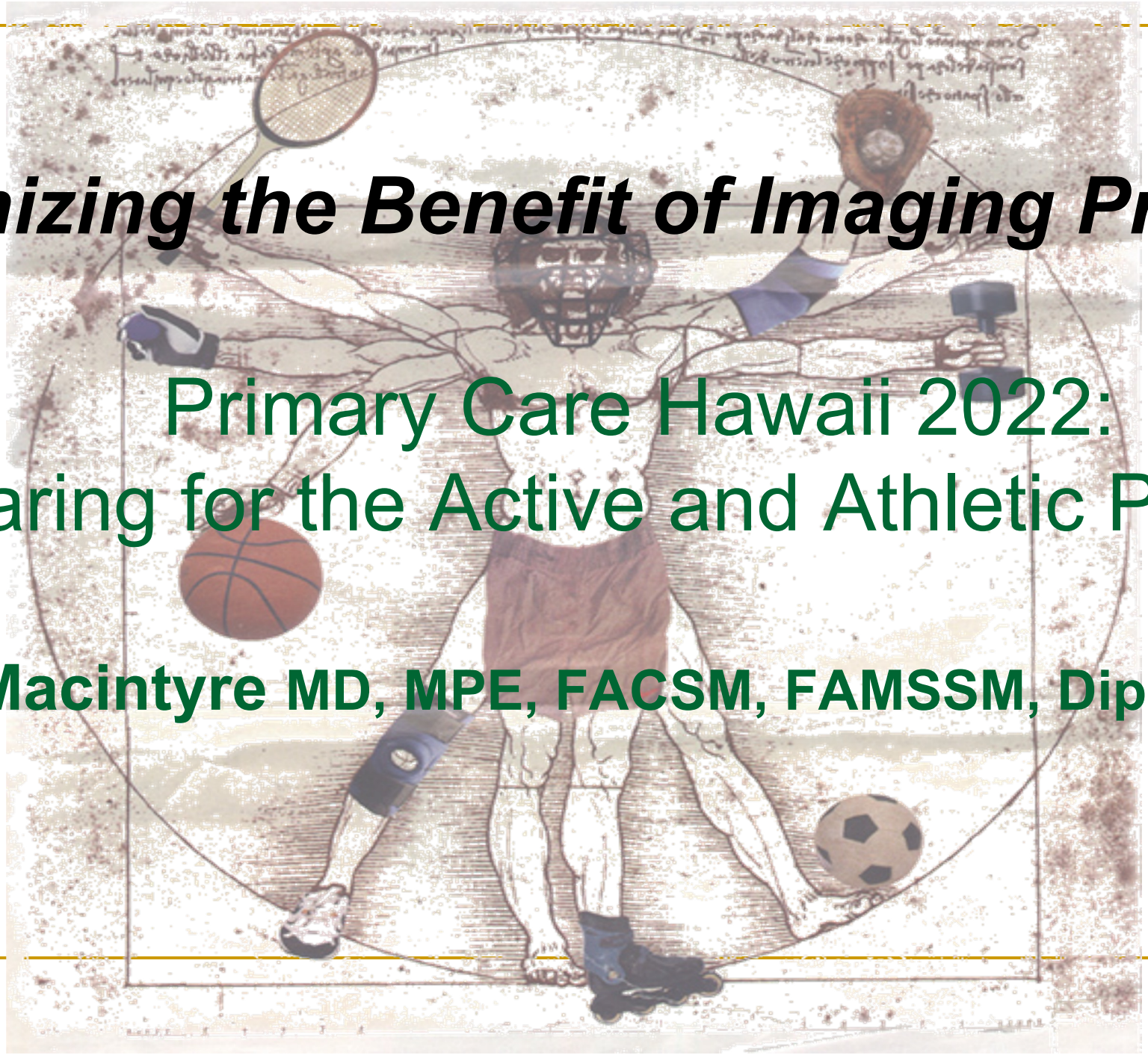
Maximizing the Benefit of Imaging Procedures



Primary Care Hawaii 2022:
Caring for the Active and Athletic Patient

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Disclosures

- I have no disclosures to make.
- No off-label medication use will be discussed.

Objectives / Outline

- Imaging is a valuable tool in assessing a patient, but it is not infallible
- It is only one part of arriving at the correct diagnosis
- We will discuss guidelines for ordering imaging, limitations, some simple X-ray views and techniques to optimize your information

Imaging

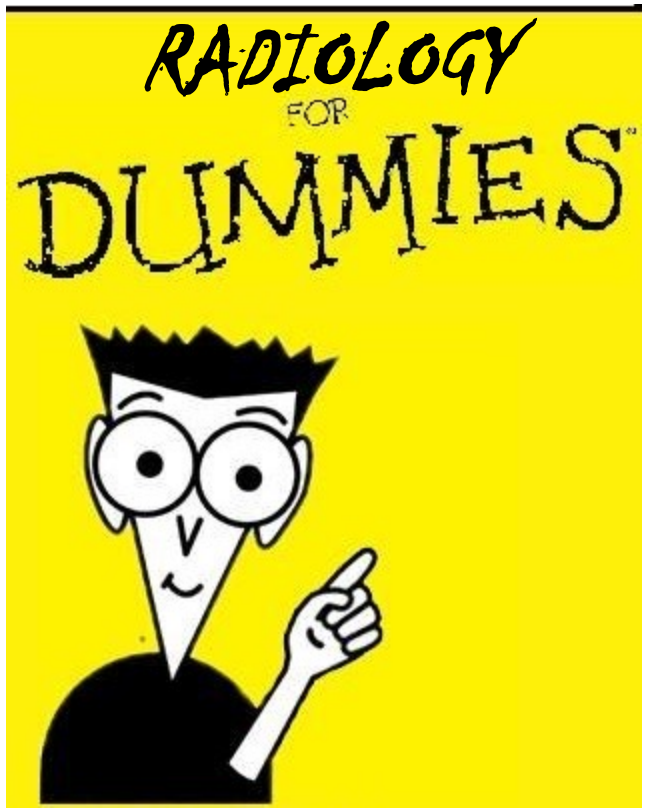
- Imaging is a ***TOOL*** and is not the Holy Grail!
- It is only one part of making a diagnosis and must be correlated with the history and physical findings
- Imaging only shows anatomy, but not where the pain is coming from
- ***Treat patients <u>NOT</u> pictures***

Stand Up for Your X-Rays!

- When looking for OA X-rays should be done in the Standing Weight Bearing Position
  - Lumbar Spine
  - Hip
  - Knee
  - Ankle
- In older patients many knee MRIs un-necessary if standing Weight Bearing views had been done

Look at All Your Images!!

- Most Radiologists are human
- They might not have been given the very specific history and questions that you wrote on the referral
- They can miss things
- They didn't talk to and examine the patient
- Look at the images yourself and call the radiologist if you have questions



Imaging: Important Considerations

- What question do you want to answer?
- What are you going to do with the information?
- Will the test results change your management at that point in time?
- Are you familiar with the limitations of the imaging modality?
- What are the normal, age-appropriate imaging changes – especially with MRI?
- Weight bearing? Bilateral comps?

What Question do you Want to Answer?

- Imaging works best when you have a specific question to answer
- Does the patient have a tear of the medial meniscus? ***NOT*** Why does the knee hurt?
- Does the patient have something impinging on the Right L5 nerve root? ***NOT*** Why do the back and leg hurt?

What are you Going to do With the Information / Answer?

- Are you ordering the test to prove to yourself and the patient how smart you are when you've already made the diagnosis clinically?
- There are times when performing imaging helps meet the patient's expectations / needs
- Avoid low yield X-rays
  - Spine in uncomplicated back pain
  - Skull films in headaches

Will the Results Change Your Management *At **That** Point in Time*?

- A test should be ordered only when the results will direct or change your immediate care
- If you're going to do the same thing whether the test is positive or negative, don't do the test
- Is the patient a surgical candidate at that time based on their current clinical situation?
  - If you suspect a rotator cuff tear, is the patient a candidate for rehab or surgery?
  - If they are a rehab candidate, then delay the MRI and do the rehab.
  - If and when the rehab fails, then do the test.

Will the Results Change Your Management *At **That** Point in Time*?

- Is the suspected diagnosis amenable to surgery?
  - Confirming a degenerative meniscus tear or early arthritis does not make the patient a candidate for surgery
  - If the patient has FAI hip changes and early OA, it is not useful to document a labral tear – surgery not indicated
- Is the patient willing to undergo surgery if the test is positive?
  - If the patient is not interested in surgery at that point in time, then why do the test?
  - The results will not change your management

Are you Familiar With the Limitations of the Imaging Modality?

