

Imaging Lower Extremity Injuries 1



"File:Samples of boots for wounded or maimed soldiers (Reeve 012667), National Museum of Health and Medicine (3443228386).jpg" by National Museum of Health and Medicine is licensed under CC BY 2.0.

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Order of Injuries

LE Injuries 1

- General soft tissue injuries
 - Myositis ossificans
 - Morel Lavallee
- Stress fractures
- Pelvis/Hip
- Ankle

LE Injuries 2

- Knee



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Myositis Ossificans

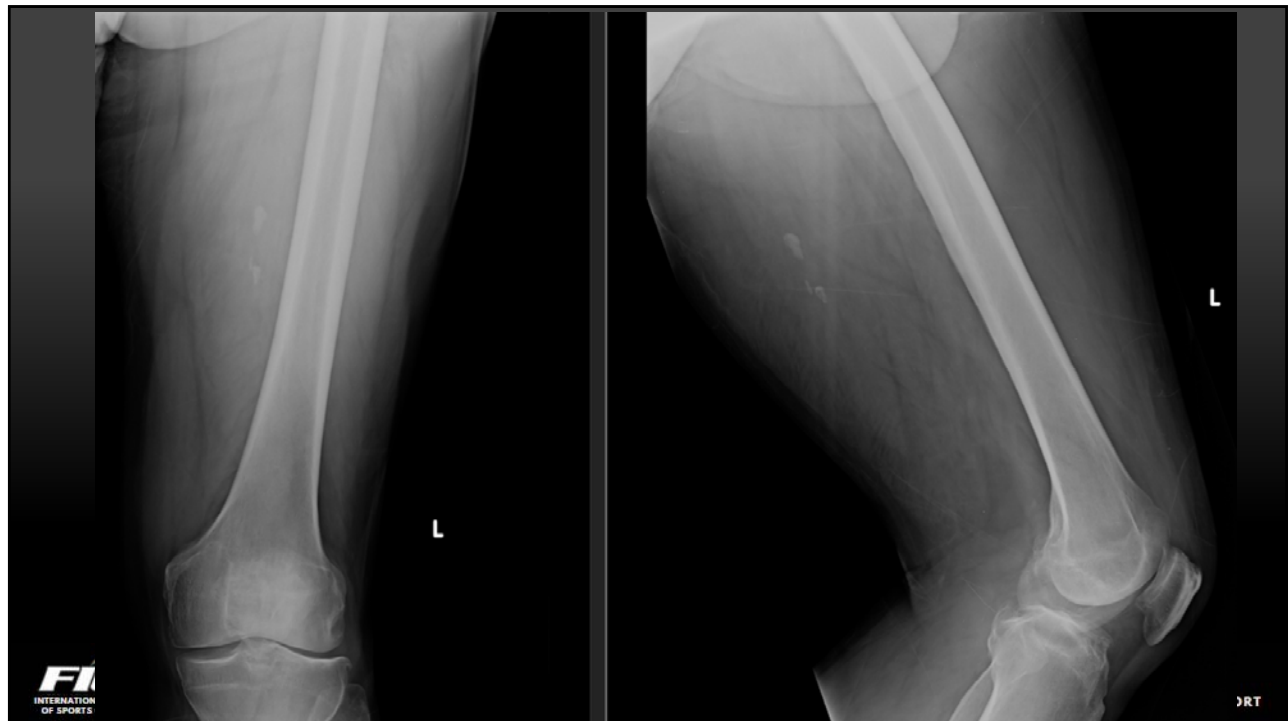
- “Heterotopic ossification”
Direct injury to muscle leading to bruising or hemorrhage
- Calcifies in a “zone phenomenon”
 - From outside in
 - Dysplastic cells in center simulating sarcomatous lesions
 - Beware of biopsy sample
- Brachialis, quadriceps, adductors of thigh



