

What Plain Views and When to Order Advanced Imaging

February 1-5, 2017

ACSM Team PhysicianSM Course – Part II

**Essentials of Sports
Medicine: From
Sideline to the Clinic**



Mary Lloyd Ireland, M.D.

Associate Professor

University of Kentucky

Dept. of Orthopaedic Surgery and
Sports Medicine

Lexington, Kentucky

www.MaryLloydIreland.com

San Diego

Sheraton San Diego

Hotel & Marina

San Diego, California



Learning Objectives:

1. Know the images and position of the patient to order for certain diagnoses
2. Understand when to order advanced images after plain X-Rays

I have nothing to disclose.



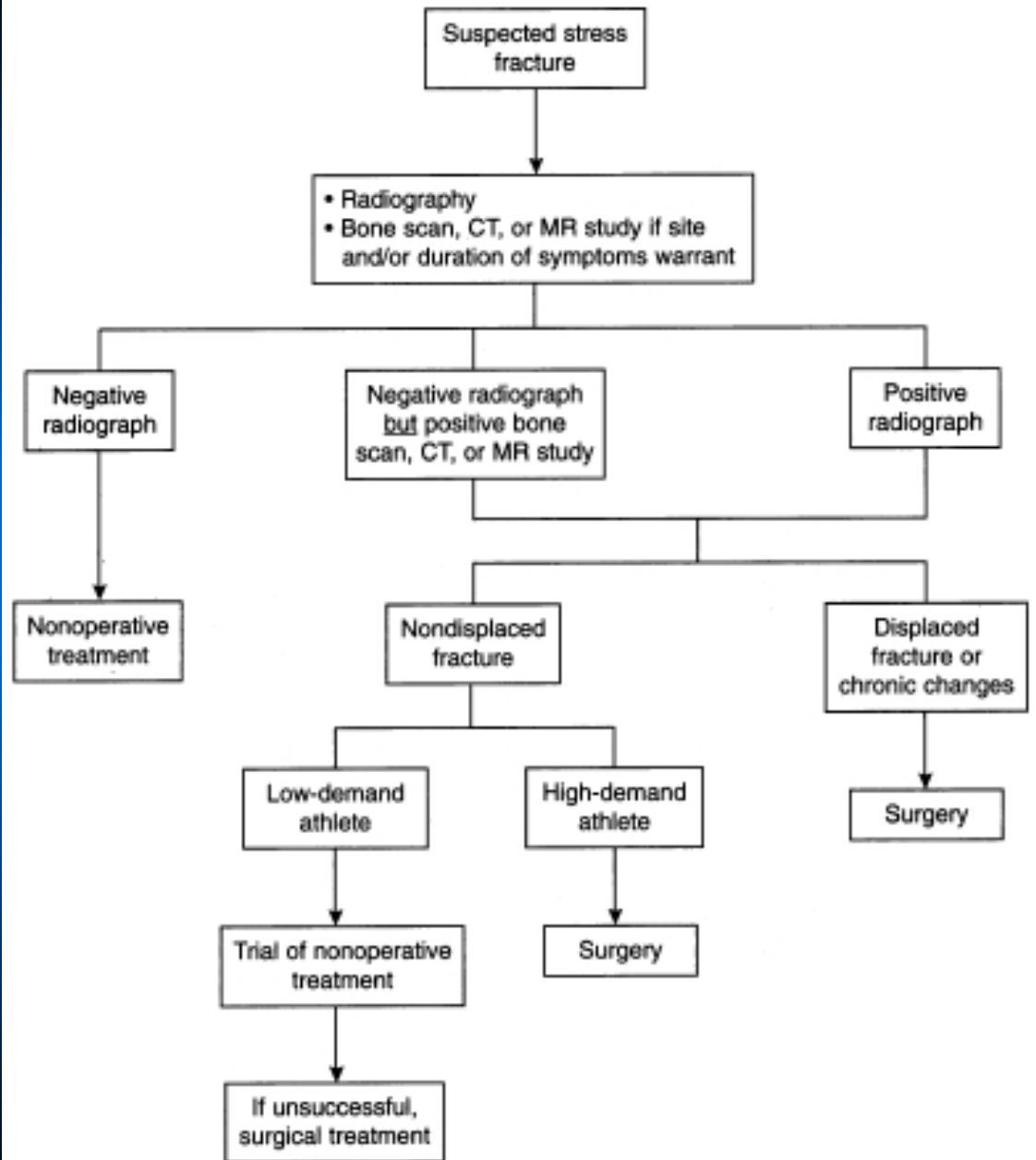
Menu

1. Intro
2. Hip
3. Knee
 - OA Case
 - Bone Bruise
4. Foot
 - Navicular
 - Calcaneus
 - Achilles
5. Conclusions

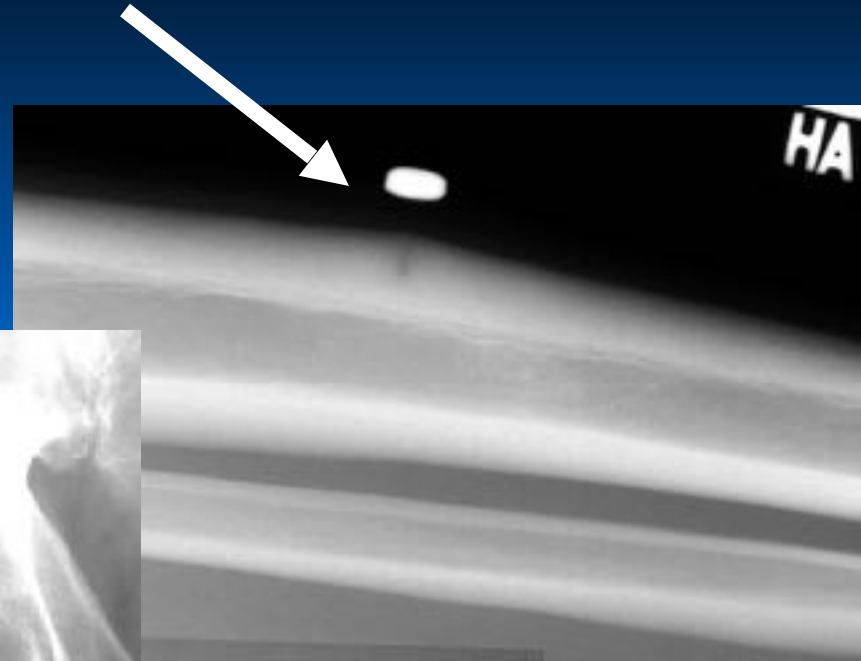
WORKUP

Algorithm for Evaluation and Treatment of Suspected High-Risk Stress Fractures

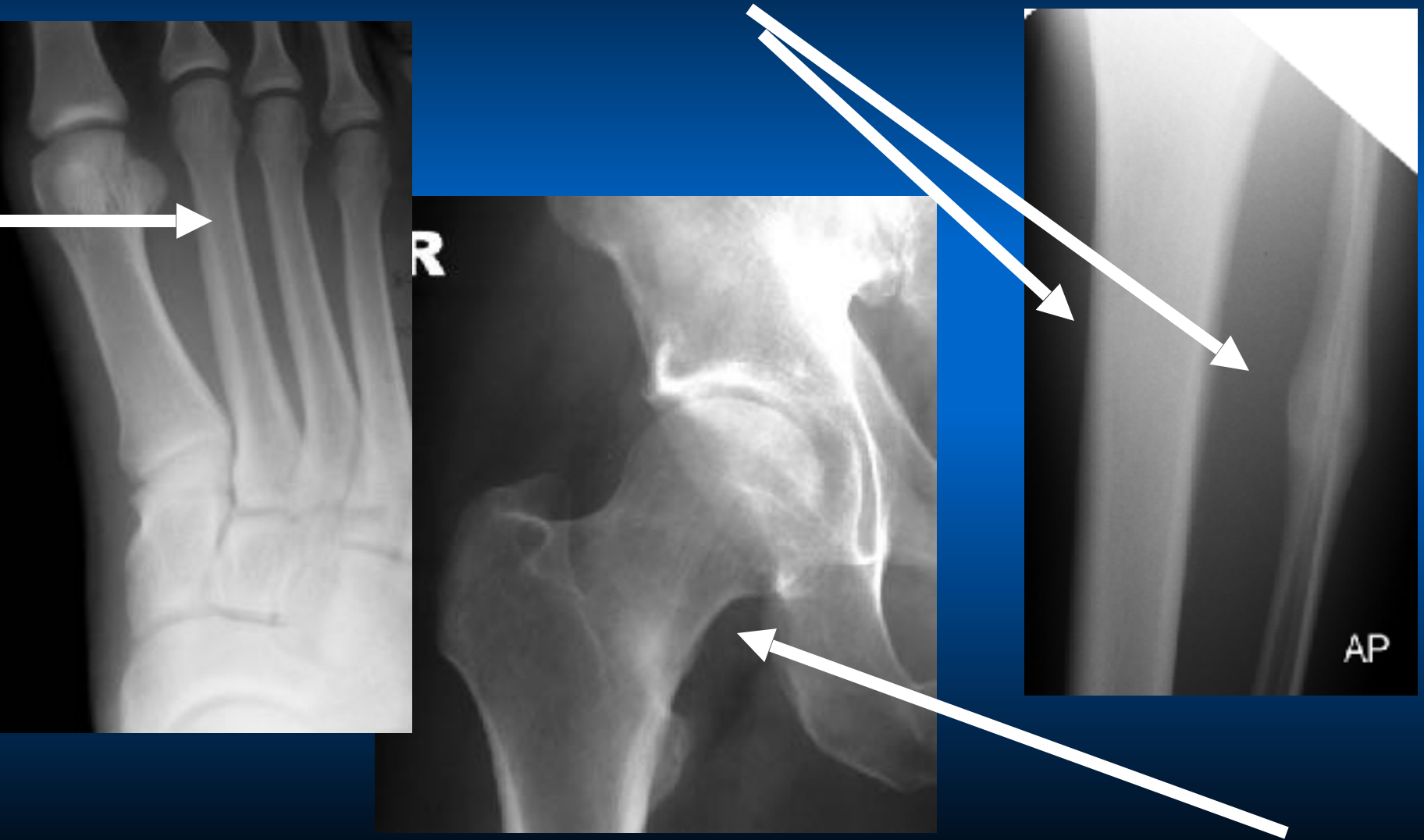
(Reprinted with permission from Boden BP, Osbahr DC. High-risk stress fractures: Evaluation and treatment. *J Am Acad Ortho Surg* 2000; 8(6):344-353, Fig. 1, p. 347.)



High Risk Tensile Side



Low Risk Compression Side



Plain Radiographs LE

- Standardized Views
- Create and Agree within your group/department
- Special Views
 - Marked Cone
 - Stress
 - Comparison

Imaging

- Special Studies
 - MRI scan
 - With or without gadolinium
 - CT scan
 - Ultrasound

When Should an MRI Exam Be Obtained?