- Many imaging modalities have false positives and negatives
- There is usually an optimum modality and technique to answer your question
  - MRI vs CT vs Bone Scan
  - Contrast vs Non-Contrast
  - Arthrogram vs Unenhanced study
- If you are unsure, call and ask the radiologist before ordering an expensive / invasive study

What are the normal, age-appropriate imaging changes – especially with MRI?

- Not much on my body looks as good as it did when I was 20
- The “Balding and Greying” of our spine / shoulder / knee / hip
- “I’ve got 5 bad discs in my back!!”
  - If you’re 20 that could be a problem
  - If you’re 80 that’s probably normal
- Imaging changes may have no relationship to the patient’s pain with many false positives

Beware of False Conclusions!

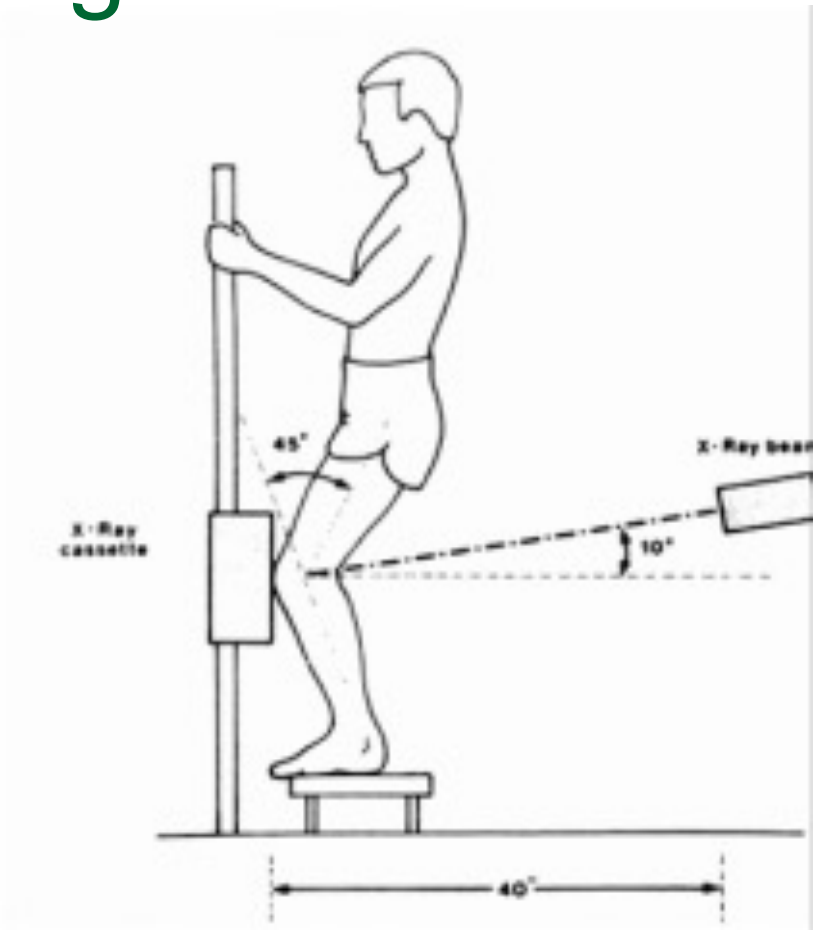
- When a chronic problem flares without trauma or inciting event, remember that the X-rays probably looked the same the day before, when the patient felt fine!
- Case Study: 75 y/o Female who was playing tennis two days earlier now unable to get out of bed due to back pain
- Was told she had arthritis and disc disease
- Died of complications from septic discitis and vertebral osteomyelitis

Knee

- Best standard X-ray views
  - Standing / weightbearing views
  - Merchant vs sunrise view
- MRI and age-related changes

45 Degree PA Weightbearing View

- Comparison + Weightbearing
- Tunnel View
- More sensitive for minor degenerative narrowing



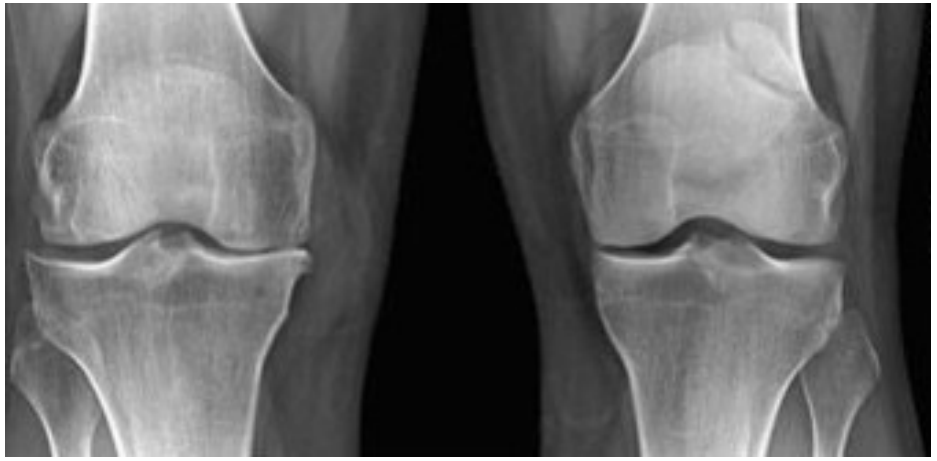
- http://www.cram.com/flashcards/abos-images-of-knee-5923934

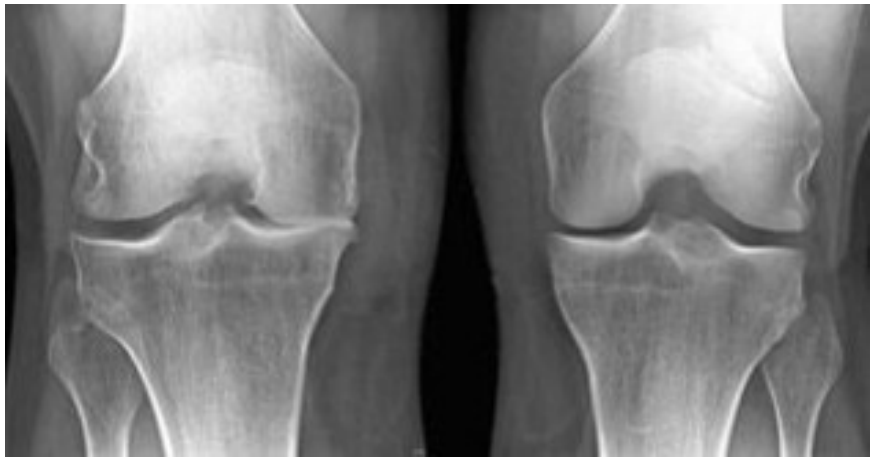
Weightbearing Views

- Weightbearing (WB) views can show subtle narrowing of the tibio-femoral joint space that would not be detected on Non-WB films
- Bilateral comparison even more valuable
- A high percentage of MRIs in patients >40 years would have been unnecessary if flexion weight bearing views had been performed, and 48% of MRIs did not contribute to treatment

- Adelani, M. A., Mall, N. A., et al (2016). The use of MRI in evaluating knee pain in patients aged 40 years and older. *J Am Acad OrthoSurg*, *24*(9), 653-659.