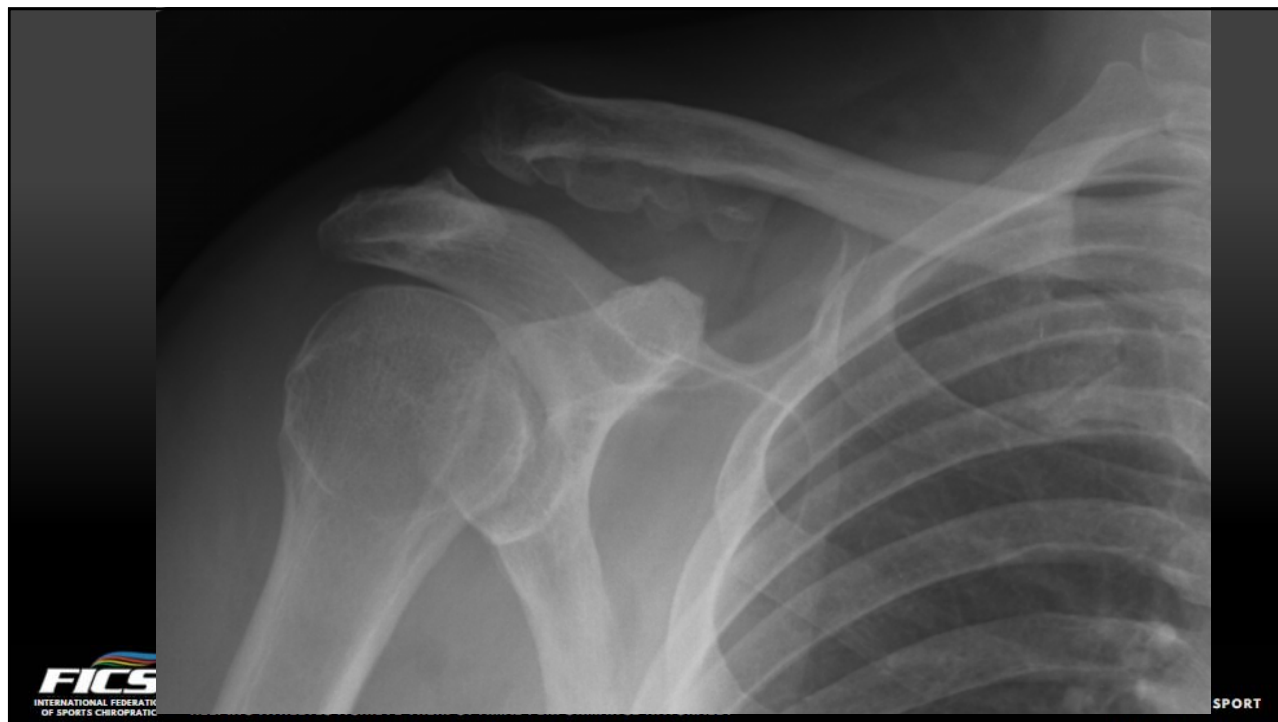
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Morel Lavallee

- Internal degloving
- Separation of the superficial fat from the deeper structures
- Creates a fibrous capsule that requires surgical removal
- Knees and hips are the most common locations
 - There was a recent case presented in NEJM
- DICOM 01



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Stress Injuries

- Stress fractures are broken into 2 categories
 - Fatigue Fx (usually called a stress Fx)
 - Abnormal stress on normal bone with mechanical failure
 - Insufficiency Fx
 - Normal stress on abnormal bone with mechanical failure
- Radiographic latent period of 7-10 days extremity, 21 days spine
- MRI is more sensitive
- In adolescents, osteoid osteoma is on the DDx



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Stress Fractures

- If either is continued to be used, can result in a complete fracture , e.g. spondylolytic spondylolisthesis

Location	Activity
Lumbar (pars interarticularis)	Hyperextension sports
Metatarsal shaft	Marching, standing, ballet
Navicular	Marching, running
Calcaneus	Jumping, running
Tibia (shin splints progressing to stress Fx)	Running
Patella	Hurdling
Femur	Running, ballet, marching, gymnastics
Sacrum	Running
Coracoid	Trapshooting
Hook of hamate	Raquet/club sports

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Stress Fracture Imaging

- Radiographs
 - Latent period where radiographically occult
 - 7-10 days in the extremities
 - 21 days in the spine
 - Findings
 - Soft tissue swelling
 - Periosteal lifting
 - White line perpendicular to weight bearing trabecula



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Stress Fracture Imaging

- Re-x-ray in 2 weeks vs MRI vs Bone Scan
 - If it isn't vital, rest and re-x-ray in 2 weeks
 - If it is vital, either MRI or bone scan can be used, equal sensitivity
- MRI is
 - More specific
 - Allows for soft tissue evaluation
 - No radiation

