Imaging the Musculoskeletal System

The Extremities

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Objectives

- Discuss:
  - commonly used imaging modalities in the musculoskeletal system
  - normal imaging anatomy in the extremities
  - fracture description
Imaging Techniques

- Plain x-rays
- CT
- MRI
- Ultrasound
- Nuclear Medicine (bone scan)
For joints like the ankle, elbow or wrist we always take 3 views:

AP, lateral and oblique
3 views: AP, oblique and lateral
Advantages of plain x-rays

- Quick
- Not expensive
- Relatively low radiation
Disadvantages of plain x-rays

- Not 3 dimensional
- Can miss pathology
- May still require other imaging studies
This is a CT scan: a longitudinal cross section

This CT shows a fracture through the medial cuneiform
Advantages of CT scanning of the musculoskeletal system

- Excellent anatomic detail
- Will detect almost all pathology related to cortical bone injury
- Great for showing displacement or joint involvement
- Now multiplanar
Disadvantages of CT

- Expensive (x-ray $100, CT $1000)
- More radiation
- Often not necessary
MRI scanner
Looks more like a tunnel, must be very careful of metal
This is an MRI of the knee.

There is no radiation used.

Circled is a normal posterior cruciate ligament.
Advantages of MRI

- No radiation
- We can slice through the body using any imaging plane
- Looks “inside” bone. **Marrow** evaluation.
- MRI is very good for looking at the **soft tissues** (muscles, ligaments, tendons and cartilage)
- MRI is very sensitive in detecting **water**
MRI shows water (fluid) behind the patella

Do you see fluid anywhere else?
Disadvantages of MRI

- Very expensive (x-ray $100, CT $1000, MRI $2000)
- Not as good as CT for cortical bone
This long black line is the cortex or cortical bone.

3 things are always black on MRI:

1. Air
2. Cortical bone/tendons/ligaments
3. Flowing blood
Posterior cruciate ligament
anterior and posterior horns “bow tie”
Normal Imaging Anatomy in the Extremities
What are the parts of a long bone?

- Terms you will need to know:
  - Cortex
  - Medullary cavity (marrow)
  - Diaphysis
  - Metaphysis
  - Epiphysis

DME
At each end of a long bone is the ________

The tapered part of the bone is the ________

Medullary cavity (marrow)

The shaft of the long bone is the ________

Diaphysis
Metaphysis
Epiphysis
Child or adult?
a. Growth plate
b. Diaphysis
c. Metaphysis
d. Epiphysis
Ankle and Foot

- Tibia
- Talus
- Navicular
- Cuneiforms
- Metatarsals
- Phalanges
- Calcaneus
- Cuboid
- Tarsal-metatarsal joints
- Metatarsal-phalangeal joints
- Fibula
Top View of Foot Bones

- Calcaneus Bone
- Talus Bone
- Cuboid Bone
- Navicular Bone
- Lateral Cuneiform Bone
- Intermediate Cuneiform Bone
- Medial Cuneiform Bone
- Metatarsal Bones
- Proximal Phalanges
- Middle Phalanges
- Distal Phalanges
Test your knowledge
Finding a Fracture on X-Ray

- Start with soft tissue, look for swelling or fat pad displacement
- Examine the cortex along the entire length of the bone
- Look for cortical irregularities, buckling, or evidence of impaction
Fracture Terminology

- **Direction** of fracture line:
  - Transverse
  - Oblique
  - Spiral
  - Longitudinal

- **Alignment** of fracture: **Displacement**
- Angulation
- Comminution
- Articular Involvement
Fracture Terminology

- **Open vs Closed**: fracture is open when exposed to air (laceration or gross exposure)
- **Pathologic fracture**: implies fracture through weakened bone
- **Stress fracture**: implies misuse or overuse
Path of the Fracture

- Normal
- Transverse
- Oblique
- Spiral
- Comminuted
- Segmental
- Avulsed
- Impacted
- Torus
- Greenstick
Normal
Transverse Fracture
Oblique Fracture
Spiral Fracture
Longitudinal Fracture
Simple vs Comminuted

- Simple - 2 bone fragments
- Comminuted - greater than 2 fragments
Avulsion Fracture

- A bony fragment produced by the pull of ligamentous or tendinous attachment
Torus Fractures

- Axial forces cause cortex to buckle
- Occurs most commonly in the metaphysis
Greenstick fracture

- Cortex broken on one side of the bone and only bent or buckled on the other side
Points to take home

- There are distinct advantages and disadvantages to plain x-rays, CT and MRI.
- Become familiar with terminology: epiphysis, metaphysis, diaphysis, cortex, medullary cavity.
- Fracture description requires specific vocabulary.