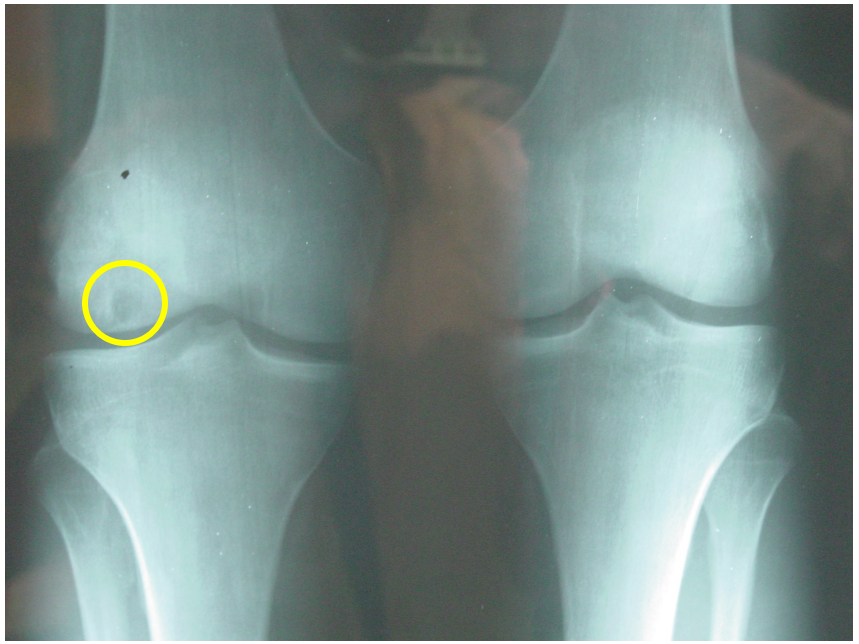
Weightbearing Views



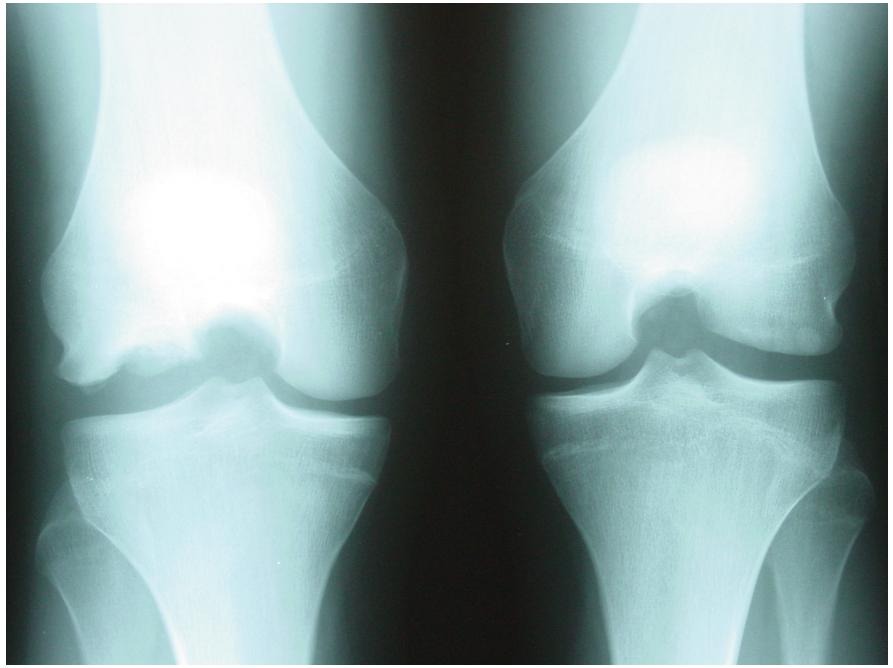


- Standing Zero Degree Weight Bearing
- Standing 45 Degree Weight Bearing

45 Degree Views Ideal for Osteochondritis Dissecans

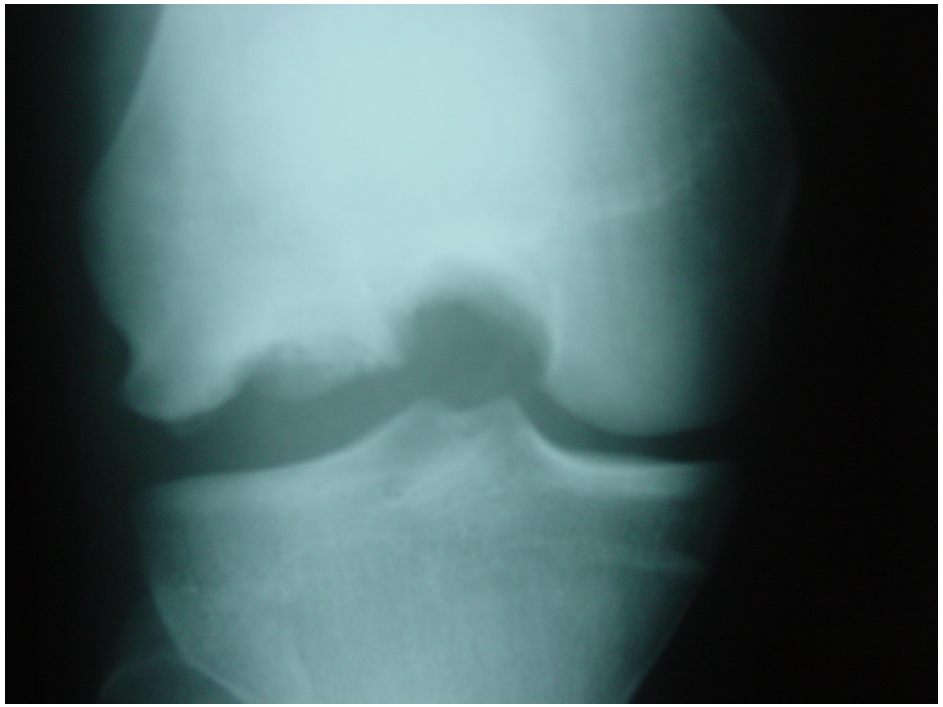


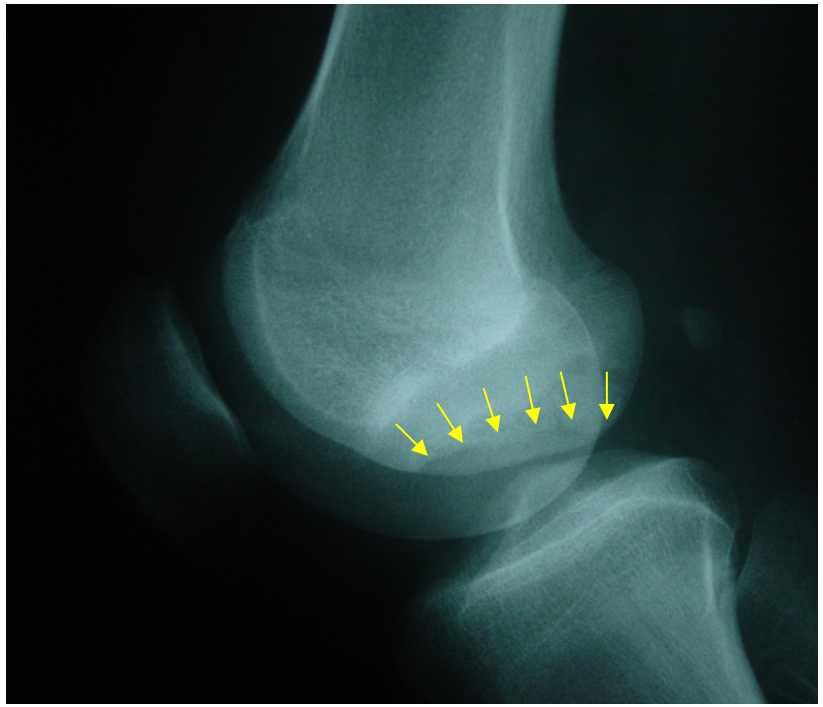
- 0 Degrees



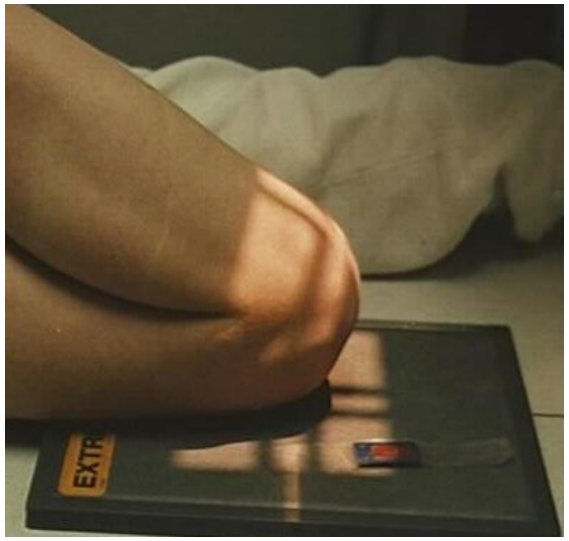
- 45 Degrees

45 Degree Views Ideal for Osteochondritis Dissecans





Skyline / Sunrise Views



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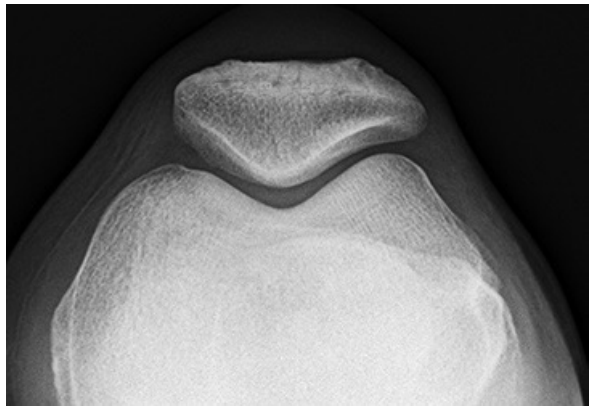
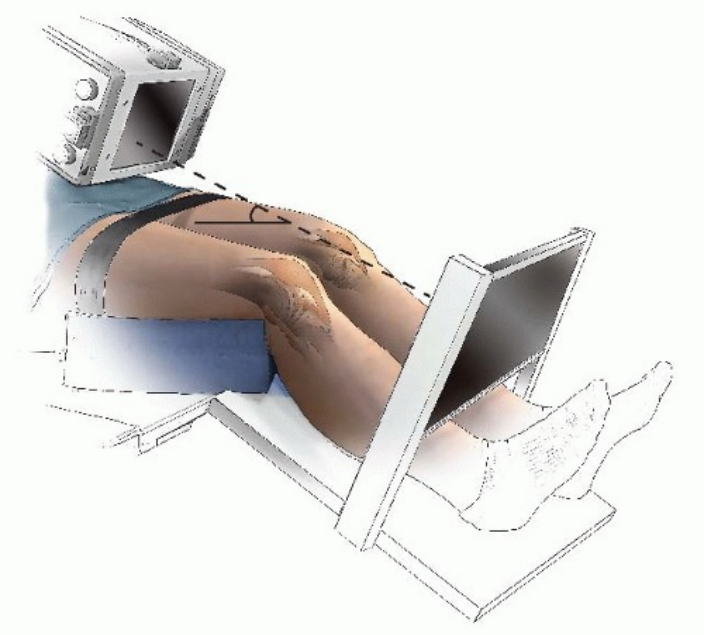


