

The Ankle Sprain That Won't Get Better

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

Jim Macintyre MD, MPE, FACSM, FAMSSM, Dip Sport Med



Acknowledgements:

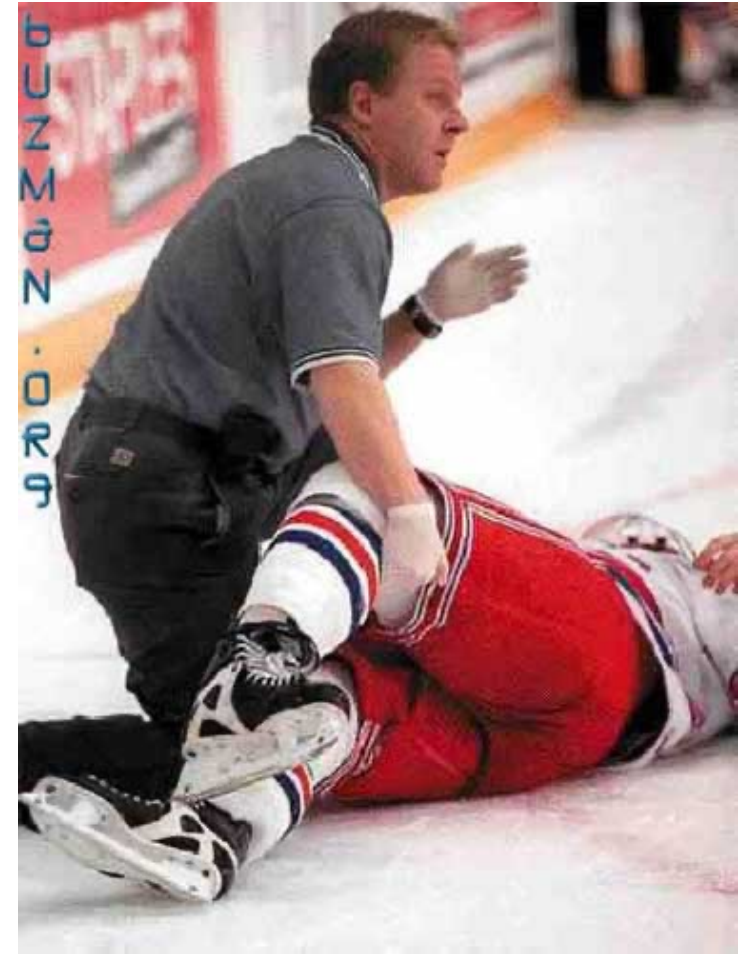
- Dr. Macintyre has no conflicts of interest
 - No off-label medications will be discussed
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Objectives

- At the conclusion of this lecture, the participant should:
 - Be familiar with the anatomy of the ankle
 - Be aware of the ankle sprain mimics that present as ankle sprains
 - Be able to outline an appropriate diagnostic and therapeutic plan for persistent ankle pain
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Outline

- Ankle anatomy
- Ankle sprain mimics
 - Significant injury masquerading as acute sprains
 - Chronic presentation – the ankle sprain that doesn't get better



Ankle Sprains: Significance of the Problem

- Most common injury in sports
 - 1/10,000 people / day
 - (Military recruits 5/10,000 training days)
 - 25,000 / day in USA
 - Huge \$ cost due to large number of sprains
 - Often ignored, but can lead to significant disability
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Lateral Ligaments

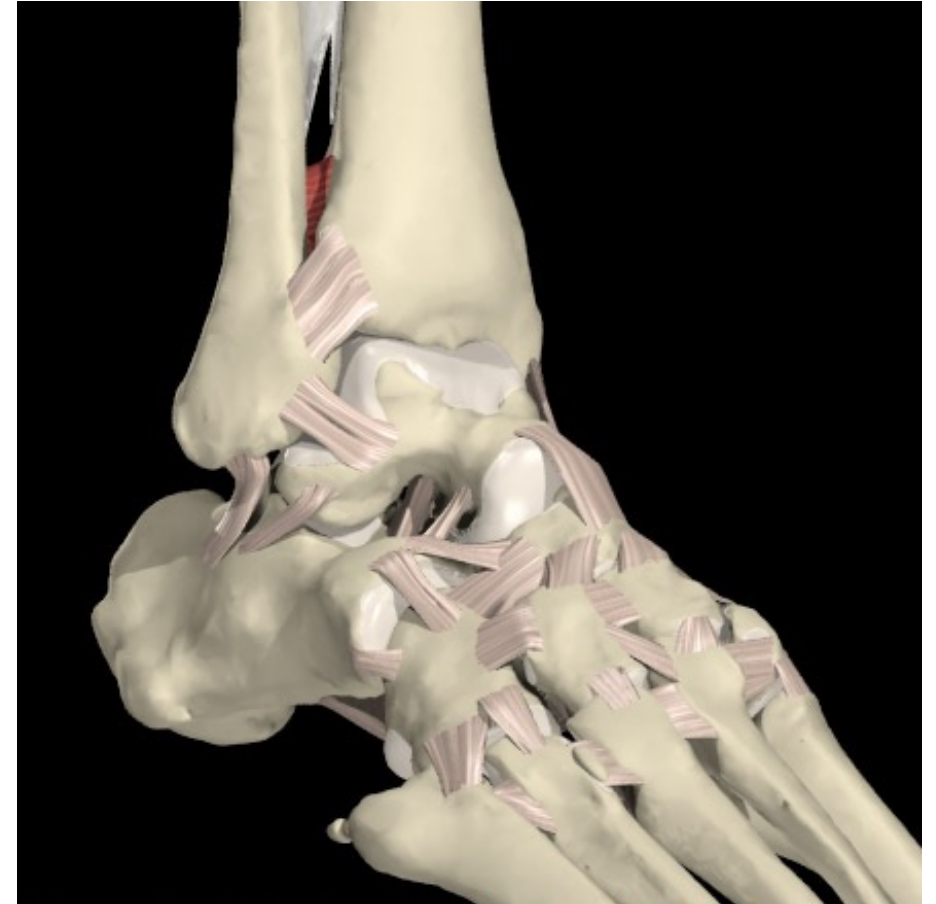
- Anterior talo-fibular (ATF)
- Calcaneo-fibular (CF)
- Posterior talo-fibular (PTF)