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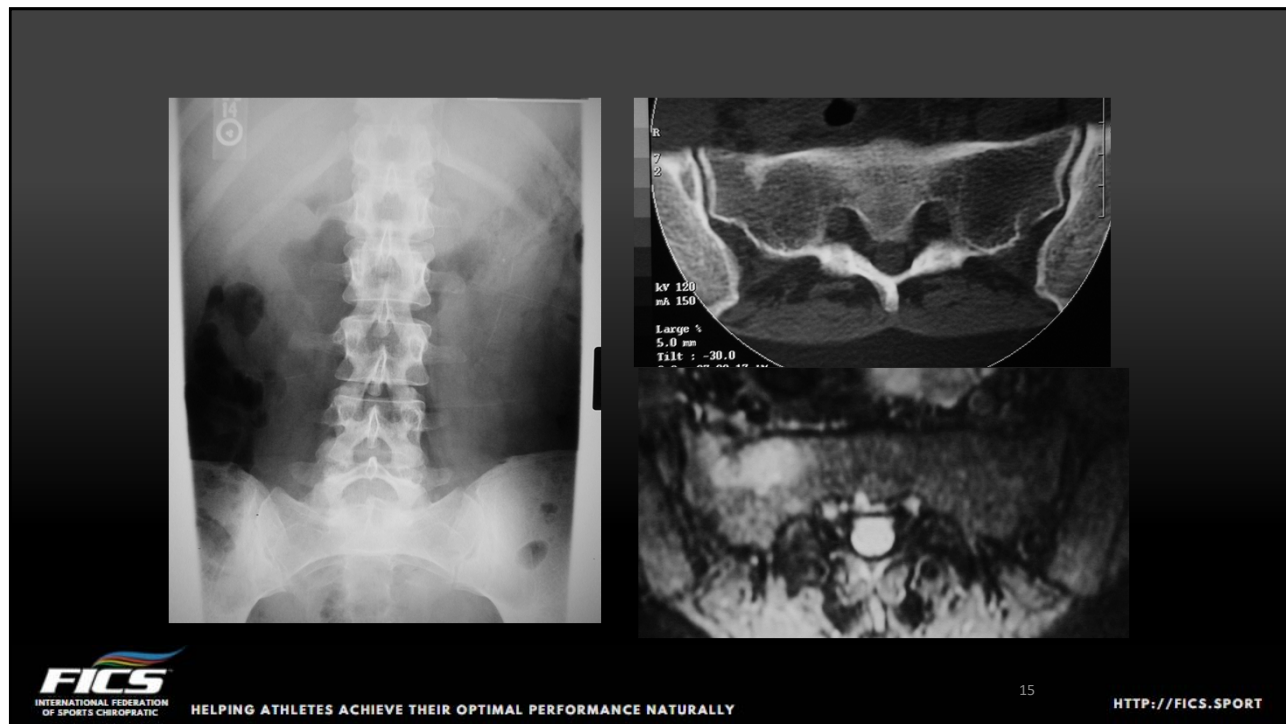
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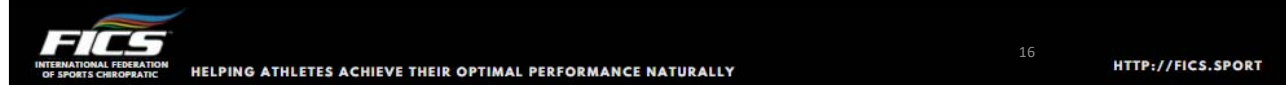
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DICOM

- DICOM 02: Navicular stress fracture
- DICOM 03: femoral neck stress fracture
 - courtesy Matt Skalski, DC, DACBR



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Pelvic Injuries



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Major Pelvic Fractures

- Malgaigne
- Bucket Handle
- Straddle
- Unilateral Straddle
- Duverney
- Pubic diastasis
- Sprung pelvis



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Acetabular Fractures

- 20% of all pelvic fractures involve acetabulum
- MVA or auto vs. pedestrian
- Femoral head driven into acetabulum
- Indirect forces from injury to:
 - Foot
 - Knee
 - Greater trochanter
- Stable or unstable



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Acetabular fractures

- 2 different diagnoses:
 - Dashboard Fracture
 - Posterior acetabular rim fracture
 - 1/3 of acetabular fractures
 - Flexion with ABDuction
 - Fx is a stable pelvic injury
 - But associated with possible femoral dislocation
 - Acetabular Blowout Fracture
 - Central acetabular fracture
 - MC acetabular Fx – Side impact
 - Unstable pelvic injury



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Pelvic Avulsion Fractures

- More common in pediatrics
- ASIS: sartorius
- AIIIS: rectus femoris
- Ischial tuberosity: hamstring



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Sports Hernia / Athletic Pubalgia

