

Pediatric Sports Injuries: Lower Extremity



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Red Tape

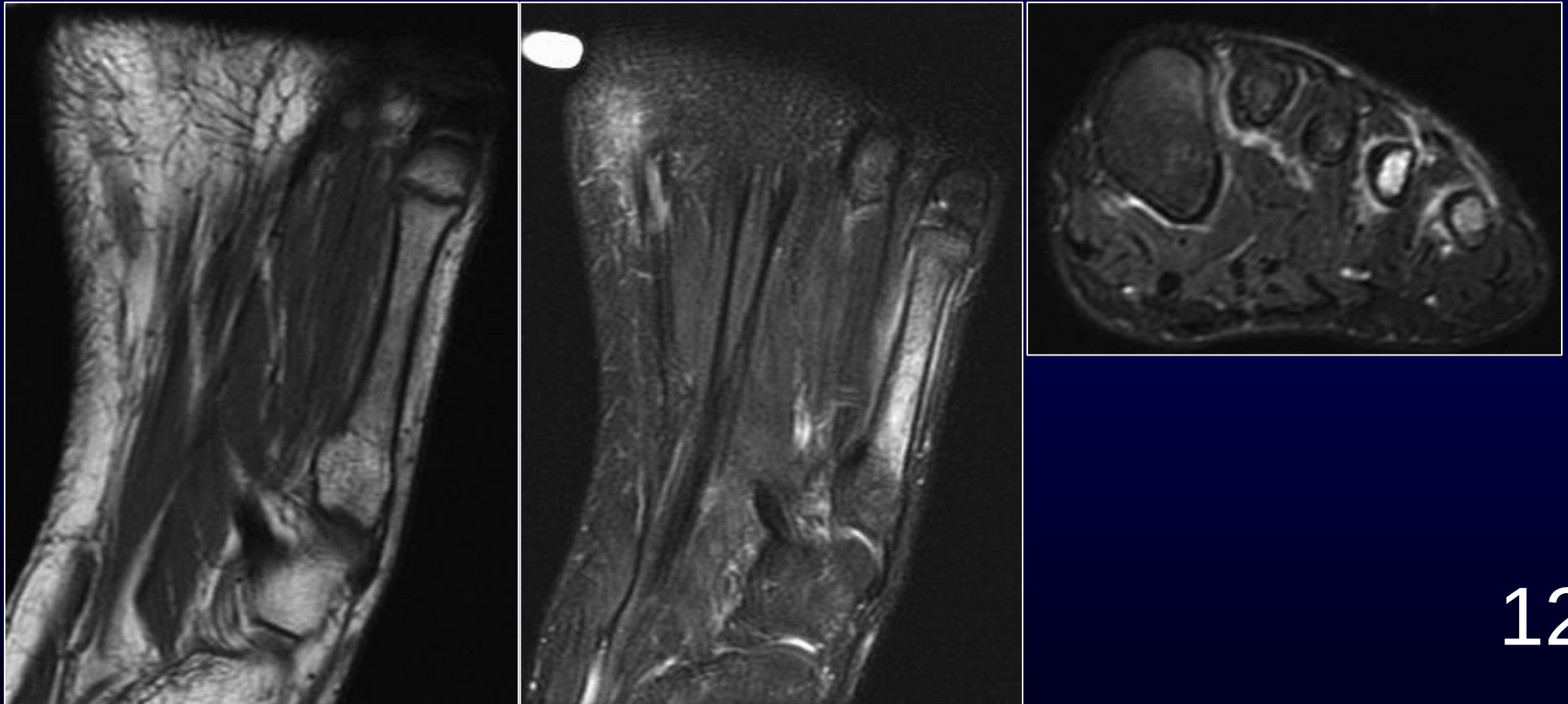
- Conflicts of Interest: 
- Off-Label Medications: Intra-articular Gadolinium 

Objectives

- Describe the utility and pitfalls of knee MRI in the pediatric athlete.
- Compare and contrast the age related differences in osteochondritis dissecans of the knee between juveniles and adults.
- Define the various overuse syndromes and injuries of the pediatric athlete.

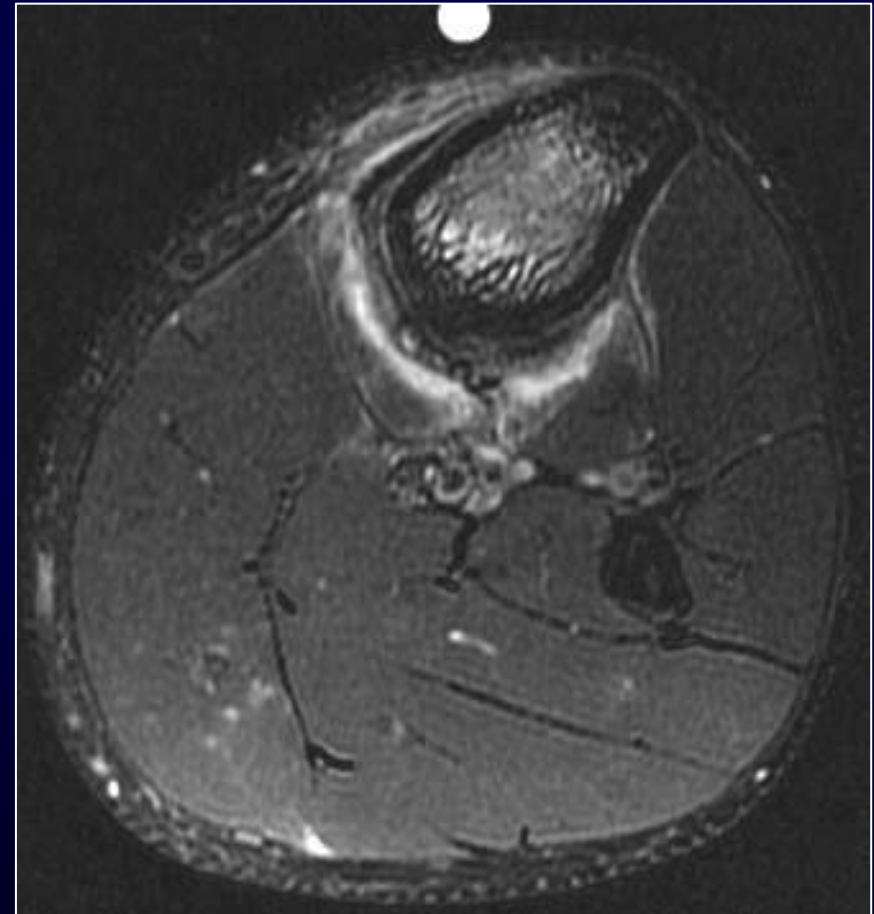
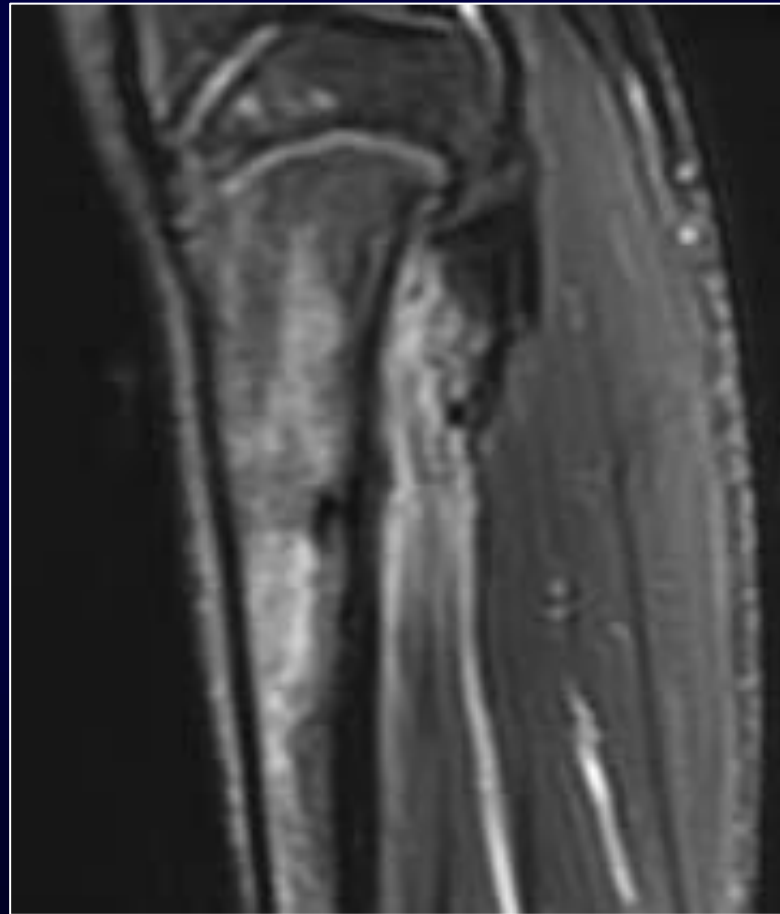
Objectives

- Stress fractures

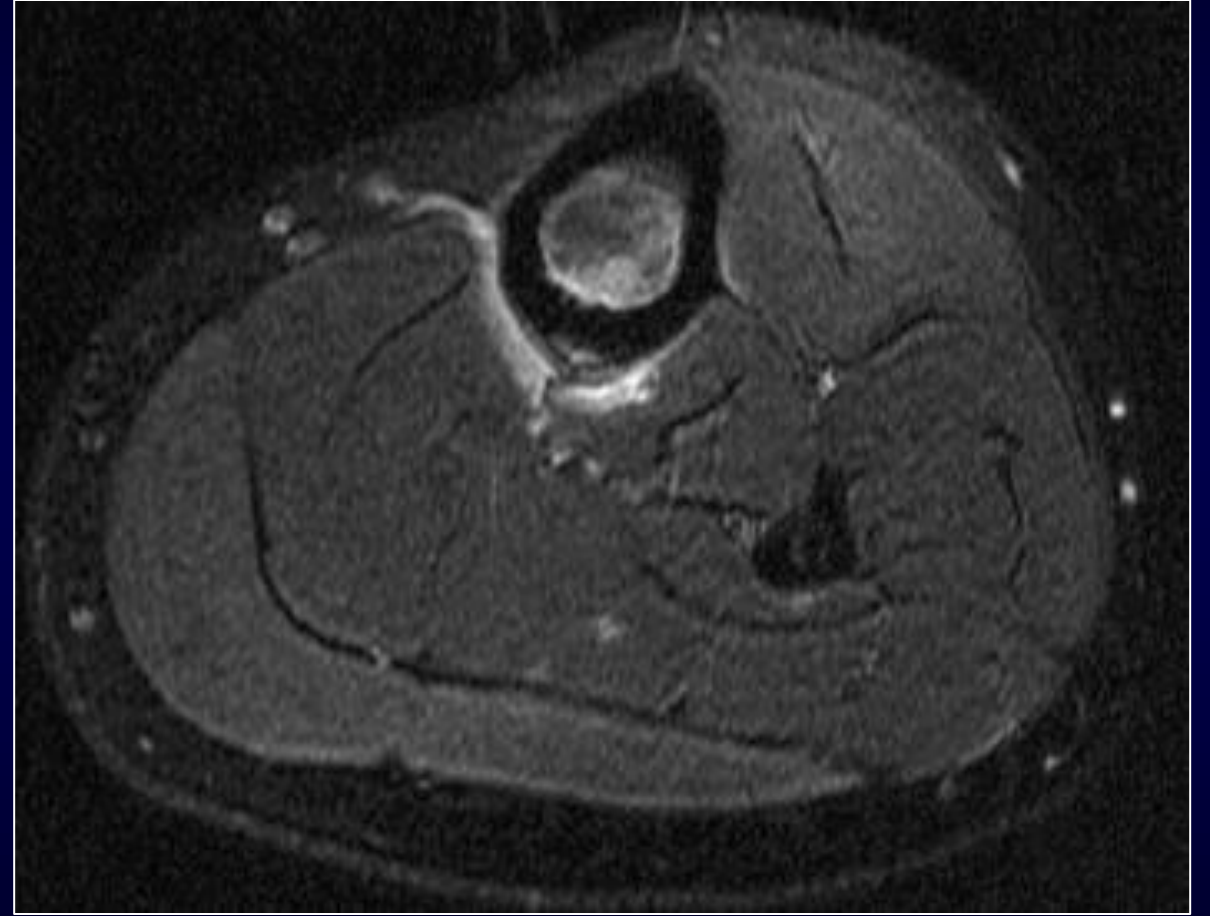
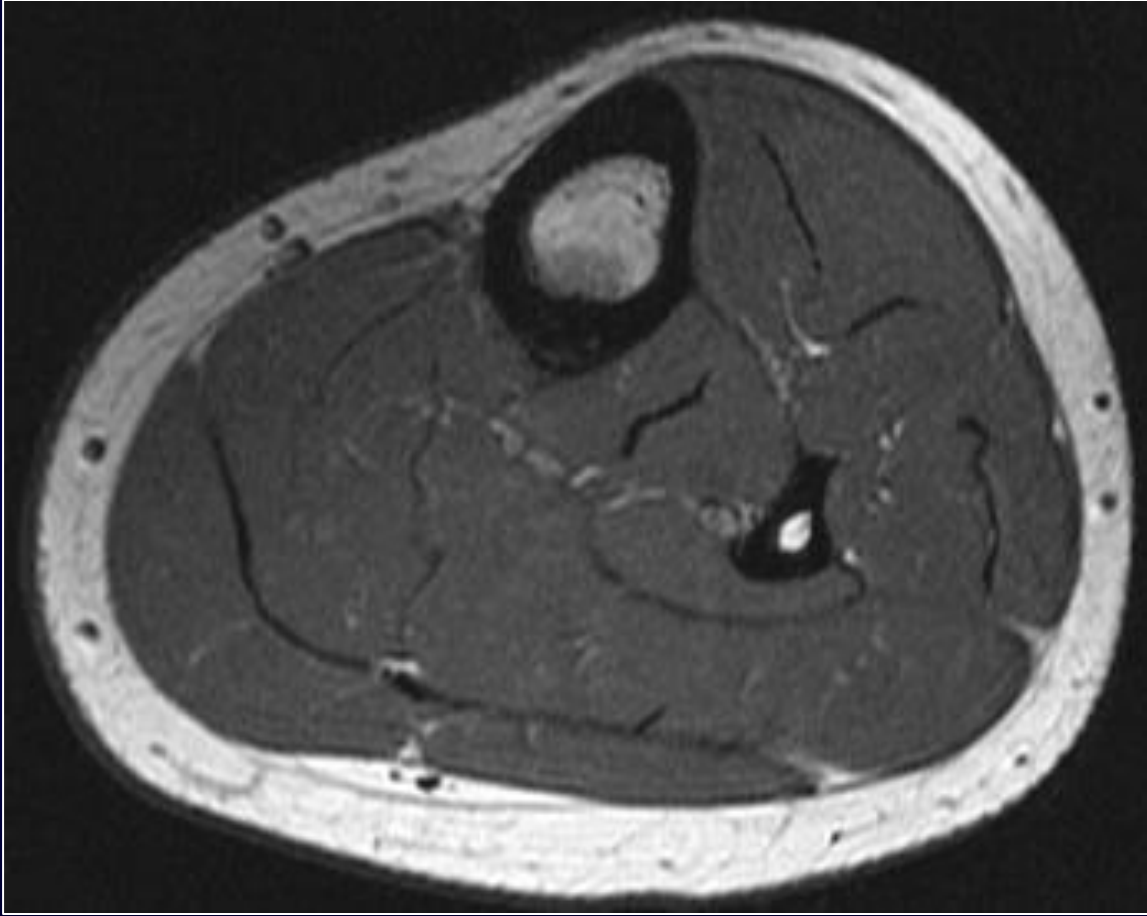