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Anterior – Posterior Ligaments

- Distal Tibio-Fibular Ligaments (Syndesmosis)
 - Anterior
 - Posterior



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Medial Deltoid Ligament

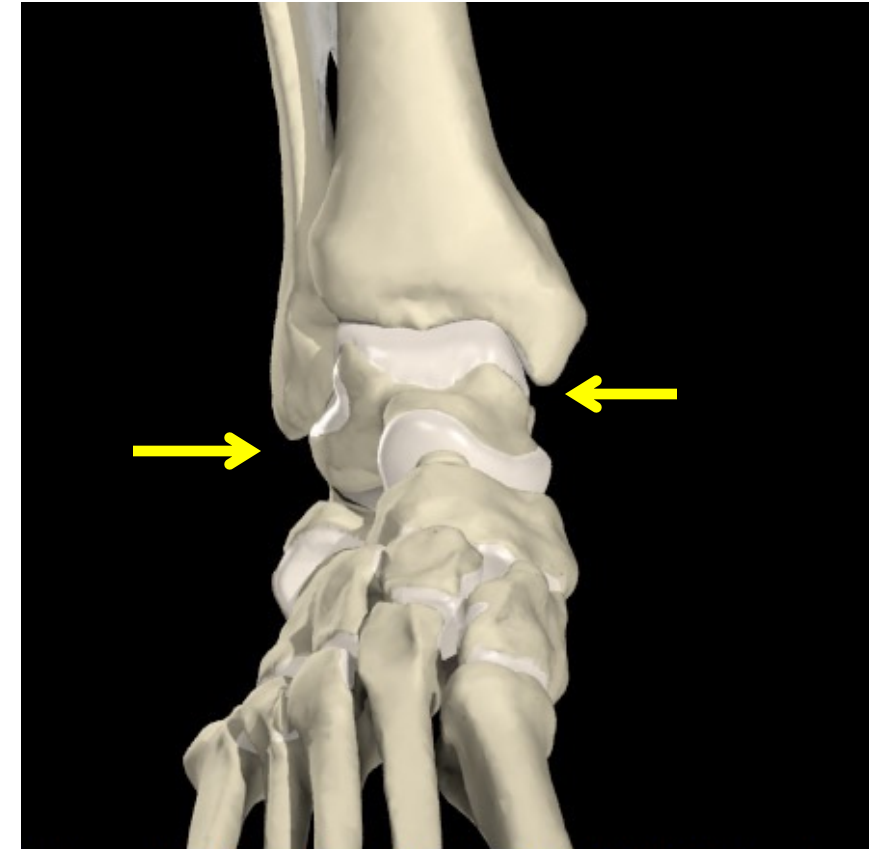
- Anterior Tibio-talar (Deep)
- Posterior tibio-talar
- Tibio-navicular
- Tibio-calcaneal



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Ankle Stability

- Lateral ligaments more vulnerable to injury
 - Medial malleolus shorter than lateral thus less buttress to prevent inversion
 - Medial ligaments are more robust than the lateral ligaments



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Ankle Stability

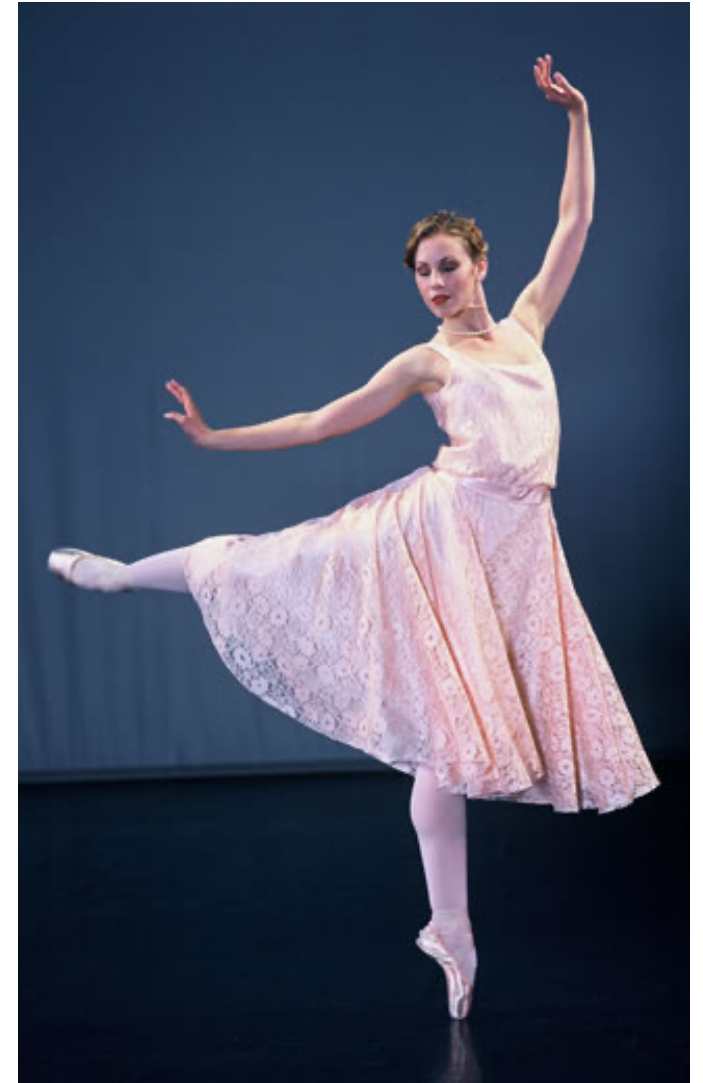
- Talus is wider anteriorly thus less stable with the foot in plantarflexion because narrow part of the talus is in the mortise