http://www.radtechonduty.com/2015/02/skyline-methods-patellar-xray.html

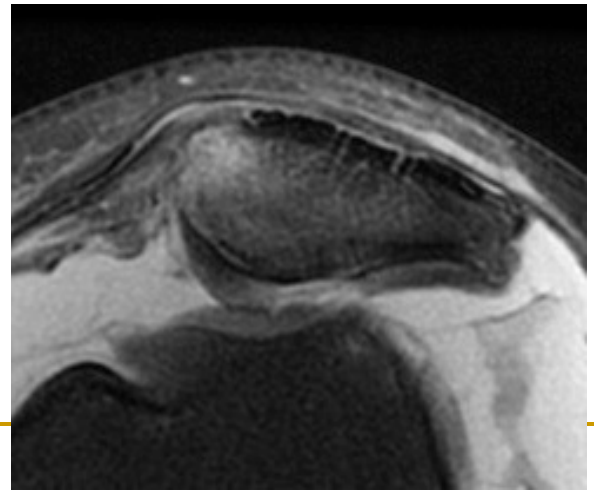
- View taken with knee flexed and patella forced to centralize within the sulcus
- Single knee only – No comparison

Merchant View

- Shows
  - Morphology of patella and sulcus
  - Lateral subluxation and tilting
  - Side to side comparison for symmetry
  - Fractures / osteo chondral injury



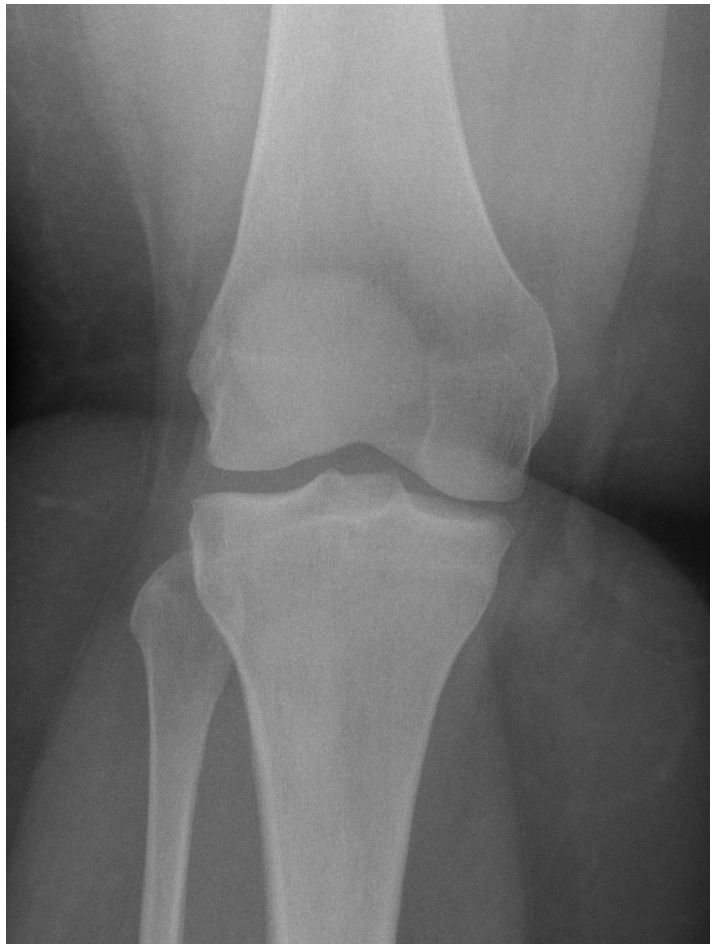
https://musculoskeletalkey.com/sports-medicine-in-the-growing-child/



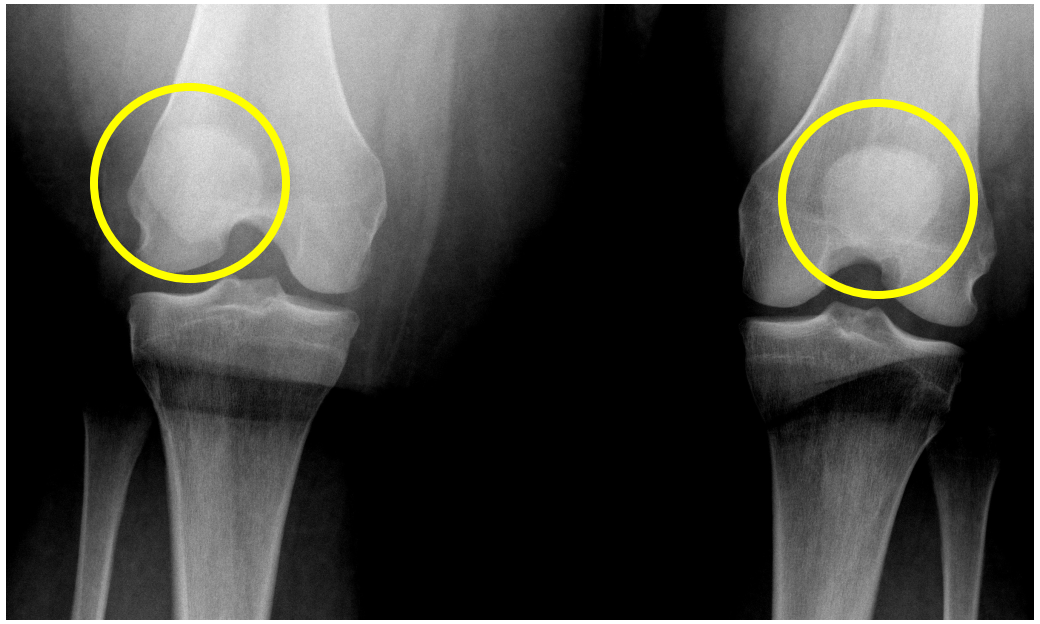
How Bilat Comp Views can Help

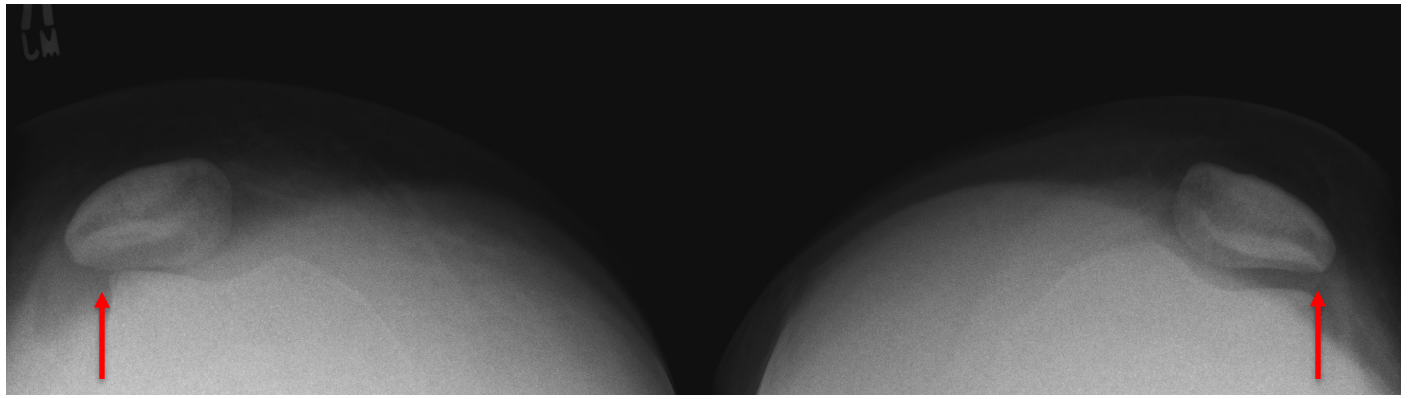
- Slipped on ice
- Felt something move
- Unable to fully weight bear
- Xrays from ER
  - Non WB
  - AP, lateral, 2 obliques

  - ***Looks pretty good!***



How Does it Look Now?