Tibial Stress Fx

15 ♂ runner: Not all this easy

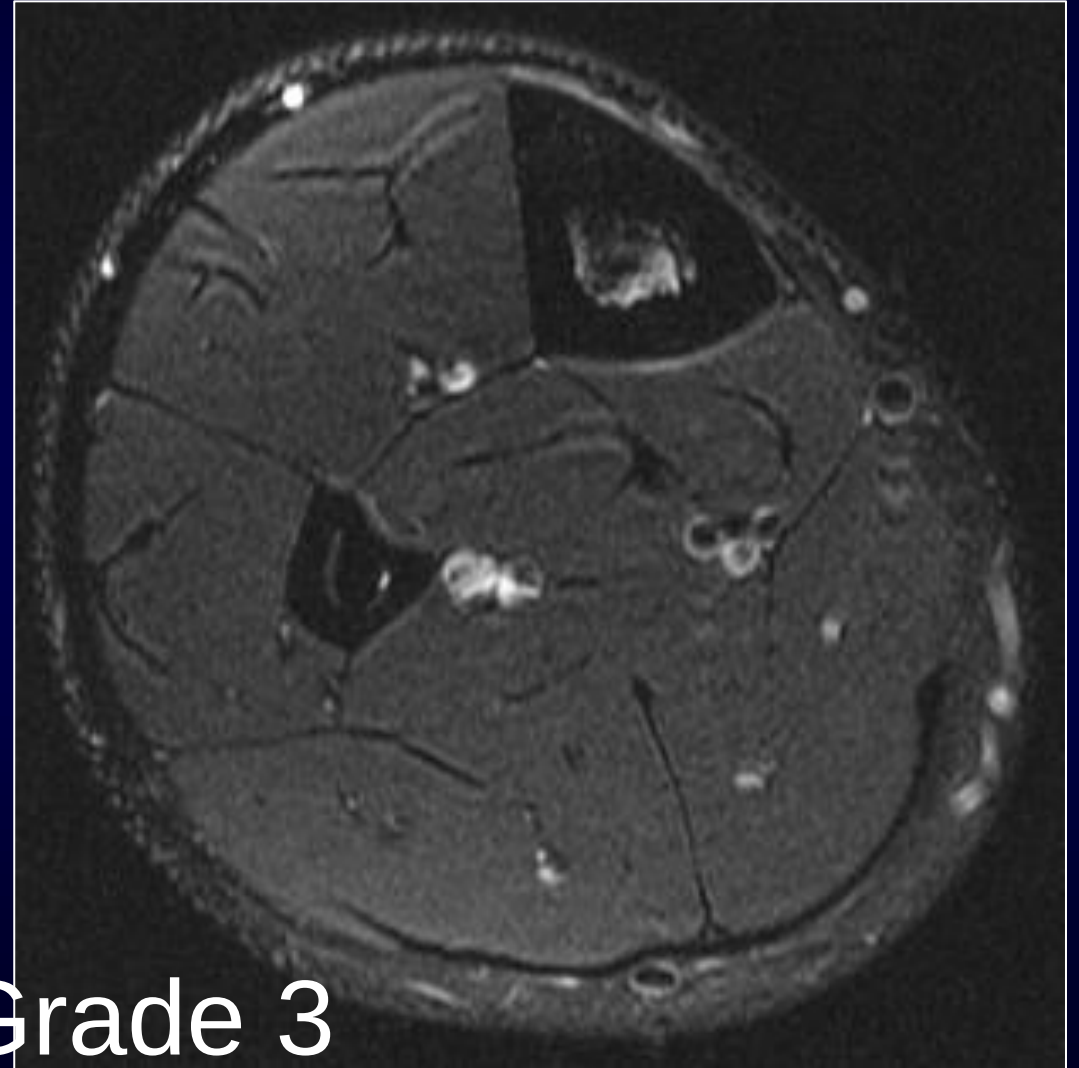
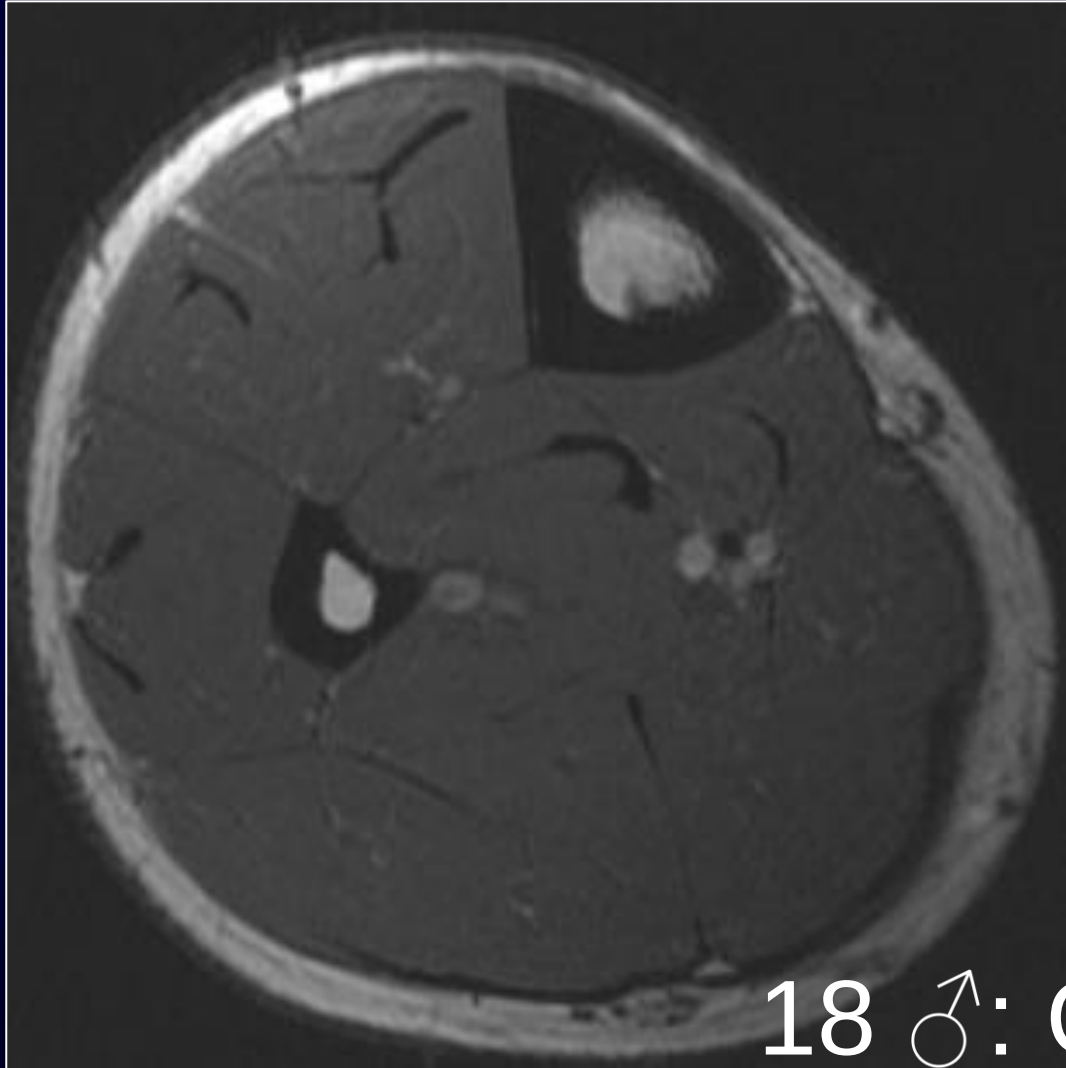