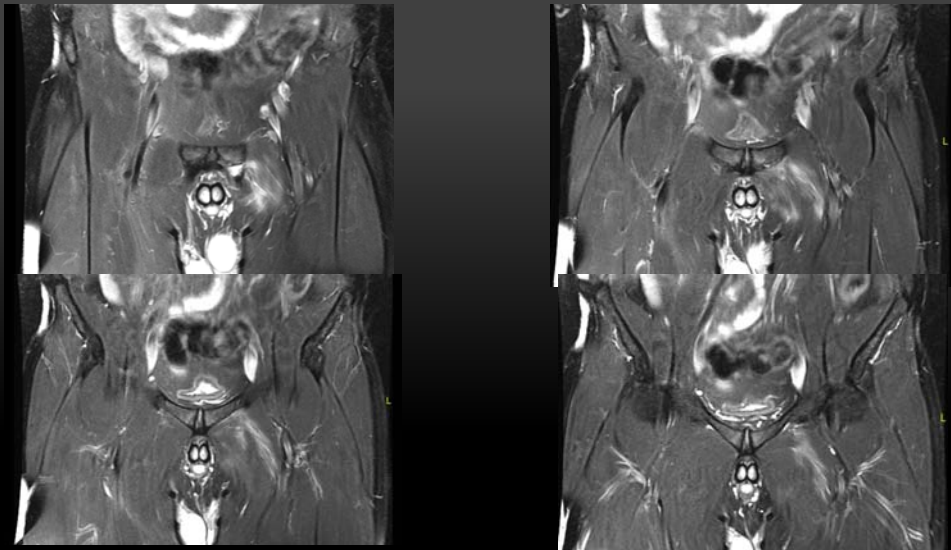
- Seen in sports with lots of torso torsion
 - Baseball pitchers
 - Hockey goalies
 - Big clinical clue is the loss of core strength for the twisting action
- Represents a musculotendinous junction injury at the insertion of muscles into the pubic rami
 - Rectus abdominus
 - Pectineus
 - Gemeli
 - Adductors

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Sports Hernia / Athletic Pubalgia

- Presents with inguinal pain similar to hernia, but not a true hernia
- DDX:
 - Inguinal hernia
 - Osteitis pubis
 - HADD
 - Pubic fatigue Fx
 - Internal derangement of the hip, e.g. labral tear
- Requires MRI for diagnosis

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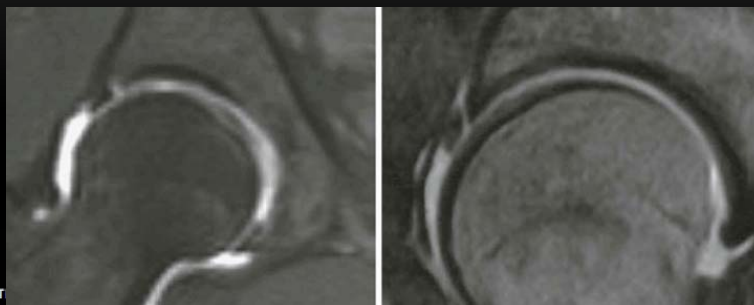
Acetabular Labrum

- Fibrocartilaginous ring that deepens the acetabulum
- Mechanical impingement and degeneration damage the labrum
- Symptoms of pain, clicking, or giving way
- Radiography may demonstrate developmental dysplasia of the hip or femoroacetabular impingement (FAI), but does not tell you about the labrum
- Imaging of the labrum requires MRI arthrogram
 - 60% more sensitive for labral pathology than conventional MRI

