AMPLIFY

The X-ray is Negative, Now What? Pediatric Soft Tissue Injury Review

Holly J. Benjamin, MD, FACSM, FAMSSM

Professor of Orthopedic Surgery, Rehabilitation Medicine and Pediatrics

Director of Primary Care Sports Medicine

University of Chicago

Holly J. Benjamin, MD, FAAP, FAMSSM, FACSM

Professor of Orthopedic Surgery, Rehabilitation Medicine and Pediatrics

Director of Primary Care Sports Medicine

University of Chicago

Head Team Physician WNBA Chicago Sky, AHL Chicago Wolves, UChicago NCAA DIII Maroons, Team Physician; Bank of America Chicago Marathon and US Soccer Federation

Email: hjbenjam@uchicagomedicine.org

https://www.uchicagomedicine.org/find-a-physician/physician/holly-j-benjamin

Financial Disclosures

- Neither I, Holly J. Benjamin, nor any family member(s) have any relevant financial relationships to be discussed, directly or indirectly, referred to or illustrated with or without recognition within the presentation.

Objectives: amplify knowledge

1. Define and discuss common injury types
   - Sprains/strains/contusions/hematomas
   - X-ray negative fractures & growth plate injuries
2. Highlight diagnostic or treatment pearls to “amplify” your knowledge
3. Review Ottawa X-ray rules as applies to pediatrics
4. Discuss indications for referral to a specialist for sports injuries

Definitions

- **Sprain**
  - Injury to a ligament -- the tough bands of fibrous tissue that connect two bones
- **Strain**
  - injury to a muscle or tendon -- (tissues that connect muscle to bone)
- **Contusion**
  - “a bruise,” blunt force injury to soft tissue that breaks capillaries under the skin and traps blood – can develop into hematoma (a collection of blood)
- **Physis and apophysis**
  - “growth plate”, physis is the cartilage region at the ends of long bones
  - longitudinal growth in children
  - weak area of skeletally immature bone
  - “Growth plate,” apophysis is where tendon attaches to bone
  - Repetitive traction stress on the cartilage causes apophysitis
- **Fracture**
  - partial or complete break of a bone (open, spiral, comminuted, transverse, greenstick, stress)

Epidemiology

- 45 million in organized sport
- 7 million kids ages 5-17 in school programs
- 25 million in unstructured recreational sports
- 4.5 million sport related injuries occur annually
- 1,000's of career ending/career limiting injuries each year
  - Sprains, strains, fractures, tendonitis, cartilage injuries

Orthopaedic Journal of Sports Medicine | SAGE

Orthop J Sports Med. 2026 Feb 20;14(2):23259671261416130. doi: 10.1177/23259671261416130

Epidemiology of Pediatric Lower-Extremity Injuries in the 5 Most Popular US Sports: A 10-Year Analysis of National Injury Data (2015-2024)

Laurel Wong [†,*], Jonathan J Huang [†], Yazan Alasadi [†], Charu Jain [†], Michael Shatkin [†], Sheena C Ranade [†]

- Descriptive epidemiology study on ER visits
- 77,654 cases identified
- Mean age of 13.74 ± 2.85 years.
- Injury distribution by sport: basketball (41.9%); football (27.7%); soccer (24.7%); baseball (4.8%); and ice hockey (0.9%)
- Injured areas: ankle (42.9%), knee (29.3%)
- Sprains/strains accounted for 50.6%, fractures (13.6%) and contusions (10.2%)
- Injuries occurred most frequently in boys (78.7%)
- Girls experienced disproportionately higher rates of sprains/strains, ankle, and knee injuries

Wong L, Huang JJ, et. al. Orthop J Sports Med. 2026 Feb 20;14(2):

Key history questions

- **Mechanism of Injury (MOI):** "How exactly did you get hurt?" (e.g., twist, fall, direct blow)
- **Onset and Timing:** "When did the pain start and was it sudden or gradual?"
- **Location and Quality:** "Can you point with one finger to the exact spot?" and "Is it sharp, dull, or burning?"
- **Functional Impact:** "What activities are you unable to do now?"
- **Mechanical Symptoms:** "Does the joint lock, click, give way, or feel unstable?"
- **Progression:** "Is the pain getting better or worse?"
- **Aggravating/Alleviating Factors:** "What makes it feel better (rest, ice) or worse (stairs, walking)?"
- **Previous History:** "Have you ever injured this area before?"

Associated history questions

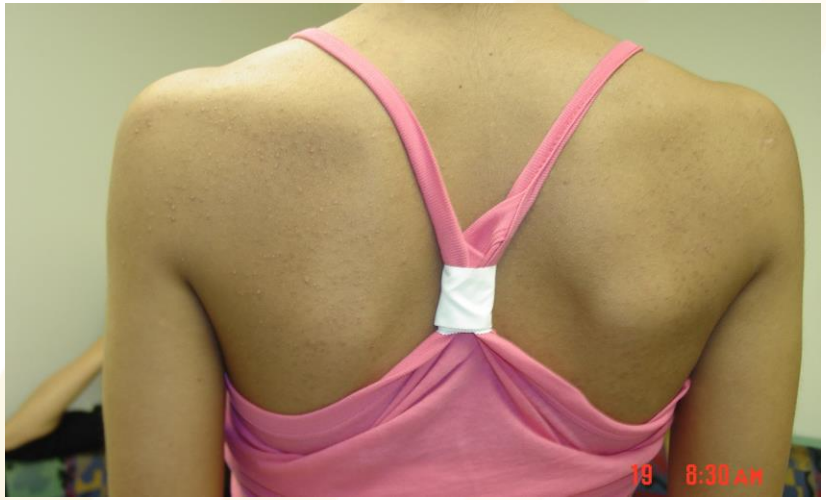
- Mechanical/functional pain versus pain at rest
- Swelling or bruising presence (immediate or delayed)
- Range of motion
- Neurologic symptoms
- Ability to weight bear or functional status (eg lift arm or weights)
- Previous injury history
- Relevant medical conditions affecting MSK health
- Use of medications for analgesia or anti-inflammatory (topicals and supplements included)
- Location injury occurred (work, school, recreational sports, home)

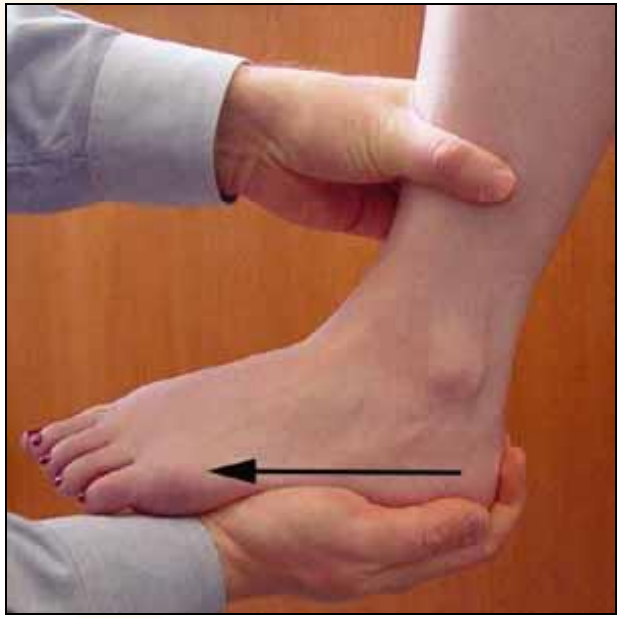
Sports medicine axiom

- “Find out what is tender, then figure out what’s there.”

Key physical examination points

- Inspection
  - swelling, ecchymosis, deformity
- Palpation
  - Bony areas
  - Ligaments
  - Tendons
  - muscles
  - Range of motion
  - Check neurovascular status
  - Ability to weight-bear (lower extremity) or lift (upper ext.)
  - Special tests



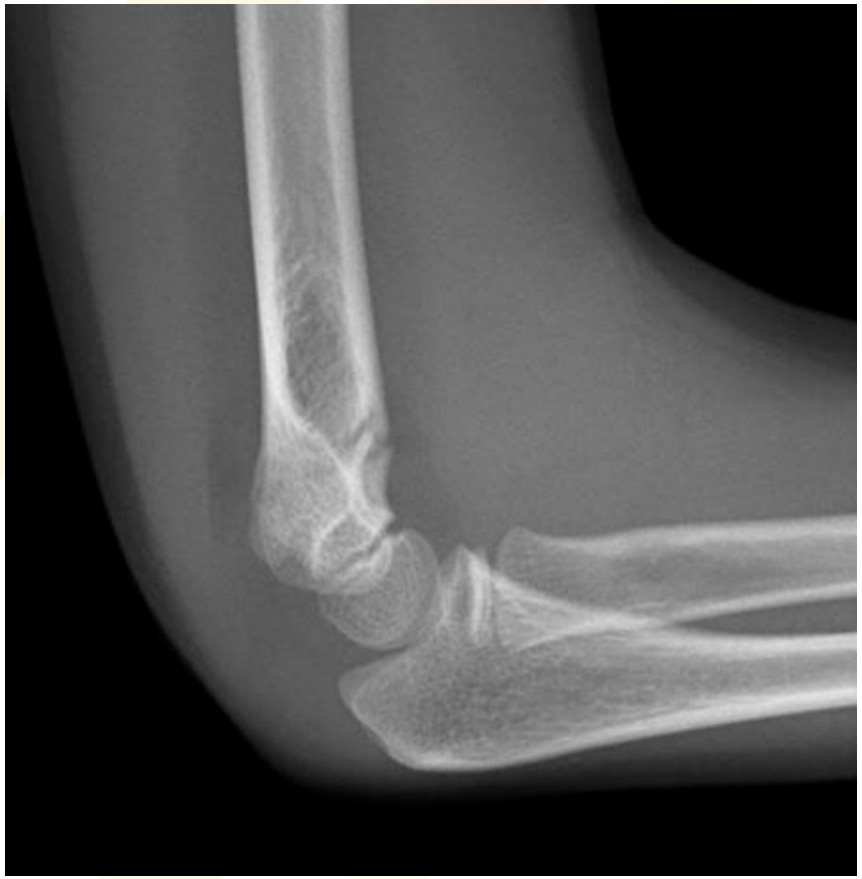


Purpose of Imaging

- Differential diagnosis
  - R/O fracture / Loose Bodies / djd
- Grading of injury
  - G1-G3 Sprain/Separation
- Treatment protocols
  - procedures, casting versus splinting, assistive devices, immobilization
  - Conservative tx. vs. surgical intervention
- Post-treatment status
  - reduction
  - Interval healing

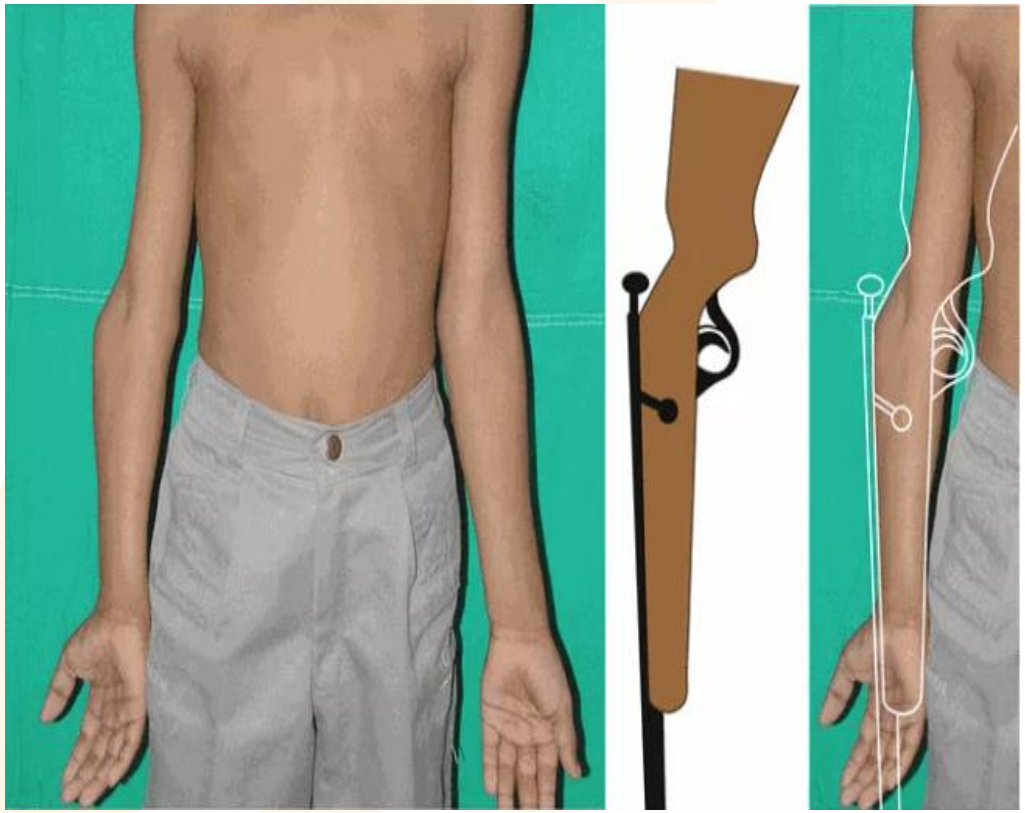
Case 1: elbow pain and swelling – AGE matters

- 6–11-year-old with fall hyperextended arm, elbow pain and swelling
- Tender around distal humerus, unable to straighten arm
- Xray negative except for posterior fat pad sign
- Pearls:
  - Assume supracondylar fx when younger
  - 60% of all pediatric elbow injuries
  - peak age: 5-8 years
  - 95% of fractures have posterior displacement of distal segment
- TX:
  - LAC or post-mold
  - Re-Xray in 2-3 weeks – refer to peds ortho