- Recent Trauma
- Difficult Physical Exam
- Physical Exam that Does not Match Clinical Symptoms
- Normal Radiographs with Significant Symptoms
- Pre-Operative Planning
- Recent MRI that was Technically Suboptimal

Courtesy Martin L. Schwartz, MD
Clinical Prof. of Radiology, UAB

How Should The MRI Scan Be Performed

- Best Possible Equipment
- Dedicated Coils for the Body Part
- Contrast When Necessary
- Correct Sequences to Define Appropriate Anatomy
- Shortest Exam to Achieve Results and Keep Patient Comfortable

Courtesy Martin L. Schwartz, MD
Clinical Prof. of Radiology, UAB

Contrast Administration

- **Intraarticular Contrast Gives Superior Soft Tissue Contrast and Significantly Enhances Diagnostic Capability**
- **Intravenous Contrast Useful for Post Operative Menisci and Tumors**

**Courtesy Martin L. Schwartz, MD
Clinical Prof. of Radiology, UAB**

IMAGING: MRI SCAN

- Communicate with radiologist skilled in hips. Now better results if intra-articular gadolinium
- Use of intra-articular injection is helpful
 - Lidocaine – if improves symptoms confirms intra-articular process
 - Gadolinium outlines labrum better
- Low resolution studies (small magnet; open scanner)
 - Unreliable except for obvious disease (i.e., AVN)
- High resolution MRI
 - 1.5 Tesla magnet; surface coil
 - Reliability improving
 - Still up to 42% false negative
 - Indirect evidence most reliable (effusion; paralabral cyst; subchondral cyst)
- MRI helpful for:
 - Labrum tear
 - Articular cartilage defects
 - Ligamentum teres tears
 - Impingement
 - Capsule/ileofemoral injury

1.5 Tesla



Courtesy Martin L. Schwartz, MD
Clinical Prof. of Radiology, UAB

0.35 Tesla Open



**Courtesy Martin L. Schwartz, MD
Clinical Prof. of Radiology, UAB**

1.0 Tesla Extremity



Courtesy Martin L. Schwartz, MD
Clinical Prof. of Radiology, UAB

**Thanks to Thomas Byrd M.D.
for the hip images**



Radiographs

- AP pelvis including both hips
 - Properly centered to assess radiographic indices
 - Allows comparison of contralateral hip for subtle variations
 - Allows assessment of surrounding areas (ilium, ischium, pubis, sacrum & SI joints)



Radiographs

- Lateral view of affected hip
 - Frog lateral (lateral of proximal femur; not a true lateral of joint)
 - Consistent, reproducible study
 - Cross table, False profile, Dunn, etc. for specific circumstances

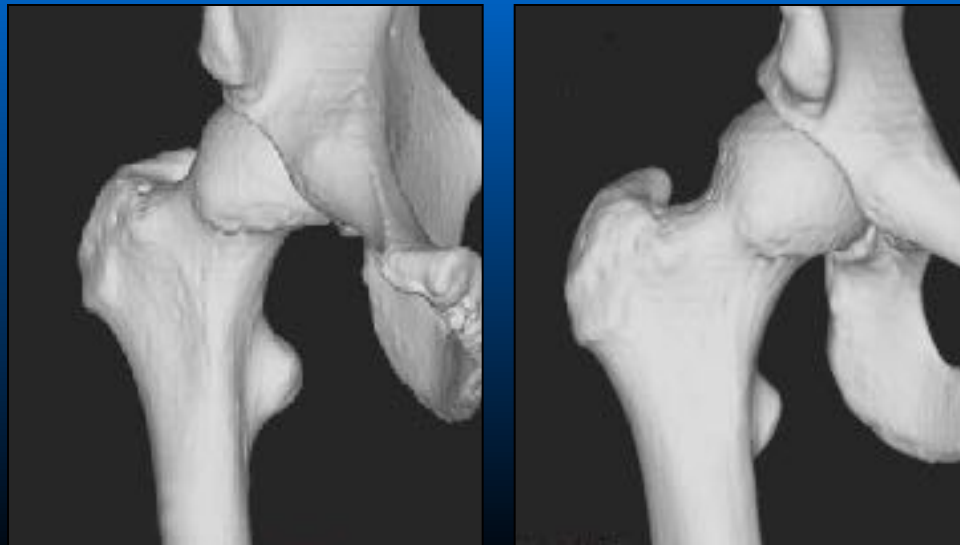


IMAGING: Femoroacetabular impingement

- Helpful identifying morphological variants predisposing to Intra-articular pathology:
- Pincer type (acetabular retroversion)
 - Cross-over sign
 - Posterior wall sign
 - Arthroscopic parameters more sensitive indicator
- Cam-type (proximal femur)
 - SCEF; “Pistol grip” deformity (premature physeal closure)
 - CT reconstruction excellent (!) for three-dimensional architecture

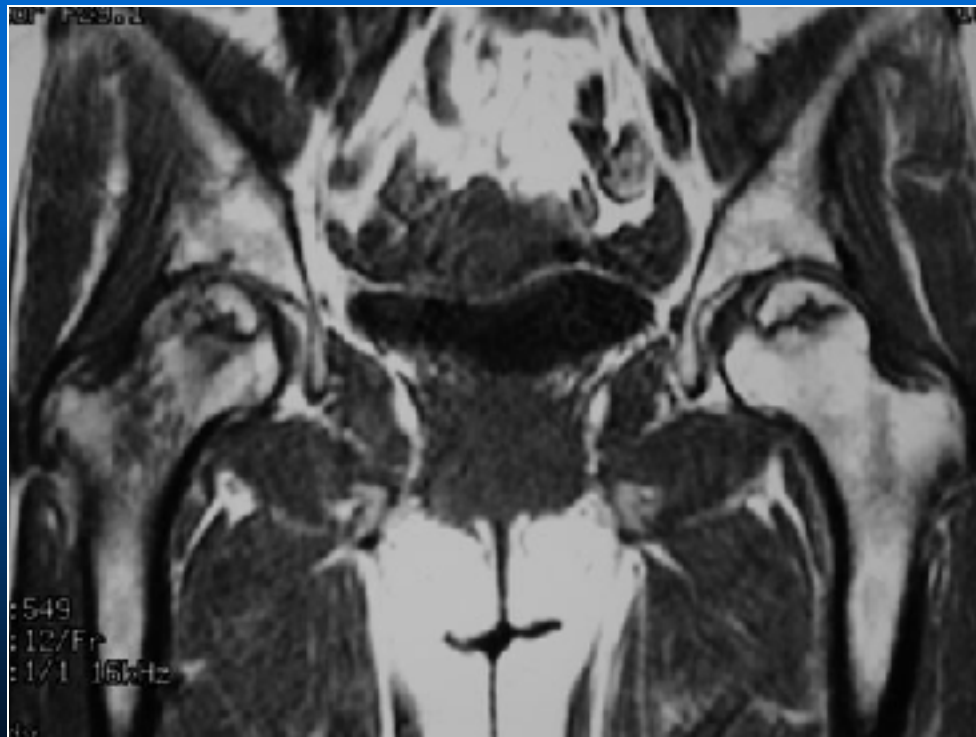
Radiographs

- Helpful identifying morphological variants predisposing to intraarticular pathology
 - Femoroacetabular impingement
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Low Resolution Studies

- (small magnet; open scanner)
 - Unreliable except for obvious disease (i.e., AVN)



High Resolution MRI

- 1.5 Tesla magnet; surface coil
- Reliability improving
- Still up to 42% false negative
- Indirect evidence most reliable (effusion; paralabral cyst; subchondral cyst)



MRA



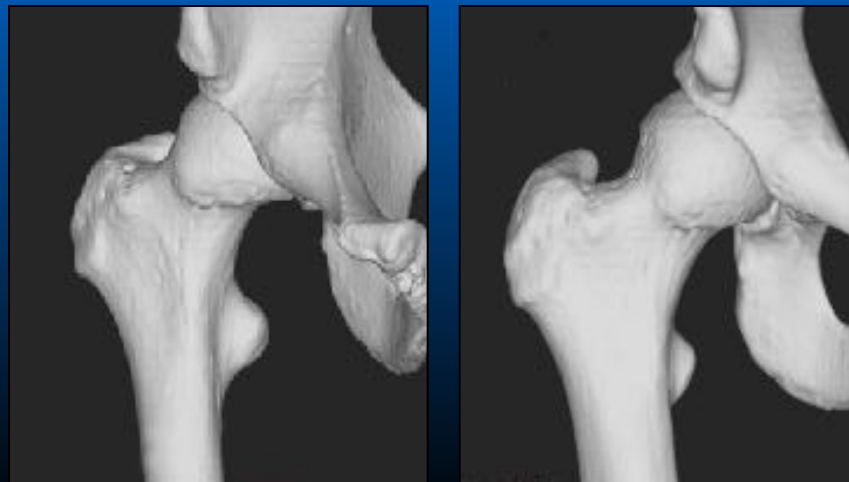
Radiographs

- Helpful identifying morphological variants predisposing to intraarticular pathology
 - Dysplasia (reduced CE angle)



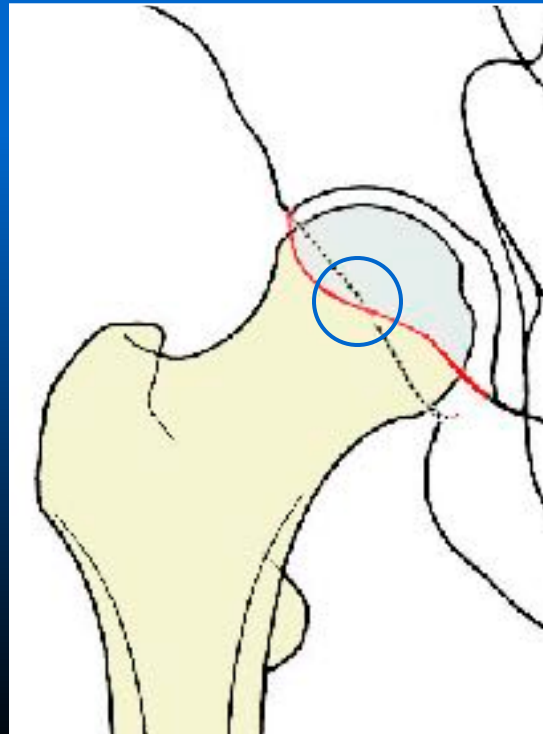
Radiographs

- Helpful identifying morphological variants predisposing to intraarticular pathology
 - Femoroacetabular impingement
 - Cam-type (proximal femur)
 - CT reconstruction excellent(!) for three dimensional architecture