- Acute lateral patellar dislocation
- MRI shows
  - Tear Medial P-F ligament
  - Bone bruise lateral condyle
  - Large chondral defect patella
- Surgery needed

Knee MRI vs Xrays

- Study of MRI findings of OA in patients >50 years with no X-ray changes on WB PA views (Kellgren – Lawrence Grade 0)
- 85+% had MRI evidence of OA, increasing with increased age
- MRI demonstrated that OA prevalent in both patients with pain (90-97%) and without (86-88%), and highest prevalence in patients with mild pain rather than moderate or severe pain.
- ***Thus: Imaging findings correlate poorly with symptoms***

- Guermazi A et al.Prevalence of abnormalities in knees detected by MRI in adults without knee OA. BMJ 2012;345:e5339 Open Access

Meniscal Tears on Knee MRI

- Blinded MRI study in 991 subjects 50+ years of age
- Prevalence of meniscal tear in subjects without Xray evidence OA
  - 32% in painful knees and 23% in painless knees
- Prevalence of meniscal tear in subjects with Xray evidence OA
  - 63% in painful knees and 60% in painless knees
- 61% of subjects with meniscal tears had no pain, aching or stiffness in the previous month
- Incidental meniscal findings on MRI of the knee are common in the general population and increase with increasing age
- "***Increased use of MRI for assessment of knee symptoms may result in considerable confusion, since it may be difficult to discriminate between symptoms associated with a meniscal tear and those associated with another cause"***

- Englund M et al. Incidental meniscal findings on Knee MRI in middle-aged and elderly persons. NEJM 2008:359(11)1108-1115

MRI for degenerative meniscal lesions: Cease and desist!

- High prevalence of degenerative meniscal tears in people over 45 years, and the majority are asymptomatic and secondary to underlying degenerative change
- Guidelines now recommend against arthroscopy for patients with degenerative knee conditions so the utility of MRI in this common clinical scenario is increasingly questionable
- Arthroscopy for meniscal degeneration neither improves long-term knee function nor improves pain associated with functional activities when compared with active rehabilitation
- First-line treatment recommendations for all degenerative knee conditions consist of a combination of exercise, weight loss, education and behavioral support, as well as oral or topical pain medication such as non-steroidal anti-inflammatory drugs
- Degenerative conditions of the knee, including meniscal lesions and osteoarthritis, therefore generally **do not benefit from MRI** as MRI findings do not alter the treatment plan
- Warden SJ, van Dyk N. et al (2019) MRI for degenerative meniscal lesions: Cease and desist! Br J Sports Med 53(18):1139-40

MRI and Patello-Femoral OA

- Prevalence of MRI findings of PF structural damage based on cartilage defect was 40% in healthy individuals and 52% in individuals with knee pain
- X-ray prevalence of PFOA was 17% in asymptomatic group and 38% in community based cohorts
- No high quality evidence that PF Pain in younger individuals leads to PFOA

- Hart H et al. The prevalence of radiographic and MRI-defined patellofemoral OA and structural pathology. Br J Sports Med 2017;51:1195-1208

Hip X-rays

- Always do bilateral weight bearing views of the pelvis to assess hips
- This can reveal subtle clear space narrowing and side-side differences not apparent on NWB views
- Might show Femoral-Acetabular Impingement (FAI)
- “Square Peg in the Round Hole”

Hip Xrays and MRI

- High prevalence of abnormalities in asymptomatic subjects with increasing incidence with increasing age
  - Abnormal hip morphology, Hip OA, hip labral tears
- 100% with moderate – severe OA had labral pathology
- "***Only good surgical candidates with chronic hip pain and minimal evidence of OA should be considered for MR Arthrogram***"

- Jayakar R et al. Magnetic Resonance Arthrography and the prevalence of acetabular labral tears in patients 50 years of age and older: Is it really indicated? The Orthopedic Journal of Sports Med 2015;3(7)(Suppl 2)
- Hack K et al. Prevalence of cam-type FAI morphology in asymptomatic volunteers. J Bone Joint Surg Am. 2010;92(A):2436-44
- Frank JM et al. Prevalence of Femoroacetabular Impingement imaging findings in asymptomatic volunteers: A systematic review. J Arthroscopic and Rel Surgery 2015 EPub

Greater Trochanteric Pain Syndrome: The Great Masquerader

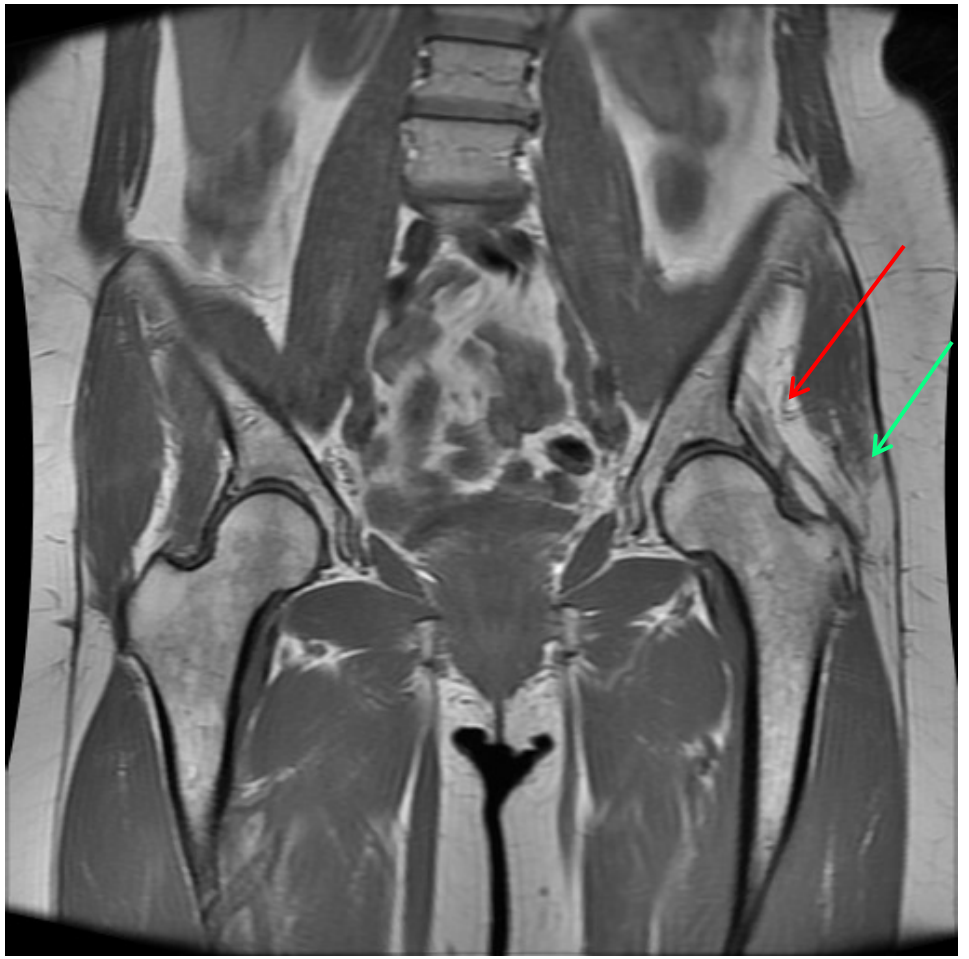
- Lateral Hip Pain / Tenderness often referred to as “Trochanteric Bursitis”
- However: Frequently “tendin***osis”*** not “burs***itis***” (Hence New Name)
- Retrospective review of GTPS patients showed only 20% had U/S evidence of bursitis with ~50% having tendinosis
  - Long SS et al. Am J Radiol:2013; 201:1083-6
- In patients with > 3months of lateral hip pain MRI showed Gluteus Tendinosis (GT) in 77%
  - Grimaldi A, et al. Br J Sports Med 2017;51:519–524

Greater Trochanteric Pain Syndrome: MRI Correlates

- Blinded (to clinical picture) retrospective MRI review showed 88% of hips with trochanteric symptoms had gluteus tendinopathy however 50% of those ***without*** symptoms had such findings
- Blankenbaker DG et al. Skel Radiol: 2008; 37(10)903-909
- Pelvis MRI without clinical history showed findings of Gluteus Medius and Minimus tendinopathy (GT) and partial tears increase with age
- Chi AS et al. Skeletal Radiol, Epub August 11, 2015
- Negative predictive value of MRI changes is high
- Positive predictive value is low
- “Balding and Graying” of the Hip

MRI Findings

- T1 weighted coronal images
- Discontinuity and fatty atrophy of Gluteus Minimus →
- Fatty atrophy Gluteus Medius →



Greater Trochanteric Pain Syndrome: Clinical Test

- Single Leg Stance is the most sensitive test for diagnosis of Gluteus Tendinopathy
- A positive test is reproduction of the patient's lateral hip pain within 30 seconds
- The SLS test has been shown to discriminate participants with MRI-diagnosed GT (100% sensitivity and 38% specificity).