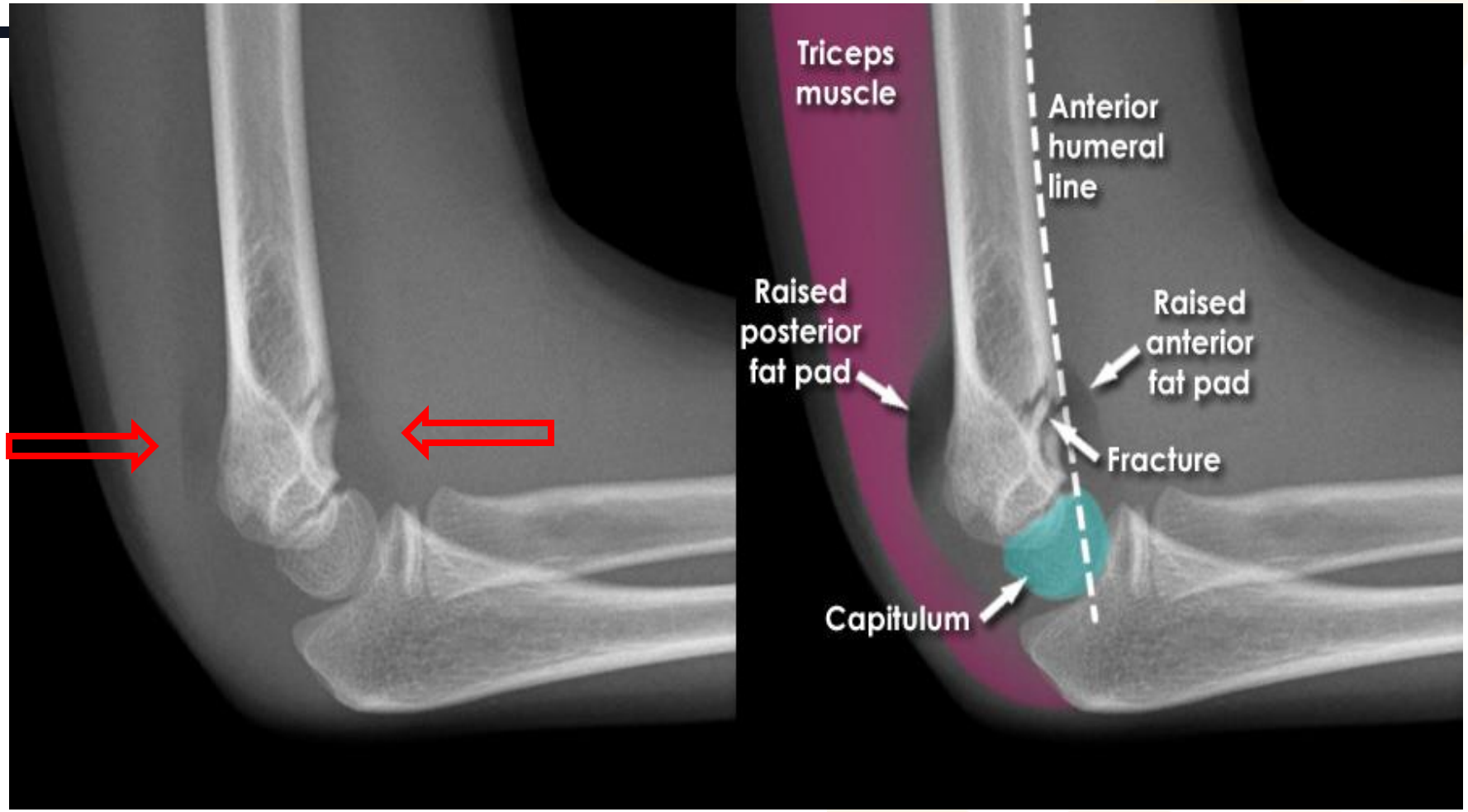


Complications of supracondylar fractures

- Compartment syndrome
- Vascular injury/compromise
- Loss of reduction/malunion
- Pin track infection
- Neurovascular injury with pin placement
- Reduced ROM
- Cubitus varus

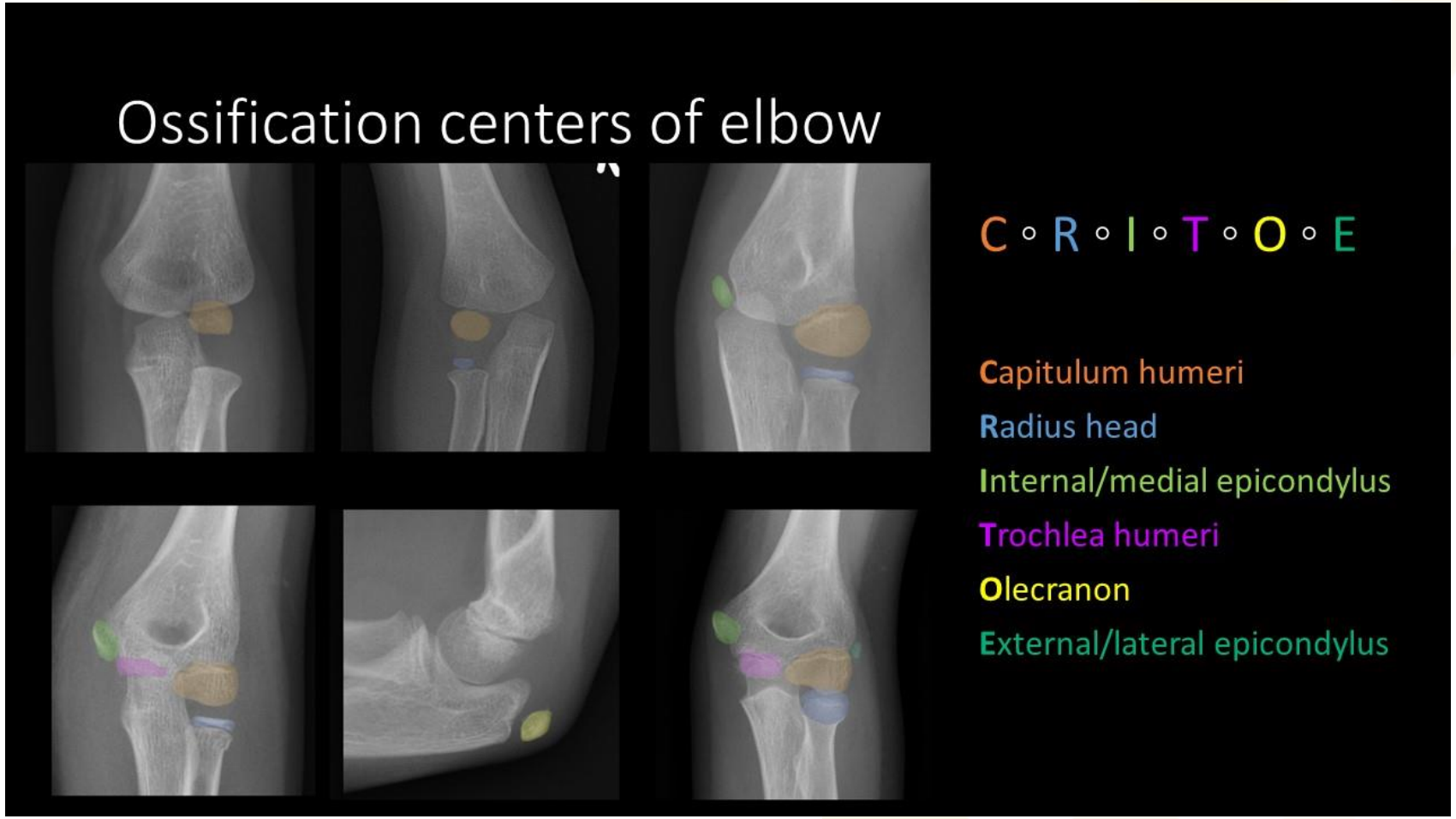


Pediatric elbow imaging: the fat pads



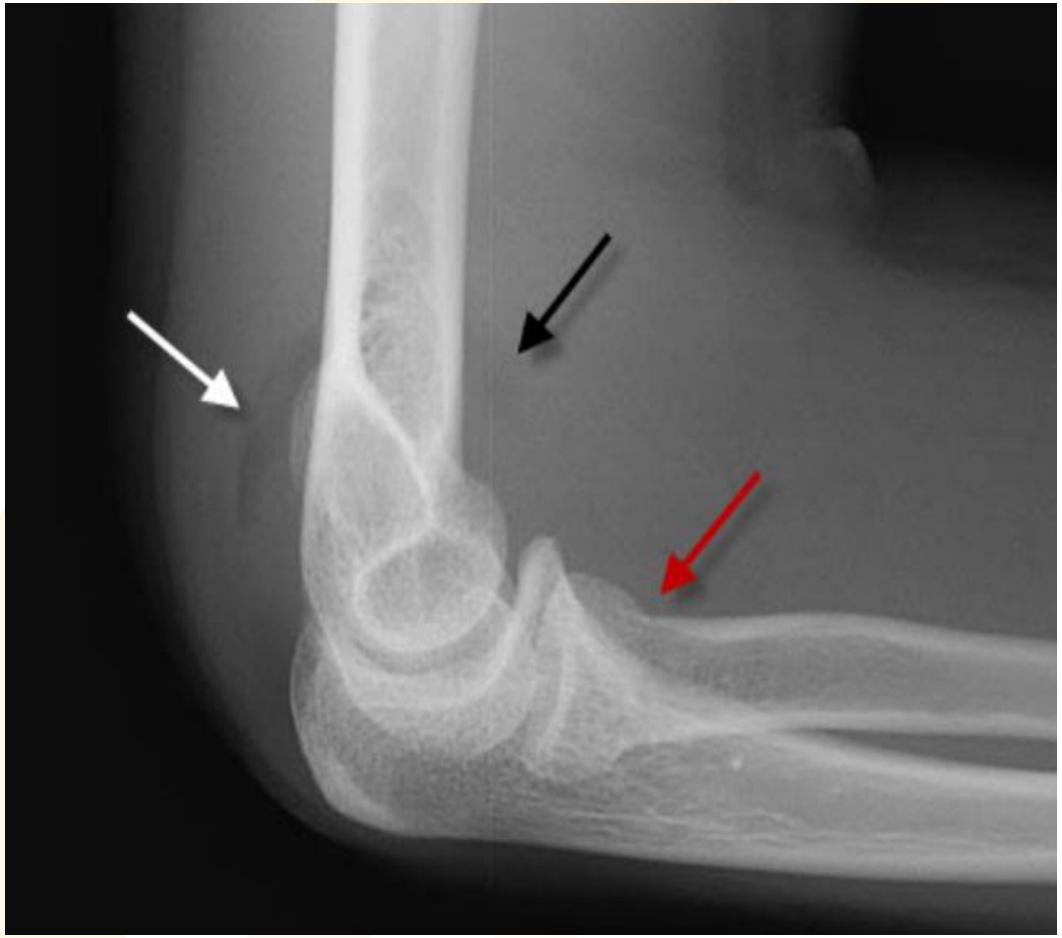
Fat pads first described in 1954

Six accessory ossification centers: C-R-I-T-O-E



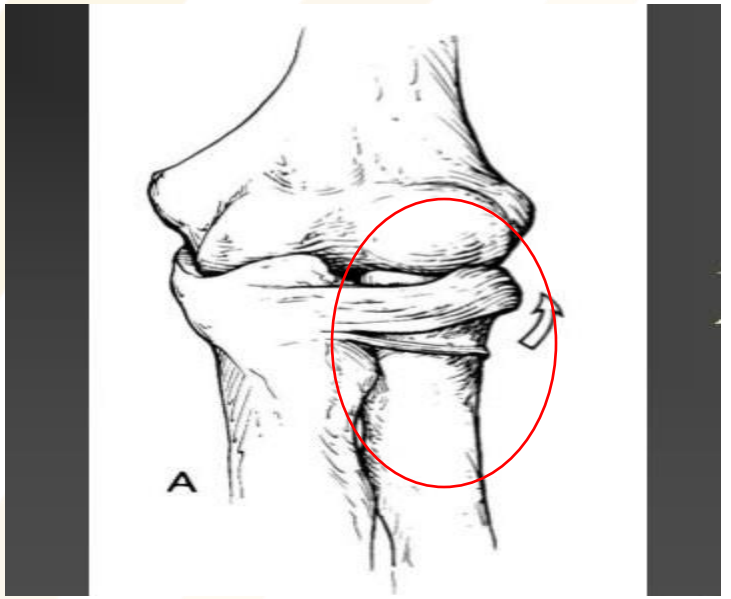
Case 2: elbow pain and swelling teen – AGE matters

- 14-year-old with fall and hyperextended arm, elbow pain and swelling
- Tender proximal radial head
- Limited supination and extension
- X-ray with posterior fat pad sign only
- Pearls: occult radial head fracture
- More common in skeletally mature
- Tx: sling for comfort, early ROM
- ***CAST is BAD for these, permanent stiffness***