Tibial Stress Fx



16 ♀: Grade 4 = fracture

Tibial Stress Fx



18 ♂: Grade 3

Tibial Stress Fx

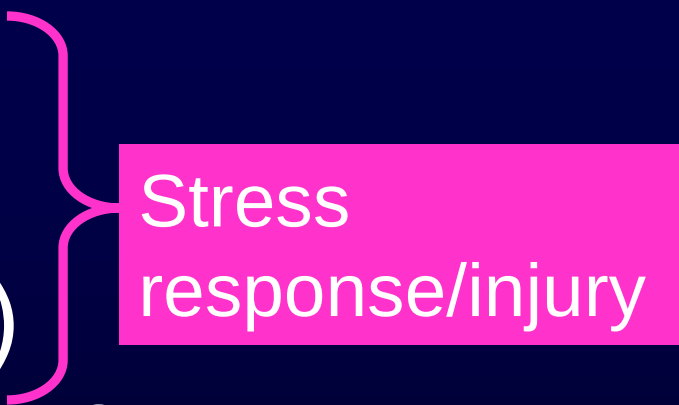
Fredericson Staging System Tibia Only

1: Periosteal edema

2: Marrow $\uparrow$ T2

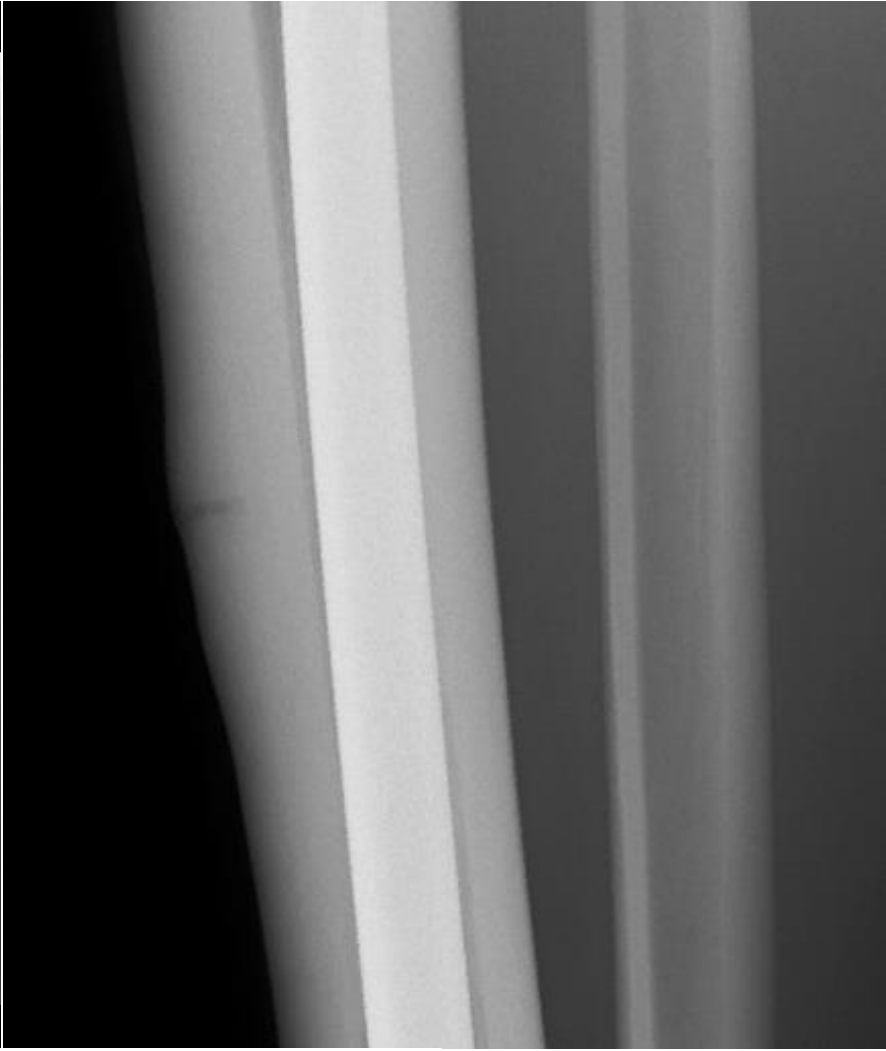
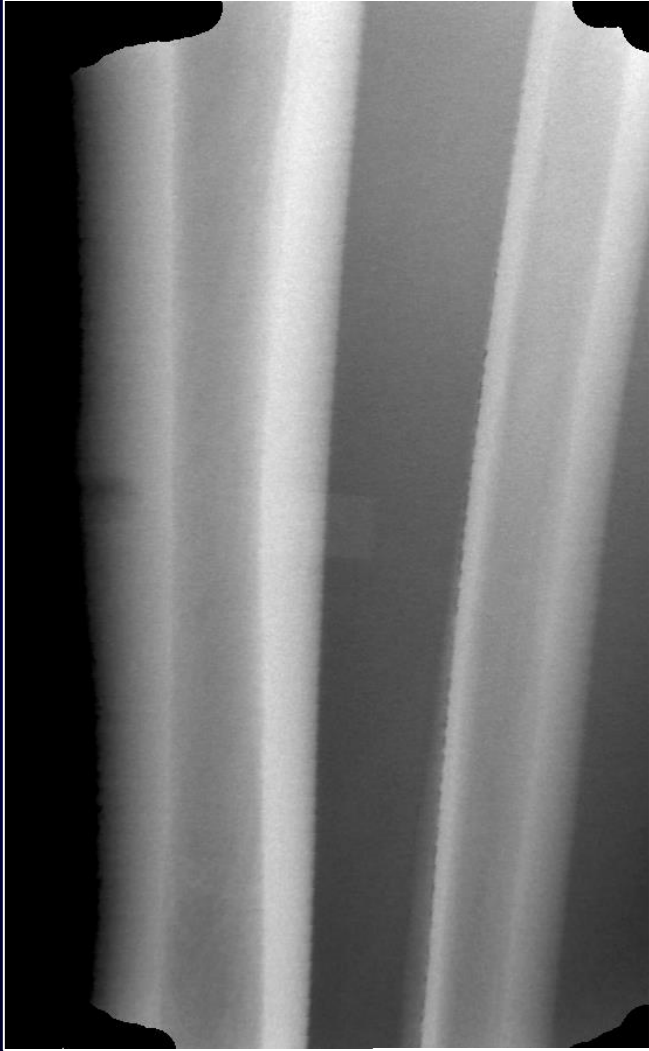
3: Marrow $\downarrow$ T1 (and $\uparrow$ T2)

4: Cortex abnormal: stress fracture

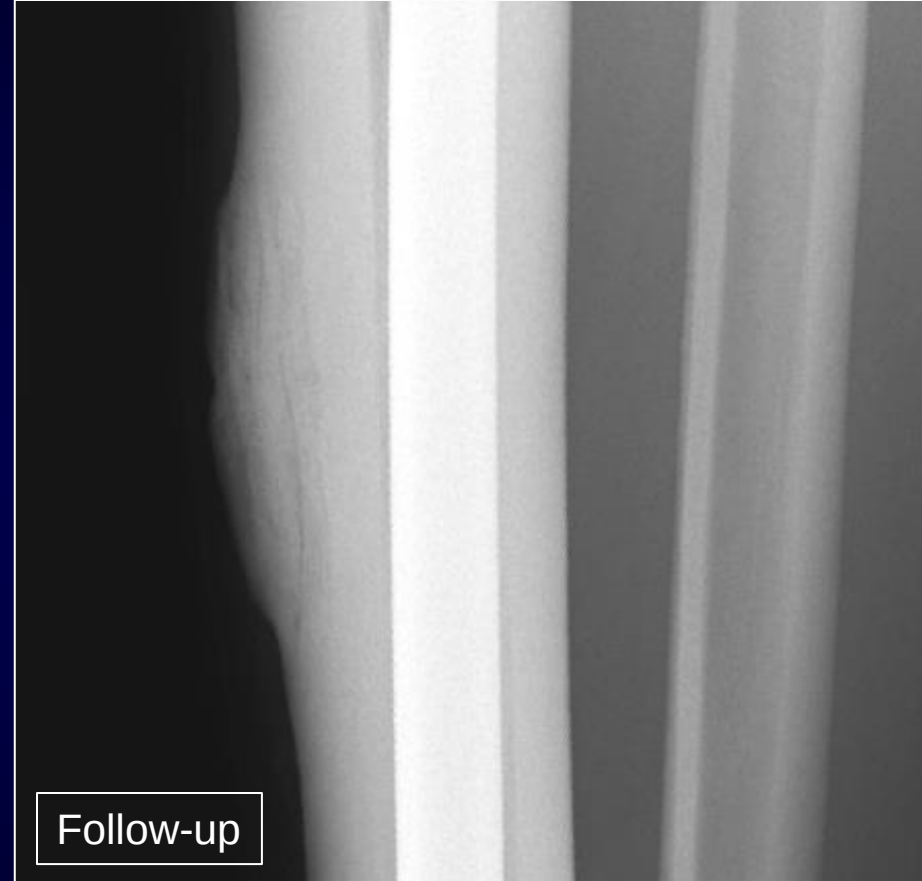


Stress
response/injury

Anterior Tibial Stress Fx



“Dreaded black line”



19 ♂: Football

Overuse Syndromes Chronic Injuries

Osteochondritis Dissecans

Knee

Talus: Osteochondral Lesion of Talus

Osteochondritis Dissecans: Knee

OCD: Knee

- Focal abnormal segment of subchondral bone and overlying cartilage
- Likely secondary to repetitive trauma
- Juvenile (open physes) form good prognosis
- Adult (closed physes) form → unstable, unremitting
- 70% classic location: mesial aspect of MFC
- Patellar and tibial lesions fare worse on average

Kocher MS. *AJSM* 2006; 34:481-491

Micheli L. *CJSM* 2006; 16:465-470

Pill SG. *JOP* 2003; 23:102-108

OCD: Knee—MRI Instability

Adult

- Defect/hole
- Cartilage breaks
- Cyst underlying the lesion
- High T2 signal rim of lesion
- Disrupted subchondral bone plate

Juvenile

- Defect/hole
- Cartilage breaks
- Cyst: multiple or >5 mm
- High T2 signal rim of lesion = fluid
- Disrupted subchondral bone plate

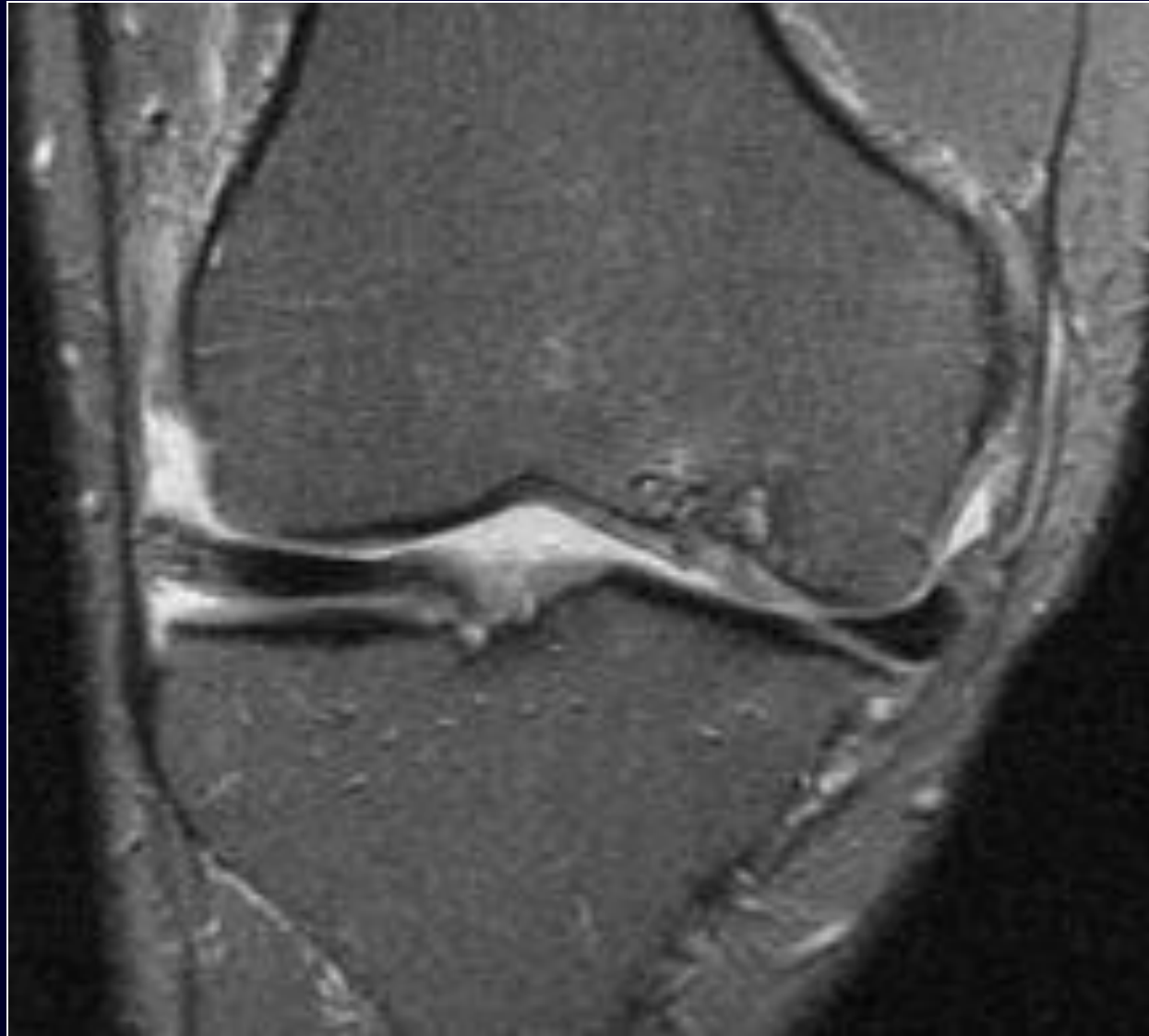
OCD: 18 ♂ Unstable



OCD: 18 ♂ Unstable



OCD: Adult ♂ Unstable



OCD: 13 ♀ Unstable



OCD: 11 ♀ Stable



OCD: 11 ♀ Stable



OCD?: 10 ♂



OCD?: 10 ♂

Normal variant ossification ctr.



Normal variant ossification ctr.

- Posterior
- Smaller than most OCDs
- Little/no surrounding edema
- Cartilage thicker
- Intact surface



Normal variant ossification ctr.



