Imaging the musculoskeletal system

An Introduction

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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
For joints like the ankle, elbow or wrist we always take 3 views:

- AP
- Lateral
- 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
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
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

MRI of a normal posterior cruciate ligament
Advantages of MRI

- No radiation
- We can slice through the body using any imaging plane
- 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”
MSK imaging anatomy
What are the parts of a long bone?

- Terms you will need to know:
  - Cortex
  - Medullary cavity (marrow)
  - Diaphysis
  - Metaphysis
  - Epiphysis
At each end of a long bone is the ________

The tapered part of the bone is the ________

The shaft of the long bone is the ________

Diaphysis

Metaphysis

Epiphysis
a. Growth plate
b. Diaphysis
c. Metaphysis
d. Epiphysis
Child or adult?
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, bucking, or evidence of impaction
Fracture Terminology

- **Direction** of fracture line:
  - Transverse
  - Oblique
  - Spiral
  - Longitudinal
- **Alignment** of fracture: **Displacement**
- Angulation
- Communion
- 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 Fracture
Oblique Fracture
Spiral Fracture

Diagram of a spiral fracture and X-ray images showing the fracture pattern.
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 Fracture

- 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