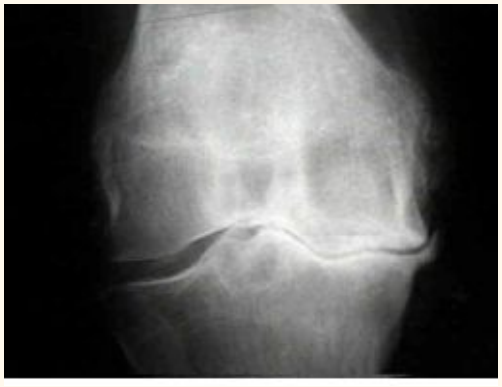
❖Cartilage:

➔ Joint spaces on x-ray.

➔ You can not actually see cartilages on x-rays.

1. Widening of the joint space => signifies **ligamentous injury** and/or fractures.
2. Narrowing of joint spaces => **Arthritis.**



	
1- Medial side is more affected because of the weight, osteoarthritis because of the narrow space and bone spur(osteophytes) 2- Valgus knee deformity and narrowing space in the lateral side.	**Pre-ABCs:**Patient identity unknown and no history. **A:** not adequate because only one view. **B:** left femoral head is deformed and distorted. **C:** left femoral head is deformed and distorted, no joint space, cartilage is worn out, multiple osteophyte. **S:** insignificant

❖Soft tissues:

1. Soft tissues implies to look for soft tissue swelling and joint effusions which can be signs of:

- Trauma
- occult fractures
- Infection
- Tumors

A lateral elbow x-ray.

There is swelling anteriorly which is displaced known as a pathologic anterior fat pad sign.

There is swelling posteriorly known as a posterior fat pad sign.

Both of these are signs of an occult fracture although none are visualized on this x-ray

Remember, *soft tissue swelling* can be a sign of occult fracture!

❖Language of Fractures:

1. Important for use to describe x-rays in medical terminology.
2. Improves communication with orthopedic consultants.
3. **Things you must describe (clinical and x-ray):**

- Open vs Closed fracture.
- Anatomic location of fracture.
- Fracture line.
- Relationship of fracture fragments.
- Neurovascular status.

❖Open Vs. Closed Fractures:

➢ Closed Fractures:

- Simple.
- No skin wounds near fracture.

➢ Open Fractures:

- An orthopedic emergency.
- Compound.
- Cutaneous (open wounds) of skin near fracture site. Bone may protrude from skin.
- Open fractures are open complete displaced and/or comminuted.
- Management:

1. Bleeding must be controlled.
2. IV antibiotics.
3. Tetanus prophylaxis.
4. Pain control.
5. Surgery for washout and reduction.

❖Anatomic Location:

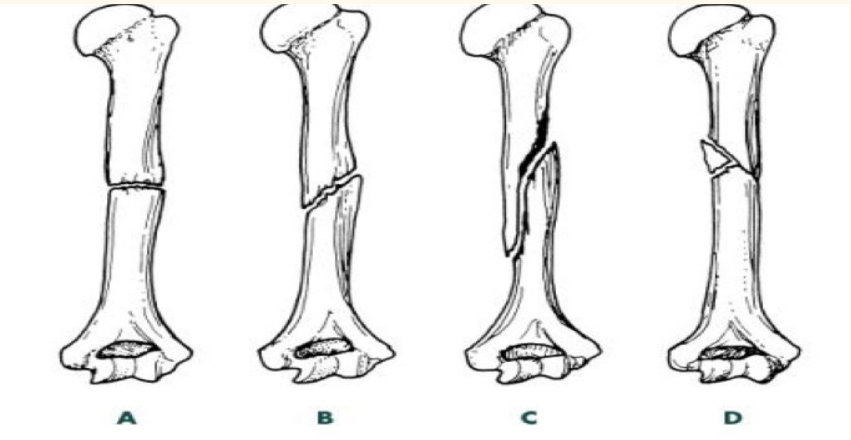
1. Describe the precise anatomic location of the fracture.
2. Include if it is left or right sided bone.
3. Include name of the bone.
4. Include location:

- Proximal ,Mid, Distal.
- To aid in this, divide bone into 1/3rds.

5. Besides location, it is helpful to describe if the location of the fracture involves the joint space—intra-articular.

❖Fracture Lines:

1. There are several types of fracture lines.



A: Transverse **B:**Oblique **C:** Spiral **D:** Comminuted

- There is also an impacted fracture where fracture ends are compressed together.