FOPE Zones

Zbojniec A, Laor T. *AJR* 2012

- FOcal
- Periphyseal
- Edema

Early stage of physiologic
physeal closure

+/- temporary symptoms



Osteochondral Lesions of the Talus: “OLT”

OLT

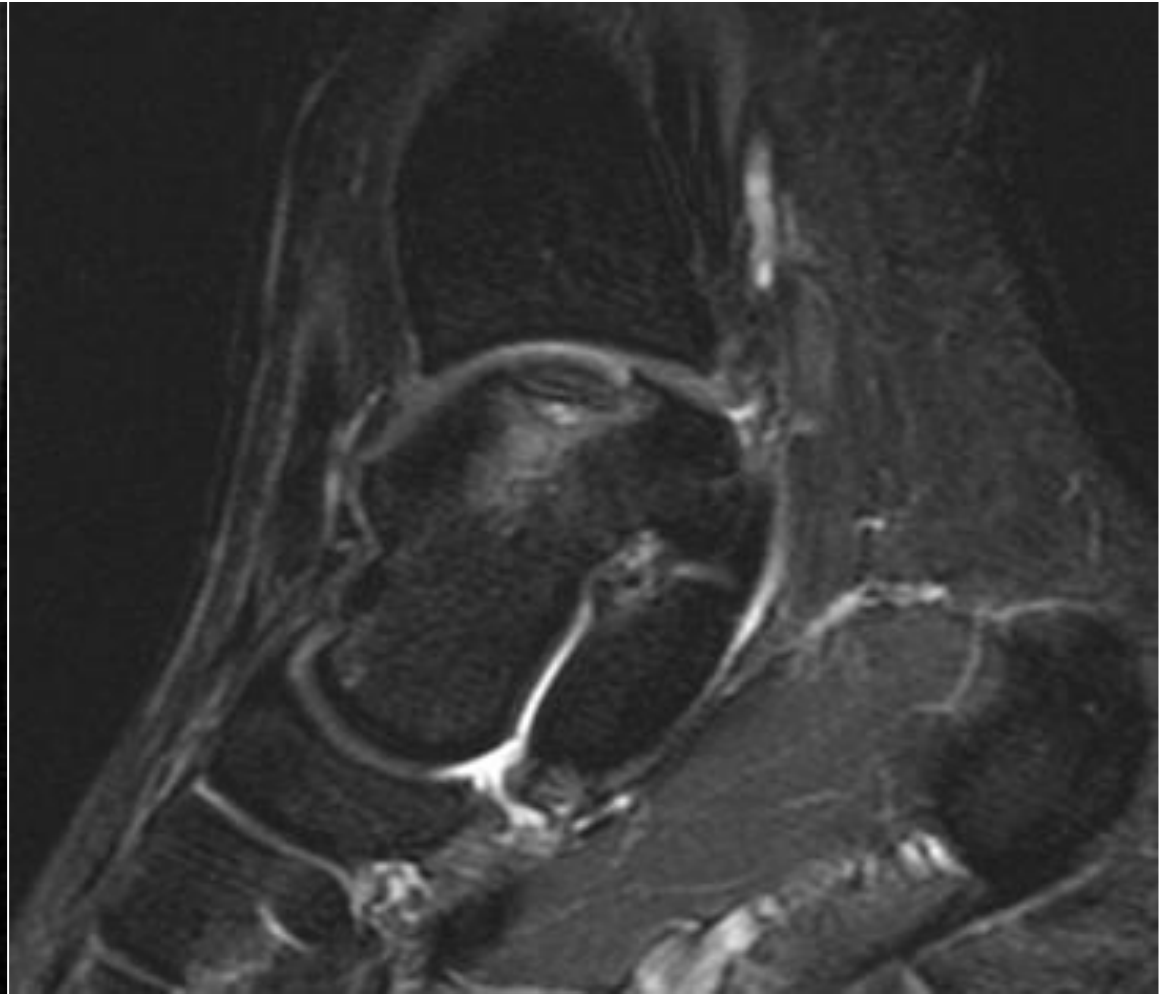
- Related to previous trauma, especially inversion stress
- Transchondral fractures from torsion or transmission of shearing forces across joint
- Single event or overuse/repeated microtrauma
- MRI stages: 0—normal 1—signal in cart 2—breach of cart 3—hi T2 rim 4—LB

Sullivan JA. *Ped Orth* 1993

Schoenberg NY. *MRI Clin* 1994; 2:109-122

Vanhoenacker FM. *JBR* 2002; 85:212-218

OLT: 13 ♀ Unstable



OLT: 10 ♀ Stable Improved with Bledsoe Boot



Overuse: Foot/Ankle

Sever Disease—Calcaneal apophysitis

Iselin Disease—5th metatarsal apophysitis

Stress fractures

Ankle impingement (esp. posterior)

Chronic: Foot/Ankle

Coalition

Accessory navicular syndrome

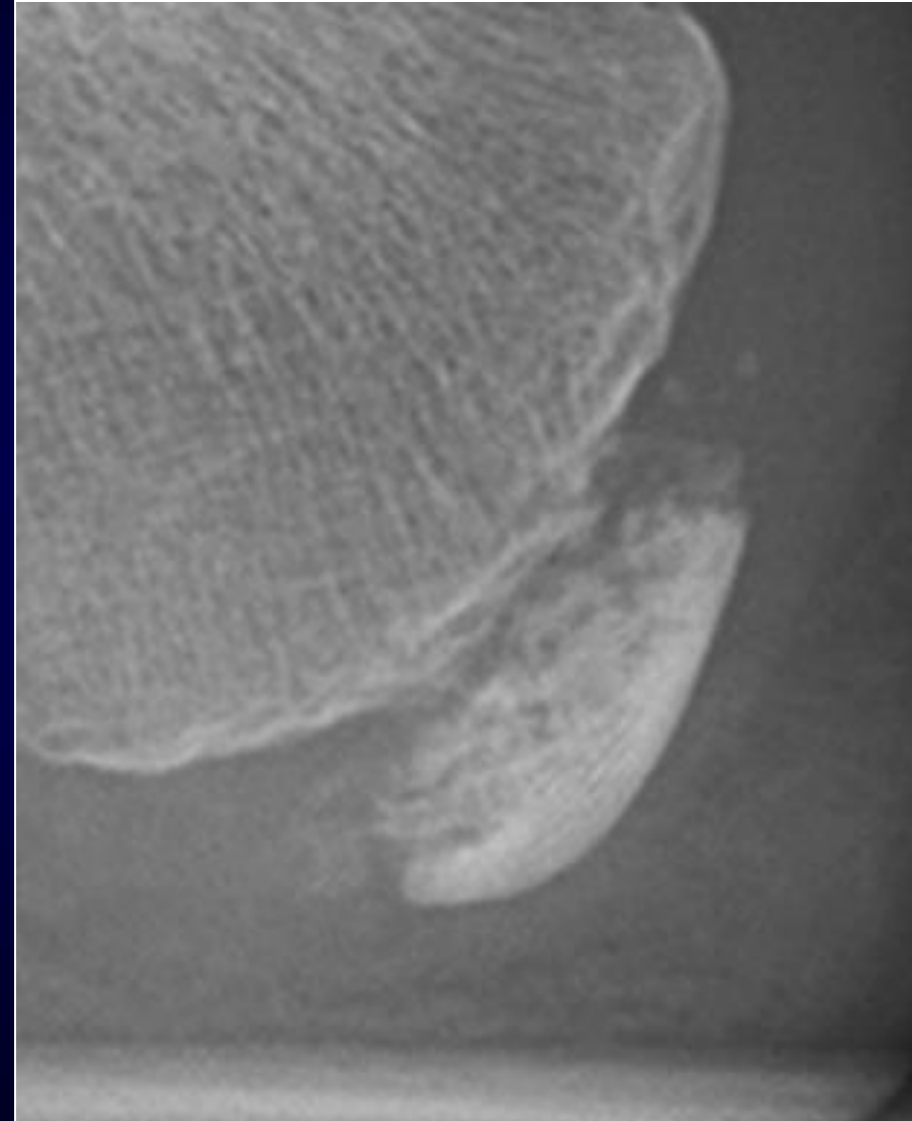
Overuse: Foot

- Sever Disease
 - Apophysitis of the calcaneal tuberosity
 - Traction of Achilles or plantar fascia
 - Causes fragmentation/irregularity of apophysis
 - Normal can look the same: clinical diagnosis
- Iselin Disease
 - Apophysitis base of 5th metatarsal
 - Runners
 - Enlargement, fragmentation, +/- widening



Vallejo JM. *MRI Clin* 2001; 9:435-446
Pontell D. *Clin PMS* 2006; 23:209-231
Canale ST. *JPO* 1992; 12:90-93

7 ♀ Foot Pain



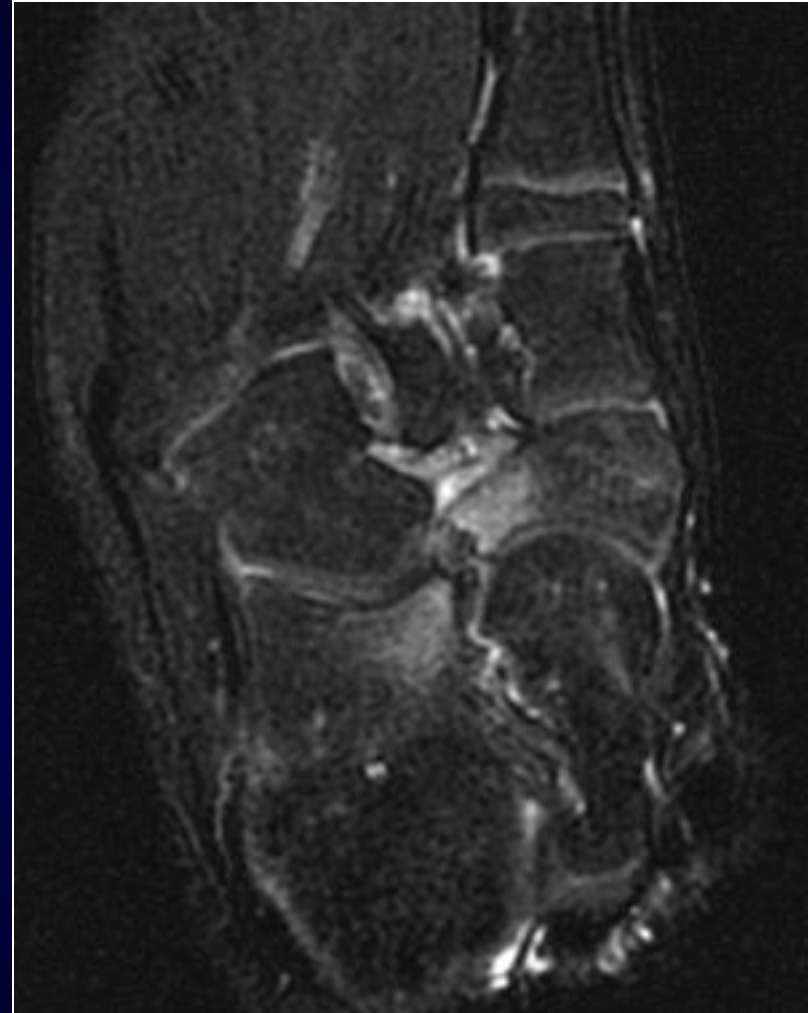
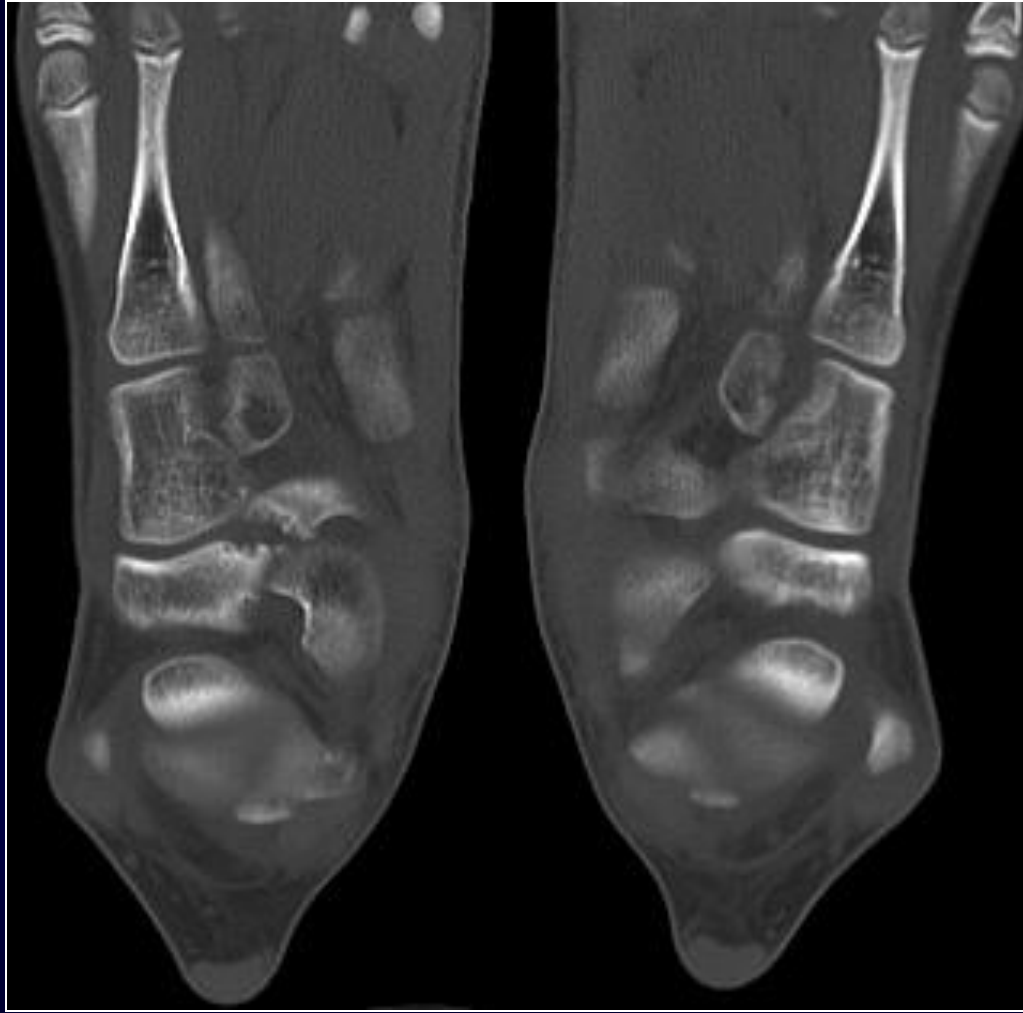
12 ♂ Bilateral Heel Pain