Rim Impingement

- Radiographic indices
 - Cross over sign
 - Posterior wall sign



Rim Impingement

- Radiographic indices
 - Cross over sign
 - Posterior wall sign

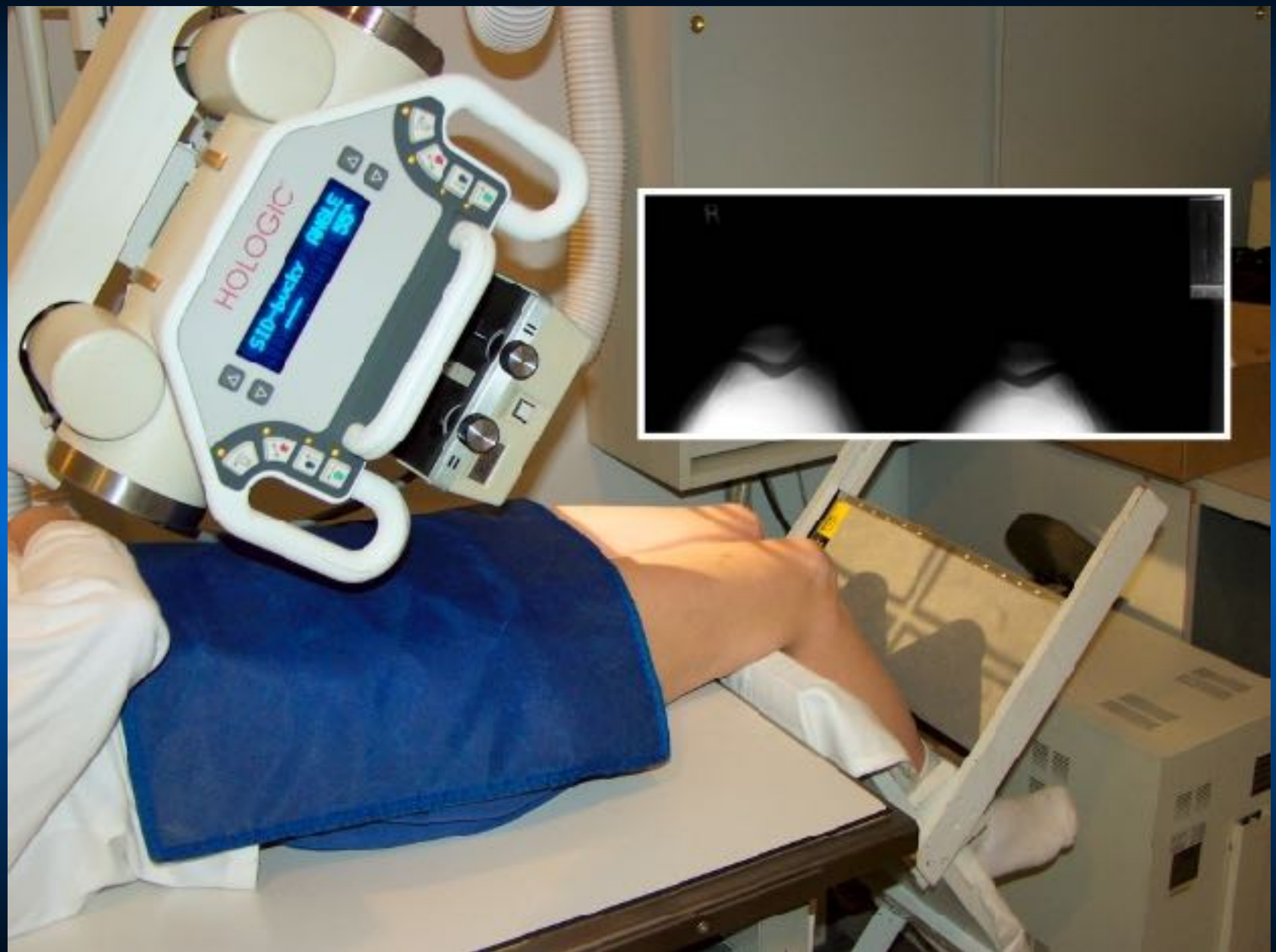


KNEE Radiographs

- **Standing 45° PA, bilateral**
 - **Patellar Views: Merchant or Sunrise Bilateral**
 - **Lateral 45° Flexion**
 - **Notch for Osteophytes**
-
- **Standardize Your Views for All Physicians**
 - **Use Goniometer**
 - **Know Your XRay Technicians**









Osteoarthritis grading systems:

- **Kellgren and Lawrence**
- **Fairbanks**
- **Joint space narrowing JSM –standing radiographs**
- **Ahlback classification**

- **Numerous studies comparing different classifications—there is disagreement on the definition and grading of osteoarthritis, as well as poor correlation with patient symptoms and progression of osteoarthritis.**

45 Degree Flexed Weight-Bearing PA View is most sensitive for detecting joint space loss

Cole BJ, Harner CD, Degenerative arthritis of the knee in active patients: evaluation and treatment. JAAOS 1999, Nov.-Dec. 7(6):389-402.

Dervin GF, Feibel RJ, Rody K, Grabowski J., 3-Foot standing AP versus 45 degrees PA radiograph for osteoarthritis of the knee. Clin J Sports Med. 2001 Jan;11(1):10-6.

IMAGING

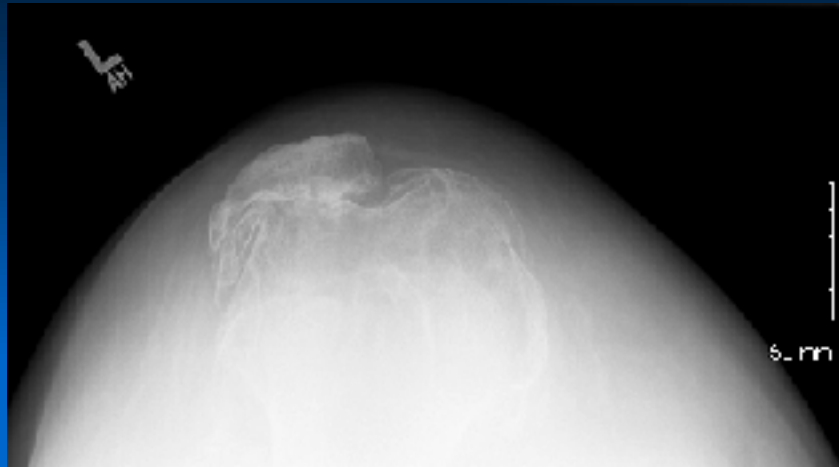
- Plain radiographs
 - Radiographs most important investigative tool
 - Poorly indicative of problems amenable to arthroscopic intervention
 - McCarthy & Busconi, Orthop 1995
- Insensitive indicator of early OA
 - Santori & Villar, Orthop 1999

History & PE

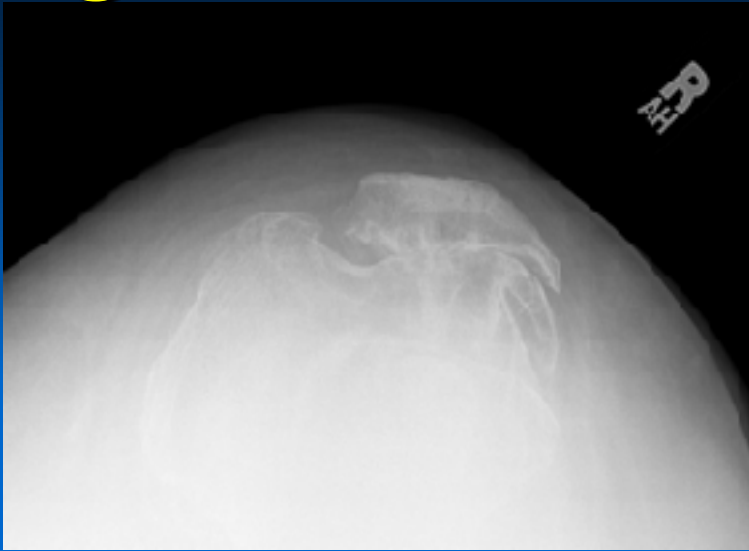
- 55 YO Female
- Difficulty walking due to left knee out of alignment
- Fell 10 years ago and was told she had meniscal tears
- PE: Height 5' 5½", weight 303: BMI 43
- Bilateral Knees:
 - Diffuse crepitus and pain
 - Mild effusion
 - No calf tenderness



Left Knee

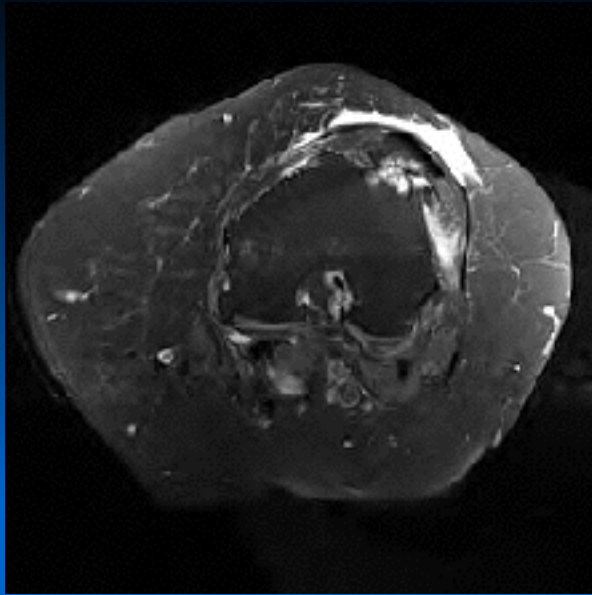


Right Knee



What test would you do next?

MRI



Are more tests needed?



MRI Scan in the Arthritic Knee After 50 years

- **Not Helpful for Articular Cartilage**
- **Meniscal Signal Will Usually Be Abnormal and come to the tibial surface.**

MRI Scan in the Arthritic Knee After 50 years

- Is the root of the Medial Meniscus Avulsed?
- What about my Baker's Cyst?
- Think tree - MRI Scan
 - In a Big Forest – Arthritis
—The Plain Xrays
show us the reason
for stiffness & pain:
Arthritis