❖Fracture Fragments:

➢ Terms to be familiar with when describing the relationship of fracture fragments to each other:

1. **Alignment:** Relationship in the longitudinal axis of one bone to another
2. **Angulation:** Any deviation from normal alignment (described in degrees of angulation of the distal fragment in relation to the proximal fragment - to measure angle draw lines through normal axis of bone and fracture fragment-)
3. **Apposition:** amount of end to end contact of the fracture fragments.
4. **Displacement:** it's the opposite of apposition.
5. **Bayonette apposition:** overlapping of the fracture fragments.
6. **Distraction:** displacement in the longitudinal axis of the bones.
7. **Dislocation:** disruption of normal relationship of articular surfaces.

❖Neurovascular Status:

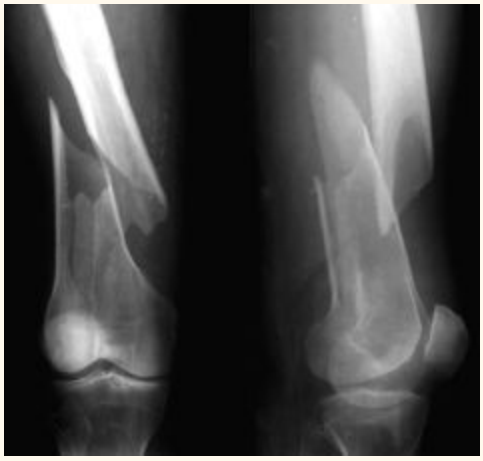
1. Finally when communicating a fracture, you will want to describe if the patient has any neurovascular deficits.
2. This is determined clinically.

❖<u>Examples</u>:

- ***Let's practice!***

- **Example #1: Where are the fractures?**

➢ If you follow ABCs, you will notice there is are problems with alignment on this x-ray.
➢ You will notice there are fracture lines through the 2nd, 3rd, and 4th metacarpals.
➢ These are 2nd , 3rd metacarpal base fractures and 4th midshaft metacarpal fracture.
➢ **A teaching point:** Notice the ring on this film. Always remove rings of patients with fractured extremities because swelling may preclude removal later.



- **Example #2: Where is this located?**

➢ This is a closed left distal femur fracture.
➢ The main thing we want you to take from this example is the description of location.

Example #3:

➢ Intra-articular fracture of base 1st metacarpal.

Example #4: What type of fracture line is this?

➢ Transverse fractures occur perpendicular to the long axis of the bone.
➢ To fully describe the fracture, this is a closed midshaft transverse humerus fracture.

Example #5:What type of fracture line is this?

- ➢ Spiral fractures occur in a spiral fashion along the long axis of the bone.
- ➢ They are usually caused by a rotational force.
- ➢ To fully describe the fracture, this is a closed distal spiral fracture of the fibula.

Example#6:

- ➢ Comminuted fractures are those with 2 or more bone fragments are present.
- ➢ Sometimes difficult to appreciate on x-ray but will clearly show on CT scan.
- ➢ To fully describe the fracture, this is a closed R comminuted intertrochanteric fracture.

Example #7:

➢ 20 degrees of angulation.

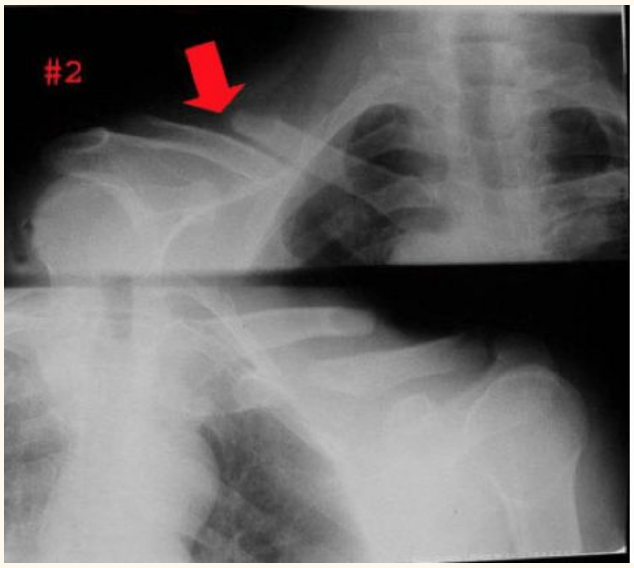
Example#8:

➢ This is a closed midshaft tibial fracture….But how do we describe the fragments?
➢ This is an example of partial apposition; note part of the fracture fragments are touching each other.
➢ Alternatively you can describe this as displaced 1/3 the thickness of the bone.
➢ **Final answer:** Closed midshaft tibial fracture with moderate (33%) displacement.

