Orthopedic Exam And CT Scans, X-rays and MRIs, OH MY!

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Educational Objectives

- 1 As a result of this activity the learner will be able to examine patient's with orthopedic chief complaints, appropriately order imaging modalities, including x-rays, ultrasound, CT scans and MRIs.

- 2. As a result of this activity, the learner will be able to recall high yield diagnostic imaging modalities to use for orthopedic injuries and conditions.

- 3. As a result of this activity, the learner will describe basic x-ray, ultrasound, CT and MRI indications for use.

Relationships with commercial interest

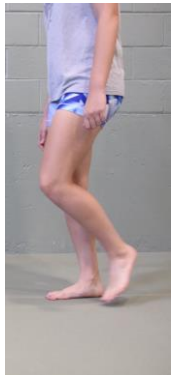
- I have no conflicts of interest or relationships to disclose.

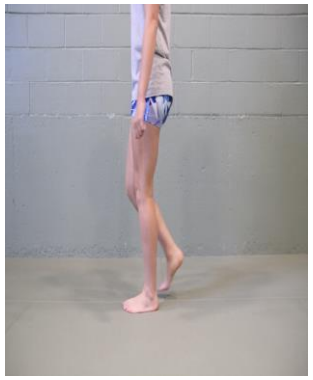
Key assessment components of the ortho exam

Inspection

- Look for any imbalances or abnormalities
- Assess side to side differences in symmetry
- Look for limitations in motion
- Skin changes

- Evaluation of gait





Palpation

- Assess for step off or unilateral abnormality
- Crepitations
- Warmth
- Tone

Muscle Strength Testing

Findings on Examination	Grade
No strength or muscle contraction	0
No movement, but muscle contraction noted	1
Movement with gravity	2
Movement against gravity, but not resistance	3
Decreased strength against resistance	4
Normal / full strength	5

Range of Motion

- Active (AROM)
  - Ask the patient to move through their motion on their own power