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Ankle Sprains: Stability

- With foot in plantar flexion the ankle has less support
 - The ATF is almost vertical
 - Narrow part of talus is in mortise



Ankle Sprains: Mechanism

- Inversion injures lateral ligaments
 - Eversion is less common and injures deltoid ligament
 - Injuries combined with rotation may injure the syndesmosis and interosseus membrane
 - Plantarflexion + inversion may also injure midfoot ligaments
-

Ankle Sprains: History

- Define exact mechanism to help determine injured structures
 - Ability to continue activity and bear weight
 - Presence of a pop?
-

Ankle Sprains: Examination

- Squeeze test - medial-lateral compression of the tibia and fibula - start at knee and work distally
 - Assesses status of interosseus membrane
 - Checks for fractures of proximal fibula
 - Also predicts syndesmotic injury
 - External rotation test for syndesmotic sprain
 - Tenderness
 - Check individual ligaments
 - Bony tenderness suggests fracture
-

Ankle Sprains: Examination

- Stability testing
 - Talar tilt
 - Anterior drawer
- Useful in cases of chronic instability
- Painful in an acute situation and doesn't change acute management
- ***I never*** use these in acute injuries

Significant Injury Masquerading as Simple Ankle Sprains

- Missed
 - Fractures
 - Dislocations
 - Tendon injuries
 - Significant ligament injuries



Significant Injury Masquerading as Simple Ankle Sprains

- Missed fractures
 - Medial and lateral domes of the talus
 - Lateral process of the talus
 - Anterior process of the calcaneus
 - Os trigonum
 - Posterior malleolus
-

Ankle Sprains: Imaging

- Radiographs frequently performed
 - Expensive
 - Low yield
 - Prolong time in ER and tie up resources and personnel
 - Ottawa Ankle Rules developed to determine necessity of X Rays
-

Ankle Sprains: Ottawa Ankle Rules

- **Ankle** X Rays performed if:
 - ❑ Patient unable to walk 3 steps after the injury or in the ER (Limping is OK)
 - ❑ *OR*
 - ❑ Tenderness over posterior portion of the lateral or medial malleolus
 - ❑ There may be greater sensitivity if midportion or crest of tibia / fibula is used
-

Ankle Sprains: Ottawa Ankle Rules

- **Foot** X Rays performed if:
 - Patient unable to walk 3 steps after the injury or in the ER (Limping is OK)
 - *OR*
 - Tenderness over navicular or base of the 5th metatarsal
-

Ankle Sprains: Ottawa Ankle Rules

- Make sure you examine the patient to determine the site of maximal tenderness before ordering XRays
 - Patients may say they've sprained their ankle when in reality they've sprained or fractured their midfoot
-

Ankle Pain vs Foot Pain

- Patient with “Ankle sprain” that turned out to be a talo-navicular dislocation
- Missed on initial ankle radiographs
- Easily seen on foot X-rays



My Rule for Advanced Imaging

- Level 5 Evidence
 - If patient has normal X-rays, but is unable / unwilling to weight bear after 4 days, then obtain a CT or MRI to rule out fracture, bone bruise, significant ligament injury
 - Exception is when patient has been immobilized by the ER and kept NWB – I'll give an extra 2-3 days to bear weight
 - Big Swelling – Big Injury
 - If swelling is minimal, significant fracture / injury is possible but less likely
-

Talar Dome Fractures

- Impaction of dome on tibial plafond or lateral malleolus causes osteochondral injury
 - LAMP (Lateral - Anterior, Medial - Posterior)
 - May or may not have bony fragment
 - May lead to chronic pain and locking
 - Detect with:
 - Radiographs
 - CT or MRI (best as can also stage)
 - May require cast or surgery
-