Example #9:

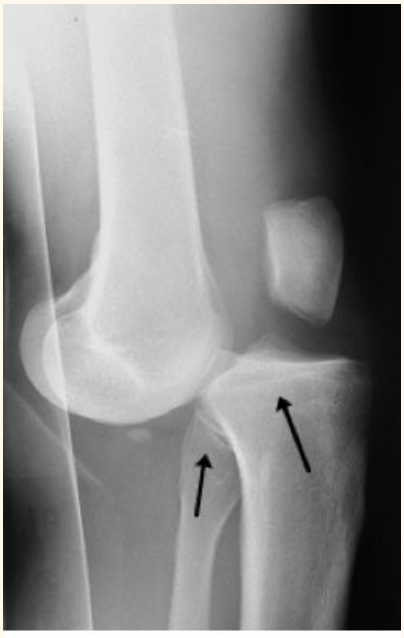
➢ There are 2 fractures on this film
➢ Closed distal radius fracture with complete displacement. Also there is an ulnar styloid fracture which is also displaced.
➢ The displacement is especially prominent on the lateral view highlighting the importance of multiple views.
➢ There may be intra-articular involvement as joint space is close by.
➢ Remember, remove all jewelry from extremity fractures.

Example #10:



- Bayonette Apposition

Example #11:



- Note the dislocation on the previous slide; the articular surfaces of the knee no longer maintain their normal relationship
- Dislocations are named by the position of the distal segment
- This is an Anterior knee dislocation

Example #12:

- Oblique fracture of midshaft of R 4th middle phalanx with minimal displacement and no angulation.
- Remember to comment if open vs closed & neurovascular status.

Example #13:

- This one is a bit more challenging!
- Right midshaft tibia fracture displaced ½ the thickness of the bone without angulation; also there is bayonette appositioning of the fracture fragments
- Right midshaft fibular fracture with complete displacement and
- Also comment if the fracture is open vs closed & neurovascular status

❖Summary:

- **A**

➢ Assess *adequacy* of x-ray which includes proper number of views and penetration.

➢ Assess *alignment* of x-rays.

- **B**

➢ Examine *bones* throughout their entire length for fracture lines. and/or distortions.

- **C**

➢ Examine *cartilages* (joint spaces) for widening.

- **S**

➢ Assess *soft tissues* for swelling/effusions.

- *Helpful link for fracture description:*

https://radiopaedia.org/articles/describing-a-fracture-an-approach

❖Torrento Notes:

Fracture Description

1. Name of Injured Bone

2. Integrity of Skin/Soft Tissue

• closed: skin/sof tissue over and near fracture is intact

• open: skin/sof tissue over and near fracture is lacerated or abraded, fracture exposed to outside (or

contaminated - such as the bowel) environment, or contaminated (i.e. bowel)

• signs: continuous bleeding from puncture site or fat droplets in blood are suggestive of an open fracture

3. Location

• epiphyseal: end of bone, forming part of the adjacent joint

• metaphyseal: the fared portion of the bone at the ends of the shaf

• diaphyseal: the shaf of a long bone (proximal, middle, distal)

• physis: growth plate

4. Orientation/Fracture Pattern

• transverse: fracture line perpendicular (<30° of angulation) to long axis of bone; result of direct high energy force

• oblique: angular fracture line (30°- 60° of angulation); result of angular or rotational force

• butterfly: fracture site fragment which looks like a butterfly

• segmental: a separate segment of bone bordered by fracture lines; result of high energy force

• spiral: complex, multi-planar fracture line; result of rotational force, low energy

• comminuted/multifragmentary: >2 fracture fragments

• intra-articular: fracture line crosses articular cartilage and enters joint

• avulsion: tendon or ligament tears/pulls of bone fragment; ofen in children, high energy

• compression/impacted: impaction of bone; typical sites are vertebrae or proximal tibia

• torus: a buckle fracture of one cortex, ofen in children

• greenstick: an incomplete fracture of one cortex, ofen in children (see Figure 50, OR41)

• pathologic: fracture through bone weakened by disease/tumour

5. Alignment of Fracture Fragments

• nondisplaced: fracture fragments are in anatomic alignment

• displaced: fracture fragments are not in anatomic alignment

• distracted: fracture fragments are separated by a gap (opposite of impacted)

• impacted: fracture fragments are compressed, resulting in shortened bone

• angulated: direction of fracture apex (e.g. varus/valgus)

• rotated: fracture fragment rotated about long axis of bone

Thank You!

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