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Acetabular Labrum Tears

- MRI arthrogram
- Looking for a tear in the cartilage
- Or a paralabral cyst



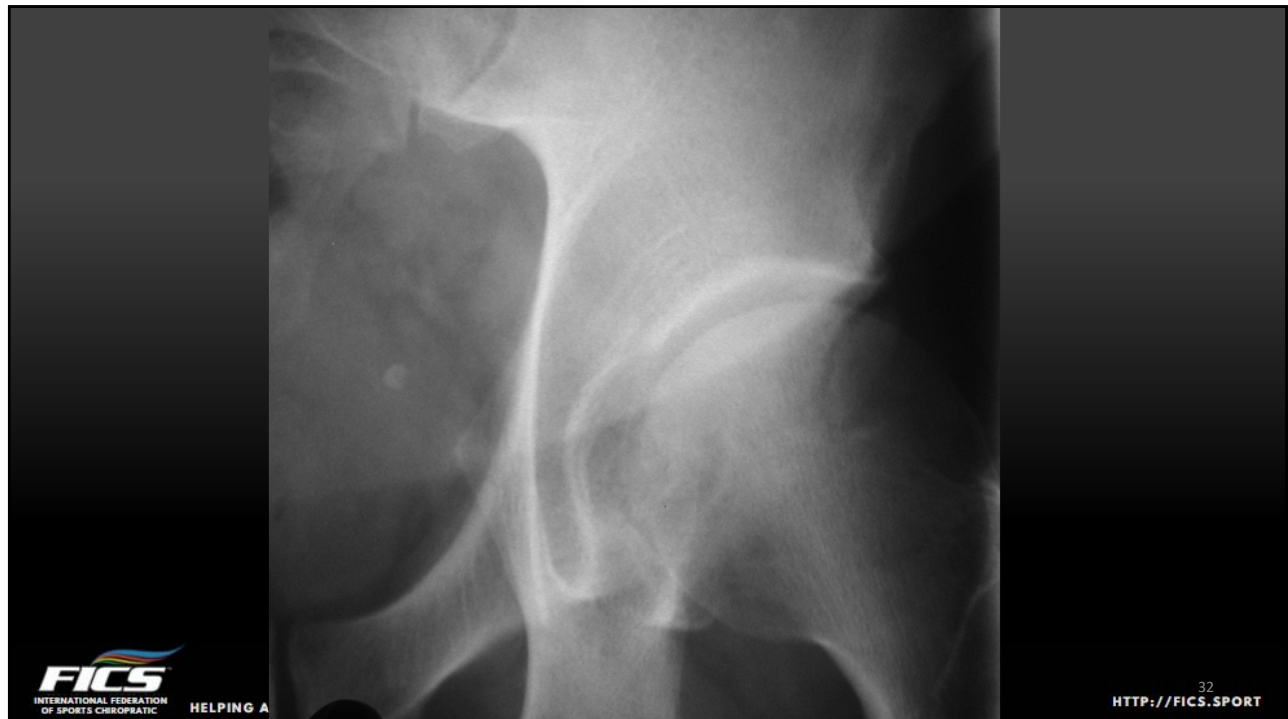
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Os Acetabulum

- Accessory ossicle of the acetabular margin
- Often mistaken for fracture
- Usually ASx, can be associated with femoroacetabular impingement syndrome (FAI)



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Femoroacetabular Impingement Syndrome (FAI)

- Abnormal shape of the FA joint can result in mechanical impingement and pain
- Cam type: oblong protrusion on the femoral neck
- Pincer type: deep acetabular socket



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"Colourful Crab Claw" by Pyrolytic Carbon is licensed under CC BY-NC-ND 2.0.

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Femoroacetabular Impingement Syndrome (FAI)

Cam Type



Pincer Type



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Pitt's Femoral Herniation Pits

- Another clue to labral problems secondary to FAI
- Pitts pits
- Used to be thought incidental, but can be related to FAI in hip pain patients



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Proximal Femoral Fractures

- Epidemiology
 - 240,000 hip fractures annually
 - 12-20% die within year of fracture
 - 50% of survivors unable to live independently

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Proximal Femoral Fractures

- Young: severe acute fracture
- Young: stress (fatigue) fracture
- Geriatric: minimal trauma in patient with osteoporosis
 - Most common
- Pathologic: Paget, tumors, etc.



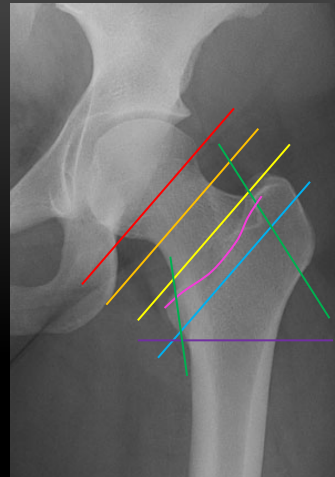
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6 Types of Proximal Femoral Fx

- Intracapsular
 - Subcapital Fx
 - Midcervical Fx
 - Basicervical Fx
- Extracapsular
 - Trochanteric Fx
 - Intertrochanteric Fx
 - Subtrochanteric Fx



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Proximal Femoral Fractures

- Intracapsular types
 - Subcapital
 - Midcervical
 - Basicervical
- Higher incidence of:
 - Avascular necrosis (8-30%)
 - Nonunion (25%)
- Total hip arthroplasty



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Slipped Capital Femoral Epiphysis

- Aka SCFE
- Age: 10-15
 - Adolescent growth spurt
- Obese
- Male > Female
- Left > Right
- Bilateral 20-30% (bilateral F > M)
 - Usually within 1 year, not simultaneous



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SCFE

- Clinical features
 - Most common hip disorder of adolescence
 - Hip pain referred to thigh and knee
 - Limp: + Trendelenberg
 - Gluteus medius weakness
 - Limitation of abduction and internal rotation