One year later



10 ♀ Gymnast



Tarsal coalition: calcaneonavicular

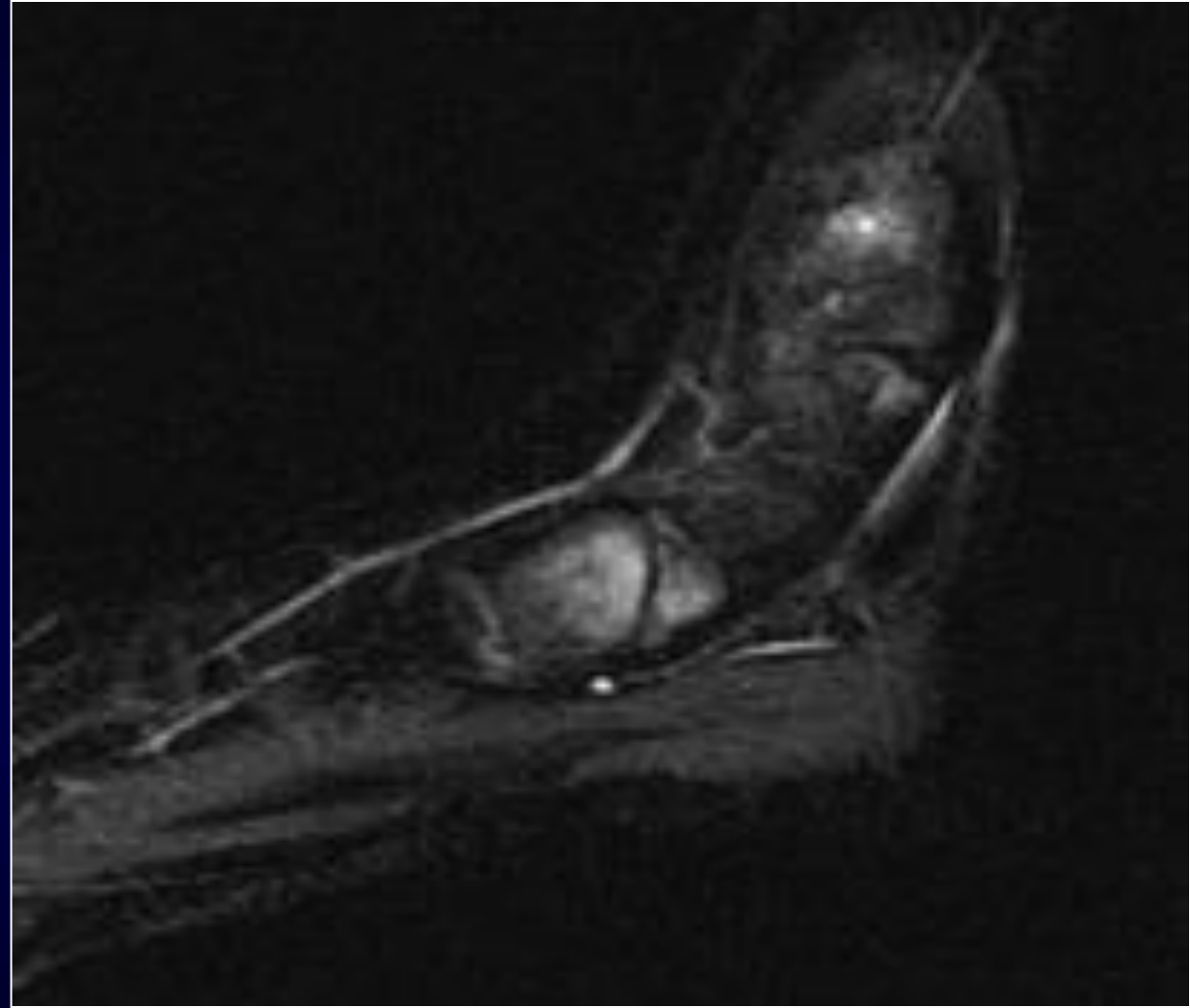
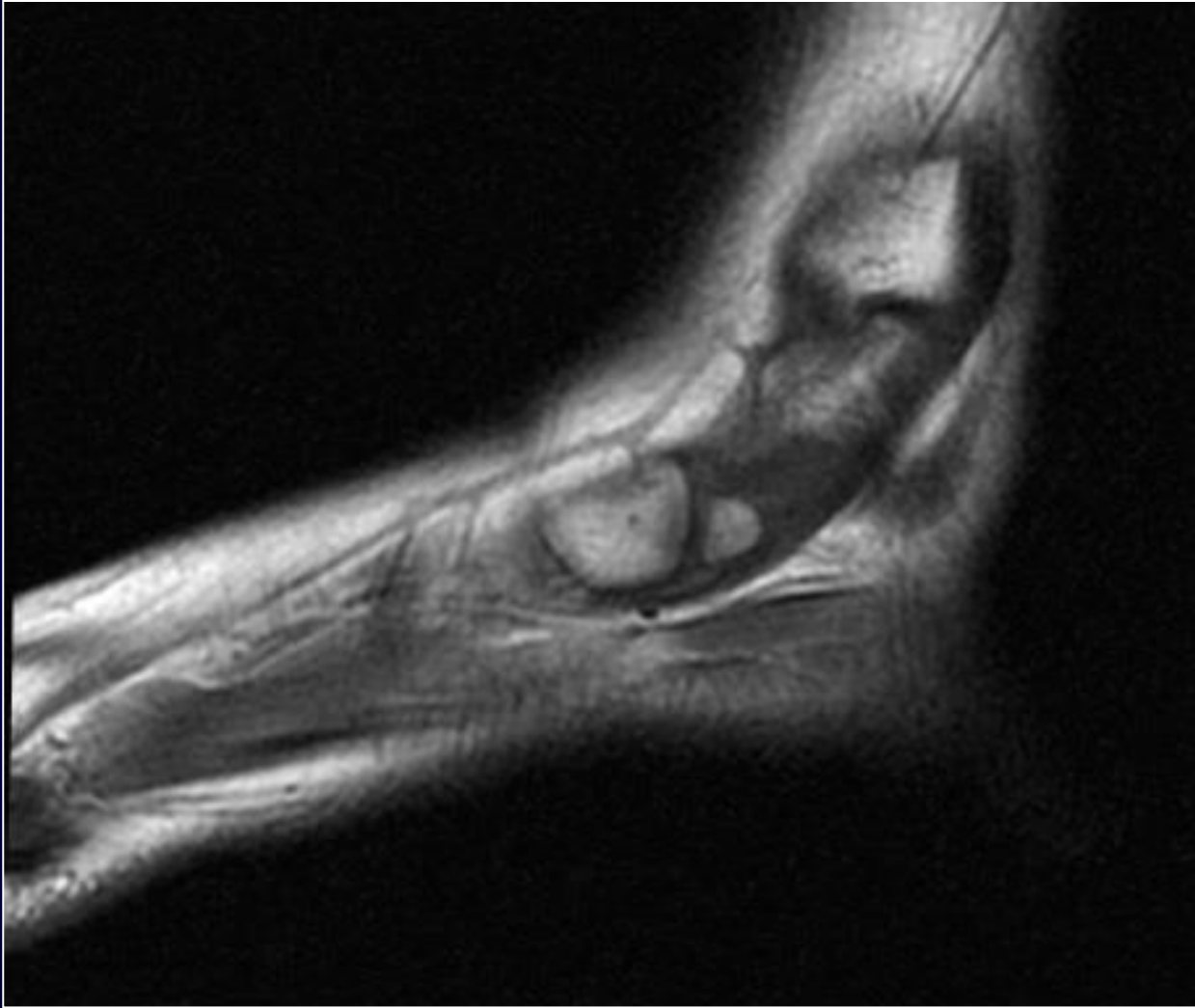
18 ♀



Talocalcaneal coalition

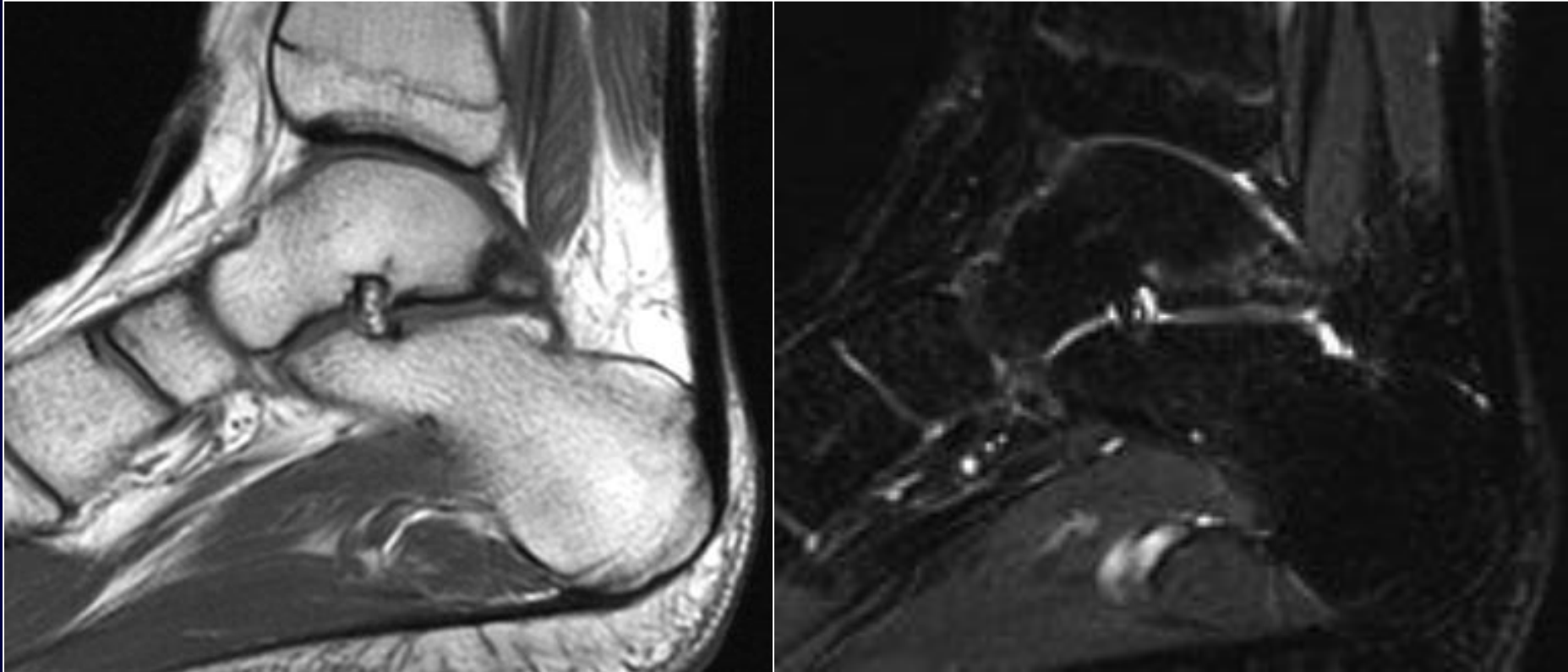


15 ♀ Soccer



Accessory navicular syndrome

15 ♂



Os trigonum syndrome = posterior impingement

Overuse: Knee

Overuse: Knee

- Osgood-Schlatter
- Tibial tubercle avulsion
- Sinding-Larsen-Johansson
- Jumper's knee
- PFSS

Osgood-Schlatter Disease

- Traction apophysitis at attachment of patellar ligament to tibial tubercle
- Repetitive tensile forces on this immature junction create an avulsion
- 50% have ossicle in tendon
- Swelling, edema
- 12-18 month self-limited course with “resolution”