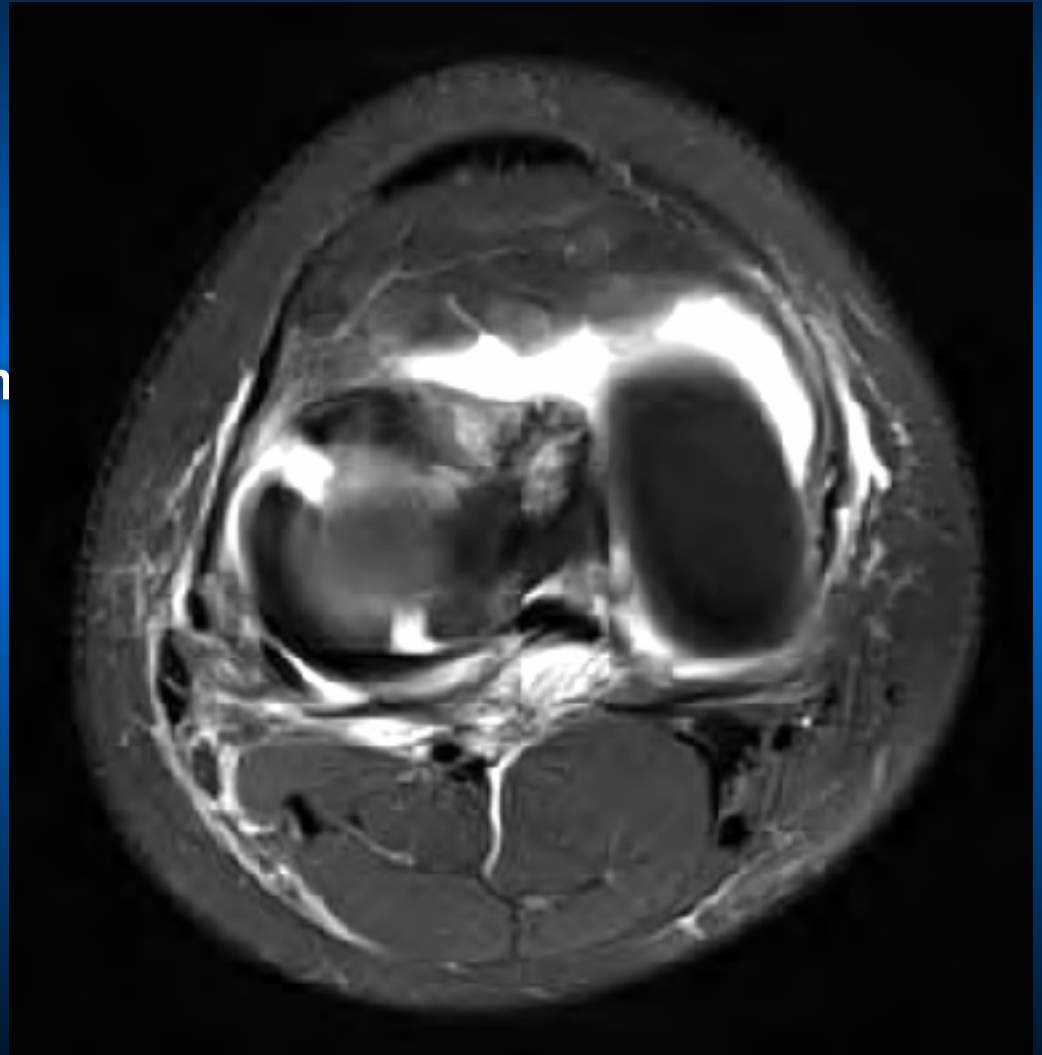


IMAGING THE ARTHRITIC KNEE

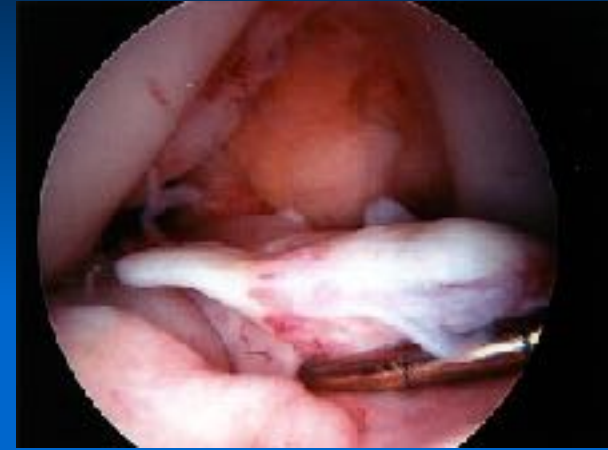
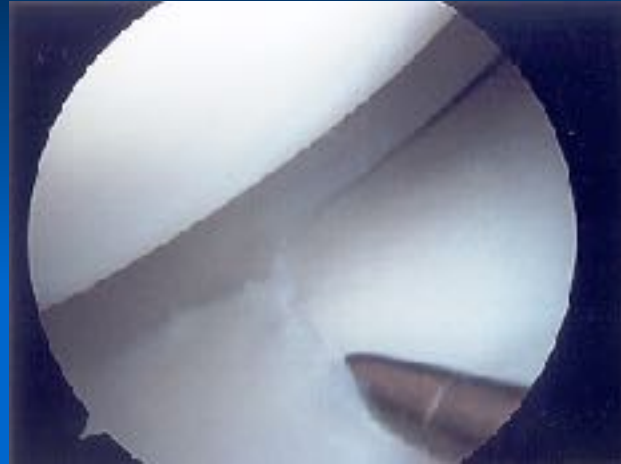
- Use goniometer to assure comparable Xrays year to year and for outcome studies
- Let the Orthopaedist Order the MRI Scan in the Arthritic Knee Patient.
 - May want DESS or special articular cartilage sequences.
 - In most cases MRI scans in patients over age 50 would not change treatment plan.
 - I don't need an MRI scan to know what to do arthroscopically! I was scoping knees prior to MRI scans!

17 YO WF Right Knee Lateral knee pain

Complete radial tear of the interval horn/body junction), with a high-grade radial tear of the posterior horn/root junction



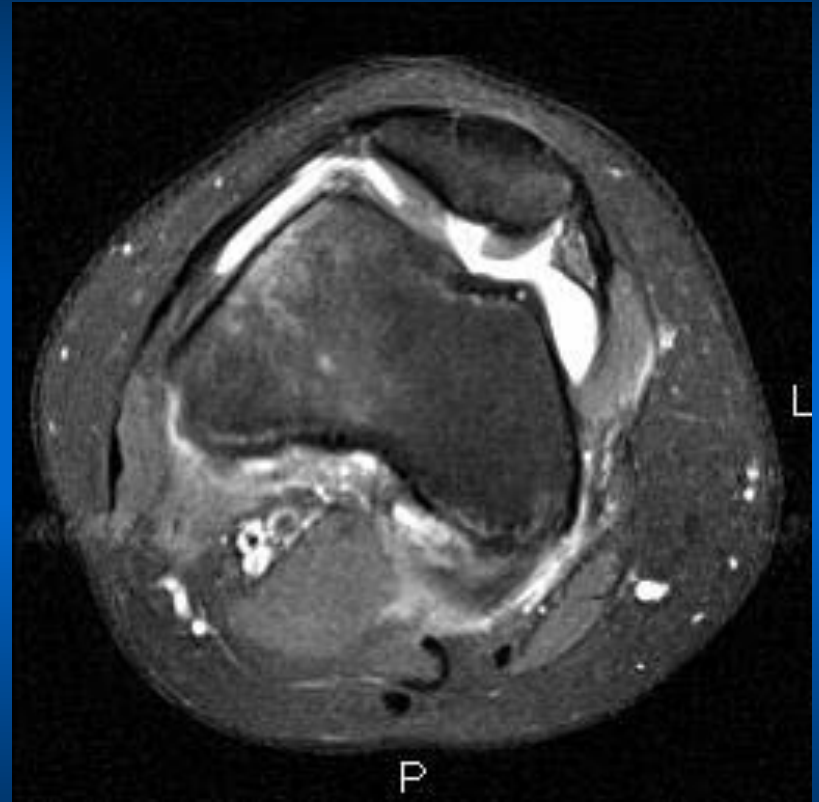
Bone Bruise



Does That Predict Development of OA?

Bone Bruise Patterns

- Acute patellar dislocation
- Medial patella anterolateral femoral condyle
- No OA from bone bruise, but from articular cartilage injury and mal-tracking



Bone Bruise Patterns

- In soccer, medial tibial plateau bone bruise no long term risk of OA
- In degenerative posterior horn root avulsions, medial tibial bone bruise often seen

? Long-term follow-up for bone bruises needed to determine significance for development of OA

What is the significance of Bone Bruises?

Unknown. . .

- Long term Bone Bruise \neq OA
- In ACL injuries noncontact compartments:
 - Lateral / acute
 - Medial / chronic OA
- Classification systems for bone bruises need further development

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**AMERICAN COLLEGE
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LEADING THE WAY

Imaging of the Foot

Secondary Center Ossifications

- Apophysis – present 22%
Appears > 8 years
Fusion: 12 years - females
15 years - males
- Os peroneum
In tendon at cuboid level
- Os versalianum – present 15%
Insertion peroneus brevis
Usually bilateral – present in 0.1%

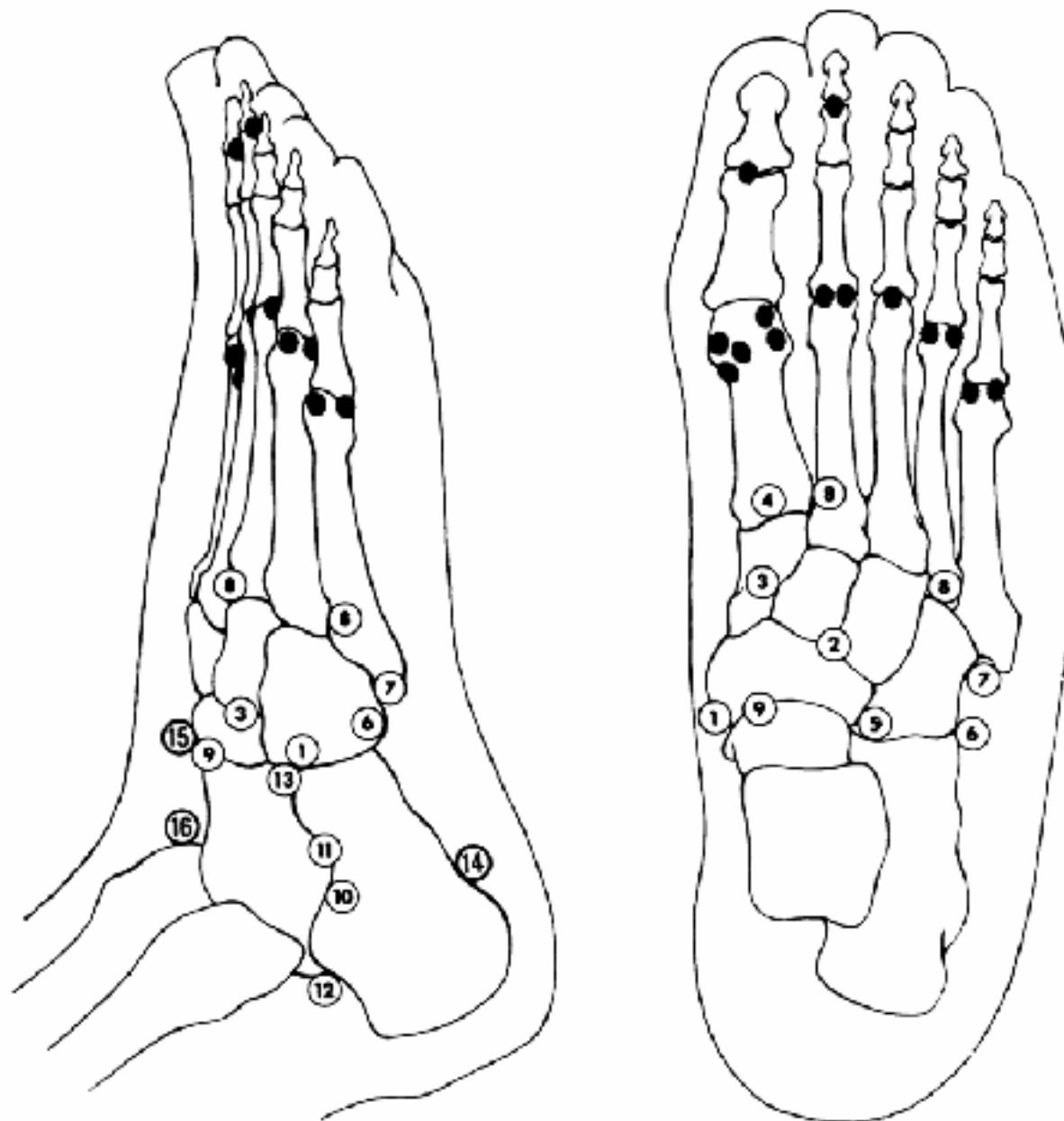


Fig. 19-25. Lateral (*left*) and anteroposterior (*right*) drawings of the foot indicating the location of the commonly found accessory bones (*circles with numbers*) and forefoot sesamoids (*shaded circles*). (1) Os tibiale externum, (2) processus uncinatus, (3) os intercuneiforme, (4) pars peronea metatarsalia 1, (5) cuboides secundarium, (6) os peroneum, (7) os vesalianum, (8) os intermetatarsale, (9) os supratalare, (10) talus accessories, (11) os sustentaculum, (12) os trigonum, (13) calcaneus secundarium, (14) os subcalcis, (15) os supranaviculare, (16) os talotibiale. (Keats, T. E., *An Atlas of Normal Roentgen Variants That May Simulate Disease*, 2nd ed., p. 371. Chicago, Year Book Medical Publishers, 1979.)