- Passive (PROM)
  - The clinician produces the motion

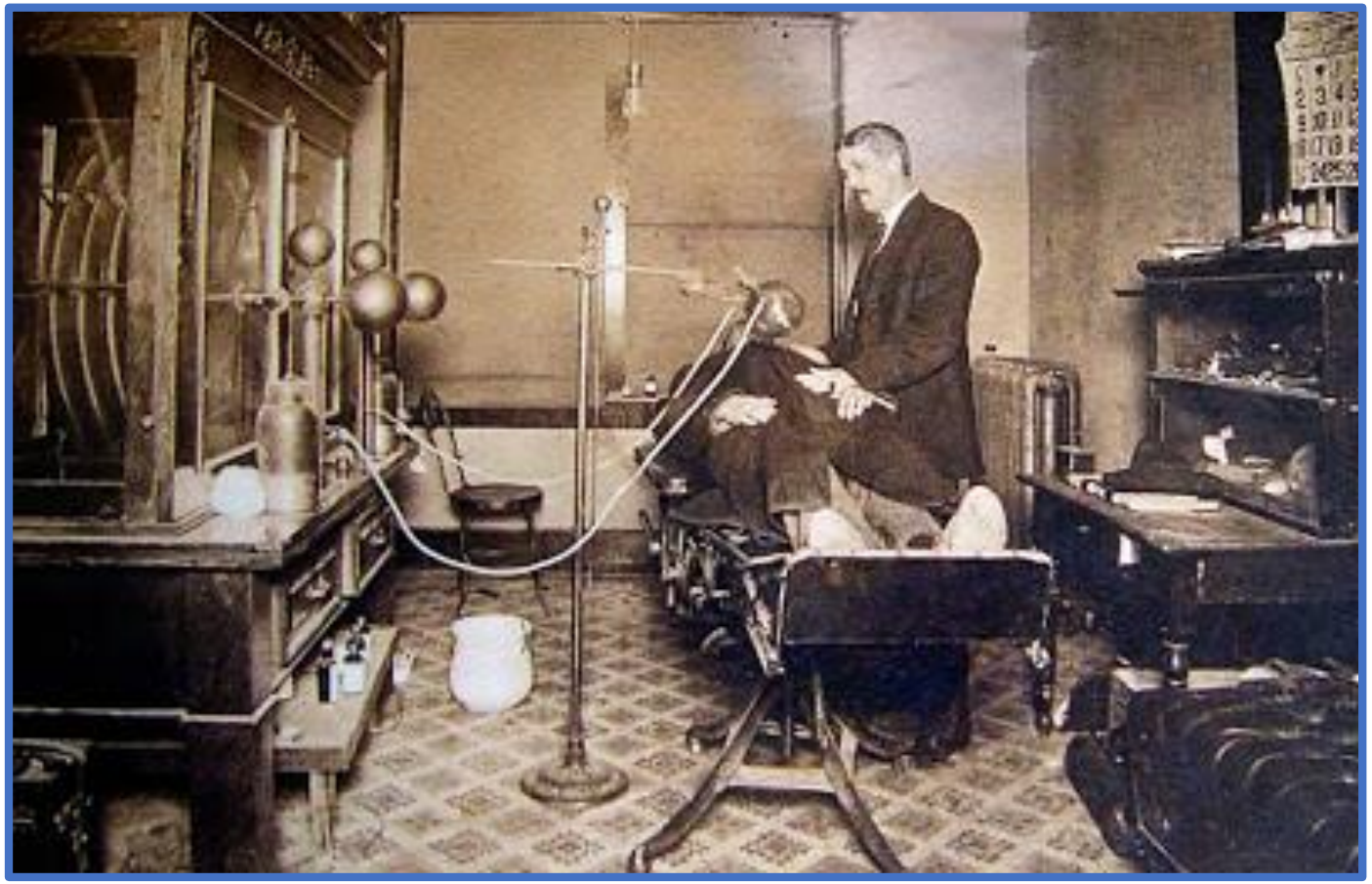
Special tests

- Supraspinatus testing

- Lachman's testing

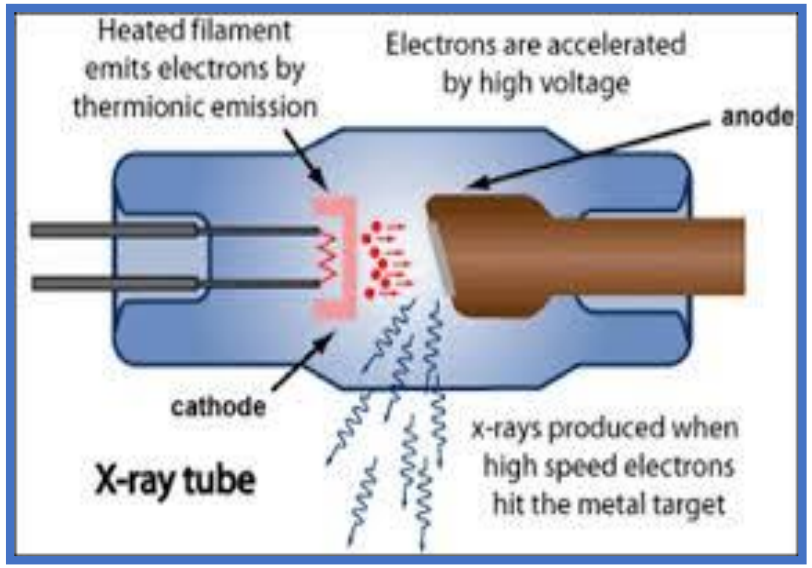
Imaging modalities

Including sensitivity and specificity



How X-rays Work

- Radiation is generated by the machine using a electricity and a vacuum tube



- A high energy beam of light is passed through the patient
- Some of the beam is absorbed by tissues in the body
- A light sensitive surface is activated by the remaining beam, in shades of gray
- Black areas indicate that nothing interfered with the beam

X-ray

- Useful for looking for fractures or bony abnormalities
- OCD (osteochondral defect)
- Degenerative changes

X-ray – Why might you order?

- Indications
  - Pain
  - Decreased motion

X-Rays (Cont.)