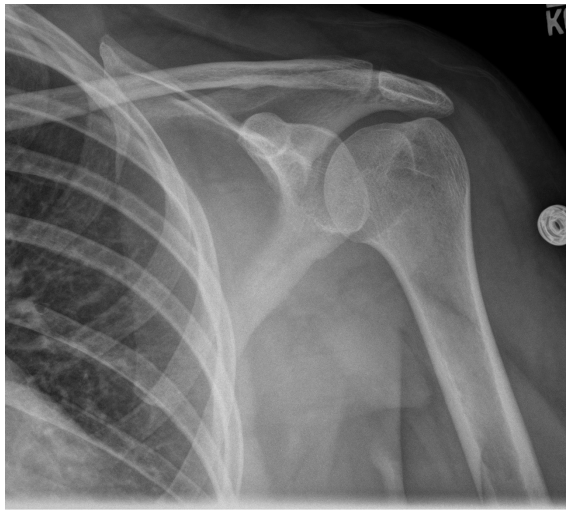
- Grimaldi A, et al. Br J Sports Med 2017;**51**:519–524

Shoulder

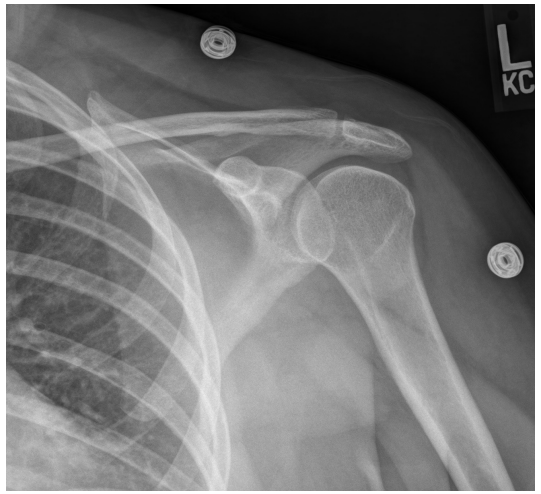
- Best views
- Repeat for occult fracture before MRI
- Shoulder not clavicle views in trauma
- Axillary views in A-C Separation
- Age related cuff changes on MRI

“Standard” Shoulder Views

- You get paid for 2+ views so many just do 2
  - A-P Shoulder in Internal and External rotation
- Not orthogonal so you miss a lot!!!
- Better (for you and the patient) to do 4 views even if you don’t get paid