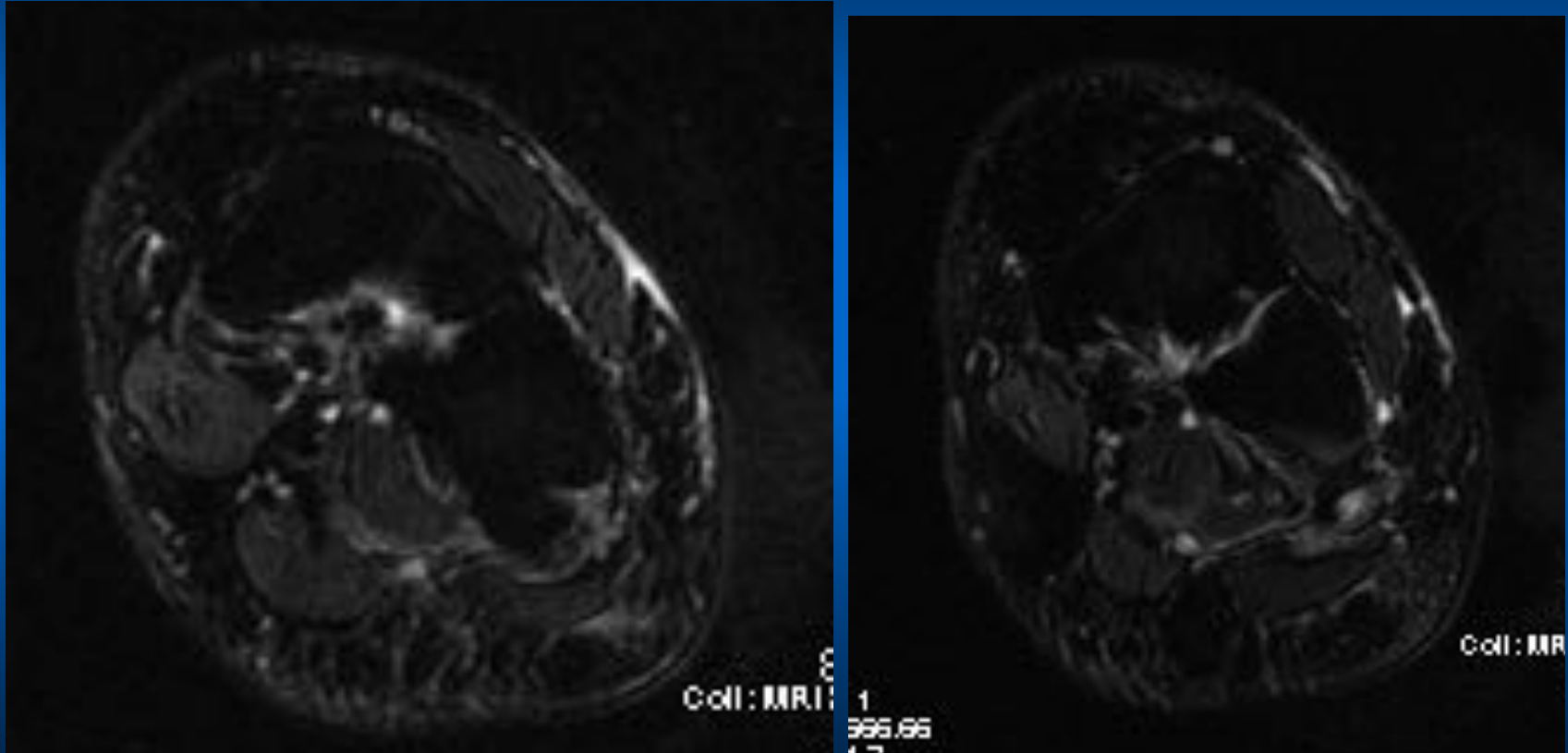


19 YO basketball player Os vesalianum bilateral feet.

Os peroneum

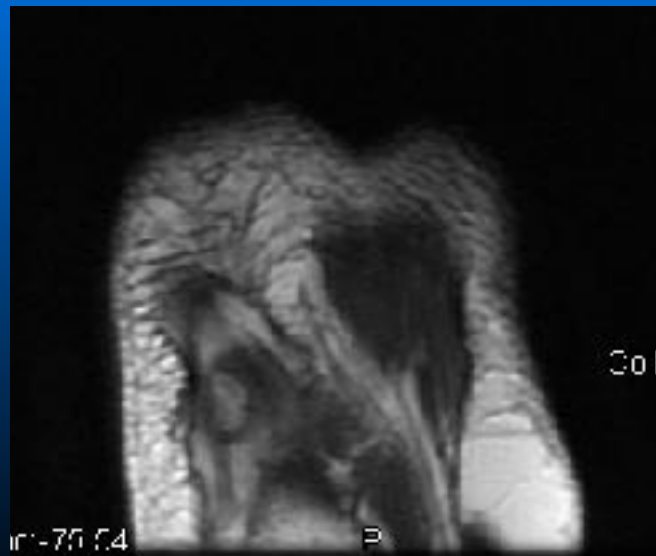
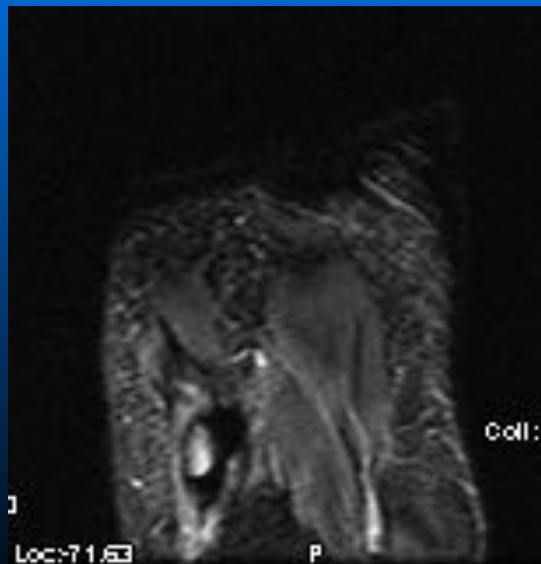
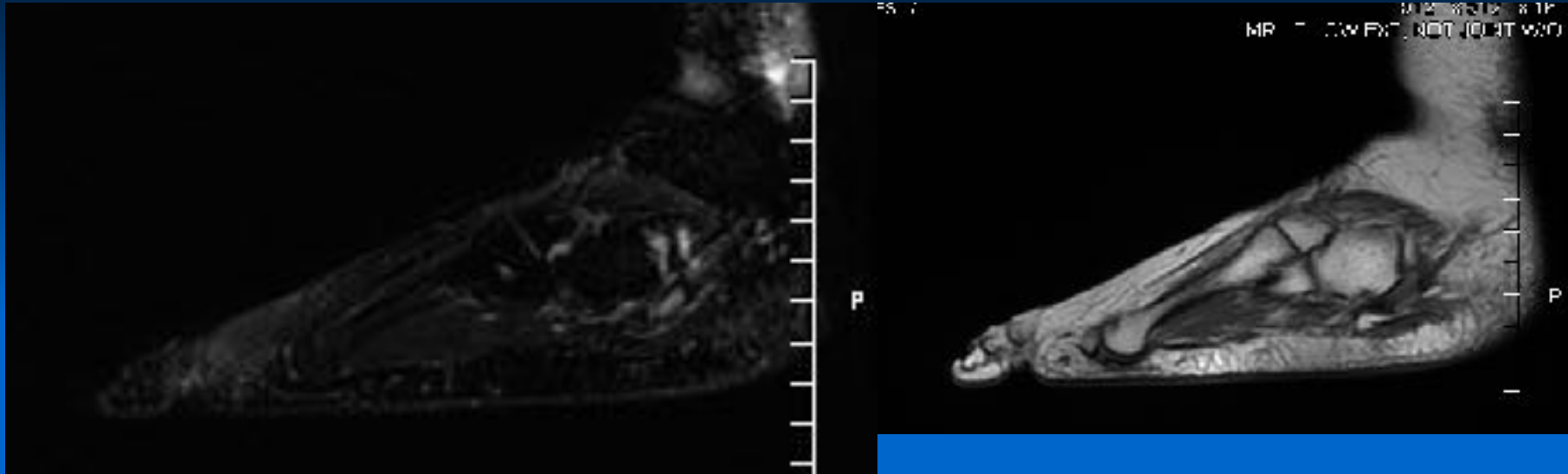


PAINFUL OS PERONEUM



Courtesy UK Radiology

PAINFUL OS PERONEUM



Courtesy UK Radiology

18 YO Freshman

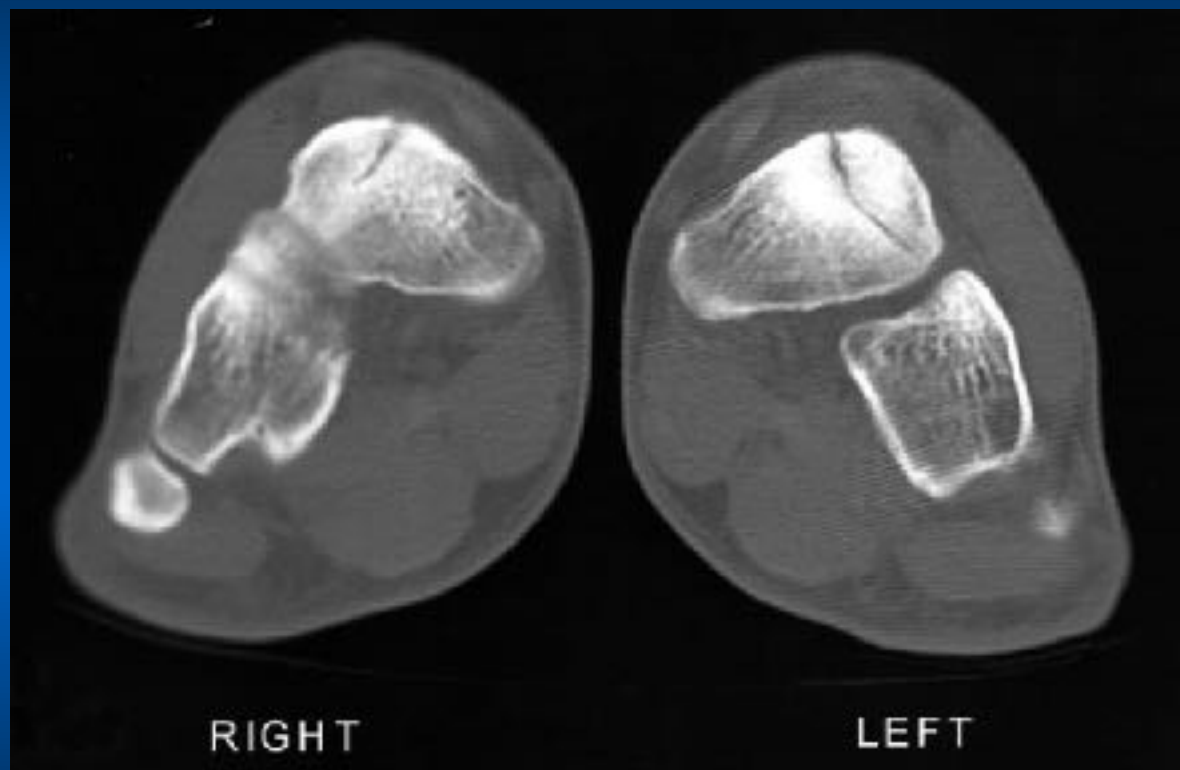
Div. I basketball athlete

- C/O mid-foot pain, L > R
- Started when she was running, playing in shoes mandated by her school
- History of “normal” periods