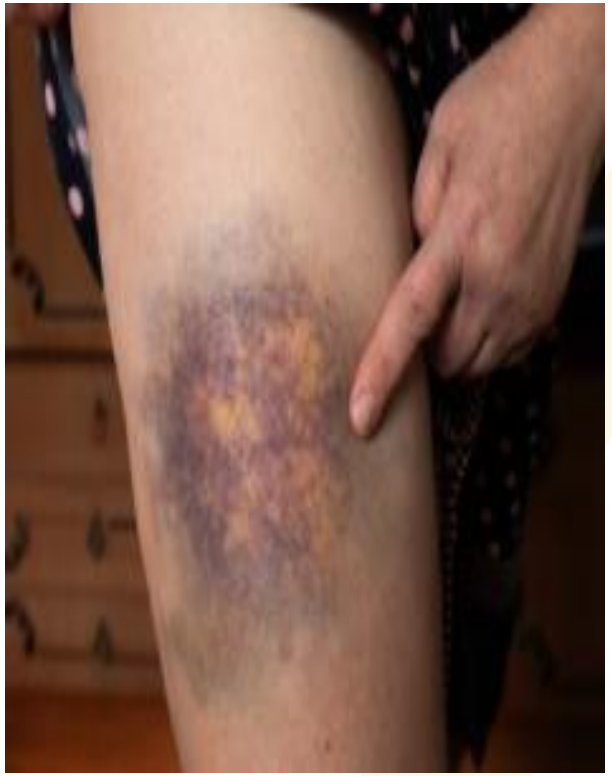
Case 3: radial head injury/subluxation – toddler

- 5% of all pediatric elbow injuries
- infancy and childhood
- Sudden longitudinal traction trauma ≠ FOOSH
- Arm slightly flexed and pronated, limited mobility
- Xray not necessary if no trauma – should be normal or subluxed radial head (no fat pads)
- Tx: Reduction maneuvers: supination/flexion or hyperpronation technique
- *See immediate improvement in ROM, decreased pain*

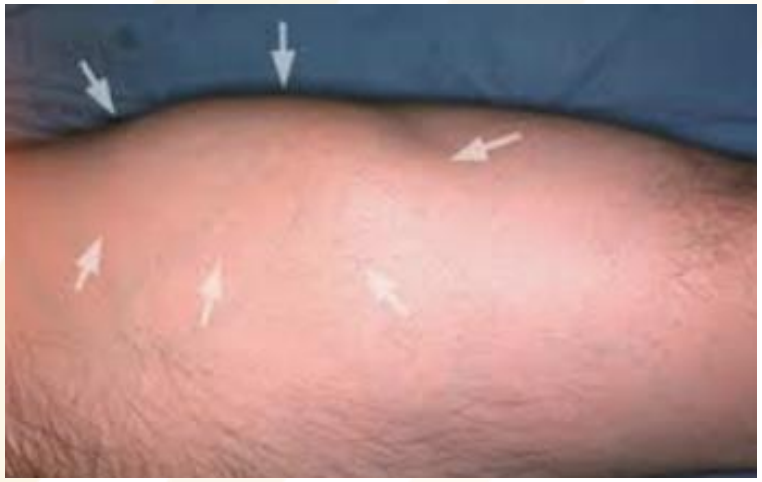


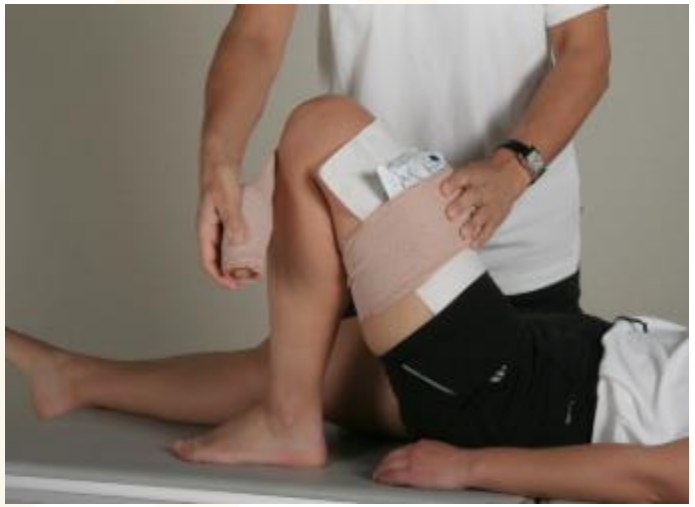
Case 4 – hip pain, football injury

- 14-year-old running back takes helmet to thigh and is unable to ambulate with hip and groin pain
- On exam he is tender anterior hip joint and mid quad with significant swelling and a tender mass
- X-rays pelvis and femur are negative
- Diagnosis?



Contusion looks bad, low risk, RICE, WBAT

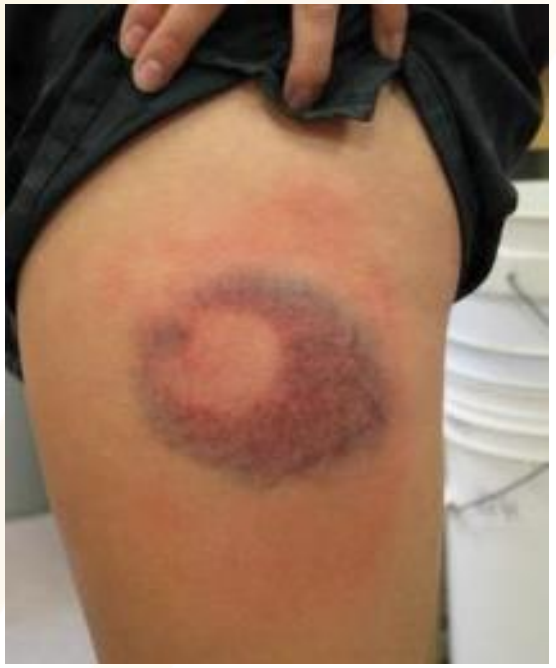


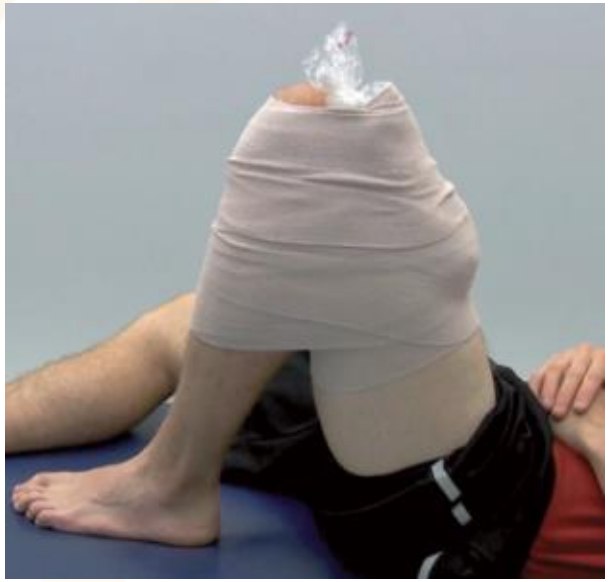


Doesn't look as bad initially, risk of myositis ossificans high if continues to bleed into muscle, hence aggressive compression

Contusion

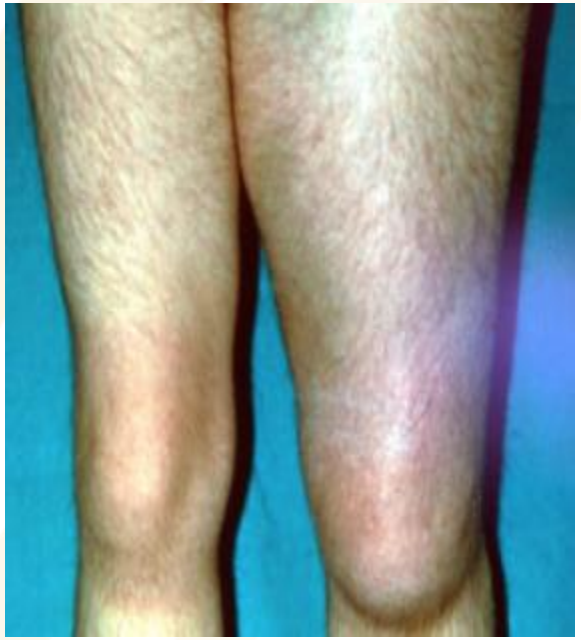
- **Types: skin, muscle, bone, organ**
- **Mechanism of injury:** usually direct blow
- **Symptoms:** Pain, swelling, discoloration, and limited range of motion.
- **Grading:** Ranges from Grade 1 (mild, no loss of function) to Grade 3 (severe, significant loss of motion/limp).
- **Treatment:** Immediate care includes 24–48 hours of rest, ice, compression (e.g., knee immobilized in flexion for quad contusions), and crutches.
- **Rehabilitation:** Gentle, pain-free active range of motion and stretching should begin once acute pain subsides to avoid stiffness.
- **Complications:** Rarely, severe contusions can lead to myositis ossificans or compartment syndrome.
- **Recovery:** Most contusions heal with conservative care within a few weeks. RTP/RTW is functional progression

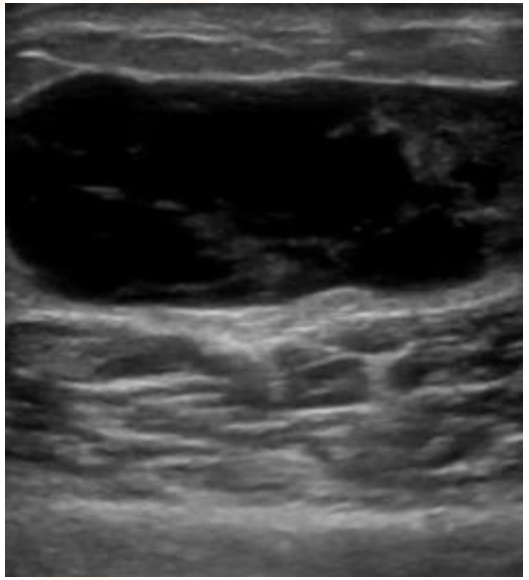




Hematoma

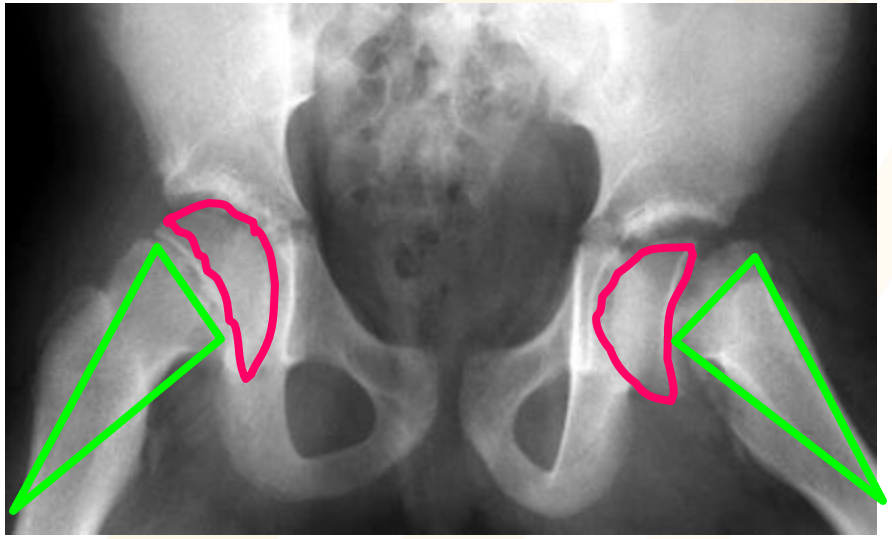
- **Causes:** Direct impact, blunt trauma, or muscle strains/tears.
- **Risk Factors:** Blood thinners (anticoagulants), advanced age, or underlying bleeding disorders.
- **Symptoms:** Swelling, bruising, pain, and sometimes restricted mobility in the leg
- Think broadly in high-risk areas (e.g. calf hematoma vs popliteal artery aneurysm or DVT)
- **Treatment:** RICE initially, can use therapy modalities to treat
- **Red flags**: extreme or increasing pain or worsening swelling, signs of infection (fever, redness, warmth).
- **Aspiration:** Rarely (high chance of re-accumulation of blood) but can be done for therapeutic relief in first 7-10 days

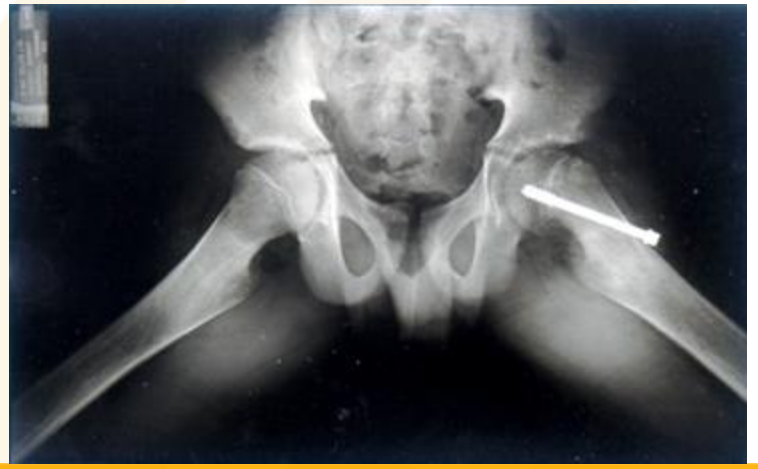




Case 5 – hip pain, football injury

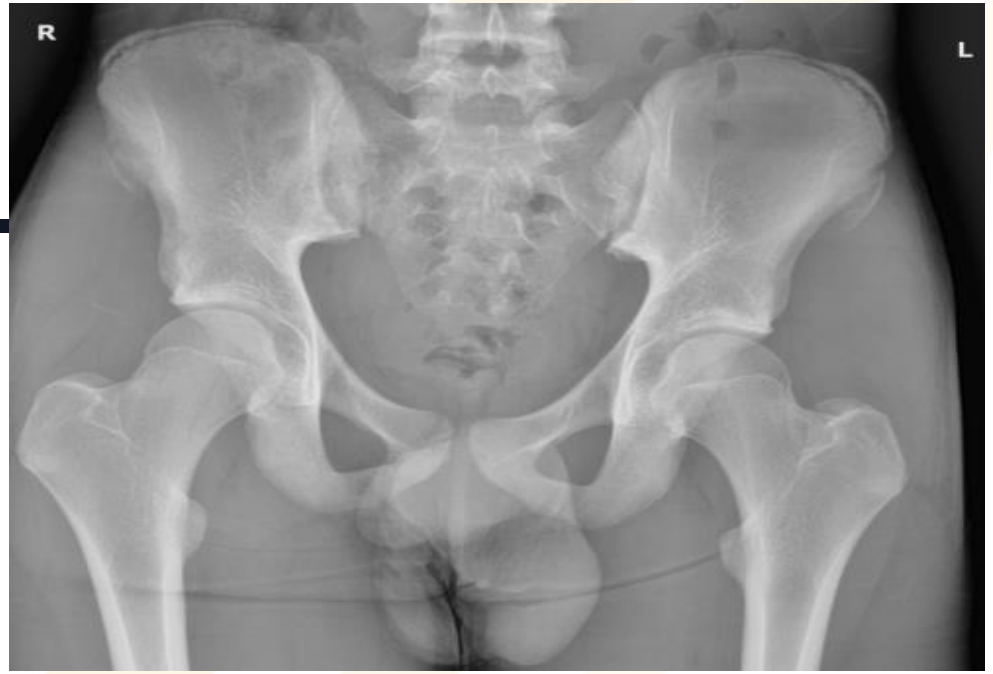
- 14-year-old running back gets tackled hard with foot planted and feels pop in hip. Is unable to ambulate with hip and groin pain
- On exam he is tender iliac crest, anterior hip joint and mid quad
- Differential diagnosis?
  - Hip pointer (apophysis avulsion)
  - SCFE – can be acute or chronic
  - Soft tissue injury
- ***Management SCFE: immediate referral to ER for admission and ORIF***