Osgood-Schlatter Disease: OSD

- 25% bilateral
- Adolescent growth spurt

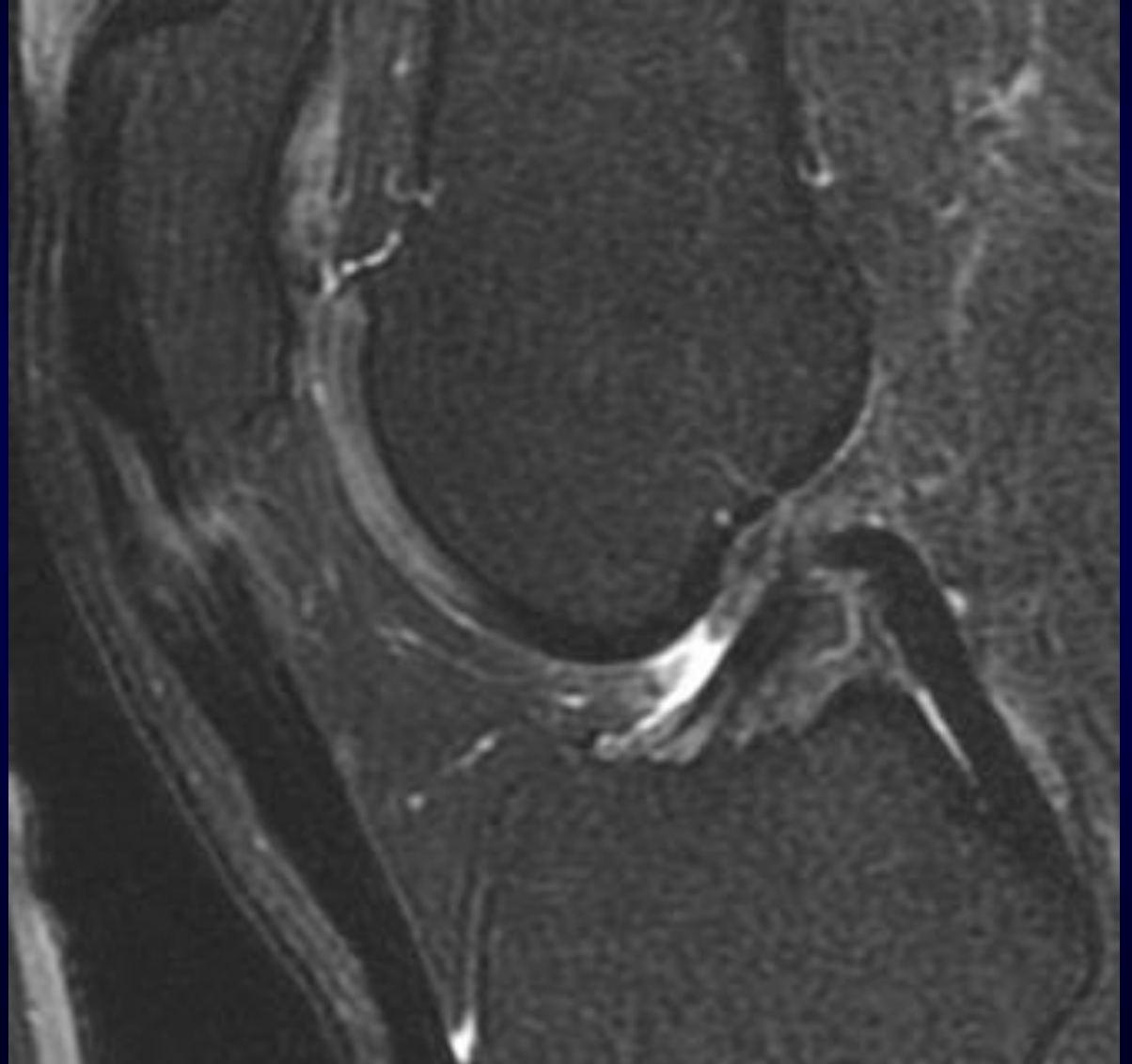


Sinding-Larsen-Johansson Disease

- Traction at attachment of patellar ligament to immature patella
- Calcification and ossification at junction
- Swelling, edema
- 12-18 month self-limited course with “resolution”
- In mature adolescent: jumper’s knee—chronic patellar tendinopathy

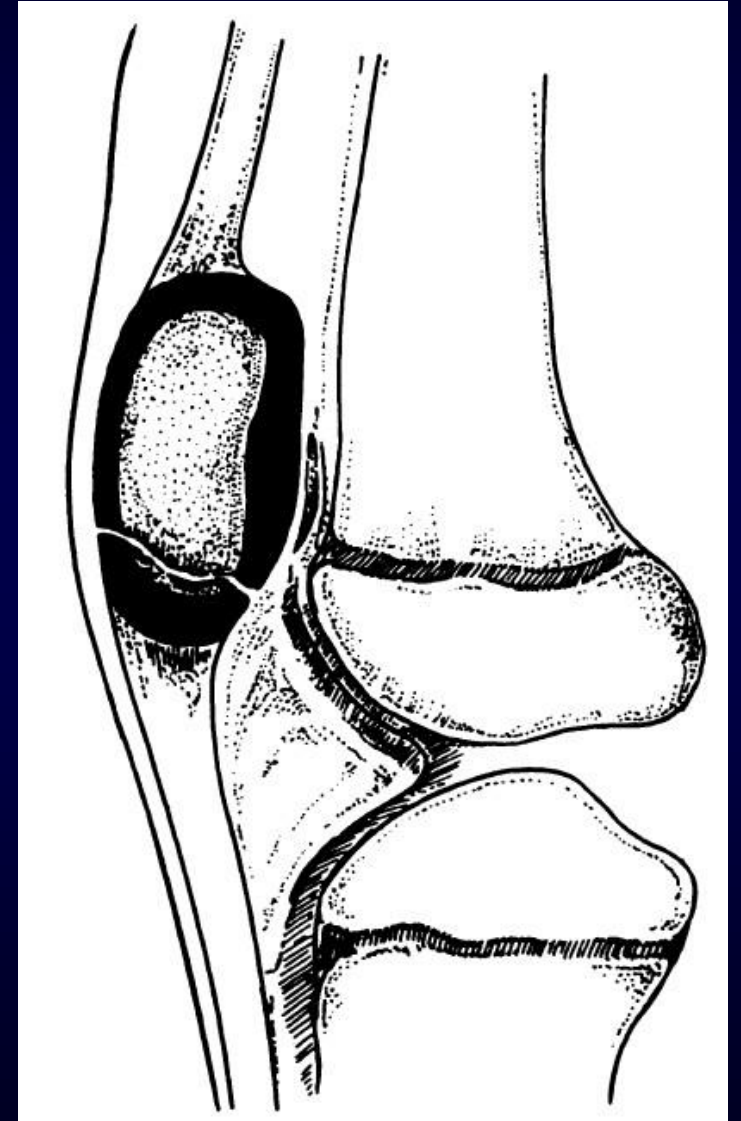


Sinding-Larsen-Johansson



Patellar Sleeve Avulsion Fracture

- Pediatric
- Small bone fragment @ inf. patella
- Significant injury also to unossified patella



Patellar Sleeve Avulsion Fracture



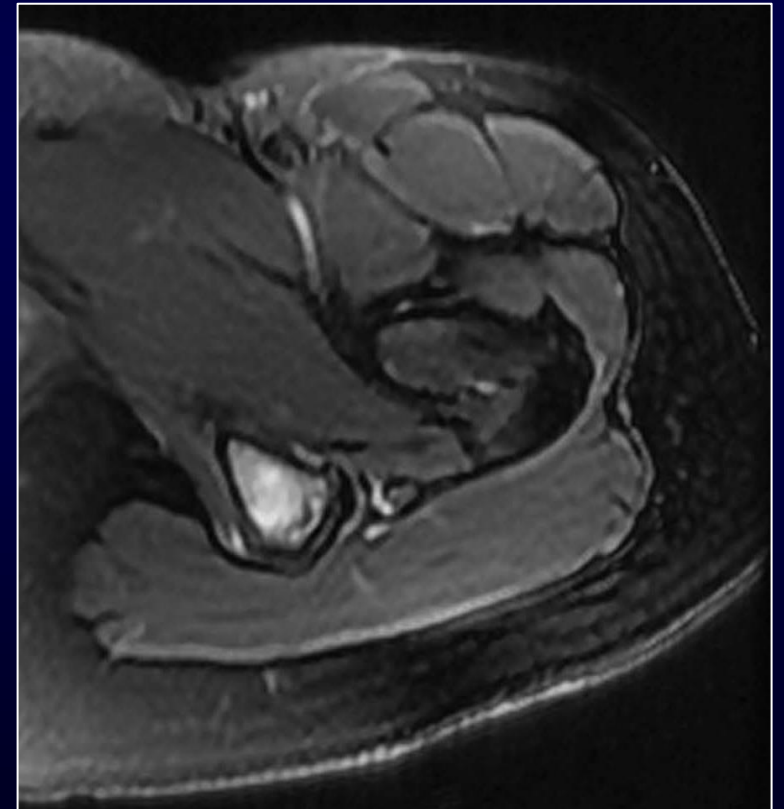


Overuse: Hip

Avulsion?



15 ♀ runner,
Increasing mileage
L hip pain



Apophysitis

Acute Injuries

Avulsion



Avulsions: Pelvis

- Displacement of apophyses—only occur while ossification center is visible but unfused
 - Not young children
- Acute: sudden onset pain—strenuous activity
- Chronic: avulsion, or apophysitis (undisplaced)
- X-ray: displacement, wide physis
- MRI: edema—marrow, soft tissue