Talar Dome Fractures

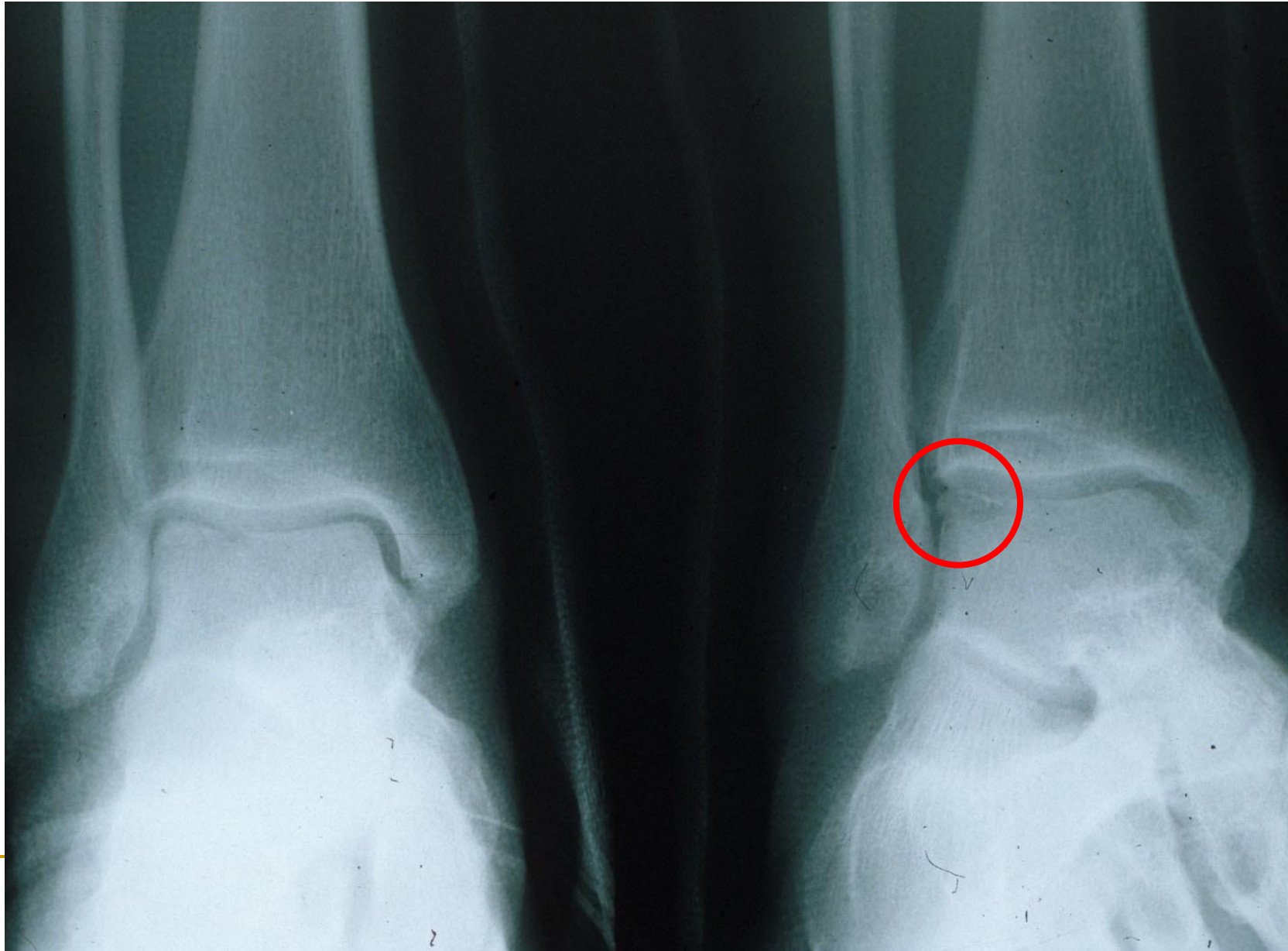


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Lateral Talar Dome Fractures



