# 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



#### Plain x-rays

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

AP, lateral and oblique



## 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

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This is a CT scan: a longitudinal cross section

This CT shows a fracture through the medial cunieform

# 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.Air2.Cortical bone/tendons/ligaments3.Flowing blood







Posterior cruciate ligament



anterior and posterior horns "bow tie"

## MSK imaging anatomy

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## What are the parts of a long bone?

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







## medullary cavity



2 3 Growth plate **a**. b. Diaphysis c. Metaphysis d. Epiphysis

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#### -MEDIAL EPICONDYLE

TROCHLEA

### CAPITELLUM -----

#### RADIAL HEAD -















## 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
- Comminution
- Articular Involvement

## Fracture Terminolgy

- 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**





## Longitudinal Fracture



## Simple vs Comminuted

- Simple-2 bone fragments
- Comminuted-greater then 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