Dillon JE. *MRI CAN* 2005; 13:783-797

Paletta GA. *Clin SM* 1995; 14:591-628

Avulsion: Typical Locations

ASIS: Sartorius

AIS: Rectus

Ischial tub: Hamstrings

Iliac crest: Obliques

LT: Iliopsoas

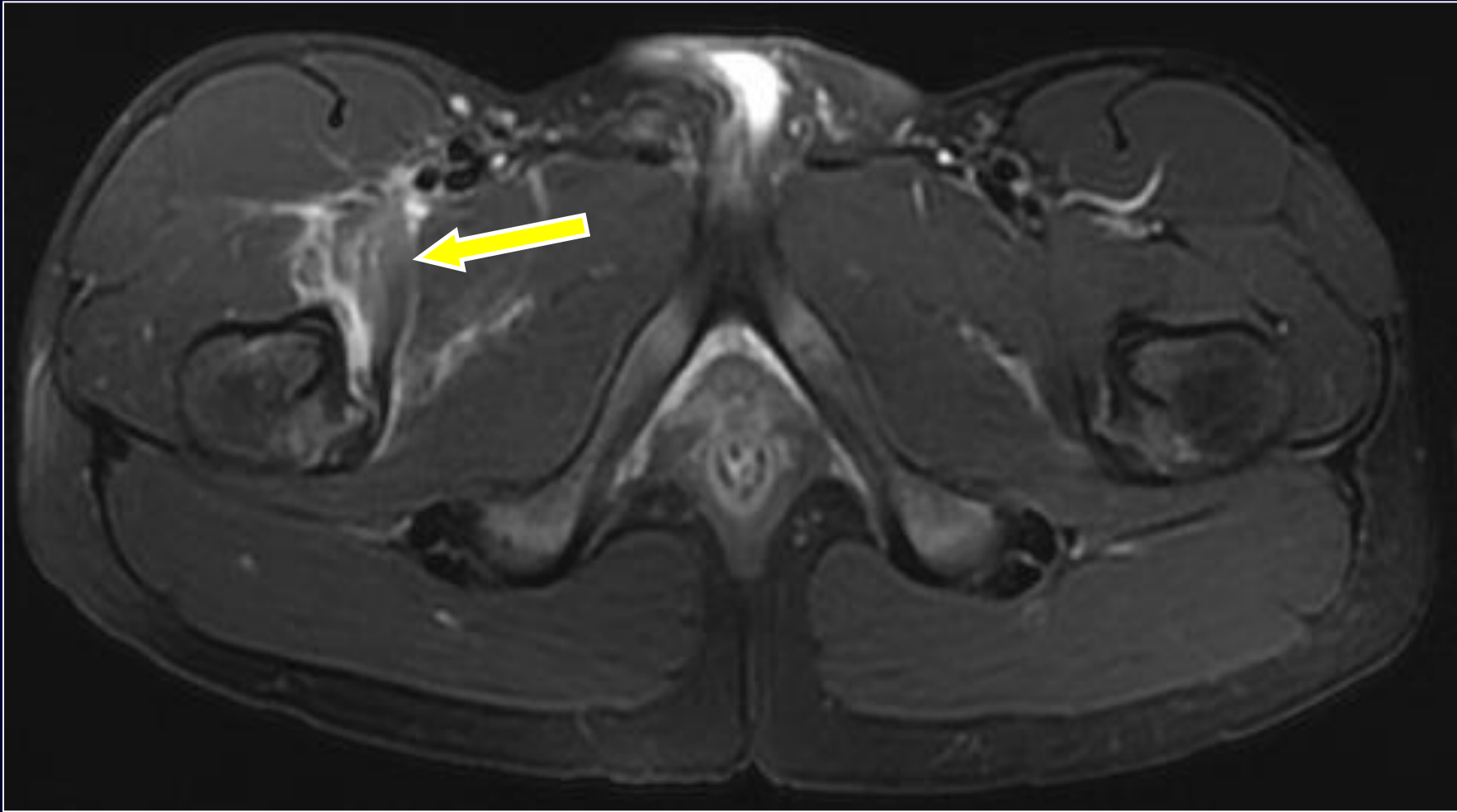
GT: Glutei



Avulsion

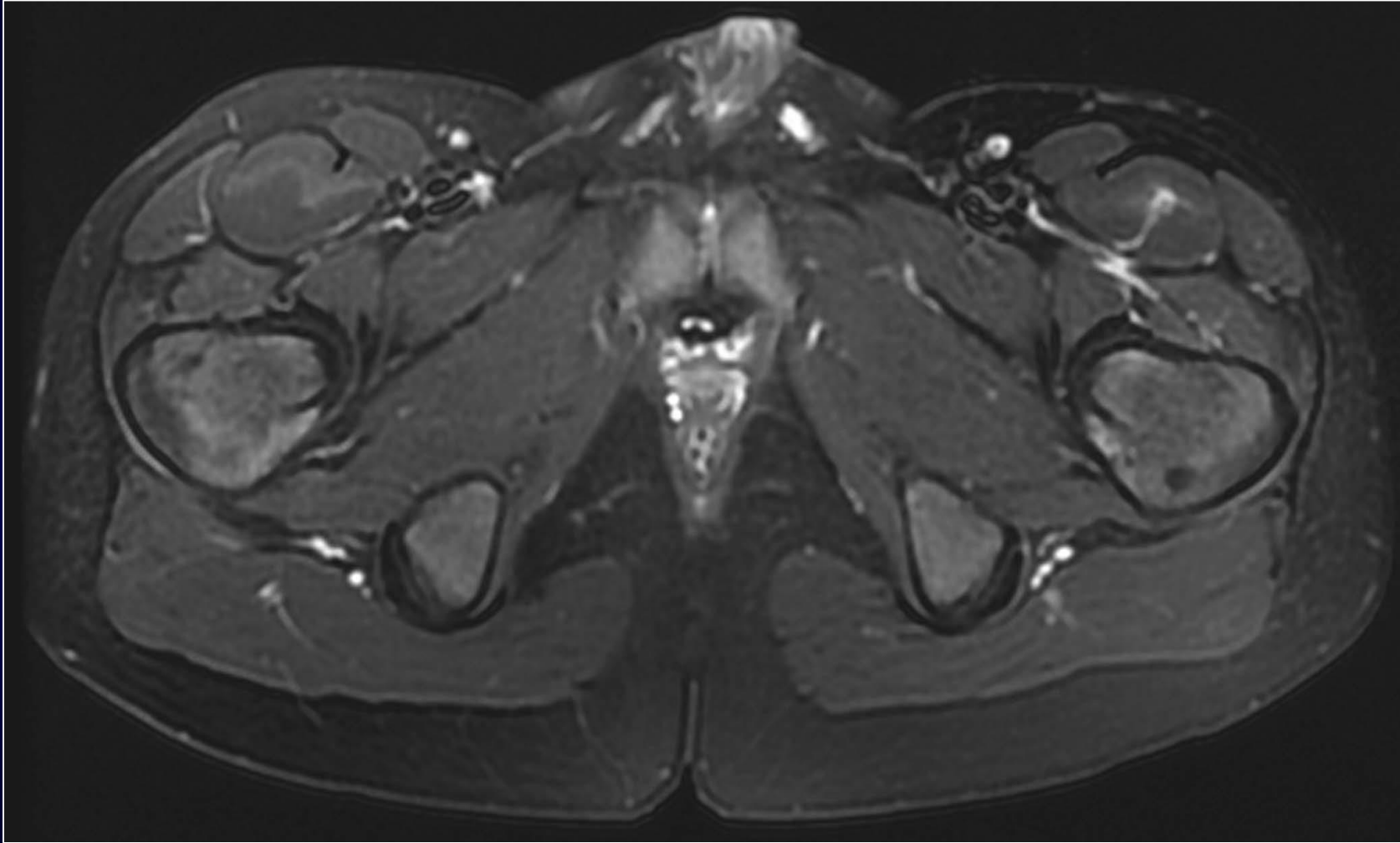


15 ♂ Soccer



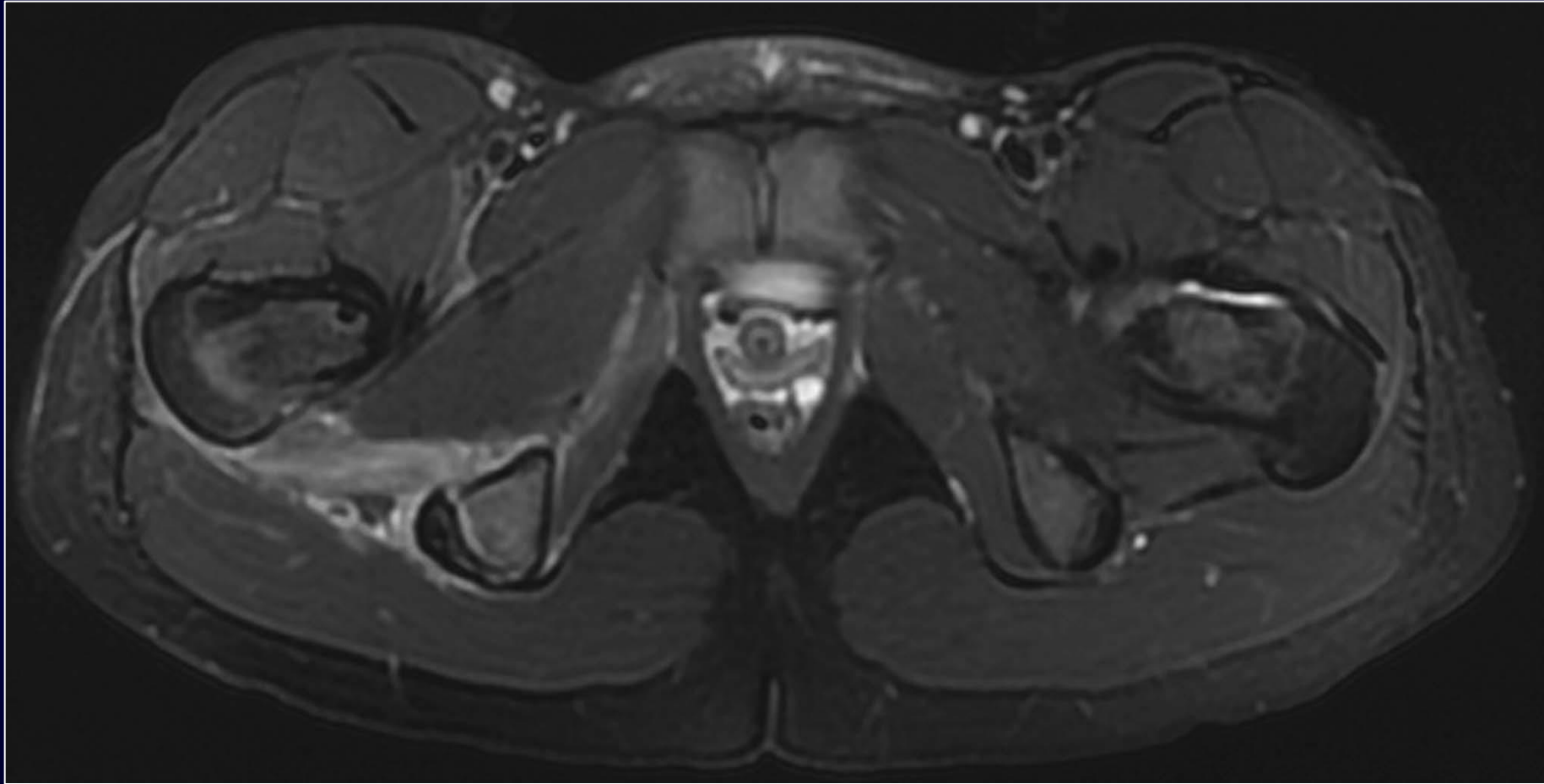
Partial tear, iliopsoas

11 ♂ Baseball



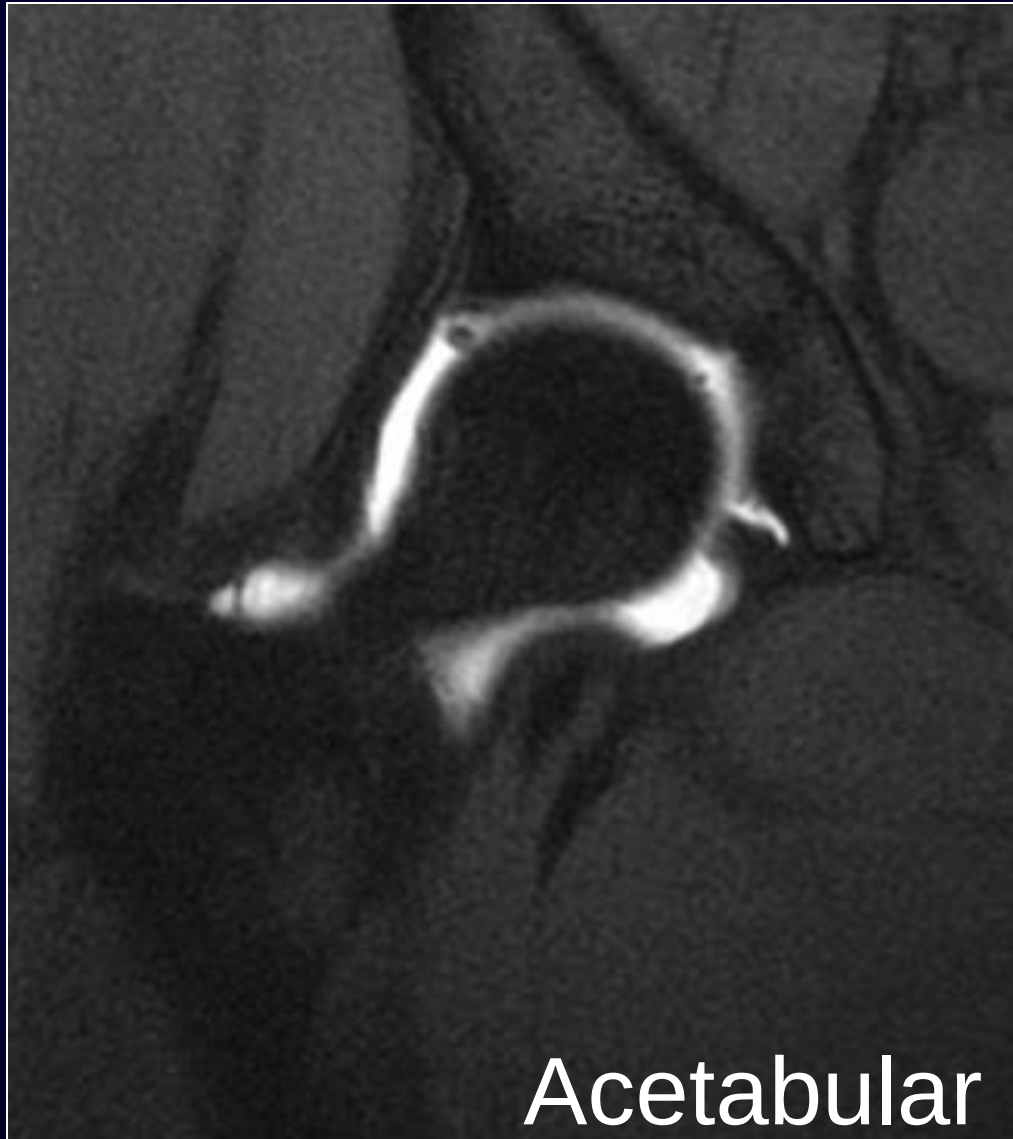
Partial tear, rectus

12 ♀ Fell during 100m dash



Partial tear, quadratus femoris

14 ♀ Soccer Goalie



Acetabular labral tear

Results: MRI Accuracy

- Medial meniscus:
 - Sensitivity $64/71 = 90\%$
 - Specificity $137/152 = 90\%$
- Lateral meniscus:
 - Sensitivity $68/91 = 75\%$
 - Specificity $123/134 = 92\%$
- ACL:
 - Sensitivity $91/92 = 99\%$
 - Specificity $129/133 = 97\%$

Lateral Meniscus--14 F: ACL Tear



Surgery: torn

Pediatric ACL Tears

- Girls >> boys after physes fuse
- Conservatively treated ACL tears do not do well → instability, cartilage damage, meniscus tears, DJD
- High grade partial ACL tears → same results
- Reconstruct:
 - If continuing instability
 - Patient refuses to modify activity
 - If there is repairable meniscus tear too
 - >50% partial tear
- Growth arrest/physeal bars are rare