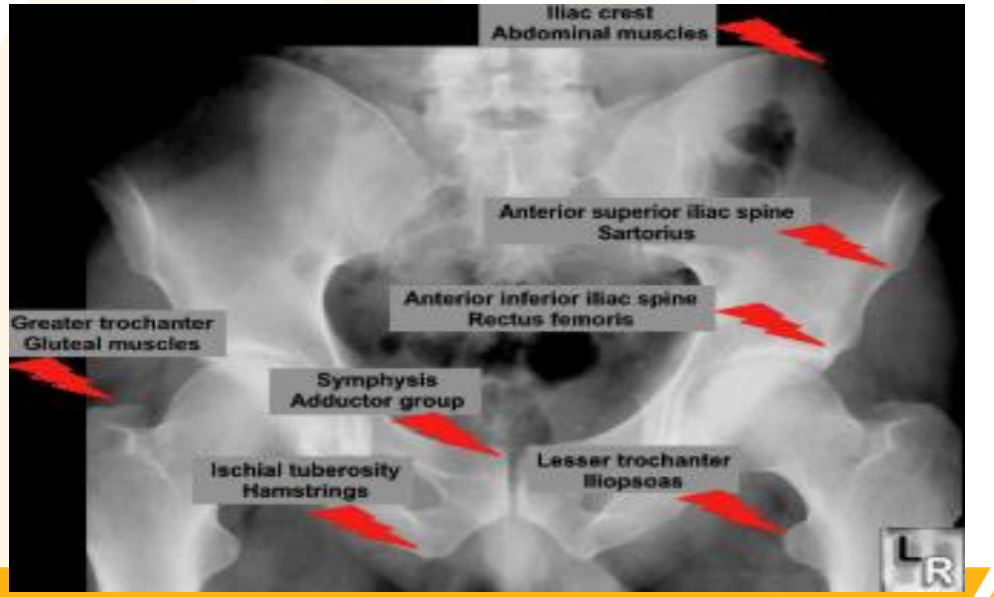




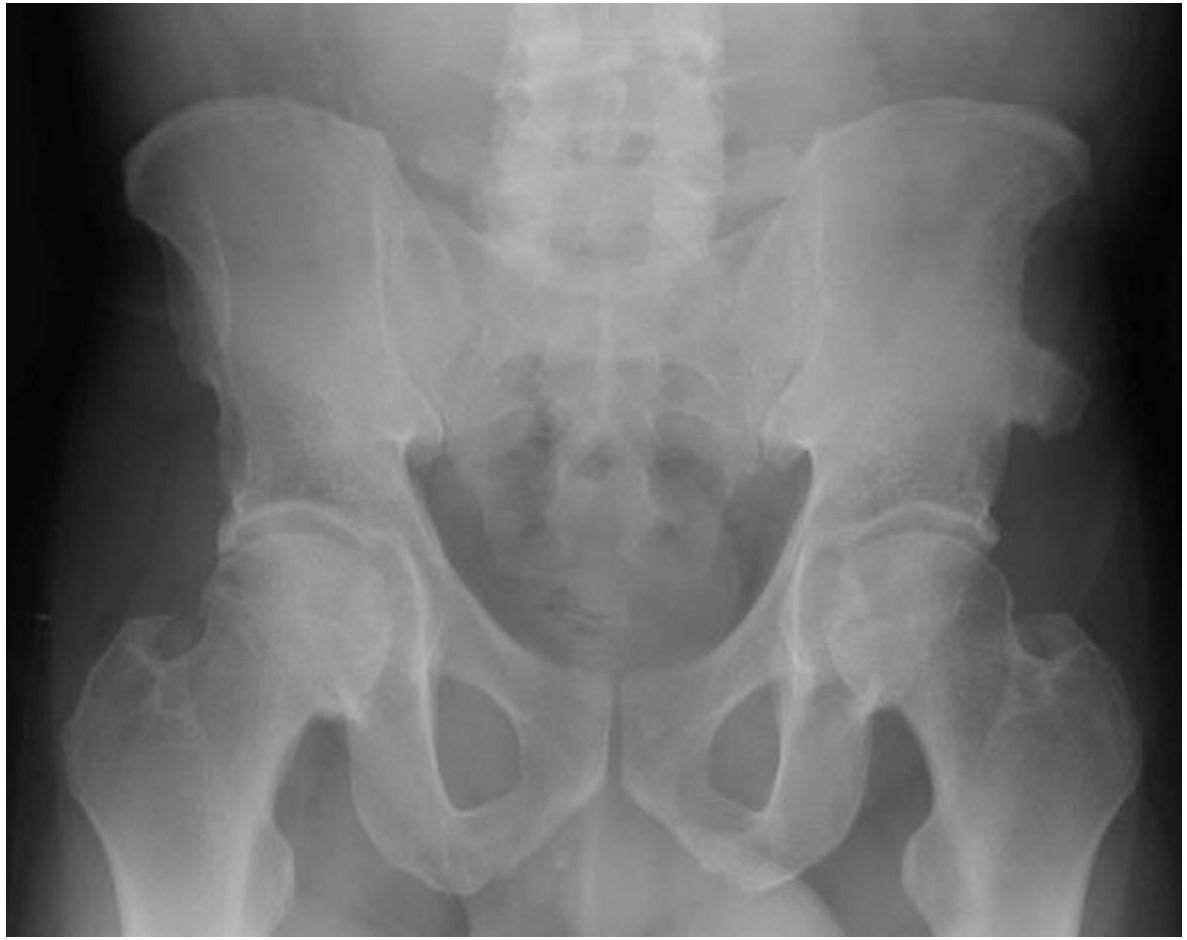
Case 6 – hip pain, football injury

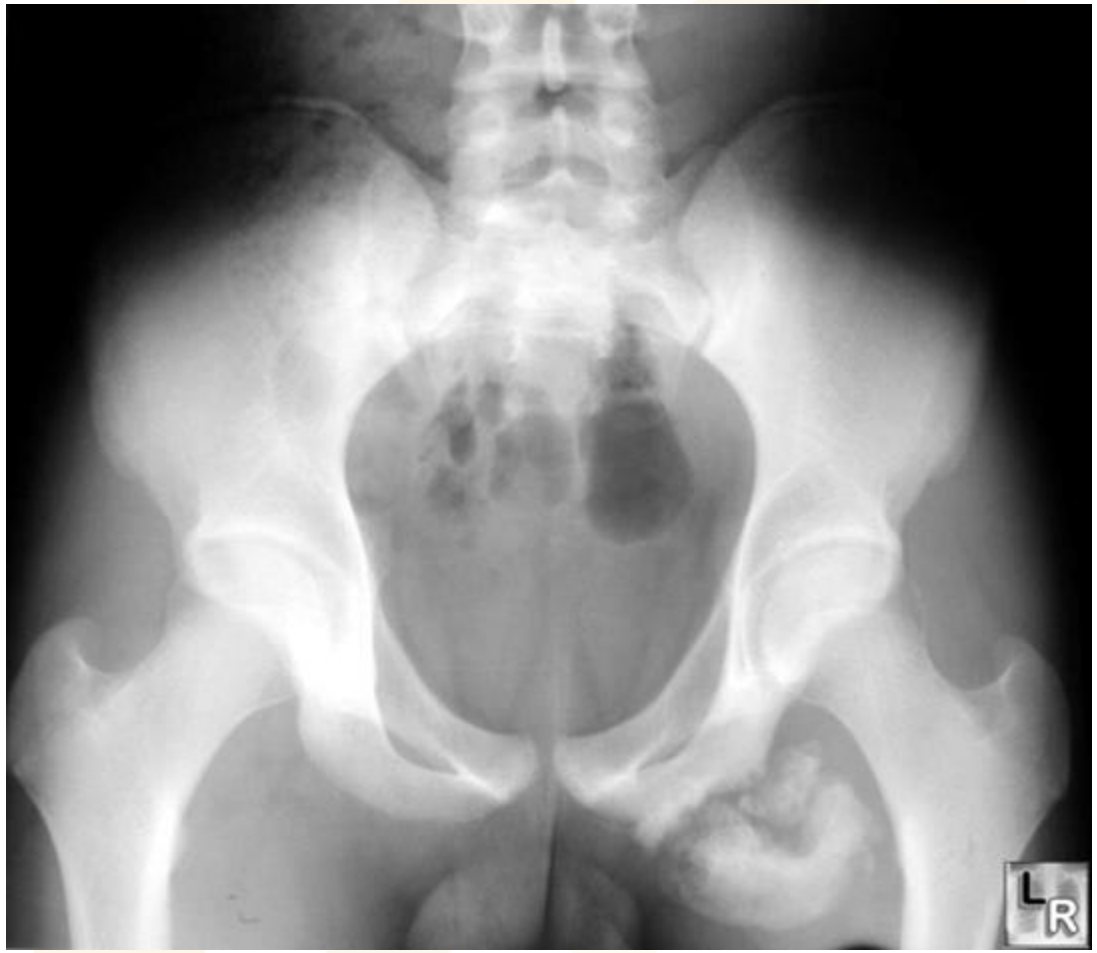
- 14-year-old running back gets tackled hard with foot planted and feels pop in hip. Is unable to ambulate with hip and groin pain
- On exam he is tender iliac crest, anterior hip joint and mid quad
- Differential diagnosis?
  - Hip pointer (apophysis avulsion), SCFE, soft tissue
- ***Management apophyseal avulsion or strain is the same.***
- ***Crutches, WBAT, RICE, nsaids prn and close follow-up***
- ***Not an orthopedic emergency***





Healing and complications of apophyseal injuries





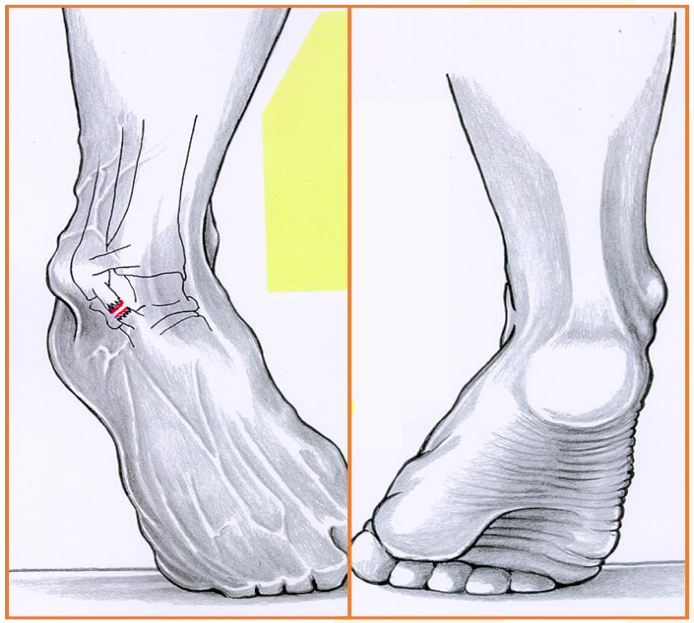
On to sprains.....