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SCFE

- Type 1 Salter - Harris fracture
- Head remains in acetabulum
- Posteromedial slippage of the head on the femoral neck



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Hip X-rays

- Minimal Dx series for a hip
 - AP
 - 15 degrees internal rotation
 - Frogleg



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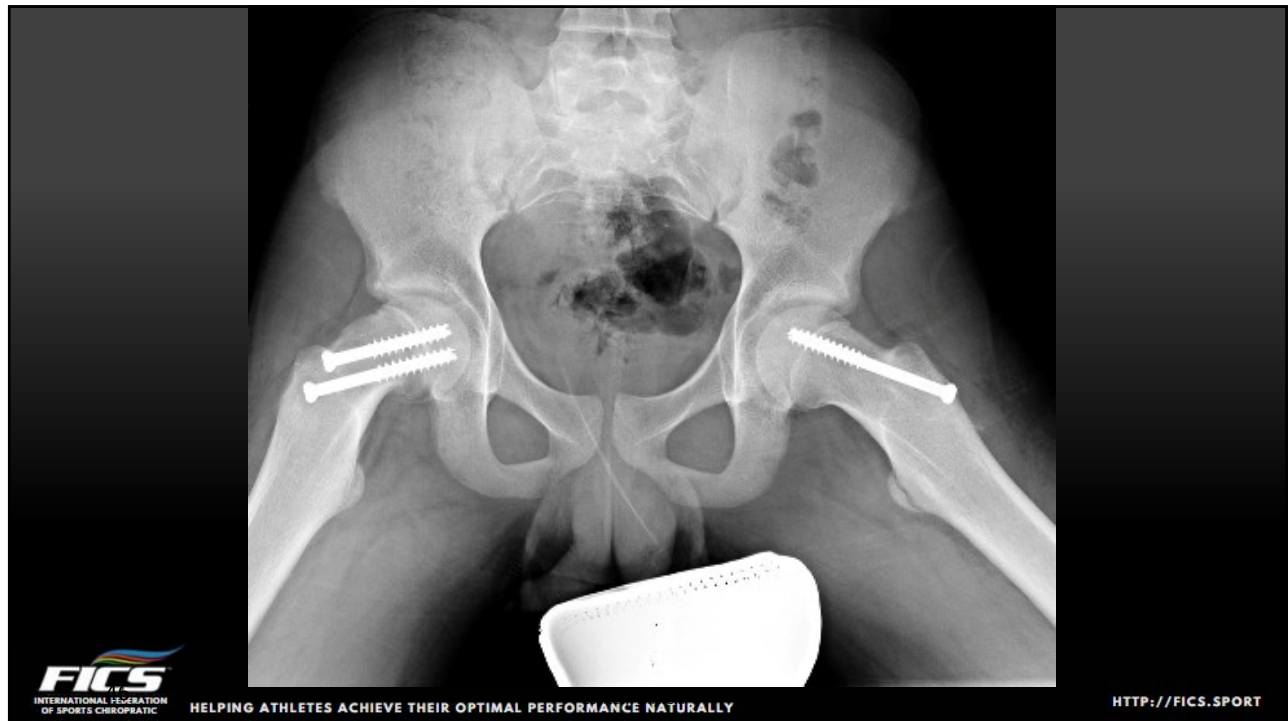
SCFE

- Imaging findings
 - Decreased epiphyseal height
 - Wide irregular growth plate
 - Abnormal Klein line
 - Metaphysis lateral to acetabulum
 - Parrot beak appearance to the head
 - Pistol grip appearance to femoral neck

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SCFE: Outcomes

- Degenerative joint disease (MC)
- Coxa vara deformity ($<120^\circ$)
- Short, broad femoral neck
- AVN



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Ankle and Foot Injuries



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Ankle and Foot Injuries

Miscellaneous

- Os trigonum
- Sever disease

Internal derangement

- Achilles rupture
- Ankle ligaments
 - ATFL
 - Calcaneofibular
- LisFranc Injury

Fractures

- Toddler fracture
- Boot-top fracture
- Malleolar fractures
- Osteochondral fracture of talus
- Calcaneal compression
- Navicular fracture
- Jones/Dancer fracture
- Sesamoiditis



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Ottawa Ankle Rules

- For ankle injuries < 7 days old
- Validated in adults and children >6yo
- If there are no positive criteria, less than 2.5% chance of significant fracture
- Stiell IG, Greenberg GH, McKnight RD, Nair RC, McDowell I, Worthington JR. A study to develop clinical decision rules for the use of radiography in acute ankle injuries. *Ann Emerg Med.* 1992; 21:384–90.
- Bachmann LM, Kolb E, Koller MT et-al. Accuracy of Ottawa ankle rules to exclude fractures of the ankle and mid-foot: systematic review. *BMJ.* 2003;326 (7386): 417.