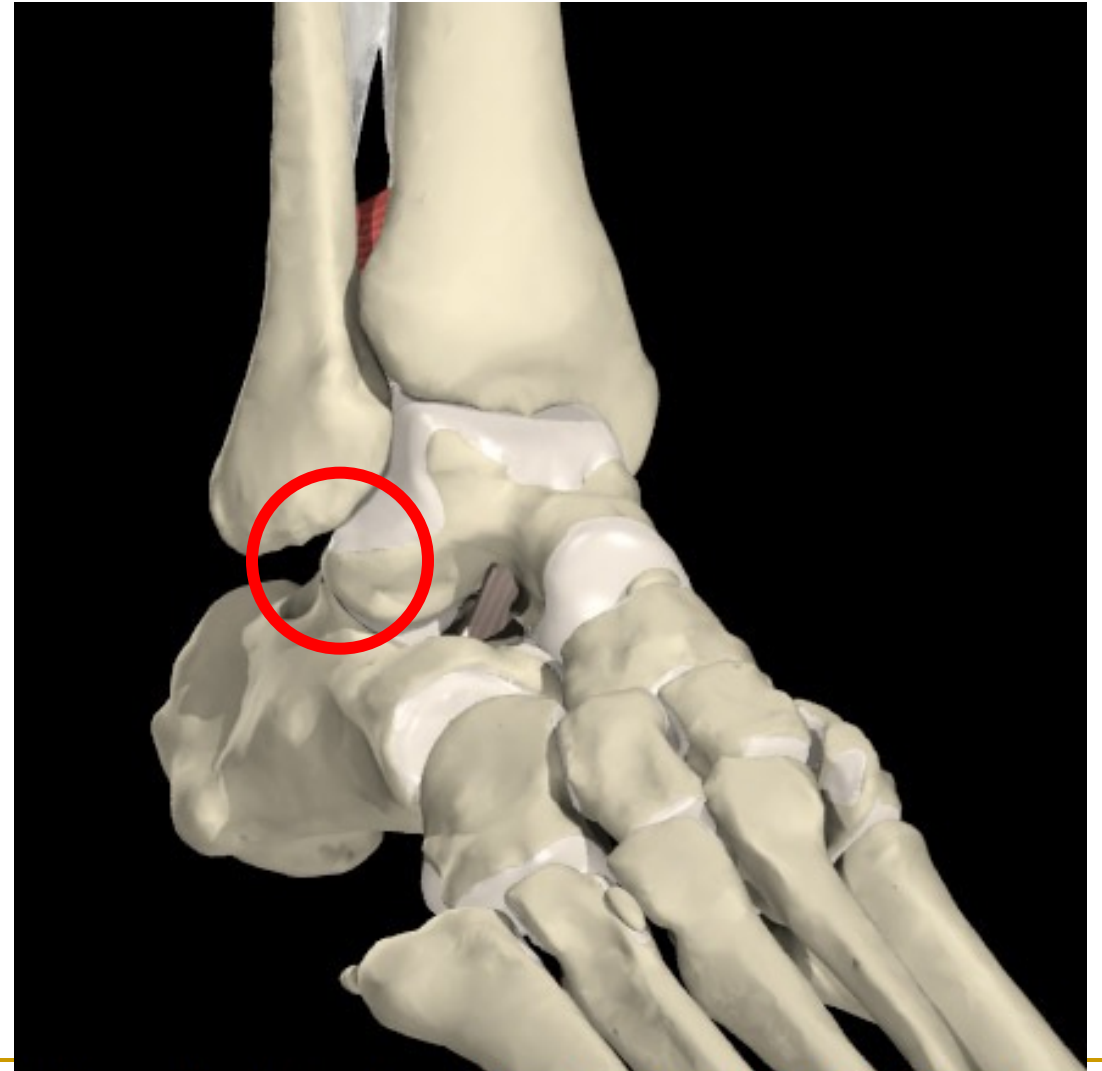
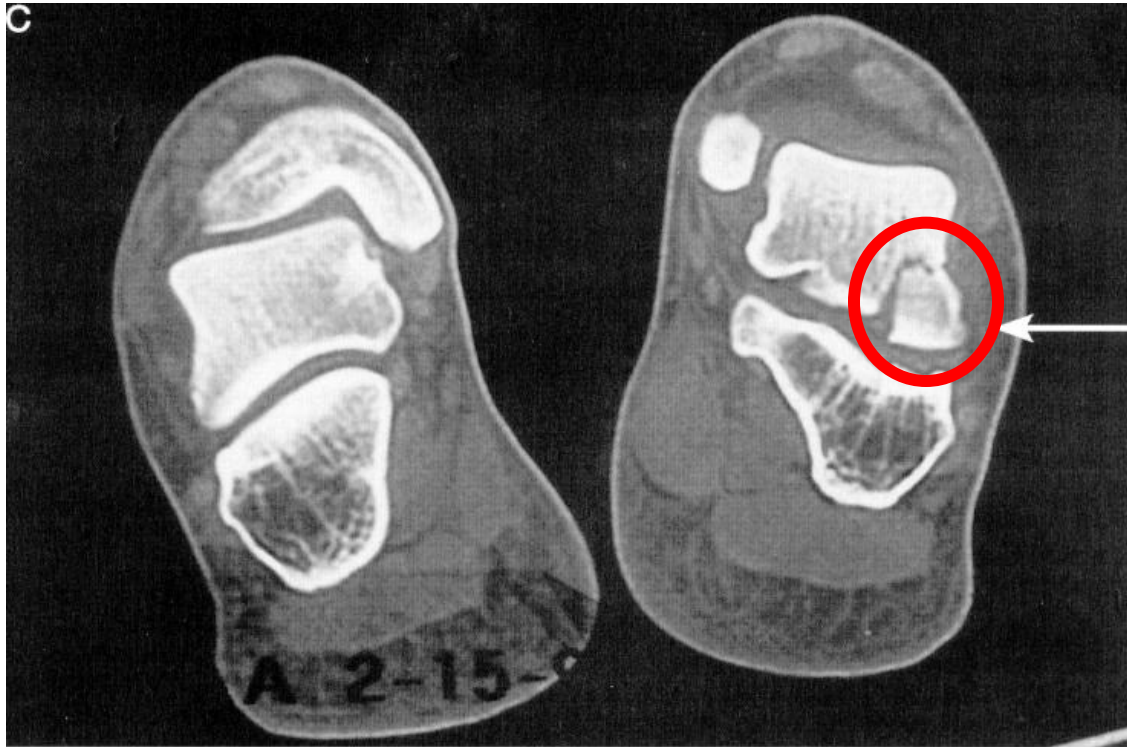
Medial Talar Dome