Ankle Sprains - #1 Sports Injury in the world

- One ankle sprain per 10,000 persons each day
- Approx. 2,000,000 sprains every year in the U.S.
- Average of 3 sprains per person in lifetime
- Peak incidence teens, females
- 50% are sports related
- 12-47% are recurrent injuries
- Approx. 40% have chronic problems (CAI = chronic ankle instability)
- ***#1 cause of reinjury or poor outcome is inadequate rehabilitation***

Sprains

- Sprain = an injury to a ligament
  - Ankle sprains
  - Knee sprains (MCL/LCL)
  - Elbow sprains (UCL)
  - Thumb sprain (UCL)
- Grading of Sprains

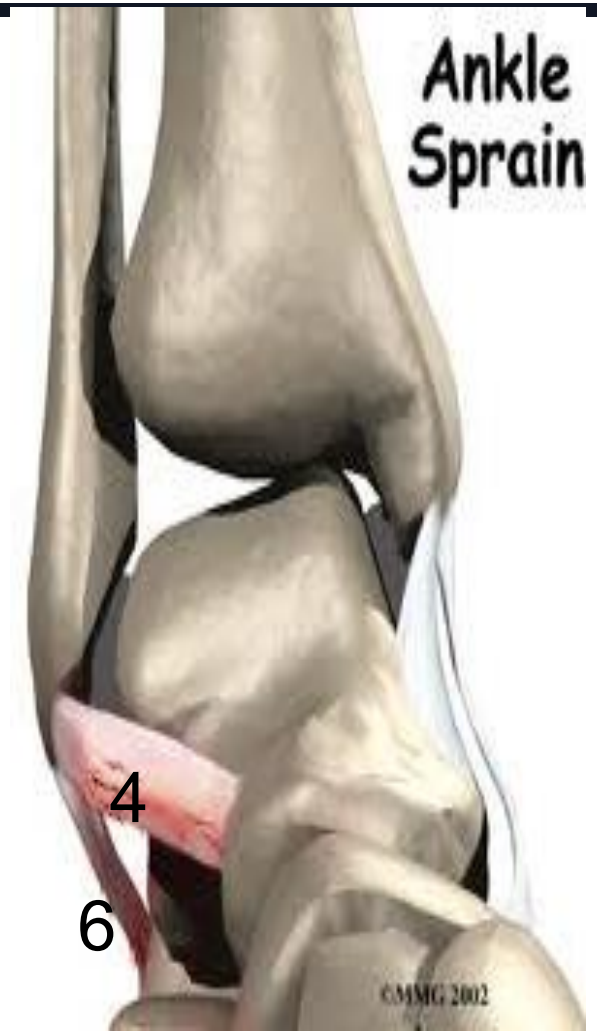


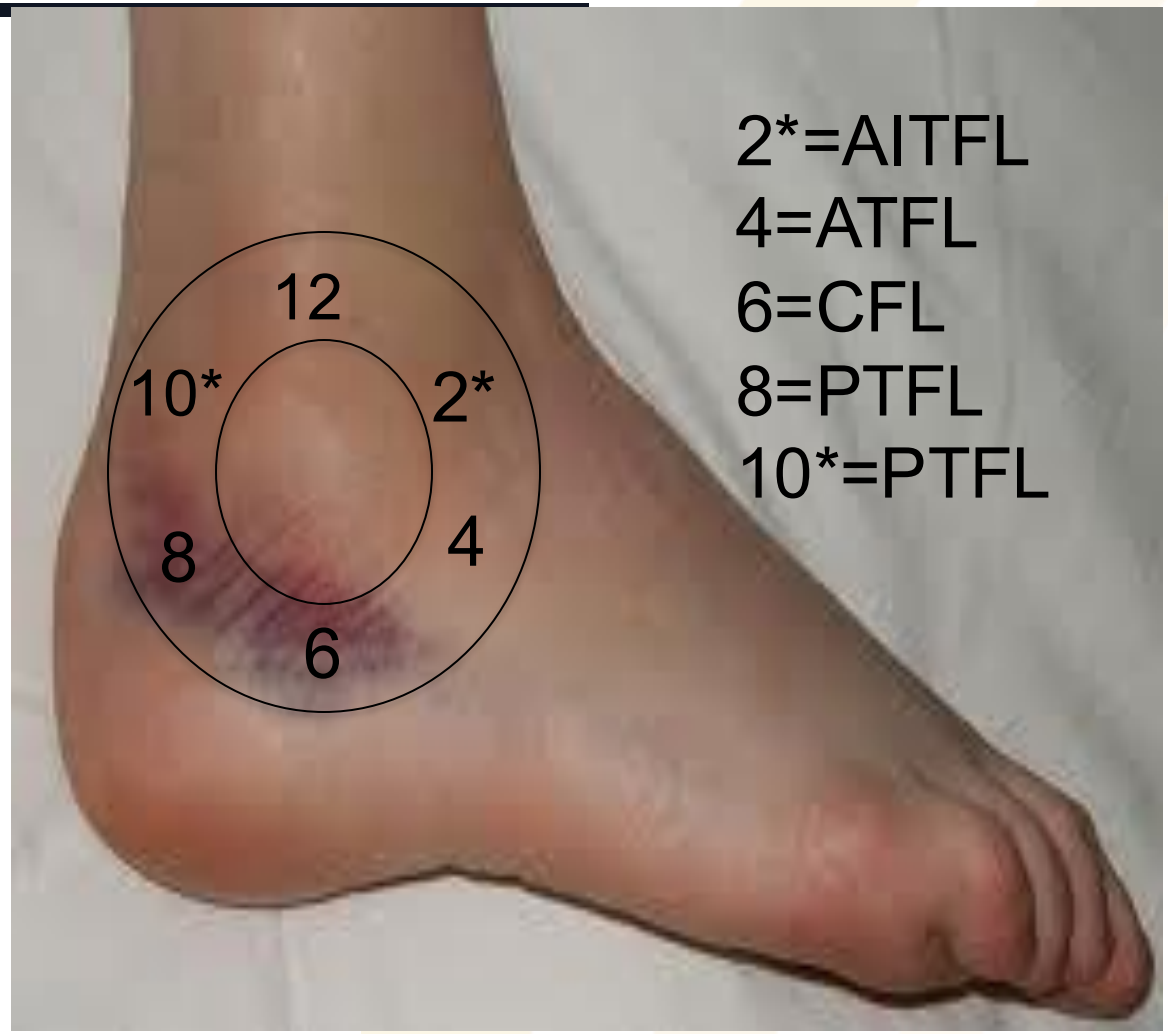
Ankle sprain grading

*Williams J G. Br J Sports Med. 1971;4:228–230.

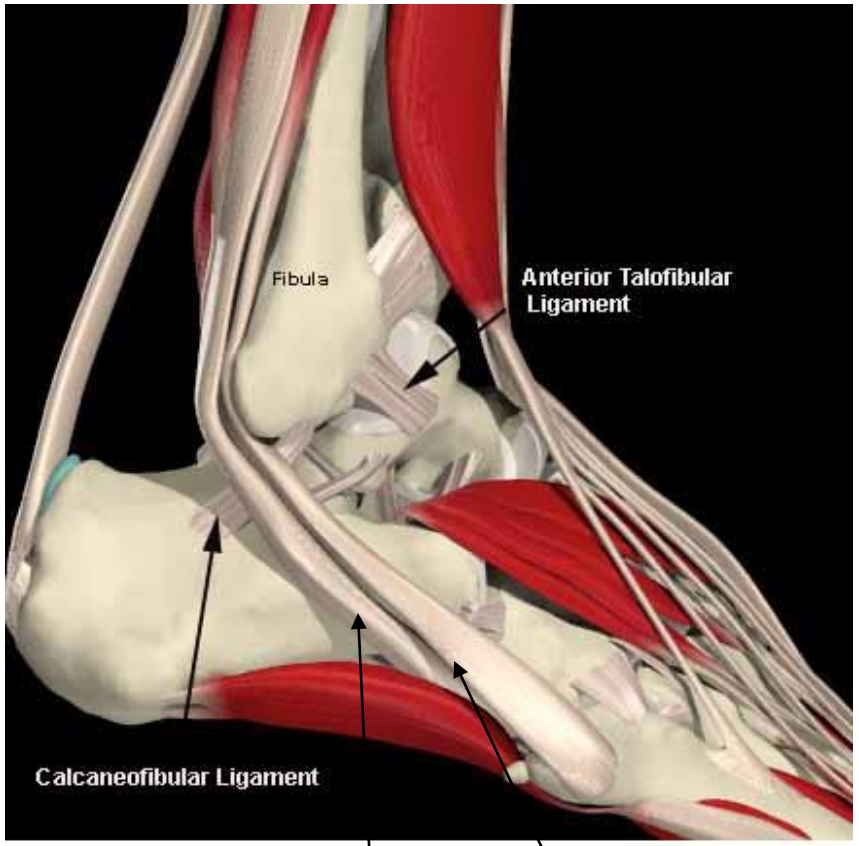
Criteria	Grade 1	Grade 2	Grade 3
Location of tenderness	Usually one ligament	moderate injury to 1 or more lig's	Severe injury to 1 or more lig's
Swelling and ecchymosis	Slight, localized	Moderate, localized	Significant, diffuse
Weight-bearing ability	Full weight bearing	Partial WB/crutches	Impossible w/o crutches
Ligament damage	Stretched	Partially torn	Completely torn
Instability	None No laxity	Slight laxity + AD/+endpt	Signif laxity +AD/no endpt

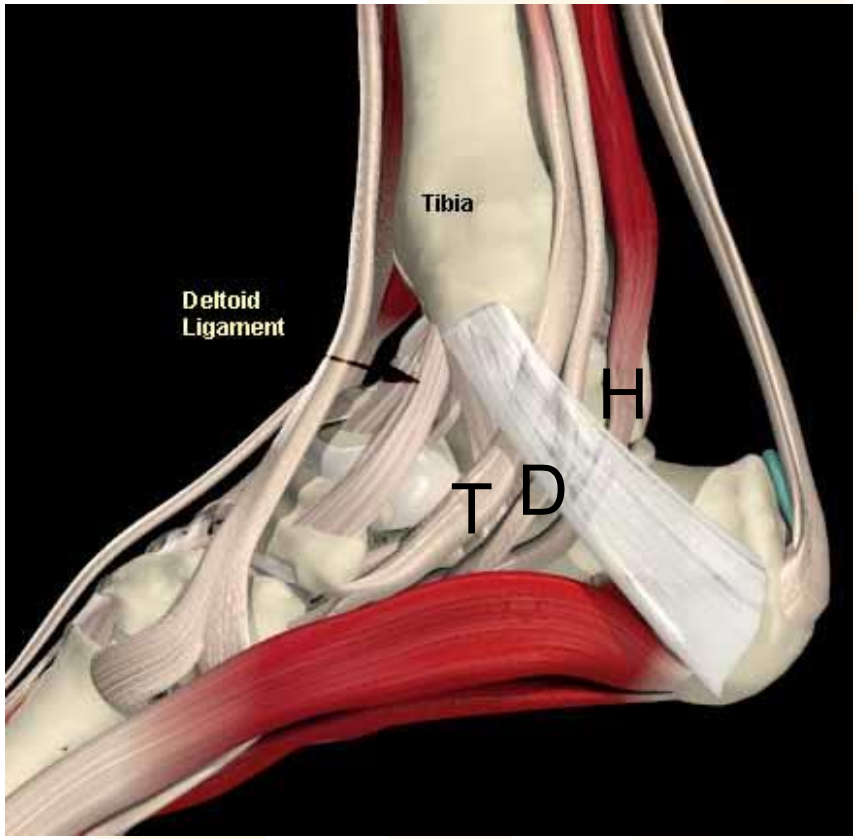
Inversion mechanism of injury – most common





Anatomy



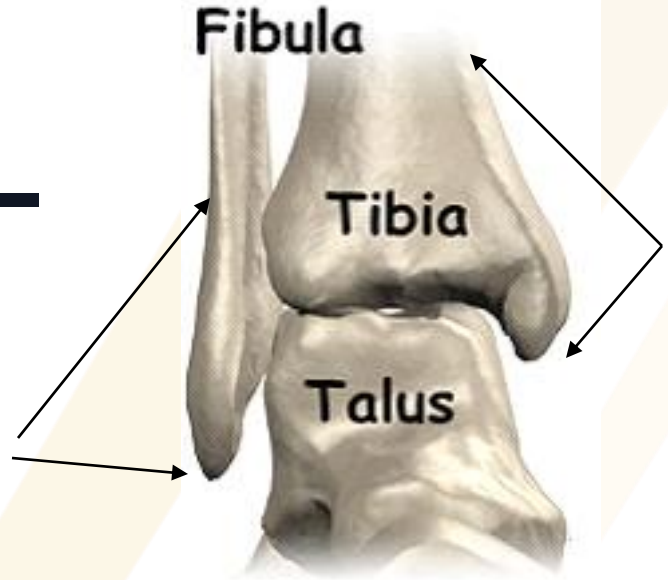


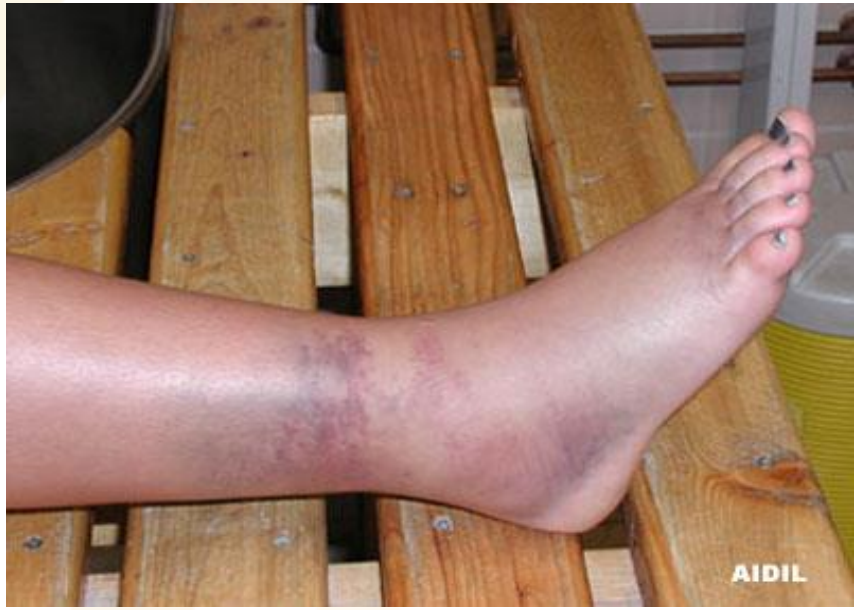
Peroneus longus and brevis

“Tom, Dick and Harry” Post tib, FDL and FHL

Ottawa ankle rules

- Bone tenderness along the distal 6 cm of the posterior edge of the tibia or tip of the medial malleolus, OR
- Bone tenderness along the distal 6 cm of the posterior edge of the fibula or tip of the lateral malleolus, OR
- An inability to bear weight
  - Immediately &/or for 4 steps
  - Low rate false negatives
  - 100% sensitive in adults (98% in children); 40% specific
- ***Validated in children over age 5-6 yrs***
- ***Sensitivity > 92%***





Dowling, et al. (meta-analysis) *Acad Emerg Med* **16** (4): 277–87.
Bachmann et al. (systematic review) *BMJ* **326** (7386): 417.
Stiell et al. *Ann Emerg Med* **21** (4): 384–90 and *BMJ* **311** (7005): 594–7.