- Benefits = highly sensitive and specific
  - fast and accurate
  - Useful for looking for fractures or bony abnormalities
  - OCD
  - Degenerative changes

- Drawbacks = radiation

Basics of Terminology

- PA Postero-anterior
- AP Antero-posterior
- Lateral
- Decubitus
- Upright
- Cross Table
- Tangential
- Oblique

Five Basic Densities in Plain Films

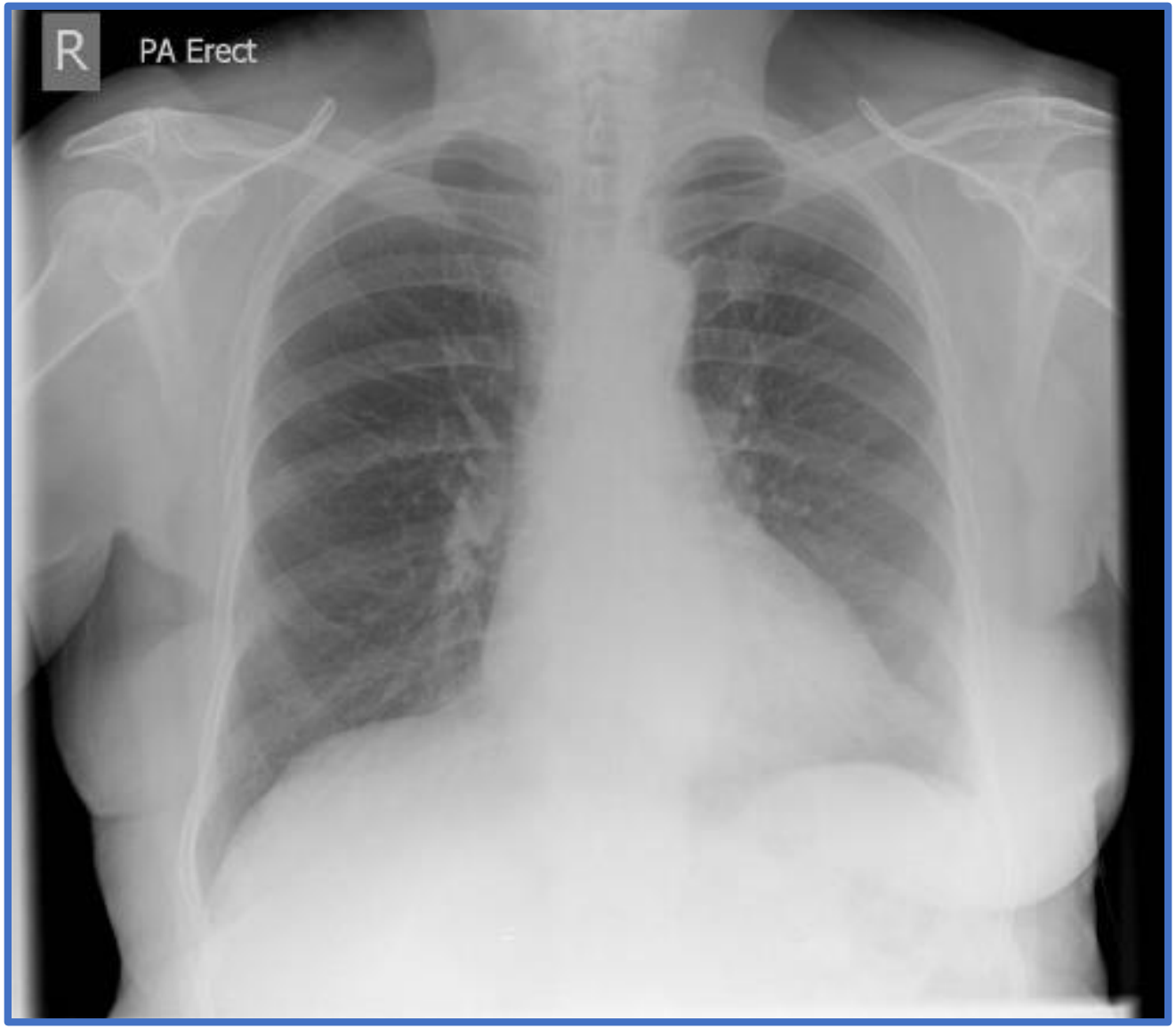
AKA Radiographs, AKA x-rays

- Air
- Fat
- Soft tissue or fluid
- Calcium, as in bone
- Metal

Air in soft tissue in neck

http://image.wikifoundry.com/image/1/DPPS6F1HE-zW0WcKamxh6Q105325/GW375H500

Fat—grey shading



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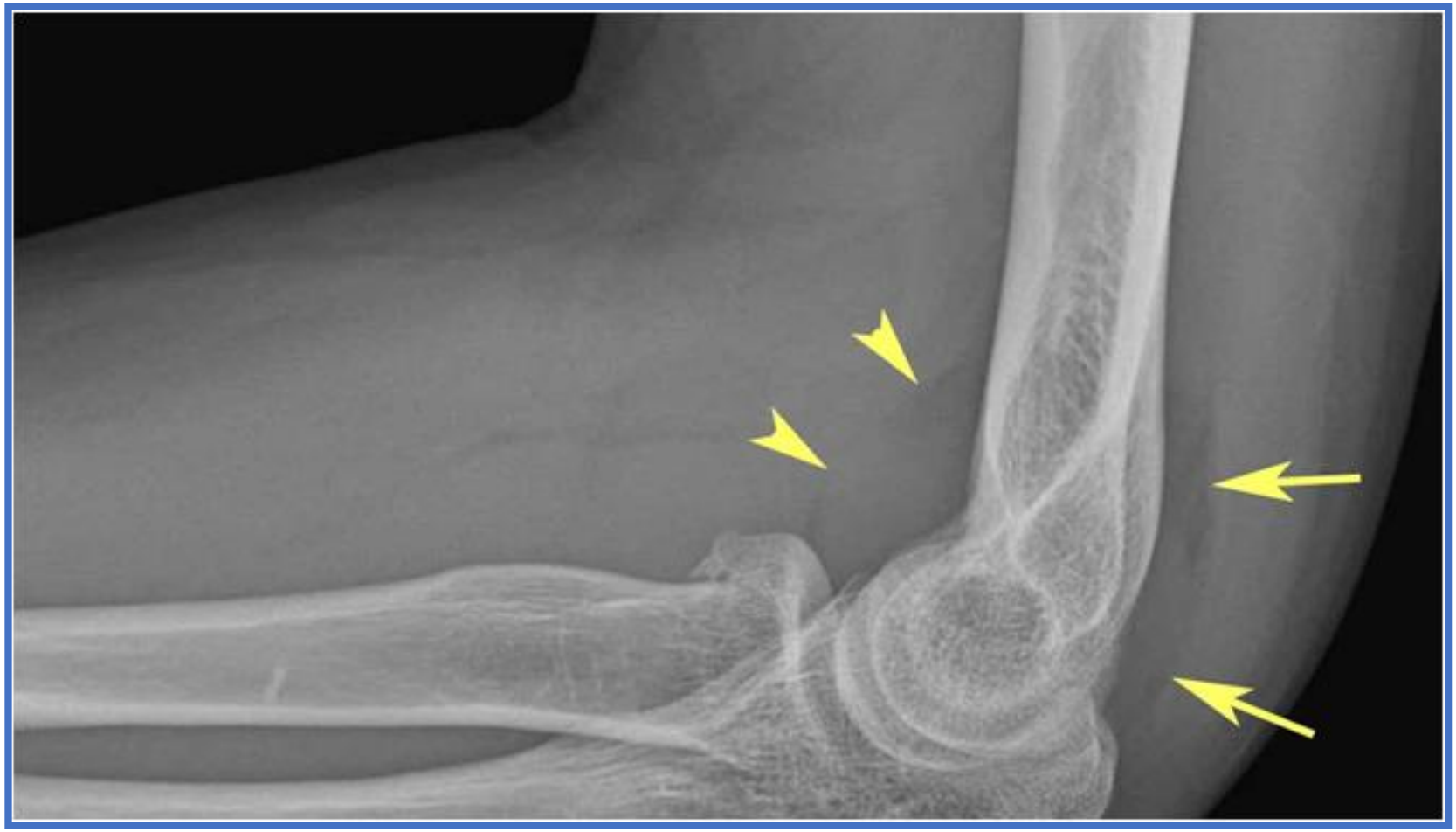
Soft tissue/fluid