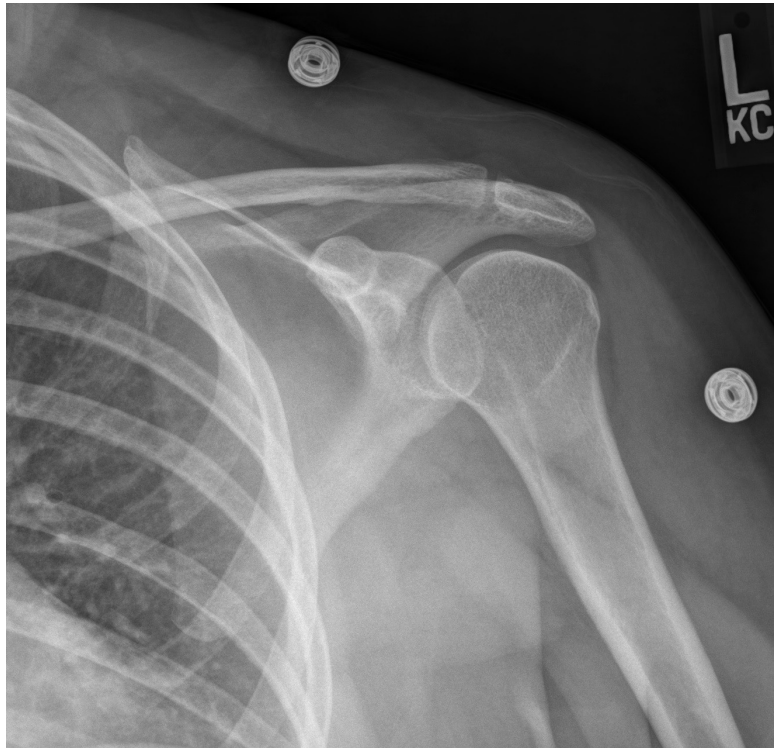


External Rotation



Internal Rotation

Best XRays: 4 Views



- A-P Shoulder

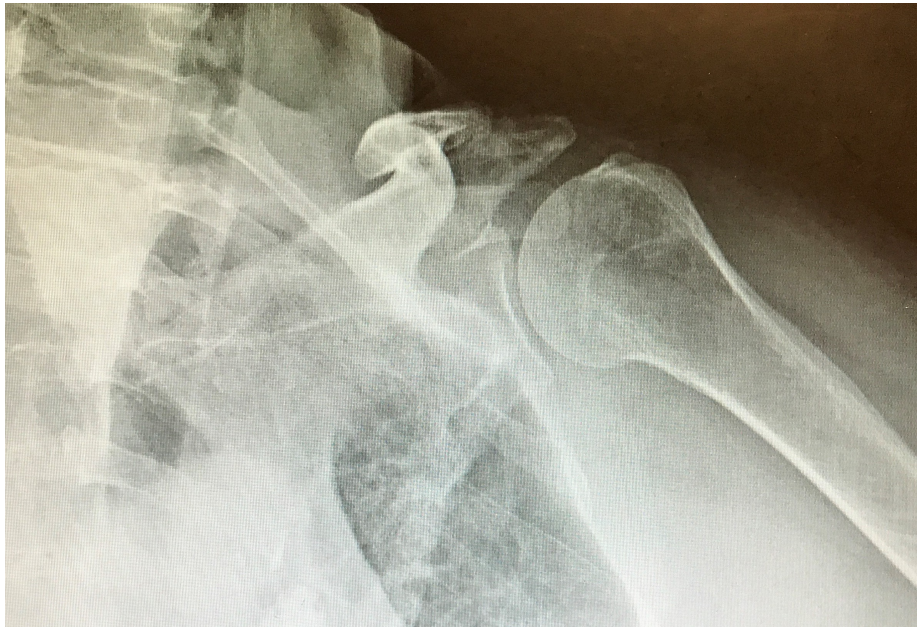
- True A-P Glenoid

Best Views

- Outlet View

- Axillary View

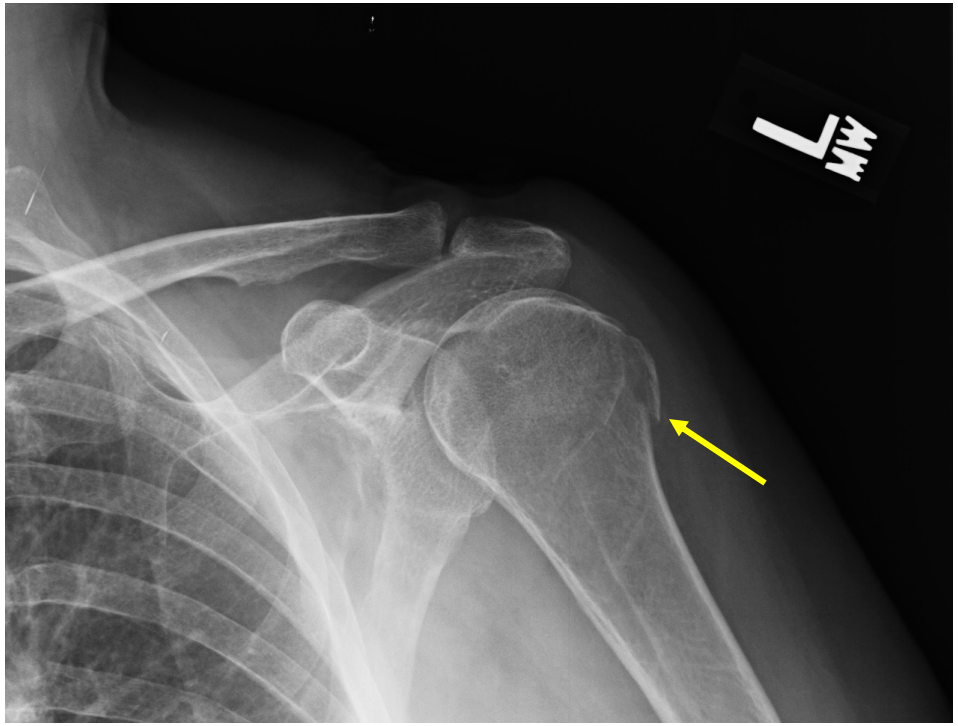
Trauma: Initial Films Normal

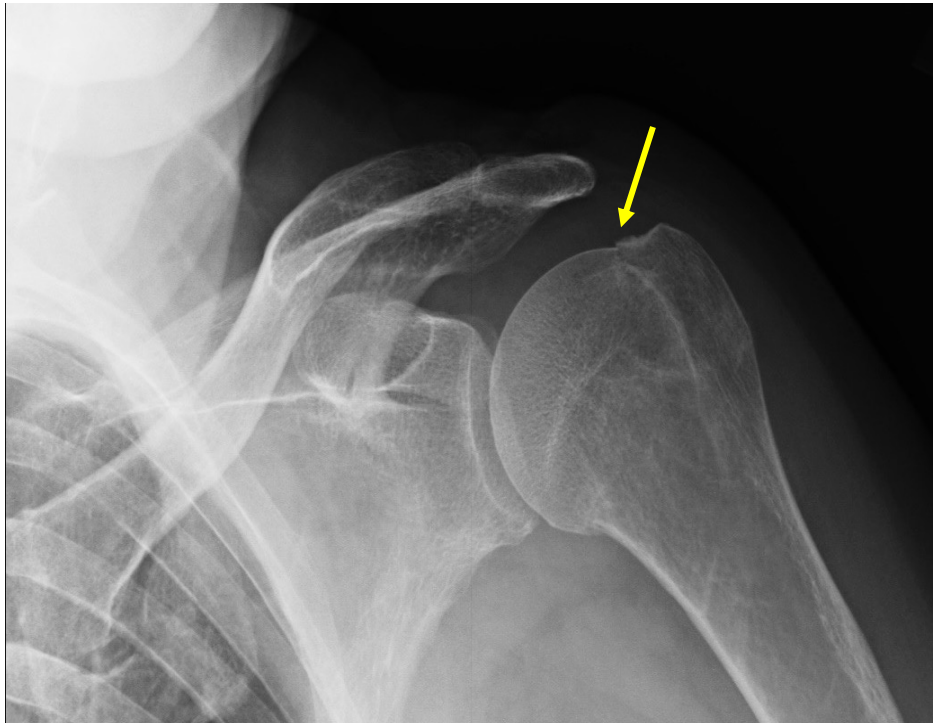


- Fall onto shoulder with immediate pain
- X-rays in Urgent Care read as “Normal” by radiologist

Persistent Pain and Weakness at 2 Weeks

- Order MRI?
- NO! Repeat Films
- Make diagnosis for $60 not $700





Full Thickness Cuff Tears with Age

- Screening study showed 22.1% had full-thickness rotator cuff tears.
  - 0% in the 20s to 40s
  - 10.7% in the 50s
  - 15.2% in the 60s
  - 26.5% in the 70s
  - 36.6% in the 80s.
- Symptomatic 34.7%, Asymptomatic 65.3%.
  - Asymptomatic: 1/2 in the 50s, 2/3 over 60.

- Minagawa H et al. Prevalence of symptomatic and asymptomatic rotator cuff tears in the general population: From mass-screening in one village. Jorthop, 2013 Mar; 10(1): 8–12.

Cuff Tears with Age

- Prevalence of cuff abnormalities increases with age
  - Overall:
    - 9.7% age ≤20 to 62% age 80+
  - Asymptomatic subjects:
    - 6.7% age 20+ to 56% age 80+
  - Symptomatic subjects:
    - 9.9% to 50%
- "***The prevalence of RC abnormalities in asymptomatic people is high enough for degeneration of the rotator cuff to be a common aspect of normal human aging and to make it difficult to determine when an abnormality is new or is the cause of symptoms"***

- Teunis T et al. A systematic review and pooled analysis of the prevalence of rotator cuff disease with increasing age. J Shoulder Elbow Surg. 2014; 23:1913-1921

Does Pain Correlate to Imaging?

- 67 patients with confirmed cuff tears diagnosed with blinded MRI review
- Cuff tear size and thickness were not correlated with pain and function
- Fatty infiltration, muscle atrophy and tendon retraction were not associated with pain and disability scores
- Mental health, age > 60 associated with higher pain scores
- Mental health, age < 60, females, and comorbidities were significantly associated with higher disability scores

- Curry, EJ et al. Structural characteristics are not associated with pain and function in rotator cuff tears. Ortho J Sports Med 2015:3(5) Sage Open Access

Does Pain Correlate to Imaging?

- 393 subjects with atraumatic, MRI confirmed, full thickness tears treated with therapy
- Extent of tear, retraction and humeral head migration did not correlate with pain
- Comorbidities, lower education level, race did correlate with pain

- Dunn WR et al. Symptoms of pain do not correlate with rotator cuff tear severity. J Bone Joint Surg Am 2014;96:793-800

Spine Imaging: Tricky

- Imaging only shows anatomy, not where the pain is coming from
- Correlation with history and examination is essential
  - Determine which root(s) are likely involved based on pain distribution, presence of nerve tension, and which muscles are weak ?
- Critical that you ask a specific question before ordering an MRI
  - Is something impinging on the Right L5 nerve?
- Remember age related changes are common!!

Indications for Spinal Imaging

- Patients with 6 weeks of medical management and Physical Therapy (PT) with little or no improvement
- “Red Flags” for serious underlying conditions (Prevalence) : Cauda equina (0.04%), malignancy (0.7%), fracture (4%) and infection (0.01%)
- Patients with severe or progressive neurologic deficit should have MRI

- Patel ND et al. ACR appropriateness criteria low back pain. JACR 2016;13(9) 1069-1078
- Chou R. et al. Diagnostic imaging for low back pain: Advice for high-value health care from American College of Physicians. Ann Intern Med 2011;154:181-189

Inappropriate Spine Imaging Harmful!

- Misinterpretation of results by clinicians results in unhelpful advice, needless subsequent investigations and invasive interventions
- Misinterpretation of results by patients results in catastrophisation, fear and avoidance of movement and activity and low expectations of recovery
- Potential adverse side effects of radiation exposure
- Cost $$

Darlow B et al. It is time to stop causing harm with inappropriate imaging for low back pain. Br J Sorts Med. 2017; 51(5) 414-415

Inappropriate Spine Imaging Harmful!

- Abnormal imaging findings
  - Increasingly prevalent in asymptomatic populations
  - Correlate poorly with pain and disability
- Early use of MRI for back pain leads to increased disability, poorer perceived prognosis and a greater chance of back surgery.

- Darlow B et al. It is time to stop causing harm with inappropriate imaging for low back pain. Br J Sorts Med. 2017; 51(5) 414-415

Spinal MRIs are Notorious Liars!

- Review of 33 studies with 3110 asymptomatic subjects
  - Disc Degeneration: 37% @ 20 yrs to 96% @ 80 yrs
  - Disc Bulge: 30% @ 20 yrs to 84% @ 80 yrs
  - Disc Protrusion: 29% @ 20 yrs to 43% @ 80 yrs
  - Annular Tear: 19% @ 20 yrs to 29% @ 80 yrs

- ***"Many imaging-based degenerative features are likely part of normal aging and unassociated with pain. These imaging findings must be interpreted in the context of the patient's clinical condition"***