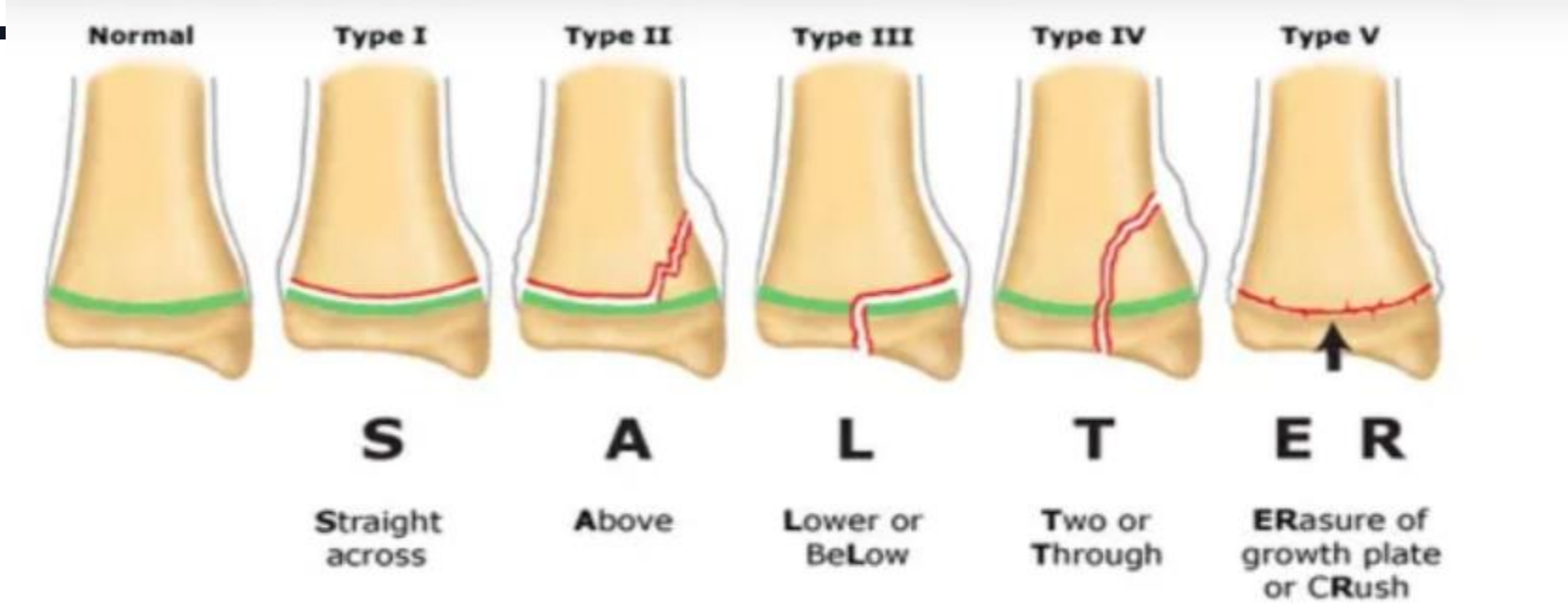
Benjamin’s take home point

“The younger they are, the more likely there is a fracture.”

Benjamin’s take home point

“In skeletally immature patients; a suspected ankle sprain is a fracture until proven otherwise.”

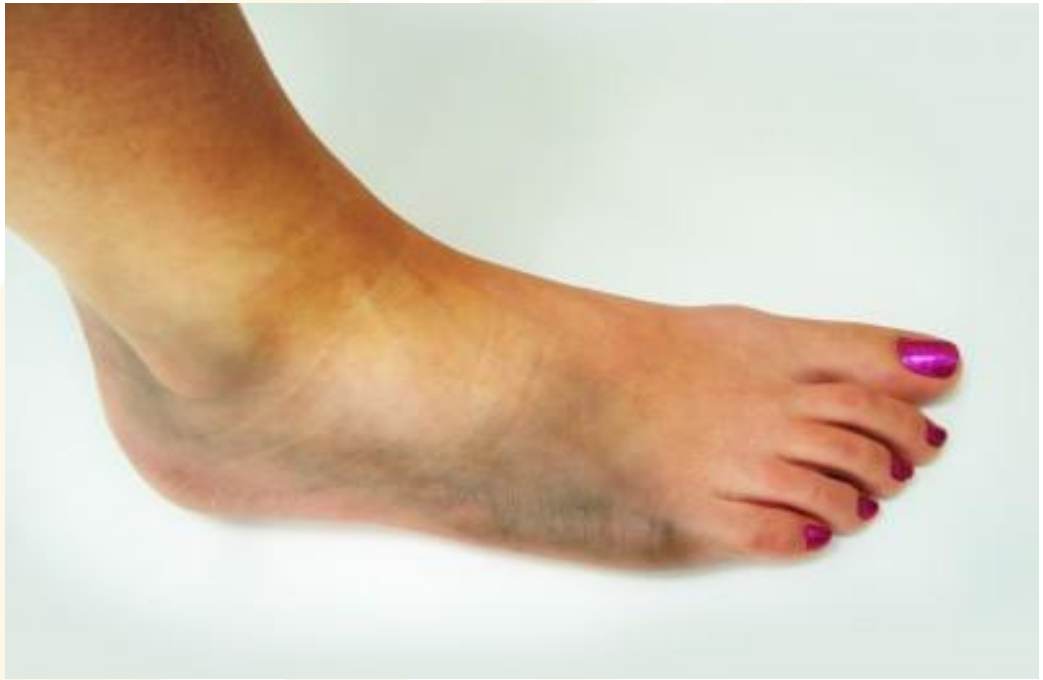
Salter- Harris classification



- Type I – transverse fracture through the physis (6% incidence)
- Type II – A fracture through the physis and metaphysis, but spares the epiphysis (75% incidence)
- Type III – A fracture through physis and epiphysis, but spares the metaphysis (8% incidence)
- Type IV – A fracture through all three elements of the bone (10% incidence)
- Type V – A compression fracture of the physis (1% incidence)

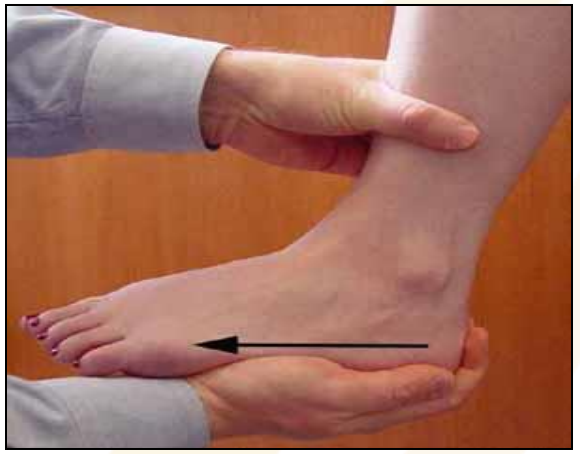
Case 7: ankle or foot pain?

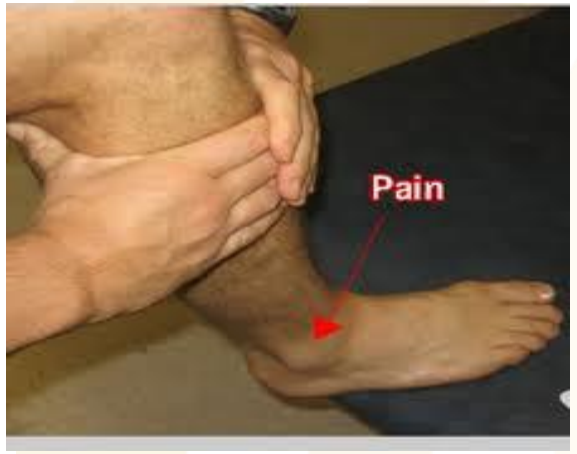
- 15 yr old gymnast landed "funny" off beam and felt painful pop with swelling and bruising lateral foot and ankle
- Limping, unable to continue
- Exam: lateral ankle and foot swelling and ecchymosis
- TTP distal fibula, ATFL, AITFL, CFL and medially
- Anterior drawer and talar tilt and provocative tests too painful



Key physical exam points

- Inspection
  - swelling, ecchymosis, deformity
- Palpation
  - Bony areas
    - Lat/med malleolus, base 5th MT; navicular & prox fibula
  - Ligaments
    - Lateral ligaments: ATFL, CFL, PTFL, AITF
    - Medial ligaments: deltoid
    - syndesmosis
  - Tendons
    - Peroneals, posterior tibialis and Achilles
  - Check neurovascular status, ROM, ability to weight-bear