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Ottawa Ankle Rules

Conventional radiographs are indicated if ("OR" Rules)...

- ANKLE radiographs
 - Bone tenderness along the distal 6 cm of the posterior edge of the tibia or tip of the medial malleolus
 - Bone tenderness along the distal 6 cm of the posterior edge of the fibula or tip of the lateral malleolus
- FOOT radiographs
 - Bone tenderness at the base of the fifth metatarsal
 - Bone tenderness at the navicular bone
- An inability to bear weight both immediately AND in the clinic for four steps, regardless of limping
 - Ankle vs foot depends on site of pain



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Os Trigonum

- Most commonly symptomatic in those that plantar flex frequently
 - Sprinters
 - Ballet Dancers
- Possible fatigue fracture



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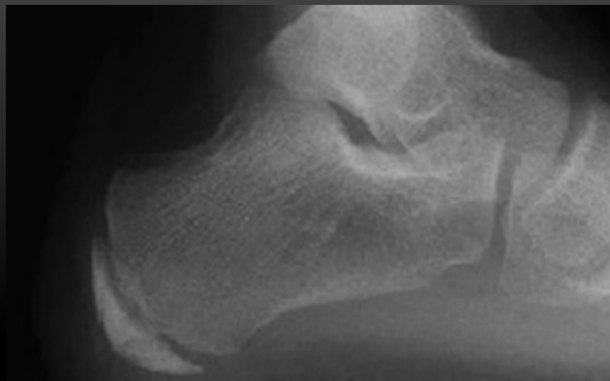
Os Trigonum

- Most commonly symptomatic in those that plantar flex frequently
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Sever disease



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Achilles Tendon Rupture

- Tendon rupture or avulsion fracture
- Tendinosis most commonly happens in runners
- Progression of tendinosis to failure
- DICOM 04

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Lateral Ankle Ligaments

- Lateral ankle ligaments injured with inversion from most common to least
 - Anterior talofibular
 - Calcaneofibular
 - Posterior talofibular
- Small avulsion fractures can be seen radiographically, but poorly correlate with ligamentous injuries
- DICOM 5a, 5b

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LisFranc Injury

- LisFranc ligament
 - 1st cuneiform to 2nd metatarsal base
- Forced plantarflexion of foot
- Destabilizes the entire tarsometatarsal joint complex



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Toddler Fracture

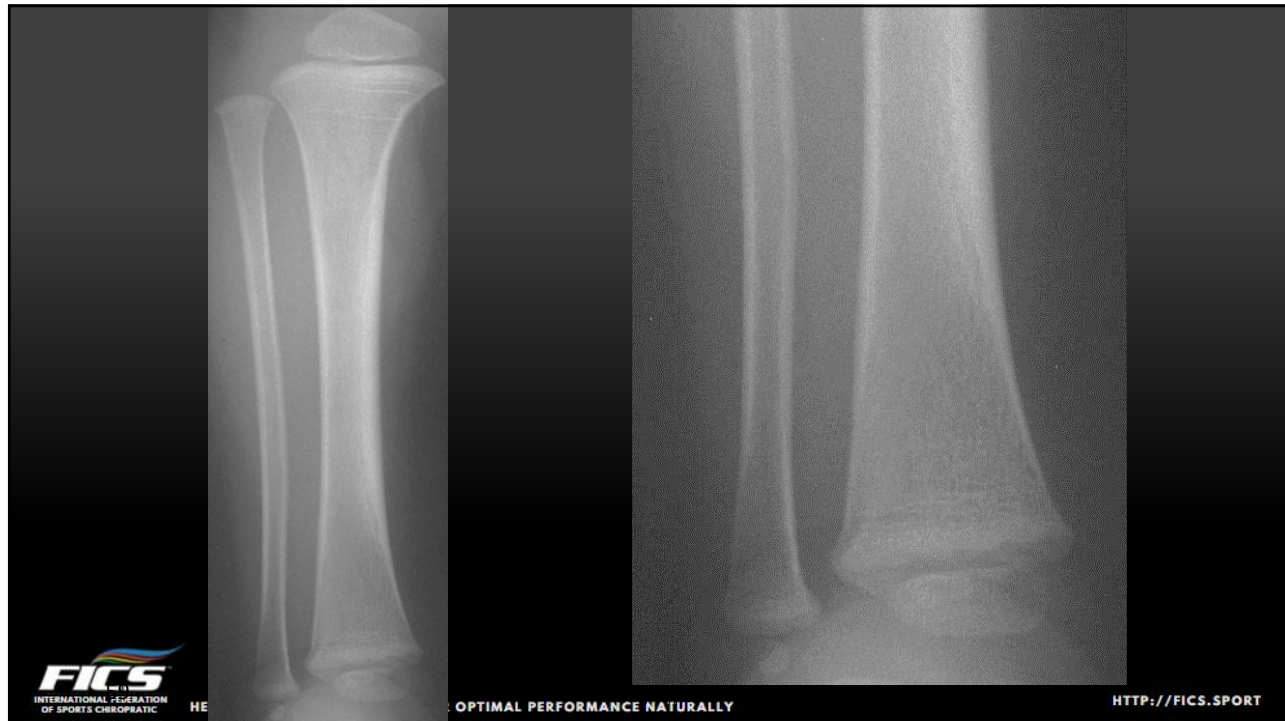
- Undisplaced spiral fracture of the tibia
- 9 months to 3 years of age
- Fall out of crib - leg caught in slats
- Usually only seen on one view
 - Good luck