Navicular

- Initial x-rays

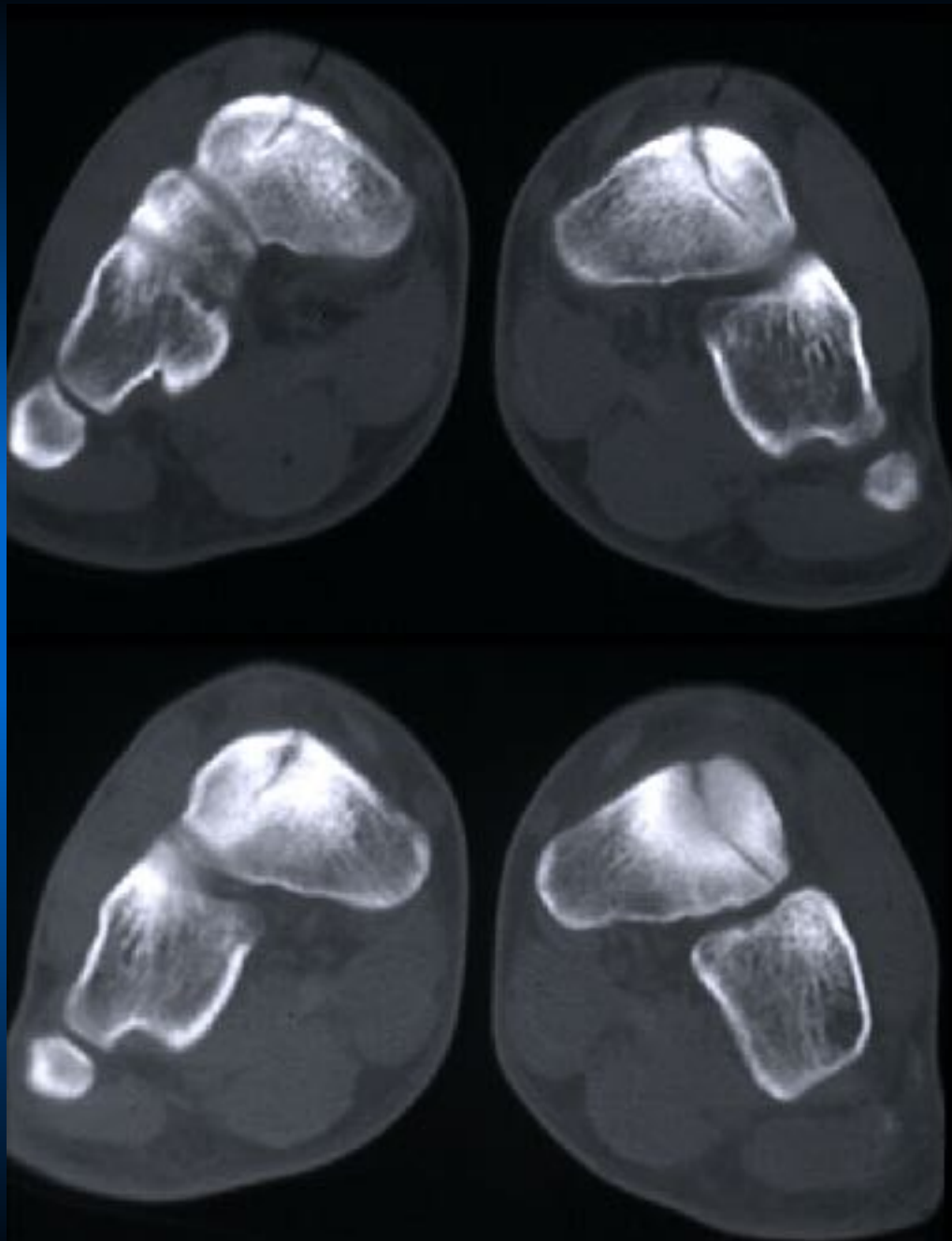




**Navicular view
30° ER
Torg described**

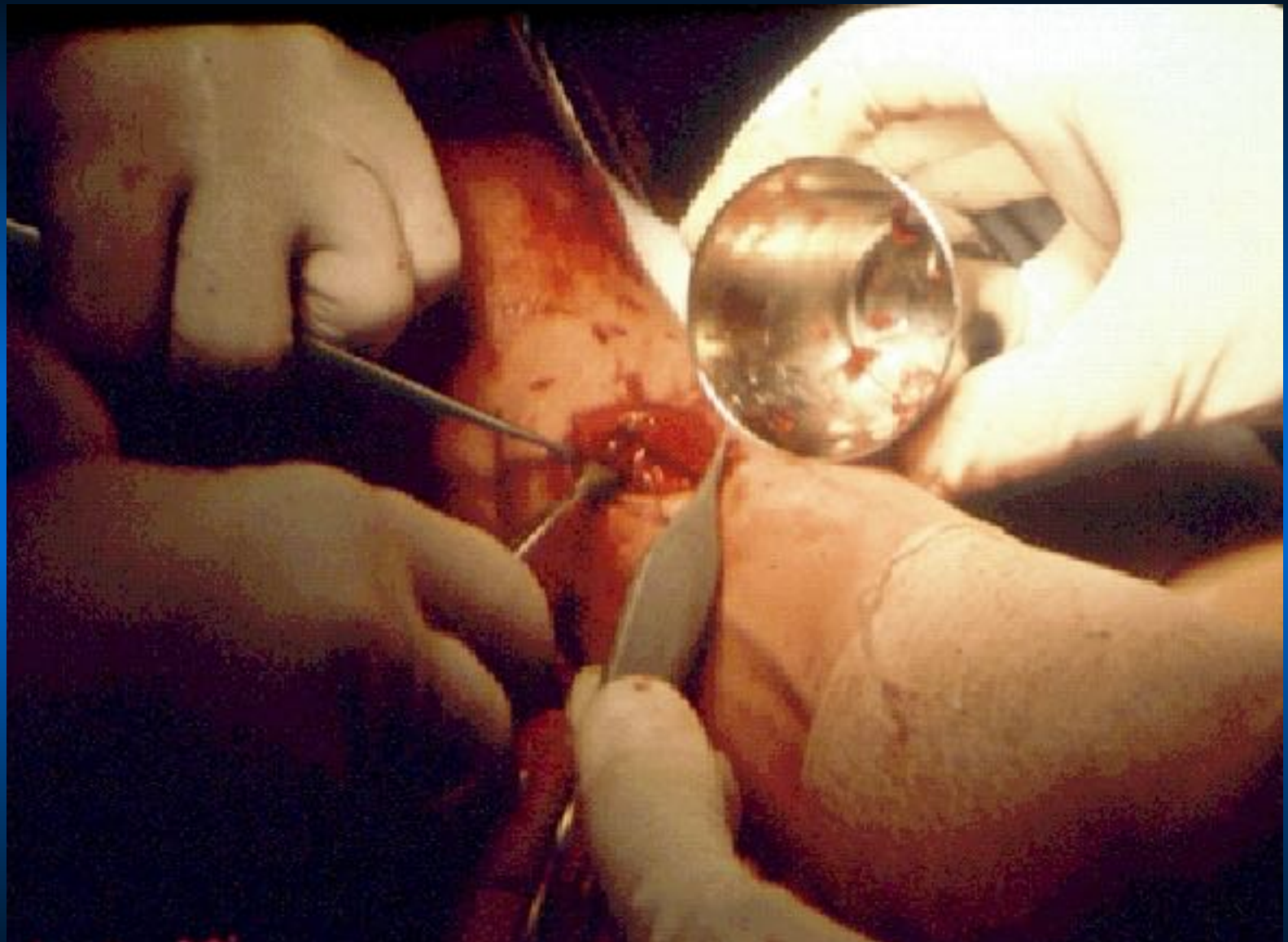
**Typical orientation
of navicular
stress fracture**





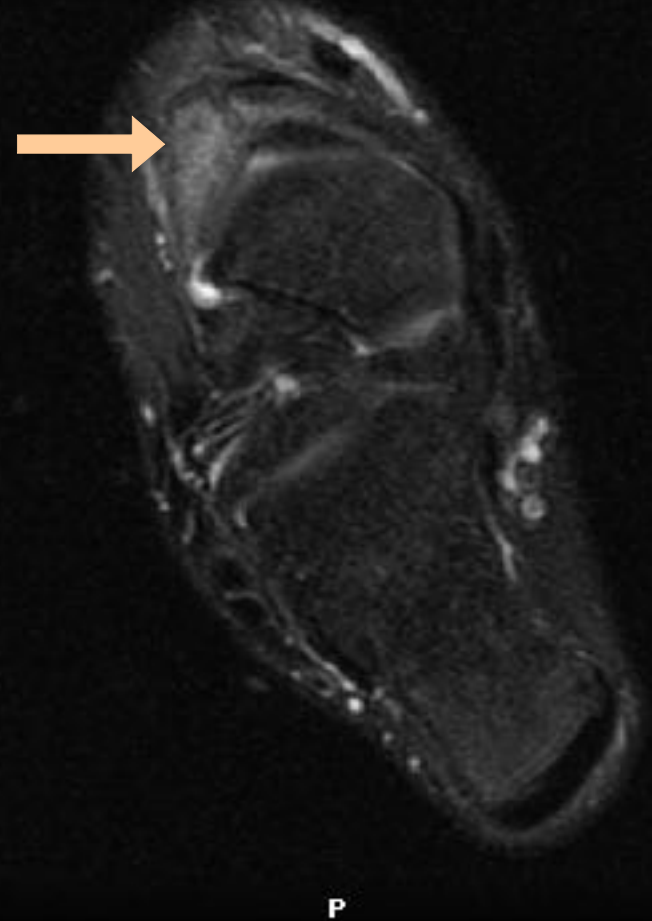
Right

Left



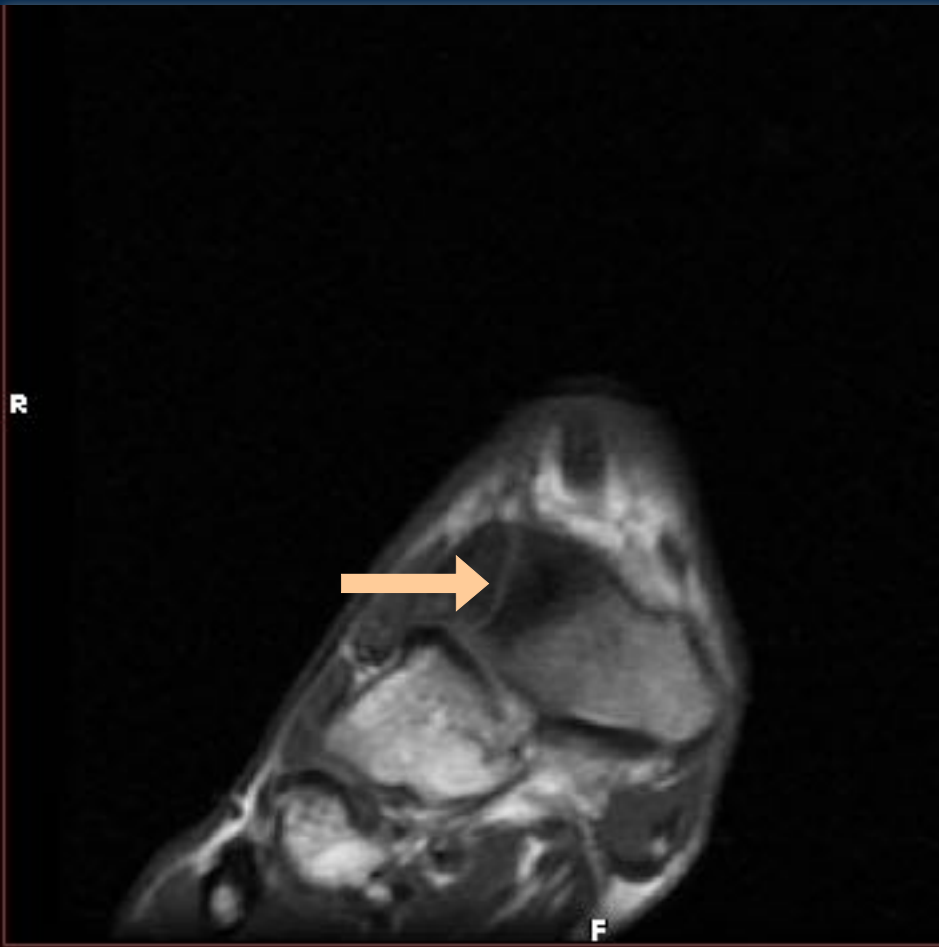


Basketball Player with Proximal Foot Pain



Courtesy Martin L. Schwartz, MD
Clinical Prof. of Radiology, UAB

Tarsal Navicular Stress Fracture



Courtesy Martin L. Schwartz, MD
Clinical Prof. of Radiology, UAB

NAVICULAR STRESS REACTION



Courtesy UK Radiology

Stress Fractures

CALCANEAL APOPHYSITIS (Sever's Disease)