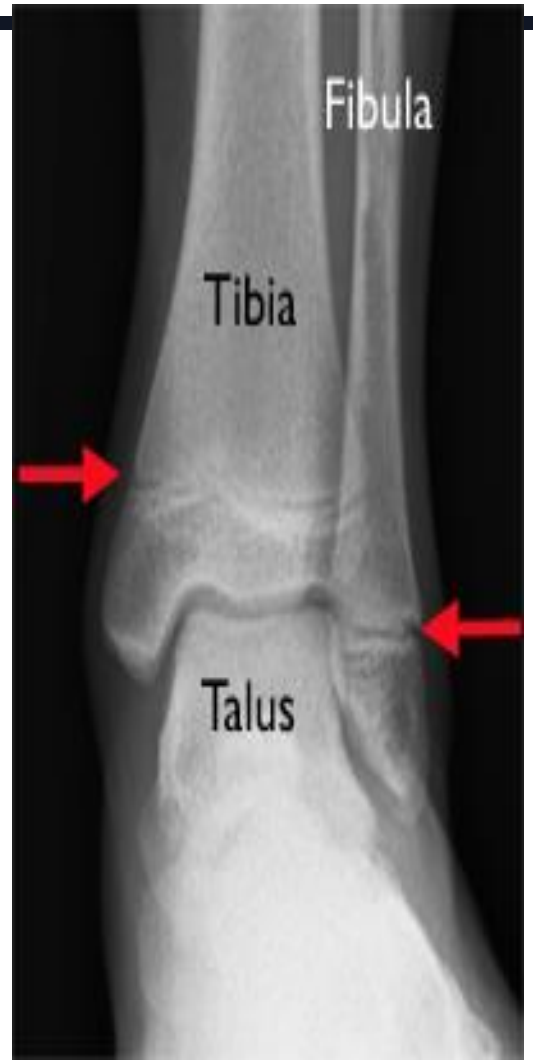


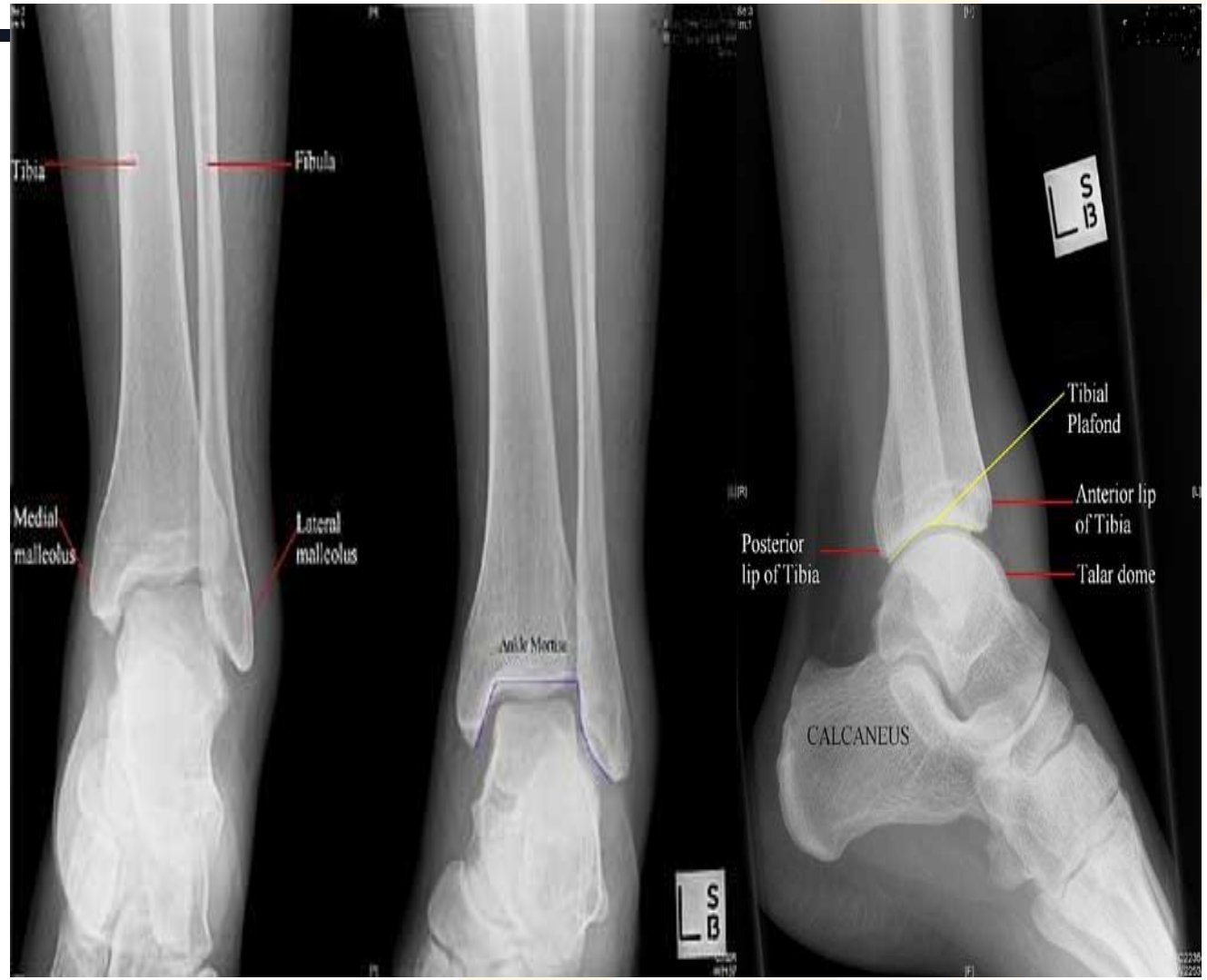


Differential Diagnosis

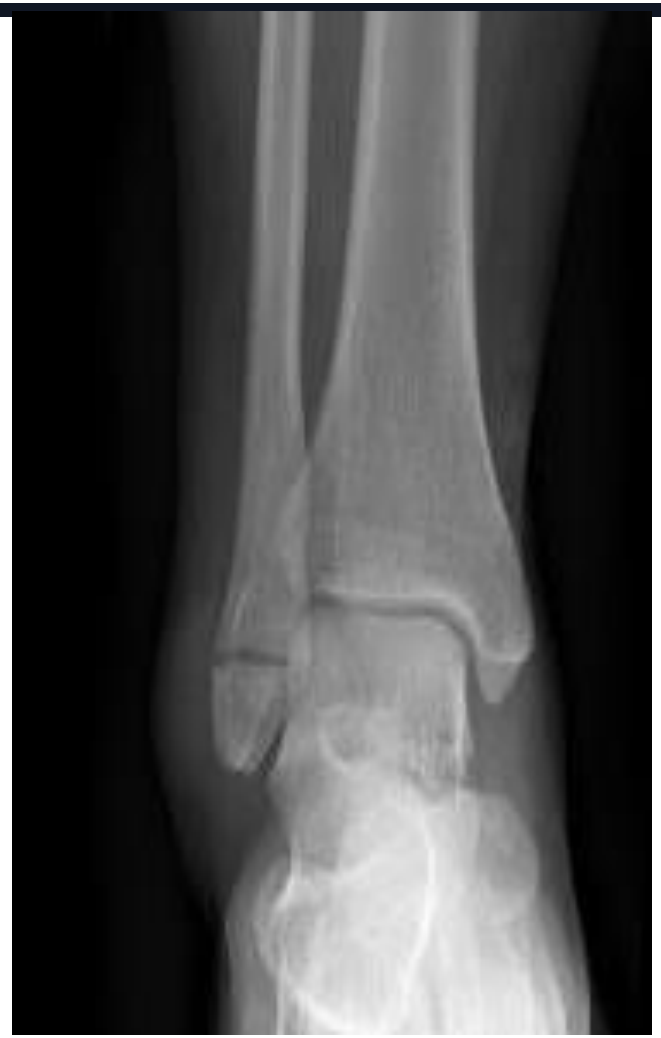
- Sprain
- Physeal fractures
- Malleolar fracture
- Peroneal tendon subluxation/dislocation
- Fracture of the base of the fifth metatarsal
- Apophyseal injury
- Jones fracture: metaphyseal-diaphyseal jxn fx
- Osteochondral fractures/osteochondritis dissecans
- Calcaneocuboid joint sprain
- Lis franc injury
- Cuboid fracture
- Talus or calcaneus fracture

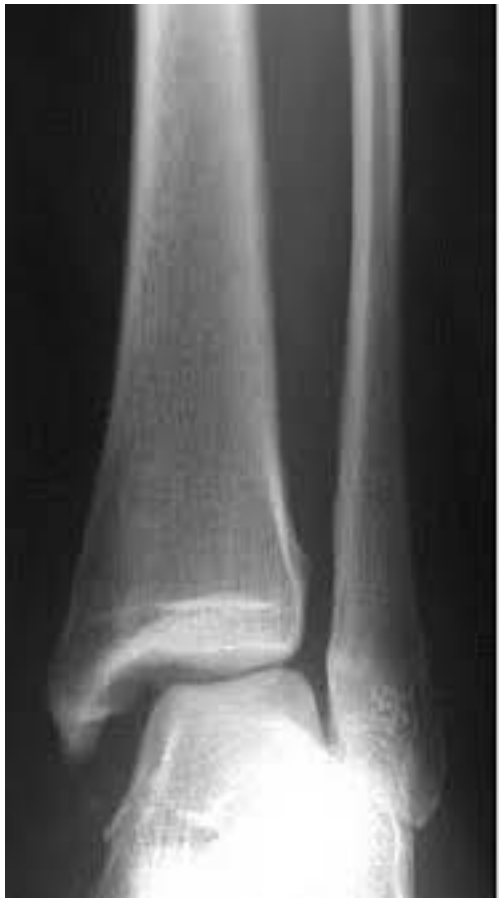
Normal Ankle Radiographs

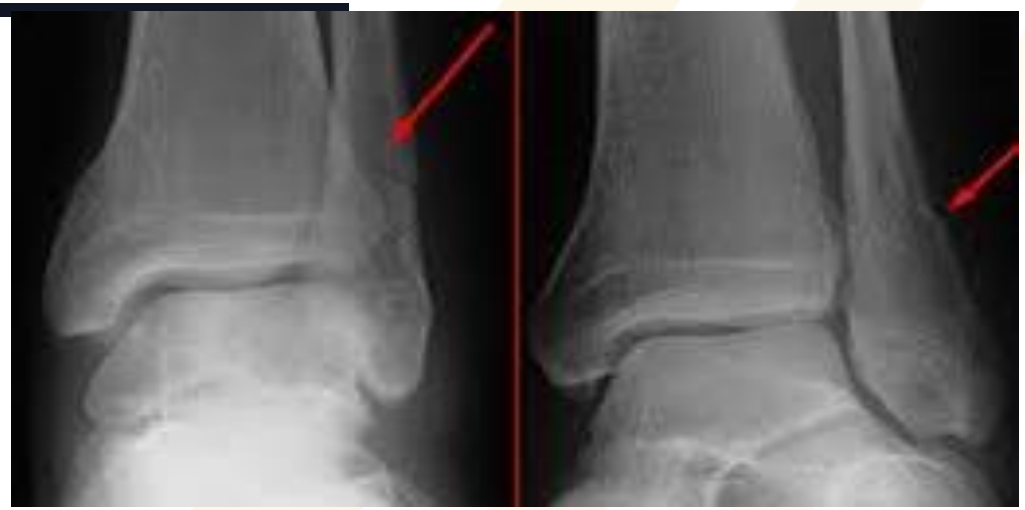


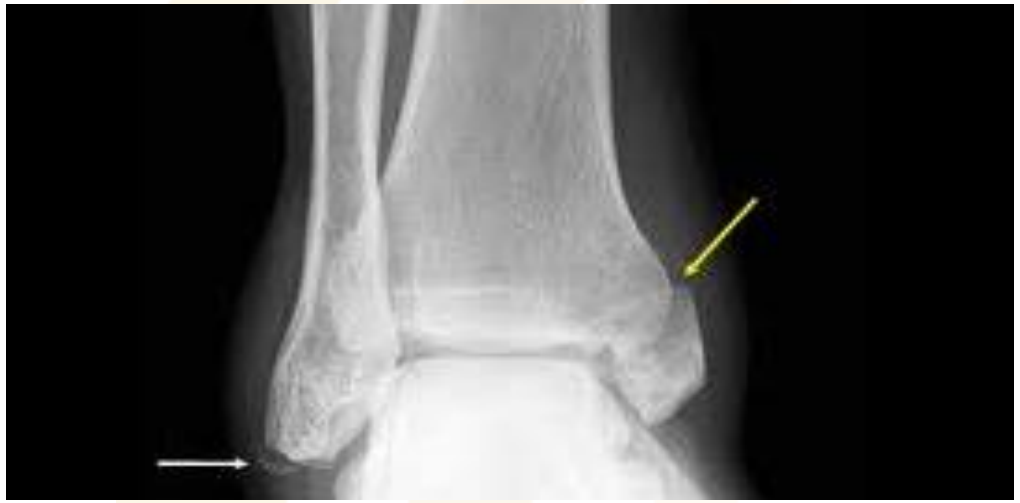


Abnormal radiographs







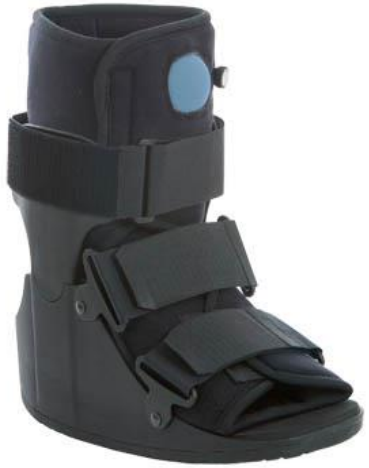


Treatment of sprains

- Phase 1: RICE: rest, ice, compression, elevation
- Phase 2: walking normally or overhead movements
- Phase 3: Functional treatment
  - Rehab to restore strength, stability and return to running, jumping, cutting
- May initially need brace or tape
- Surgery rarely needed
- Younger athletes: worry more about growth plate fractures (xrays required)

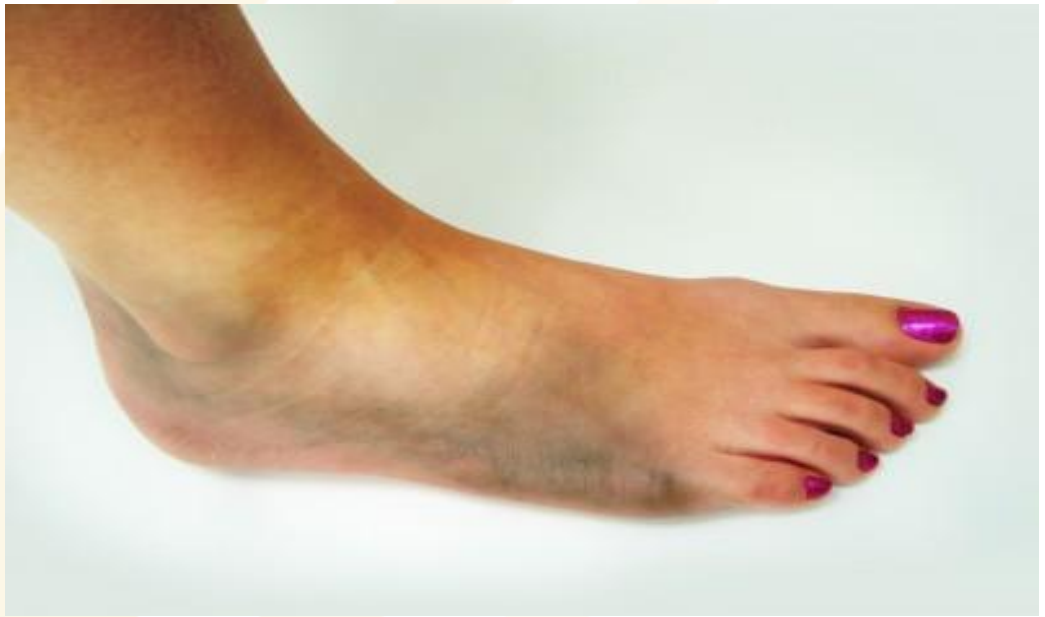
Timeframes to recovery

- Grade 1: 7-14 days
- Grade 2: 2-6 weeks
- Grade 3: 4-26 weeks



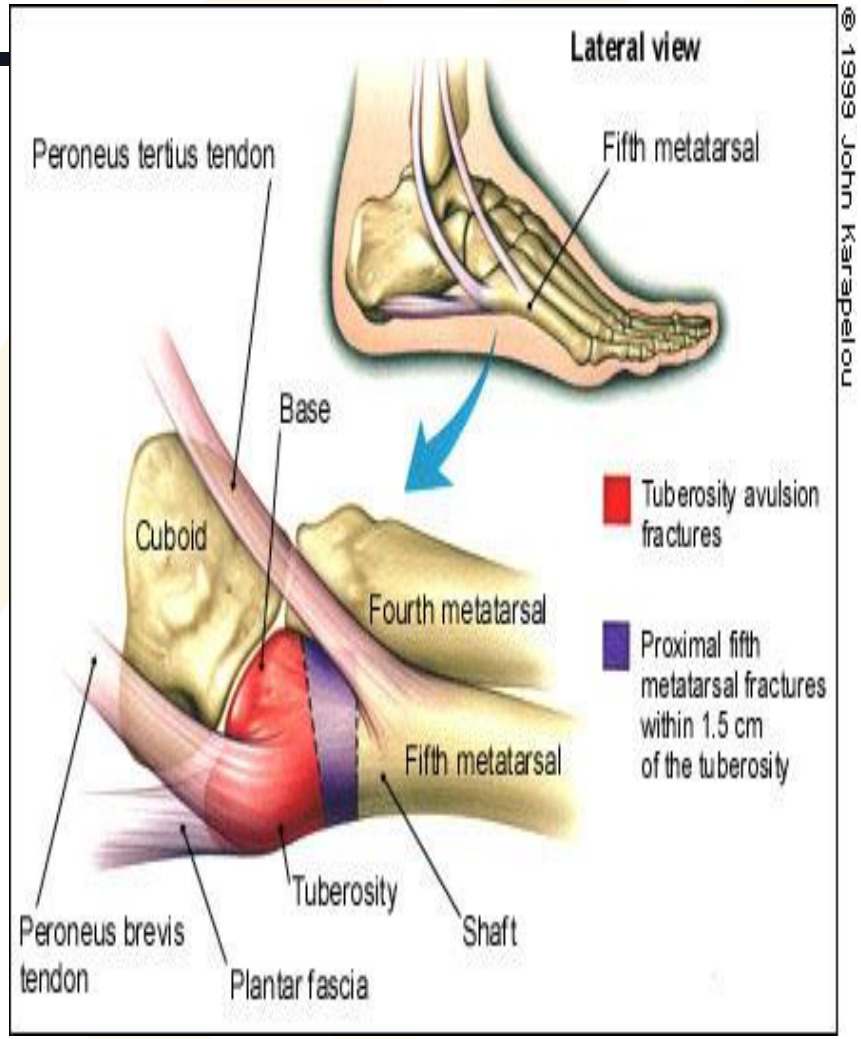
Case 8: ankle or foot pain?