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Boot-top Fracture

- Adults
- Fracture of tibia and fibula
- Skiing injury



Imaged in Ski boot

Case courtesy of Dr Henry Knipe, Radiopaedia.org, rID: 70421

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Malleolar Fractures

- Medial
- Lateral
- Bimalleolar
- Trimalleolar (including posterior)
- Avulsion fractures
- Weber classification
 - 2 disruptions in the ankle mortise = instability



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Trimalleolar Fracture

- Bimalleolar fracture combined with fracture of the posterior malleolus of the tibia



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Because we love eponyms...

- There are numerous named ankle fractures. Most overlap and have poor definitions.
 - Potts
 - Duputryen
 - Pilon
 - Tillaux
 - Juvenile Tillaux
 - etc

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Osteochondral Fx

- aka osteochondritis dissecans (OCD)
- Talar dome
 - Anterolateral or posteromedial corners
- Young patients
- Inversion injury
 - Associated with lateral ligamentous injury



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Calcaneal fractures

- Most common tarsal bone to fracture
 - 75% subtalar joint and body
 - 25% processes
- Don Juan Fx
 - Compression Fx
 - Land from a height
 - Abnormal Boehler angle (28-40°)
- Achilles avulsion Fx
- Fatigue fracture
- Numerous small avulsion Fx

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Don Juan Fx

- Fall from height; land on feet
- 10% bilateral
- 10% associated vertebral fracture
- Often comminuted
 - May require surgery
- Intra-articular (subtalar joint involved)



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Talus Fractures

- 2nd most common tarsal to fracture
- Most frequent type: avulsion of anterior process
- Body
- Neck
 - Aviators fracture
- Head



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Talus Fractures

- 2nd most common tarsal to fracture
- Most frequent type: avulsion of anterior process
- Body
 - Neck
 - Aviators fracture
- Head



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Jones / Dancer Fracture

- Transverse fracture of base of 5th metatarsal
- Mechanism
 - Inversion and plantar flexion
- M/C bony injury of foot
- M/C Fx associated with inversion injury
- Frequent nonunion
- Frequently overlooked
- DDx vs normal apophysis



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Sesamoiditis / Sesamoid Fracture

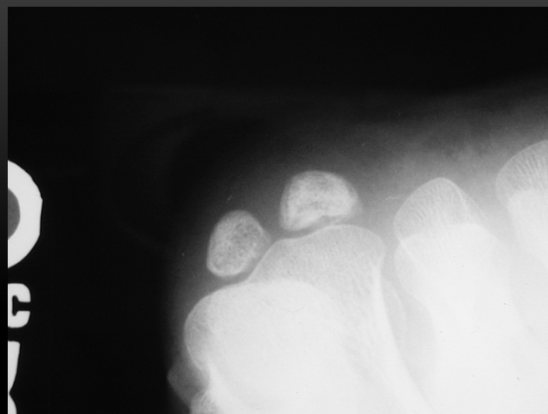
- Repetitive plantar flexion on hard surface
- Fracture of the hallux sesamoid(s)
- Sesamoid view can be helpful
- DDx vs bipartite sesamoid



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Sesamoiditis / Sesamoid Fracture

- Repetitive plantar flexion on hard surface
- Fracture of the hallux sesamoid(s)
- Sesamoid view can be helpful
- DDx vs bipartite sesamoid



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End of Lower Extremity Injuries 1



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