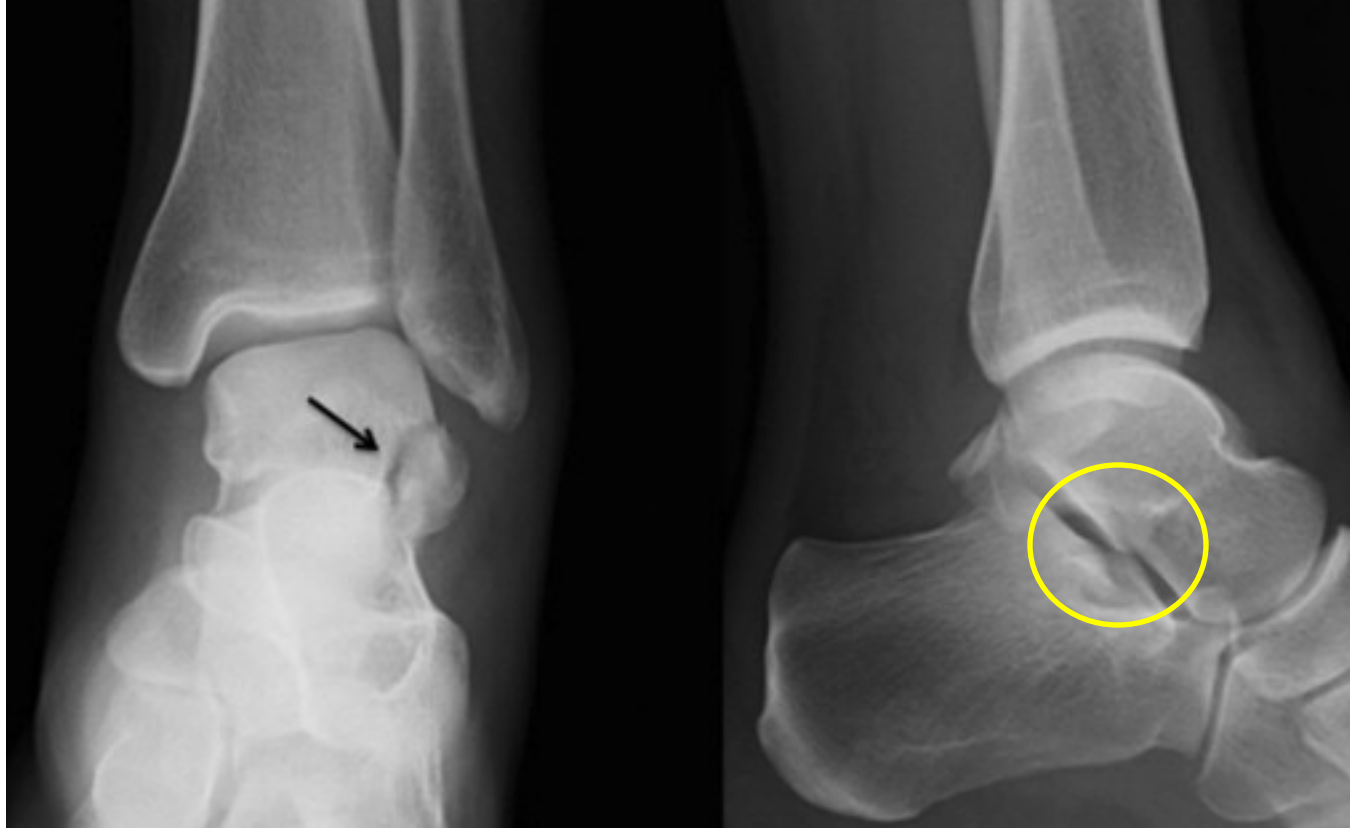
Lateral Process of the Talus

- Usually hyper-dorsiflexion injury
 - “Snowboarders fracture”
 - Easy to miss – CT determines extent
 - Small fragment <2mm displacement
 - Cast immobilization NWB
 - Large or displaced fragments
 - ORIF
 - Chronic may require ORIF vs. excision depending on size and extent of joint involvement
-

Lateral Process of the Talus

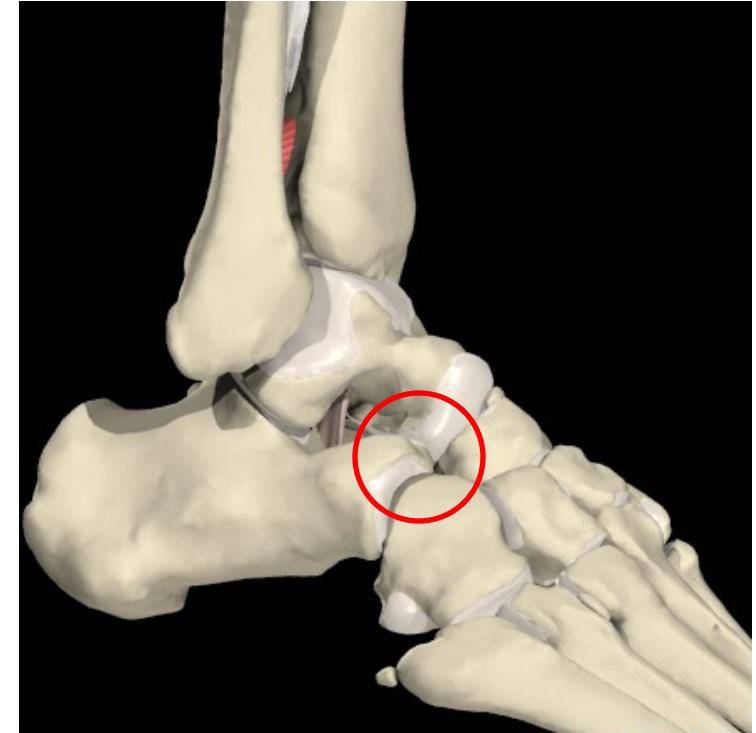


Lateral Process of Talus: “Snowboarders’ Fracture”