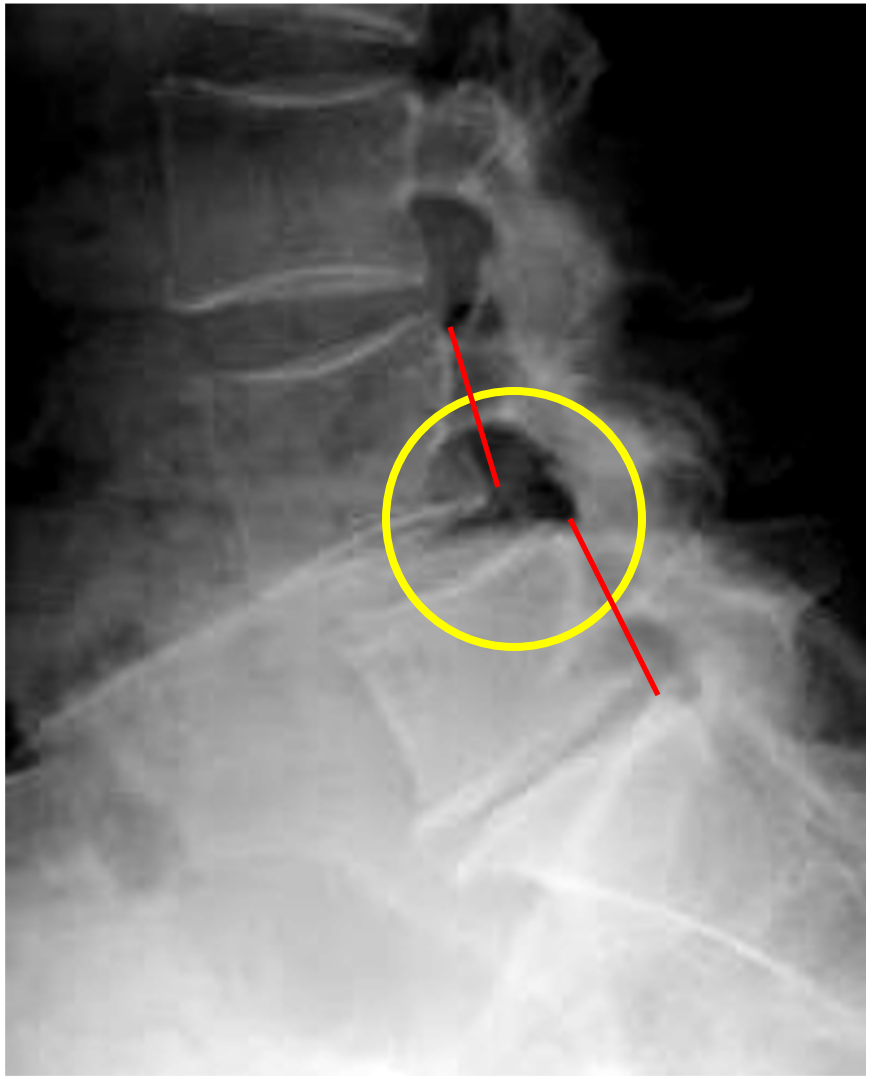
- Brinjikji W et al. Systematic literature review of imaging features of spinal degeneration in asymptomatic populations. Am J Neuroradiol. 2015; 36:811-816

Where's the Stenosis?

- Patient had classical symptoms of spinal stenosis
- Walking related buttock and thigh pain
- Relieved with squatting and leaning on shopping cart
- Neuro exam normal
  - No deficit
  - No nerve tension

Where's the Stenosis? Standing UP!

- Same patient!
- MRI is usually done supine, so spondylolisthesis naturally corrects and spinal stenosis may be masked
- Standing views will reveal slip which may increase with flexion and extension
- Always do lumbar X-rays standing!

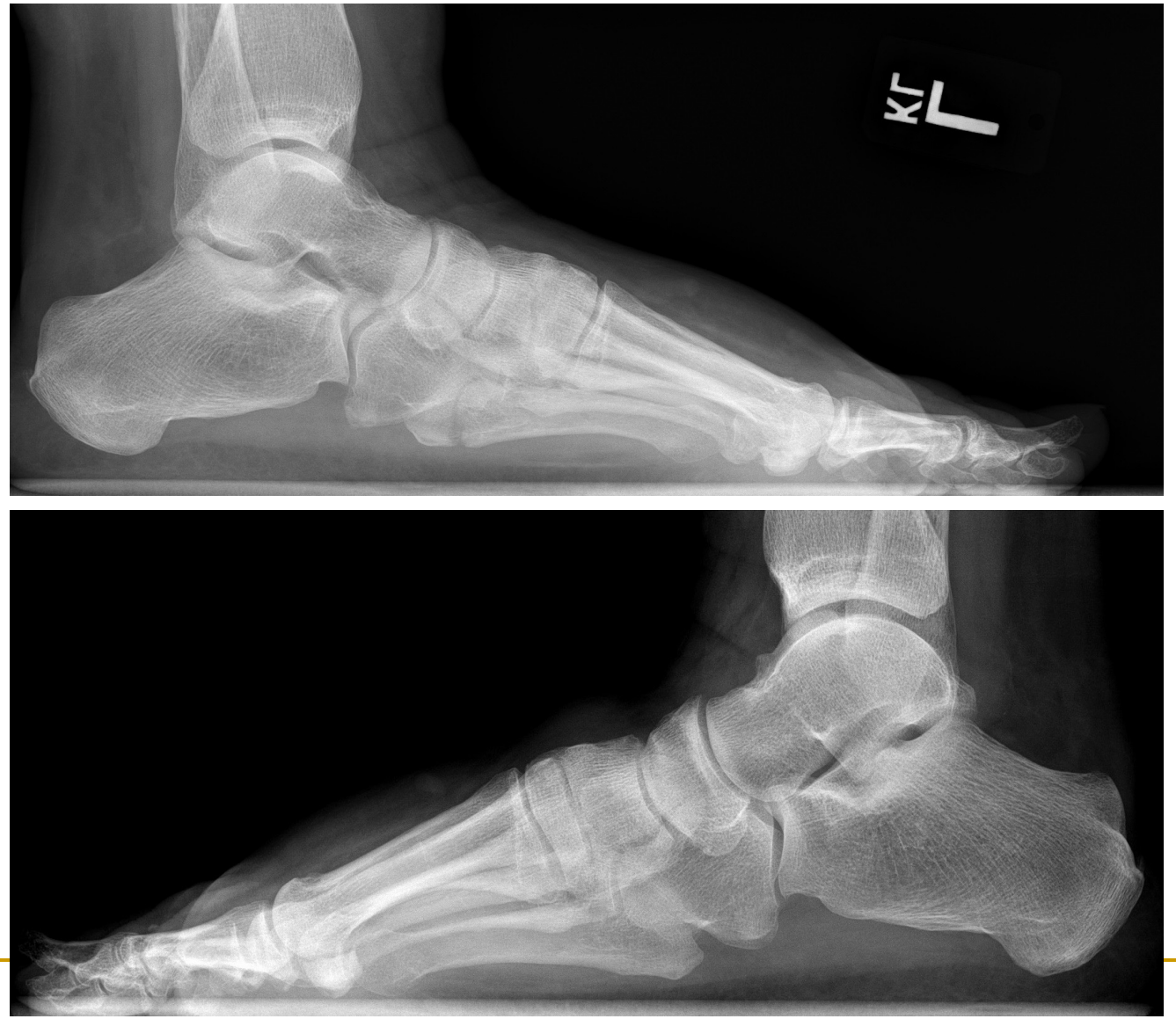


Foot and Ankle

- Best views
- Weight bearing views with bilateral comps
  - Important in OA, Lisfranc injury
- Examine the patient first to make sure you get the right views (Foot vs Ankle)
- Most commonly missed fractures around the ankle
- Gravity stress views
- Maisonneuve fracture – get proximal fibula

Standing Foot X-rays

Standing Foot X-rays



Standing Ankle X-rays

Ankle Pain vs Foot Pain

- Before ordering routine ankle films for an “ankle sprain” have the patient point to the exact site of the pain
- It may be in the foot, not the ankle!

Gravity Stress View Ankle

- Non-displaced distal fibula fracture
- BUT
- Tender medially
- What now??

Gravity Stress View Ankle

- Ankle hangs over the edge of the Xray table
- Medial side up
- Gravity widens mortice

Wrist and Hand

- Beware occult fractures
  - Scaphoid and Radial styloid fractures may not show up on initial Xrays.
  - Splint / cast as if fracture, repeat X-ray 1-2 weeks
- If you need to know: Do MRI
- Watch for instability
  - Scapho-lunate
  - CMC joint
- Stress views - bilateral comps

Scapholunate: Plain Films

Non-Stress Views

Stress Comps: Clenched Fist

Stress Comps: Ulnar Deviation

Summary

- Imaging is a tool and is only an adjunct to a good history and complete physical examination
- Asymptomatic age-related changes are common and should not be confused with significant symptomatic pathology
  - Never assume degenerative changes are the source of pain
  - Avoid ordering imaging especially MRIs where age related degenerative changes that are not amenable to surgical treatment are likely to be found Hip, Knee Spine and Shoulder

Summary

- Have a plan in mind when you order imaging
  - What are you going to do with the results?
  - Will they influence your treatment at that moment?
  - Is the finding you are looking to confirm amenable to surgery?
  - Is the patient a surgical candidate?
  - Is the patient ready to act on any potential abnormal imaging findings?
- Two Keys for Plain XRays
  - Bilateral Comparison Views
  - Weight Bearing / Stress Views


Thank You!
Any Questions??