- 15 yr old gymnast landed "funny" off beam and felt painful pop with swelling and bruising lateral foot and ankle
- Limping, unable to continue
- Exam: lateral ankle and foot swelling and ecchymosis
- TTP base fifth MT; limited strength with eversion
- Anterior drawer and talar tilt and provocative tests negative

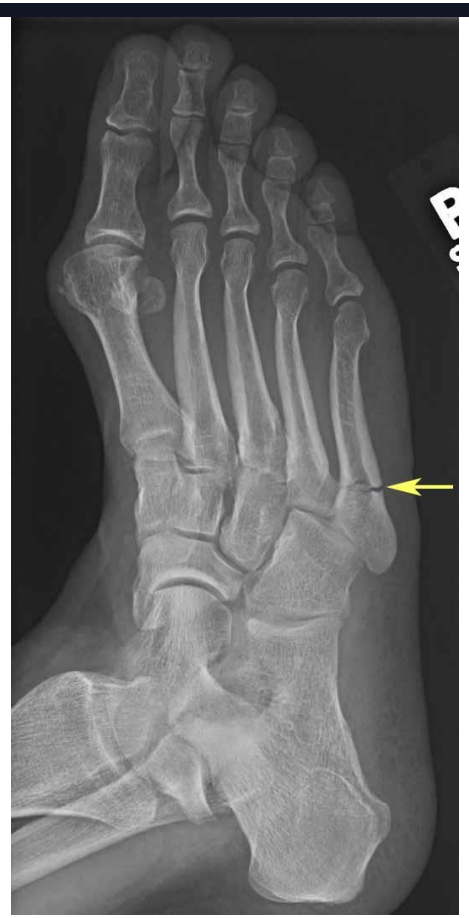


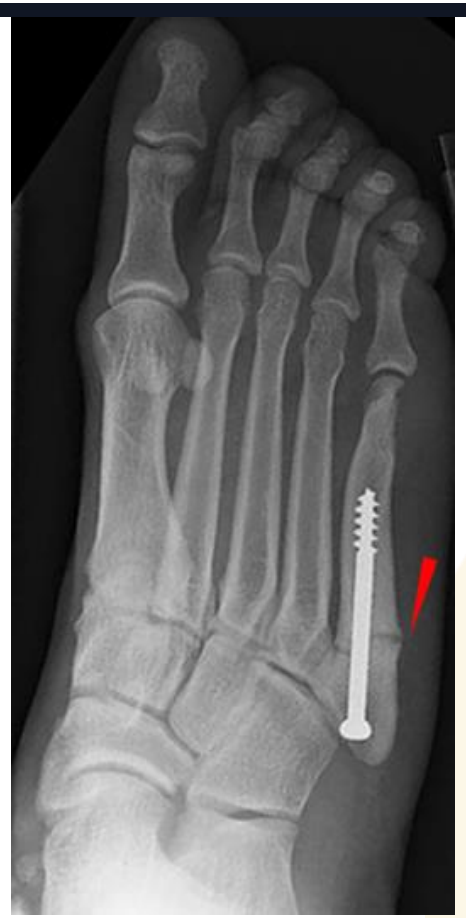
Ottawa Foot Rules

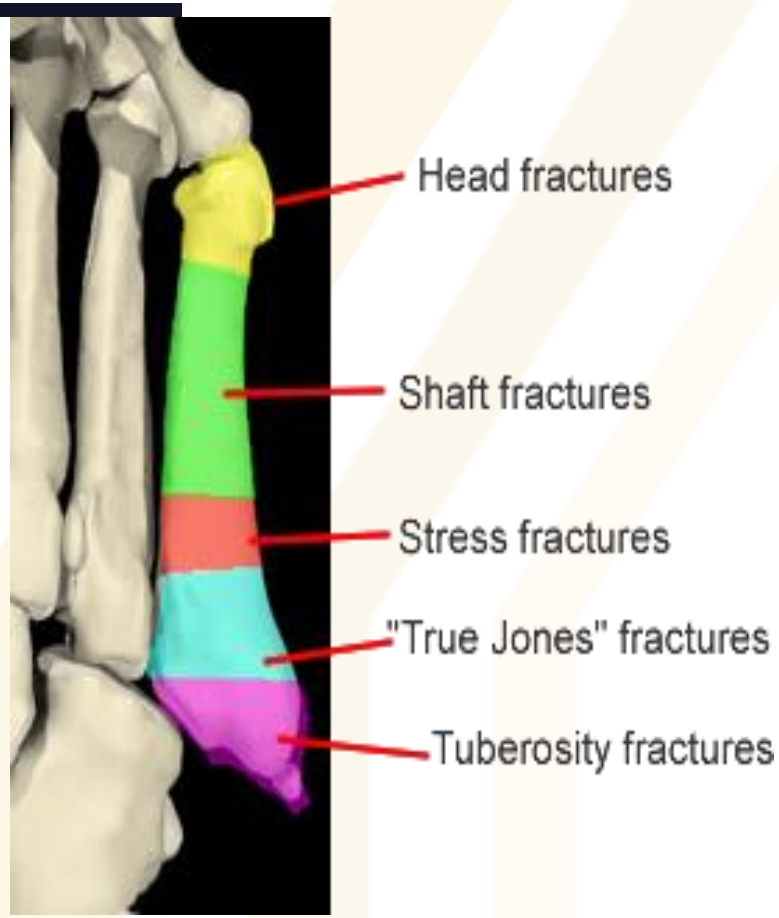
- Bone tenderness at the base of the fifth metatarsal (for foot injuries), OR
- Bone tenderness at the navicular bone (for foot injuries), OR
- An inability to bear weight
  - Immediately
  - &/or for 4 steps
  - Validated in children over age 5-6 yrs



What not to miss....



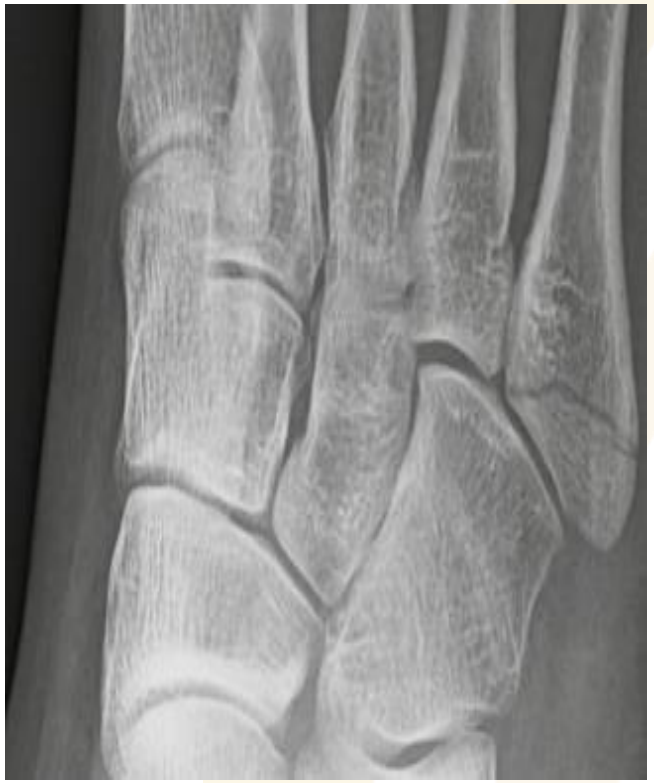


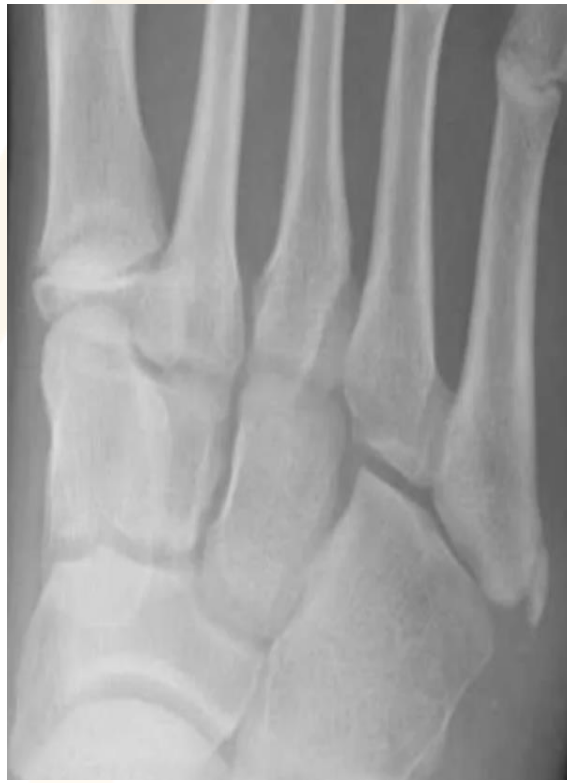


Strayer, et al. Fractures of the Proximal Fifth Metatarsal. *Am Fam Physician.* 1999 May 1;59(9):2516-2522.

Radiographs and treatment

- **Diagnosis:**
  - Fifth MT avulsion fx
  - In peds - apophyseal avulsion or acute apophysitis
- Stiff shoe, boot or cast
- WBAT
- Check instability
- RTP when can weight-bear and fracture healed
- Approx 3-4 weeks





Non-traumatic causes of joint pains +/- swelling

- Infectious – septic arthritis, cellulitis, osteomyelitis, post-viral arthropathy, Rhabdomyolysis
- Rheumatologic – JIA, SLE, Rheumatic Fever, fibromyalgia, amplified pain, myositis
- Neoplastic – sarcoma, leukemia, lymphoma
- Hematologic – sickle cell, hemophilia (hemarthrosis)
- Inflammatory – synovitis, periostitis,
- Orthopedic -- functional impingement, tendonitis/tendinosis/strains, biomechanical

Breathe....

Summary: **AMPLIFY** your knowledge --take home points

- The better you know your anatomy, the easier orthopedics is
- Skeletally immature patients are fractures until proven otherwise
- There is value in repeat radiographs and comparison views to assess growth plate injuries
- Some physeal and apophyseal acute injuries are orthopedic surgical emergencies
- Joint effusions often signal internal derangement and have high suspicion for fractures or significant soft tissue injury
- Practice reading your own radiographs
- Know your red flags and keys for urgent referrals

Thank-you!

Porter DA. Fifth Metatarsal Jones Fractures in the Athlete. *Foot & Ankle International*. 2018;39(2):250-258. doi:10.1177/1

References

- Wong L, Huang JJ, Alasadi Y, Jain C, Shatkin M, Ranade SC. Epidemiology of Pediatric Lower-Extremity Injuries in the 5 Most Popular US Sports: A 10-Year Analysis of National Injury Data (2015-2024). Orthop J Sports Med. 2026 Feb 20;14(2):23259671261416130. doi: 10.1177/23259671261416130. PMID: 41732224; PMCID: PMC12924982.
- Bulloch B, et al. Validation of the Ottawa knee rule in children: a multicenter study. *Ann Emerg Med.* July 2003;42:48-55.
- Nguyen JC, Markhardt BK, Merrow AC, Dwek JR. Imaging of Pediatric Growth Plate Disturbances. *Radiographics*. 2017 Oct. 37 (6):1791-1812
- DeFroda S, Hansen H, Gil J, Hawari A, Cruz A. Radiographic Evaluation of Common Pediatric Elbow Injuries. Orthop Rev (Pavia). 2017;9(1):7030
- Saeed W, Waseem M. Elbow Fractures Overview. 2021 Nov 7. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan–. PMID: 28723005.
- Skaggs, David L. MD Elbow Fractures in Children: Diagnosis and Management, Journal of the American Academy of Orthopaedic Surgeons: November 1997 - Volume 5 - Issue 6 - p 303-312
- Gaillard, F., Hobson, C. Salter-Harris classification. Reference article, Radiopaedia.org. (accessed on 11 Apr 2022) https://doi.org/10.53347/rID-2017
- Strayer, et al. Fractures of the Proximal Fifth Metatarsal. *Am Fam Physician.* 1999 May 1;59(9):2516-2522.
- Halabchi F, Hassabi M. Acute ankle sprain in athletes: Clinical aspects and algorithmic approach. World J Orthop. 2020 Dec 18;11(12):534-558. doi: 10.5312/wjo.v11.i12.534. PMID: 33362991; PMCID: PMC7745493.

I Need Your Feedback – Scan the QR

Prefer paper?

On the form in front of you, please score me and the content I shared with you today.

AFTER THE CONVENTION

You may claim CME here www.urgentcareassociation.org/learning-center/cme/