Bone

Principles of reading bone films

- ABCS
- Alignment
- Bones
- Cartilage (space)
- Soft tissues

Alignment

Bones


uis
13.3
14.2
13.3
16.1
13.6
13.5
13.7
12.8
12.9
13.3
BA (GP): 13.49 y (13y6m) (M)
BA SD: 0.45 y
BA SDS: -2.57 (Caucl:u)
BA (TW3): 13.21 y
Age: 16.27 y
BHI: 4.77
BHI SDS: -0.49 (Caucl:u)
BoneXpert: 2.4.5.1

Cartilage

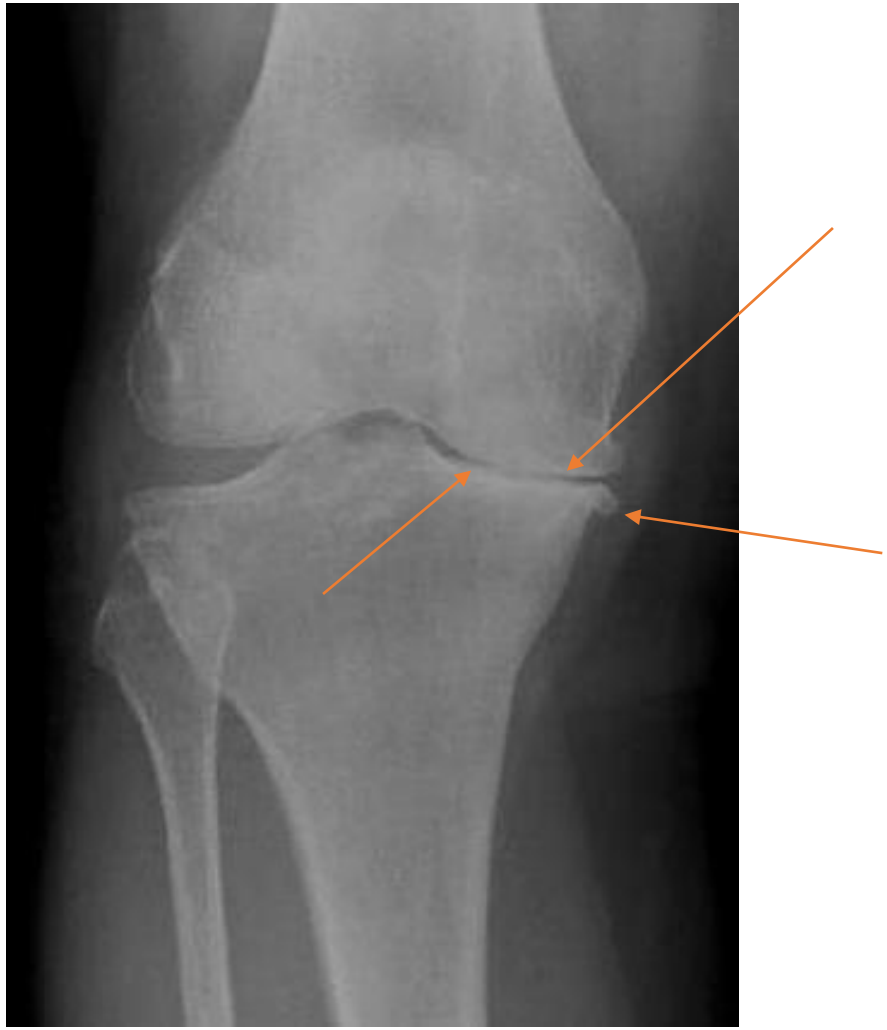
Soft tissues

Osteoarthritis

Joint space narrowing

Osteophyte formation

Subchondral sclerosis



Ultrasound

- Indications
  - Tendon injuries
    - Tears
    - Tendinopathy
    - Tendinosis

How it Works

By generating high frequency sound waves, which “bounce” or echo off tissue, and return to the transducer.