Anterior Process of the Calcaneus

- Tenderness just anterior / inferior to ATF insertion
- Detect / assess extent with plain films or CT / MRI
- Management:
 - Cast immobilization if non displaced
 - ORIF if large or displaced



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Anterior Process of the Calcaneus



Posterior Malleolus

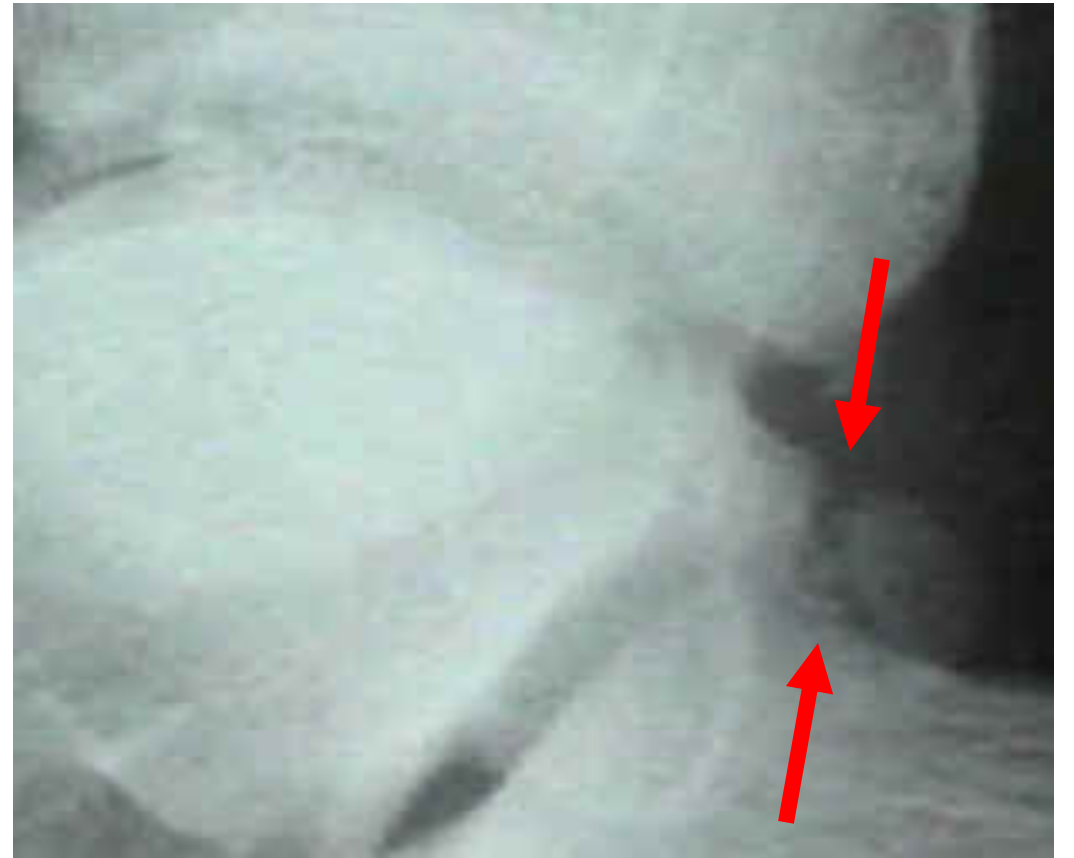
- May be isolated and non-displaced
- May line up with fibular border on lateral XRay
- May require oblique radiographs, CT or MRI to detect



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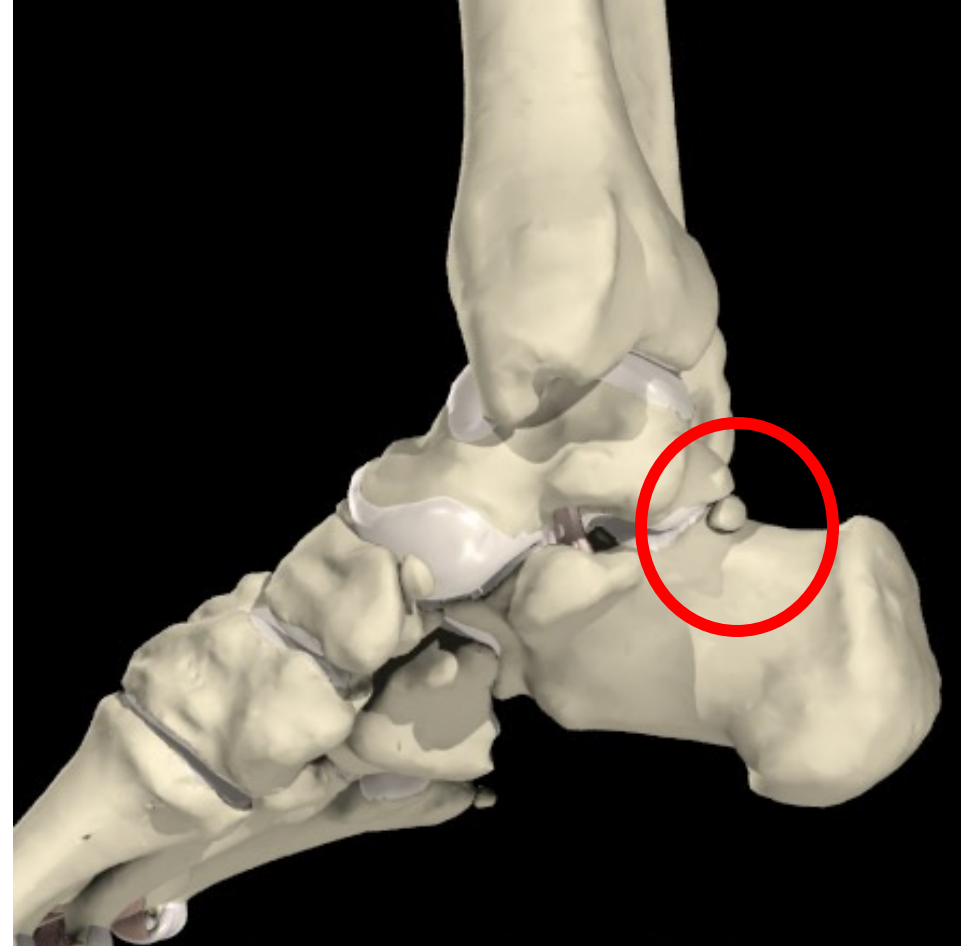
Os Trigonum