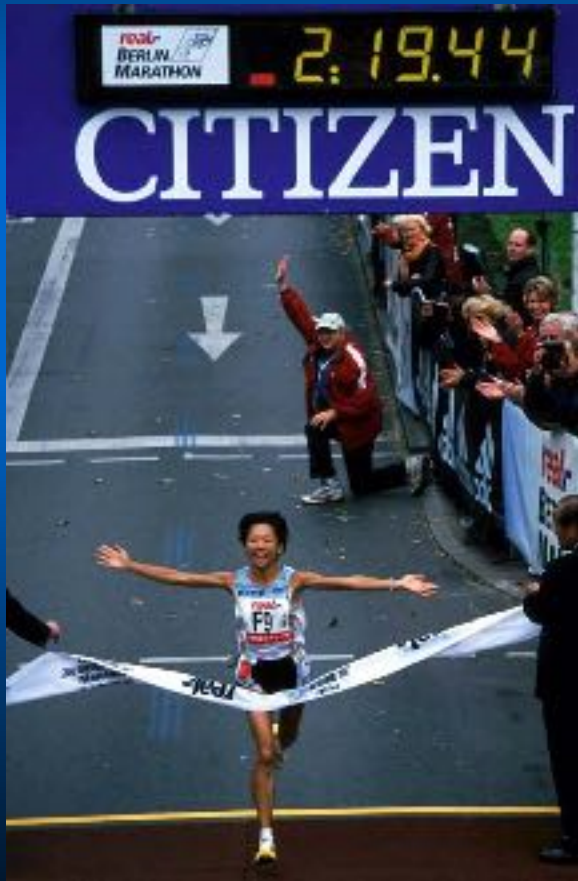
- Repetitive microtrauma
- Normal Radiographs
- Sclerosis due to normal multicenter ossification





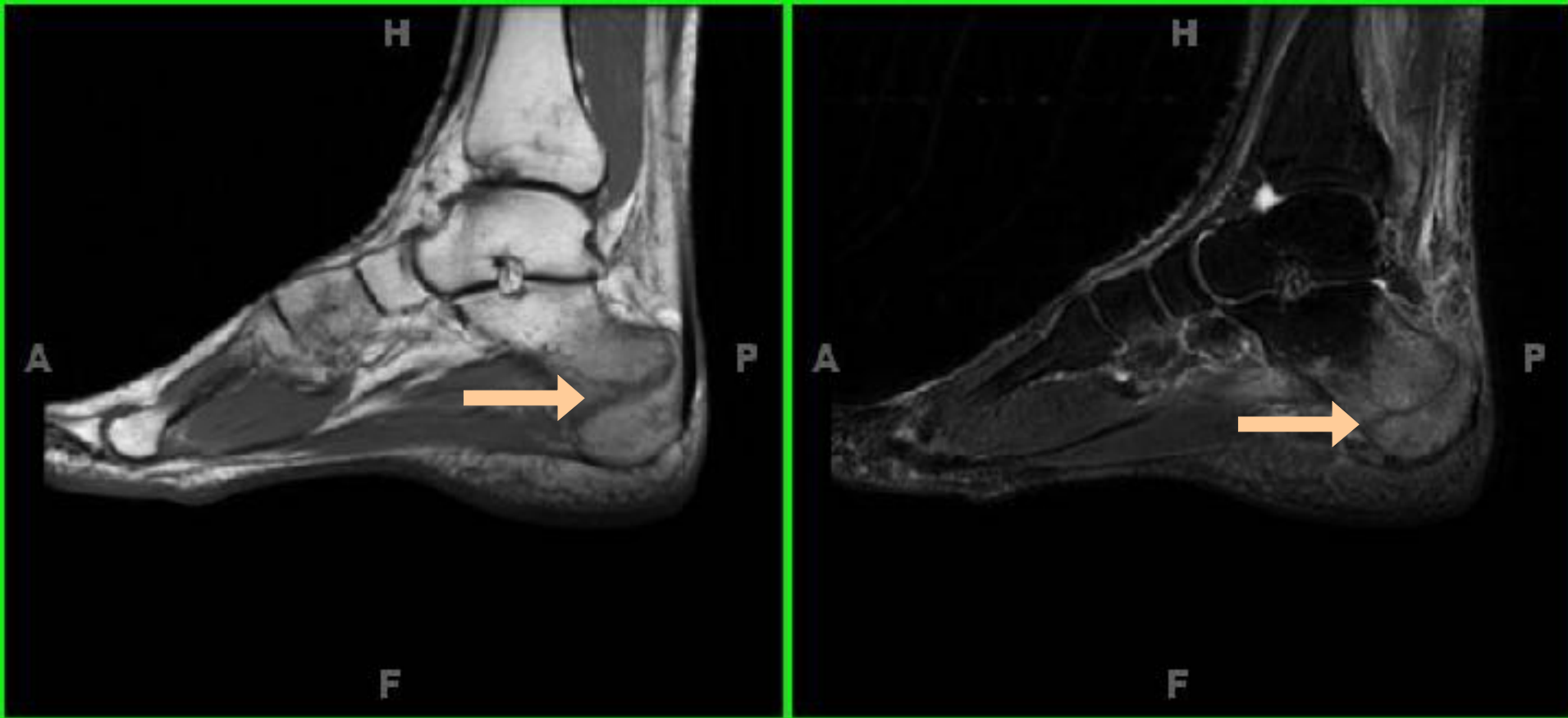
Calcaneal Stress Fractures

Marathon Runner Complains of Heel Pain Around Achilles Tendon 2 Weeks Post Race



Courtesy Martin L. Schwartz, MD
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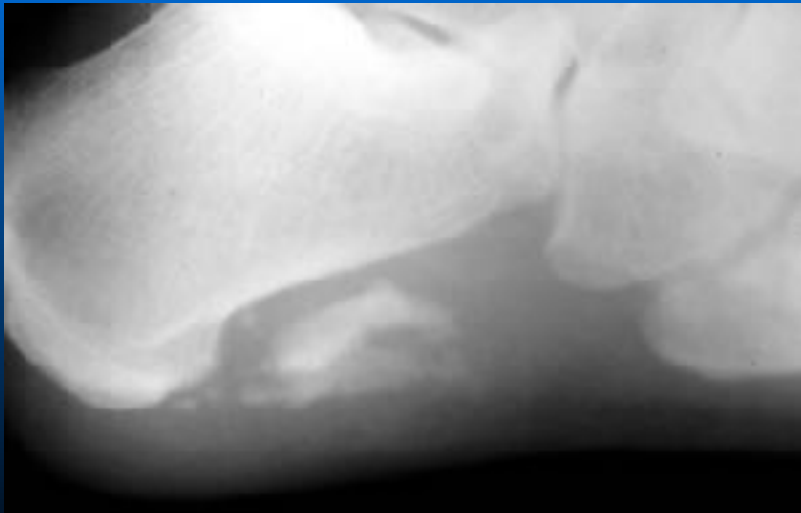
Occult Calcaneal Fracture

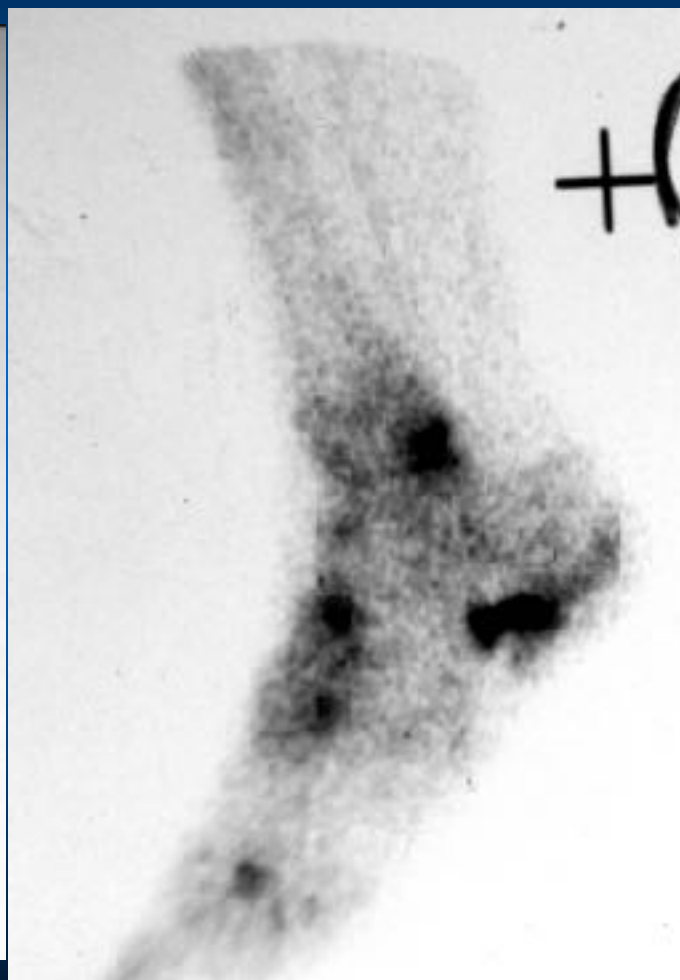
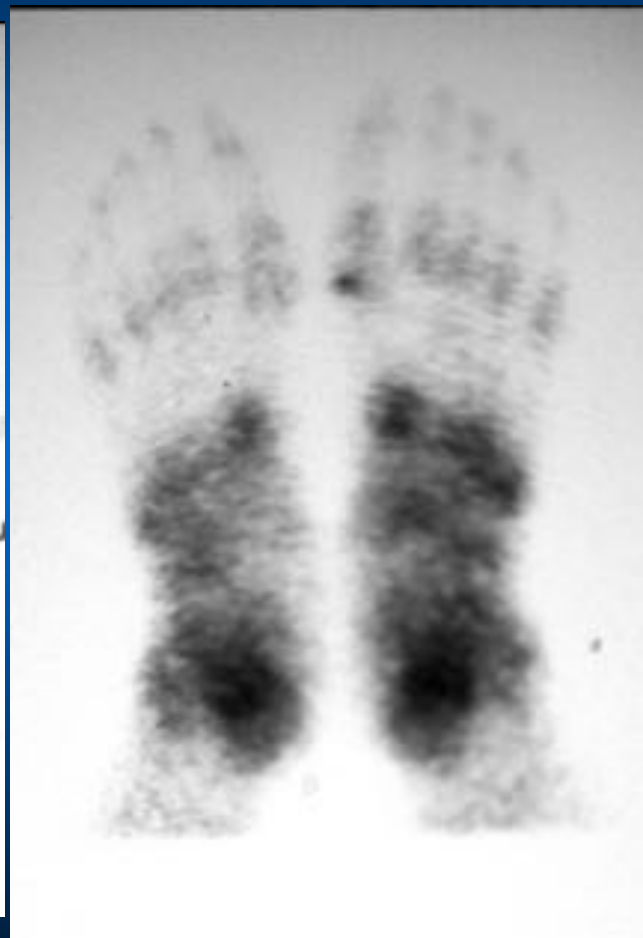