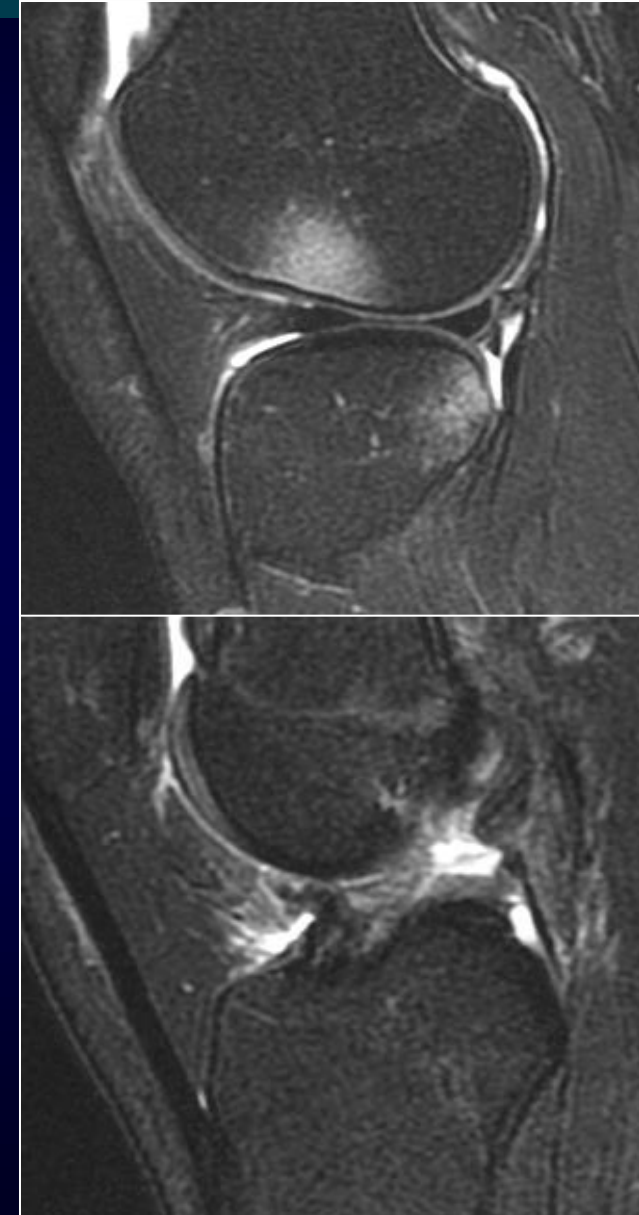
Benjamin HJ. *Ped Ann* 2007; 36:719-726

Larsen MW. *JAAOS* 2006; 14:736-744

Knee: Kissing Contusions

- Adult: ~100% ACL tears
- Peds: 28% with classic kissing contusions no ACL tear

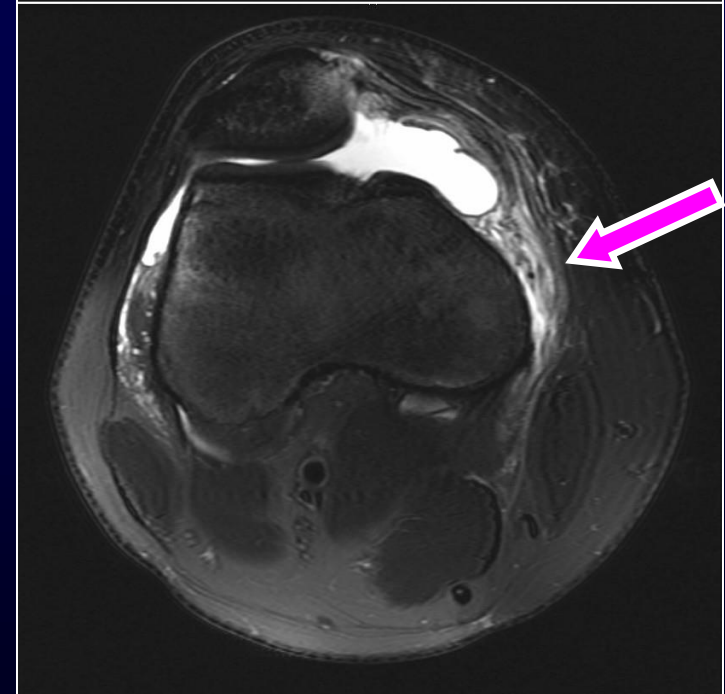
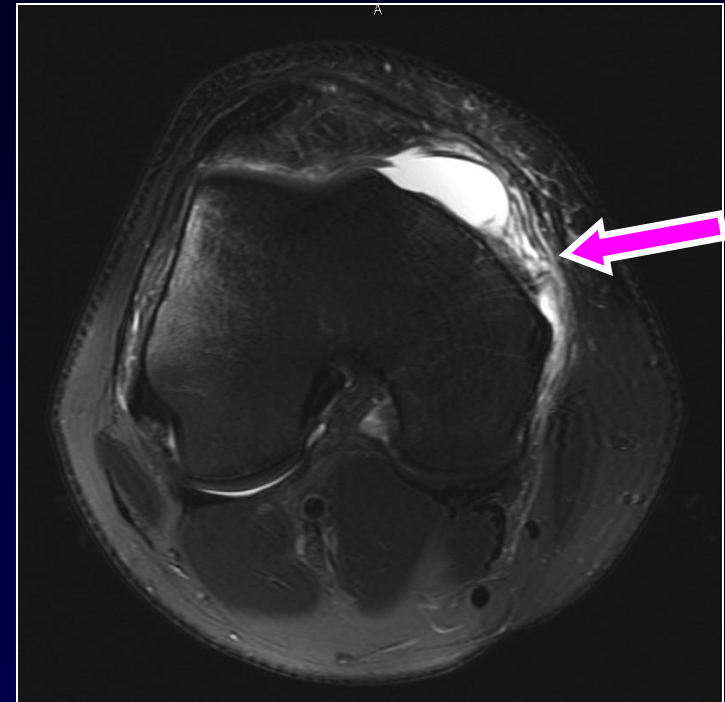
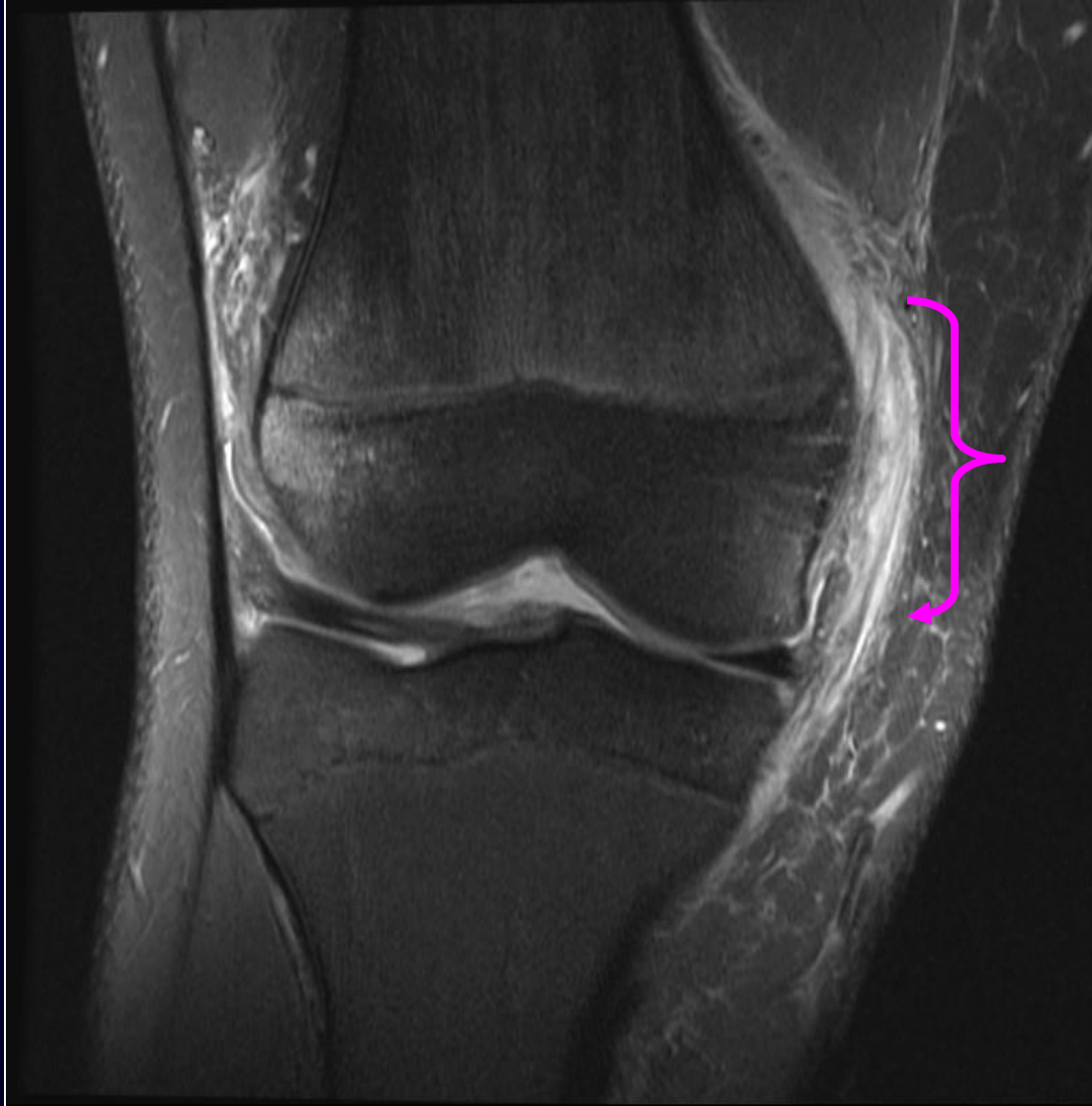
Snearly WN. *Rad* 1996; 198:205-208



Tibial Spine
Avulsion: 11 ♂
Twisting injury
→ ACLT
equivalent



MPFL Tear

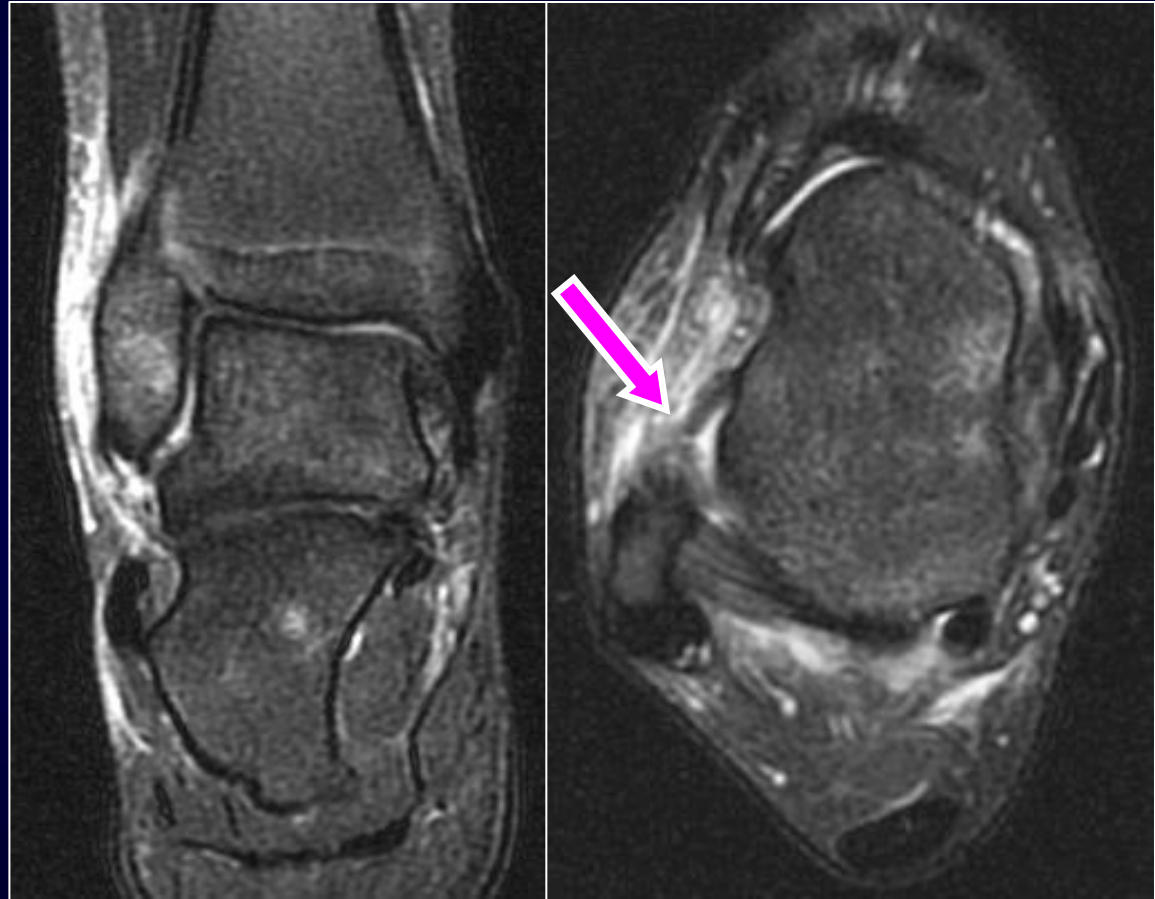


Acute: Ankle



- Soft tissue swelling over the fibula considered SH I clinically
- Often takes the place of a sprain

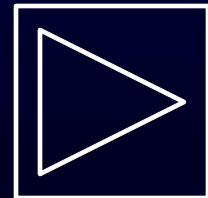
Lig. Injury: 12 ♀ B-ball





THANKS!

Brief Recap



Pediatric Knee

- Accuracy of MRI rivals that for adults
- Unstable OCD:
 - Defect
 - Large ($> 5\text{mm}$) or multiple cysts
 - Breaks in the cartilage or subchondral plate
 - T2 fluid underlying lesion
 - Surrounding rim of low T2

Pediatric Knee

- Signs of transient dislocation of patella:
 - Torn medial patellofemoral ligament (MPFL)
 - Torn medial retinaculum
 - Injured vastus medialis obliquus
 - Contusion of medial patella
 - Impaction fracture of inferomedial patella
 - Contusion of lateral femoral condyle
 - Displaced osteochondral fracture from LFC

Pelvic Avulsions

- Most common at the ASIS, AIIIS, ischial tuberosity
- Occur after ossification center appears, but before fuses
- Occurs through the zone of hypertrophy