The transducer then converts sound to electrical data to form an image on the screen.

Conceptualize: Images depend on the acoustic properties of tissue. Water transmits sound waves better than air (it is denser) therefore, ultrasound is very useful for detecting fluid filled structures.

Ultrasound

- Indications – high yield for
  - Tendon injuries
    - Tears
    - Tendinopathy
    - Tendinosis

Ultrasound (Cont.)

- Benefits= quick, no radiation, ?in office

- Drawbacks = very dependent on the skill level of the technologist

  Often need another confirmatory test

Examples

- Achilles tear
- Ligamentous disruption
- Tendinitis

MRI (Magnetic Resonance Imagery)

- Soft tissues
- Ligaments
- Tendons
- Cartilage

How it Works

Strong electromagnets and pulses of radiofrequency waves use the potential energy stored in Hydrogen atoms in tissue to create an image using sophisticated computers.

MRI

Advantages

- No radiation
- Highly sensitive data
- Useful where other imaging is not at all helpful

Disadvantages

- Patient cooperation needed for best imaging
- Claustrophobia
- Contraindicated with pacemakers and certain prosthesis
- Risks of dye, when it is needed

Examples

- Ligaments
- Tendons
- Cartilage (MRI)

Menisci

MRI Arthrogram

- Dye (To dye or not to dye)
- *Indicated when there is question of a new cartilaginous tear, or there has been a repair of cartilage in the past :*
- Meniscus repair
- Labral repair
- TFCC tear (Triangular fibrocartilage complex)

MRA Example

CT scan (Computed tomography)

- Benefits= can evaluate joint congruity
  - highly specific for joint step off

- Drawbacks = high dose of radiation
  - Time to test

How it Works

Similar method as X-ray

But multiple rotating beams spiral around the patient who is also moving on a gantry

The images are computer derived by pixilation and can have very sophisticated reconstruction

Patient: Mr. Stanford

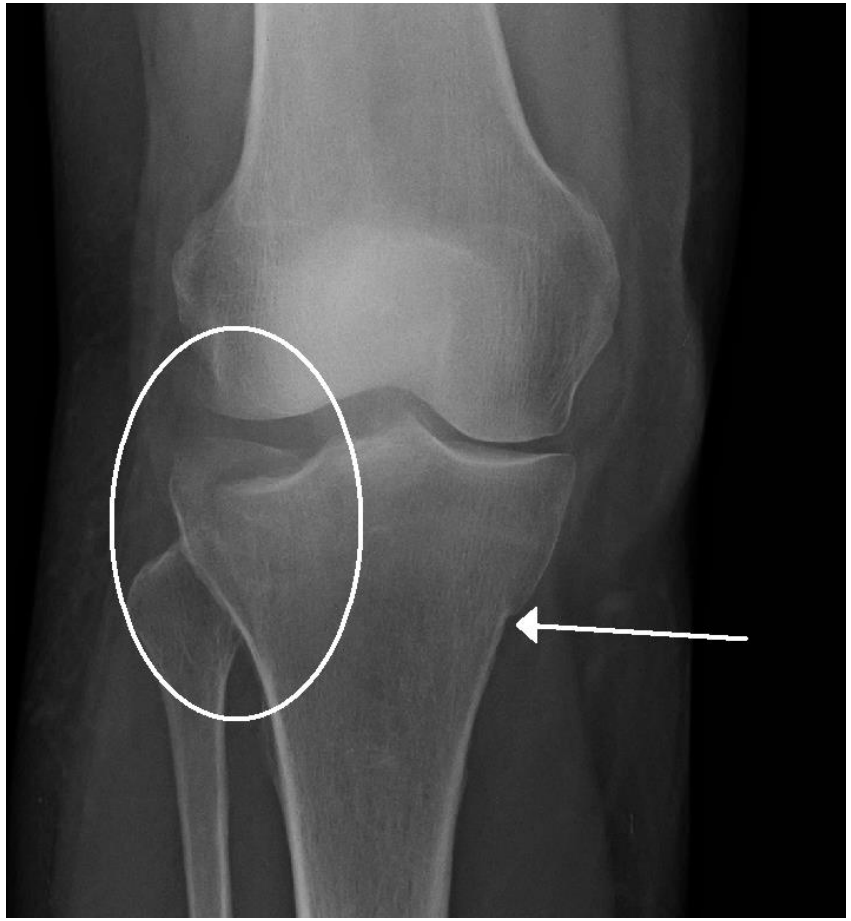
- Active 67 year old, fell off of ski lift with an extended leg. Felt pain, was unable to weight bear. Taken down mountain via ski patrol on sled. Leg was immobilized with knee immobilizer.