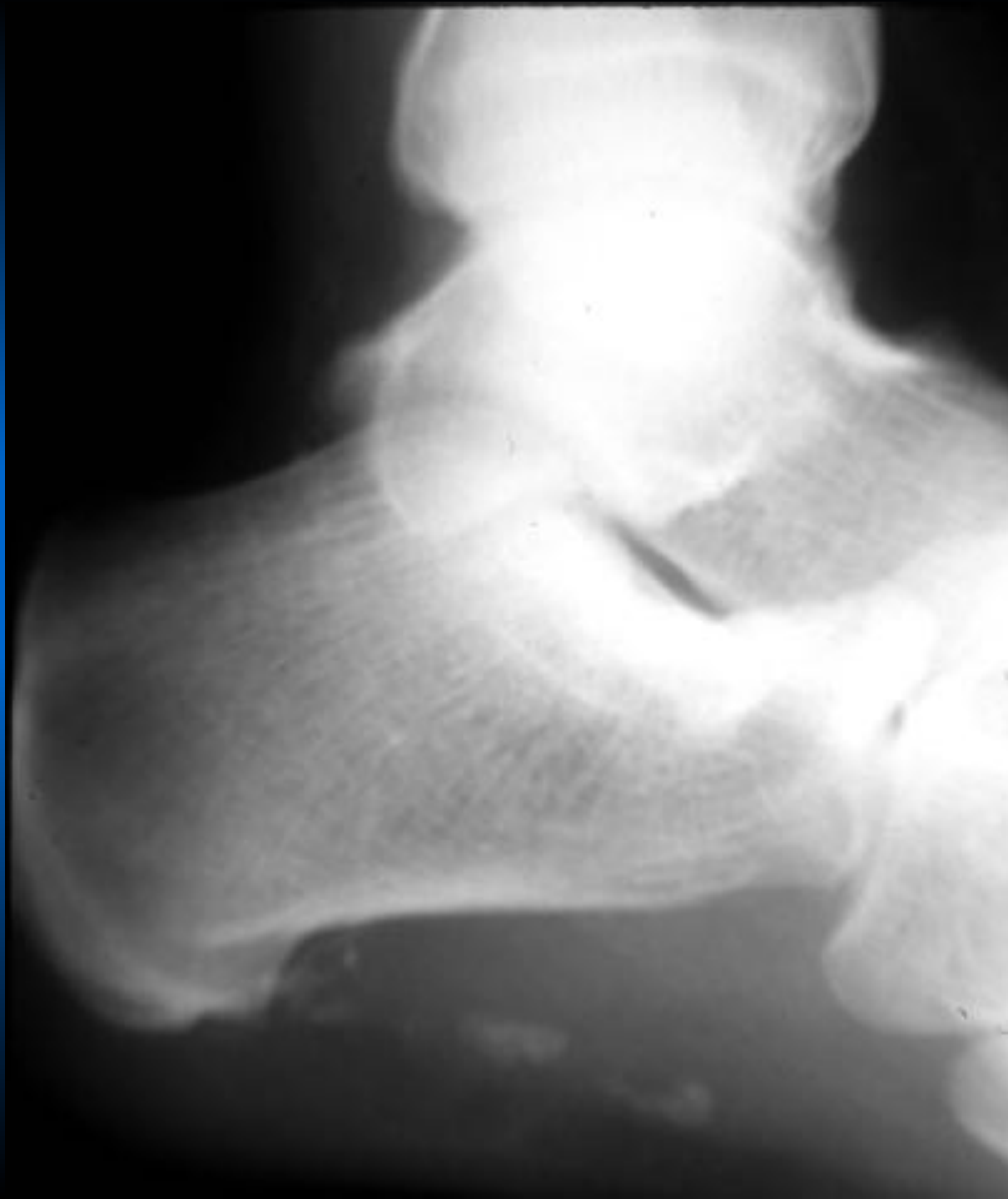
Courtesy Martin L. Schwartz, MD
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20 YO Football Athlete

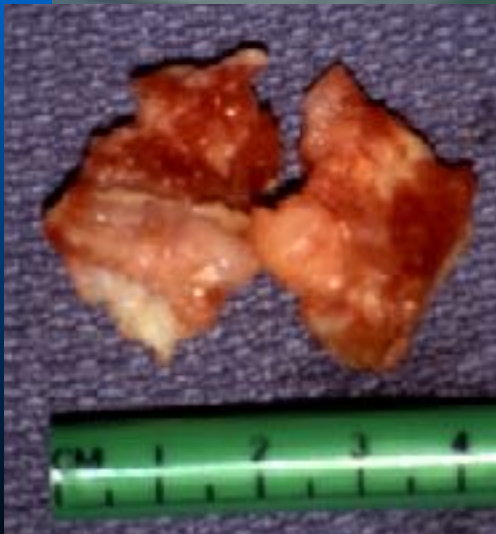
- Diabetic
- Heel pain
- DX: plantar fasciitis
- Xray: performed after the season







Open excision, ectopic bone

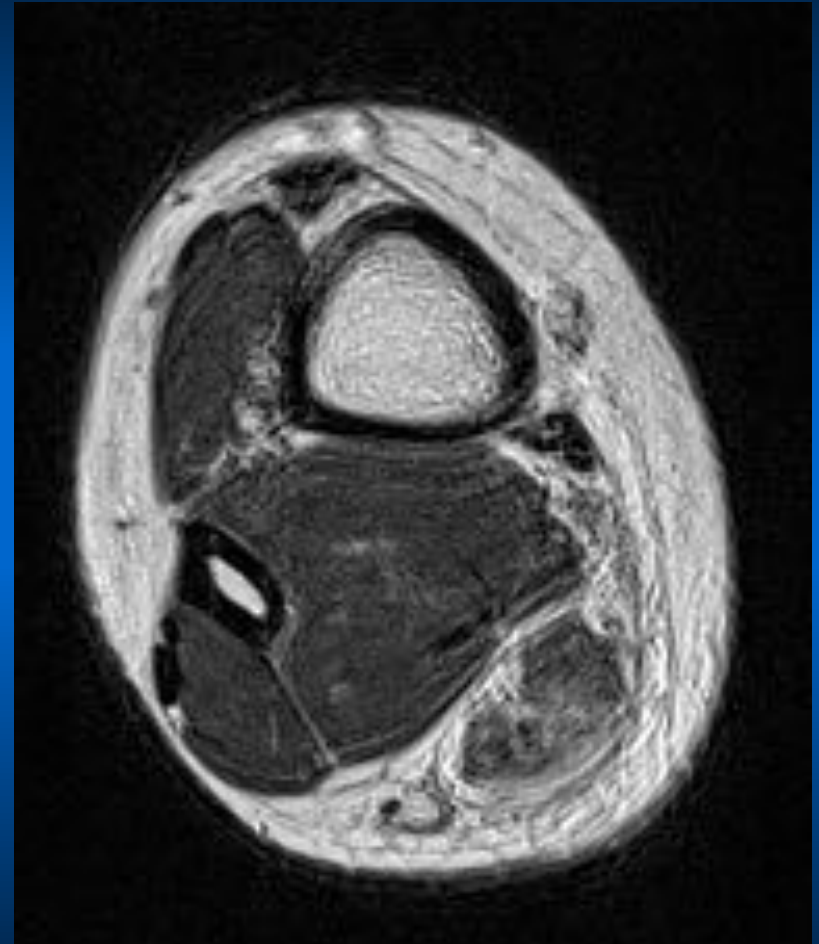
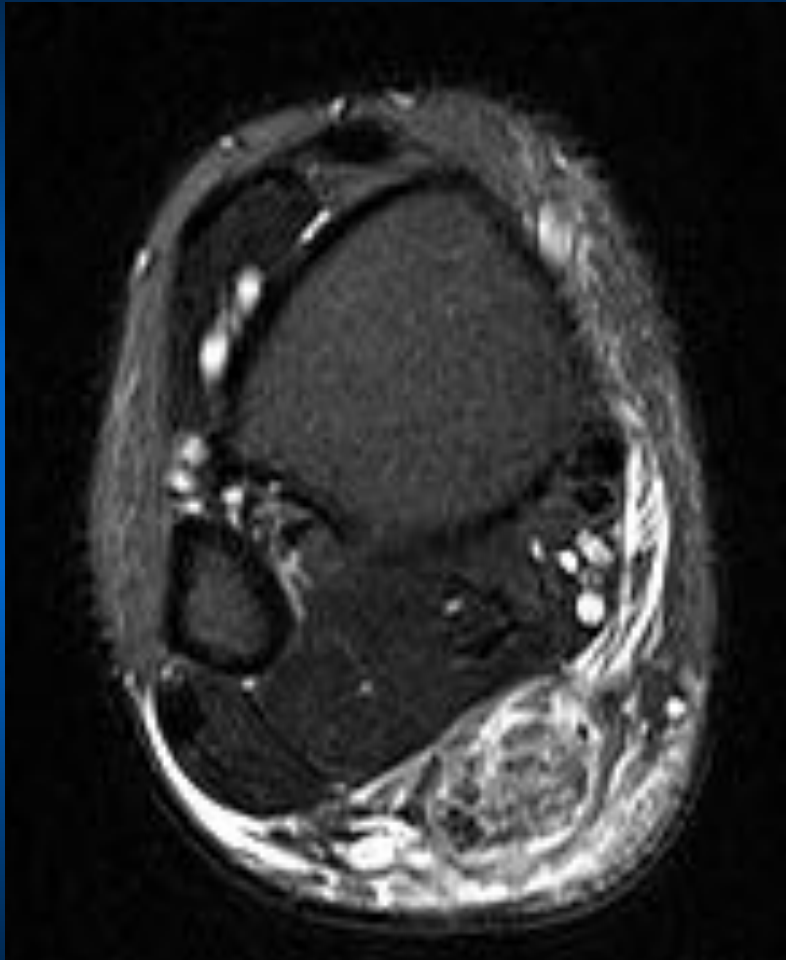


ACHILLES TEAR



Courtesy UK Radiology

ACHILLES TEAR



Courtesy UK Radiology

57 YO WM

- College Professor
- Heel Pain for 1 Year
- PMH + for Hypertension Only
- Left Ankle
- Symptomatic Calcific Tendinitis

Physical Exam

- Pain Over Lateral Insertion, Achilles Tendon
- Symmetrical Calf Strength and Flexibility

Radiographs

- Calcific Deposits in Achilles
- Calcaneus Normal



**Calcific
Achilles
Tendinitis**



**Opposite
Foot for
Comparison**

Radiographs from Emergency Room

While waiting for an appointment to see a foot and ankle specialist, a motorcycle fell on his left ankle.

He complained of weakness of the calf and inability to go up on his toes.



Test and Results

- Lateral Radiograph Compared to Pre-Injury Film
- Proximal Displacement of Calcific Nodule, Mild Haglund's Deformity

Final Working Diagnosis

- **Avulsion of Calcific Achilles Tendon from Calcaneus**

Operative Findings

- **Complete Avulsion Achilles Tendon**
- **Calcific Degeneration of Tendon**

Surgery





Operative Treatment

- Direct repair with metal anchors to calcaneus
- Augmentation with plantaris tendon weaved in pulvertaft fashion

1 Week Post Surgery



**You Look for What You Know
and You Find What You Look For**



The End

Thank You!



Mary Lloyd Ireland, M.D.

www.MaryLloydIreland.com

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References

Mazzuca SA, Brandt KD, Schauwecker DS, Buckwalter KA, Katz BP, Meyer JM, et al. **Bone scintigraphy is not a better predictor of progression of knee osteoarthritis than Kellgren and Lawrence grade.** J Rheumatol 2004;31:329-332.

Oiestad BE, Holm I, Engebretsen L, Risberg MA. **The association between radiographic knee osteoarthritis and knee symptoms, function and quality of life 10-15 years after anterior cruciate ligament reconstruction.** Br J Sports Med 2011;45:583-588.

Tapper EM, Hoover NW. **Late results after meniscectomy.** J Bone Joint Surg [Am] 1969;51-A:517-26.