- Pain better with rest and ice, worse with weight bearing or motion.

- No numbness or tingling.

- Comes to see you, and you obtain an x-ray. This comes back

CT Case example



- Seeing this lateral tibia fracture, you want more information, so you order a CT scan

CT Results

- The commuted nature of the fracture can be appreciated, as well as the joint step off.

Appropriate use criteria for orthopedic injuries and conditions for x ray and MRI

- National guidelines:
- American College of Radiology (ACR) Appropriateness Criteria

- https://acsearch.acr.org/list

Musculoskeletal			
Topic Name	Narrative & Rating Table	Evidence Table	L
Acute Hand and Wrist Trauma	Narrative & Rating Table	Evidence Table	
Acute Hip Pain—Suspected Fracture	Narrative & Rating Table	Evidence Table	
Acute Trauma to the Ankle	Narrative & Rating Table	Evidence Table	
Acute Trauma to the Foot	Narrative & Rating Table	Evidence Table	Lit S
Acute Trauma to the Knee	Narrative & Rating Table	Evidence Table	Lit S
Chronic Ankle Pain	Narrative & Rating Table	Evidence Table	Lit S
Chronic Back Pain: Suspected Sacroiliitis/Spondyloarthropathy	Narrative & Rating Table	Evidence Table	Lit S
Chronic Elbow Pain	Narrative & Rating Table	Evidence Table	Lit S
Chronic Extremity Joint Pain–Suspected Inflammatory Arthritis	Narrative & Rating Table	Evidence Table	Lit S
Chronic Foot Pain	Narrative & Rating Table	Evidence Table	
Chronic Hip Pain	Narrative & Rating Table	Evidence Table	Lit S
Chronic Wrist Pain	Narrative & Rating Table	Evidence Table	Lit S
Follow-up of Malignant or Aggressive Musculoskeletal Tumors	Narrative & Rating Table	Evidence Table	Lit S
Imaging After Shoulder Arthroplasty	Narrative & Rating Table	Evidence Table	Lit S
Imaging after Total Hip Arthroplasty	Narrative & Rating Table	Evidence Table	Lit S
Imaging After Total Knee Arthroplasty	Narrative & Rating Table	Evidence Table	Lit S
Management of Vertebral Compression Fractures	Narrative & Rating Table	Evidence Table	

Imaging After Shoulder Arthroplasty	ble	Evidence Table	Lit Search
Imaging after Total Hip Arthroplasty	Narrative & Rating Table	Evidence Table	Lit Search
Imaging After Total Knee Arthroplasty	Narrative & Rating Table	Evidence Table	Lit Search
Management of Vertebral Compression Fractures	Narrative & Rating Table	Evidence Table	
Metastatic Bone Disease	Narrative & Rating Table	Evidence Table	
Nontraumatic Knee Pain	Narrative & Rating Table	Evidence Table	
	Narrative & Rating Ta-		

American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Nontraumatic Knee Pain**

Variant 1: **Child or adolescent: nonpatellofemoral symptoms. Initial examination.**

Radiologic Procedure	Rating	Comments	RRL*
X-ray knee	9		☢
X-ray hip ipsilateral	1		☢☢☢
CT knee without IV contrast	1		☢☢
CT knee with IV contrast	1		☢☢
CT knee without and with IV contrast	1		☢☢
CT arthrography knee	1		☢☢
MRI knee without IV contrast	1		O
MRI knee without and with IV contrast	1		O
MR arthrography knee	1		O
US knee	1		O
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			*Relative Radiation Level

Variant 2: **Child or adult: patellofemoral (anterior) symptoms. Initial examination.**

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Thank You!