- Os trigonum an extension of the lateral tubercle of the posterior process of the talus
- FHL in close approximation
- May be un-fused normal variant / separate structure in 14 - 25% of population



Os Trigonum - Fracture

- Mechanism twisting of plantarflexed foot
- Swelling and tenderness in posterior ankle
- Positive posterior ankle impingement test
- May require MRI / CT
- Treatment: NWB casting for small, rarely excision if chronic



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Significant Injury Masquerading as Simple Ankle Sprains: Dislocations

- Missed Dislocations
- Rarely talo-navicular dislocation can be missed on XRay if an ankle radiograph is ordered instead of a foot XRay



Cuboid Subluxation



Cuboid Subluxation: Mechanics

- Cuboid articulates with
 - Calcaneus – anterior process
 - Lateral cuneiform
 - Base of 4th and 5th metatarsals
- Calcaneo-cuboid is a saddle joint
- Peroneus brevis contraction locks the lateral column
- Peroneus longus loops under the cuboid to stabilize the medial midfoot



Cuboid Subluxation: Mechanics

- Plantargrade subluxation of medial border of cuboid
 - This elevates the base of the 4th metatarsal in dorsal direction
 - Metatarsals are like a teeter – totter, so elevation of the base results in plantar grade displacement of the 4th MT head
 - Loss of mechanical advantage of the peroneus longus at the “cuboid pulley” resulting in overload of the peroneus tendon
-

Cuboid Subluxation: History

- Lateral midfoot pain
 - Often follows ankle sprain or 5th MT fracture
 - Pain and weakness for push off
 - Pain with rolling through the foot or onto pointe in ballet dancers
 - Pain may radiate up peroneal tendons / muscles
 - Always consider cuboid dysfunction in cases of peroneal tendonitis / pain
-

Cuboid Subluxation: Examination

- ***If you don't look for it, you'll never find it***
 - Reduced functional supination
 - Reduced lateral midfoot motion and cuboid glide
 - Abduction of the forefoot
 - Tenderness over dorsal ligaments
 - NB differentiate from other structures
 - Firm, tender prominence on plantar surface (Plantargrade displaced cuboid)
 - Tenderness / pain on resisted peroneus function
-

Cuboid Subluxation: Examination

- Plantarflexed 4th Metatarsal head
- Step off at base of 4th MT at articulation with the cuboid (Tender++)
- Often pain with mobilization and flexion / extension of the 4th MT
- Marshall & Hamilton Am J Sports Med, March /April 1992



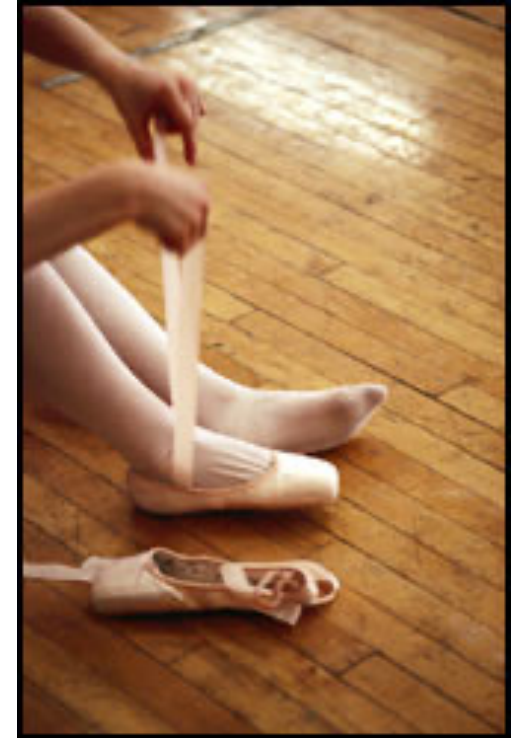
Cuboid Subluxation: Treatment

- Restore mobility of distal tibio-fibular, talo-crural, subtalar and lateral midfoot
- Adduct the forefoot
- Cuboid reduction
 - Relax peroneals
 - Squeeze technique
 - Cuboid whip
- Marshall & Hamilton Am J Sports Med, March /April 1992
- Muscle energy techniques – kinder and gentler



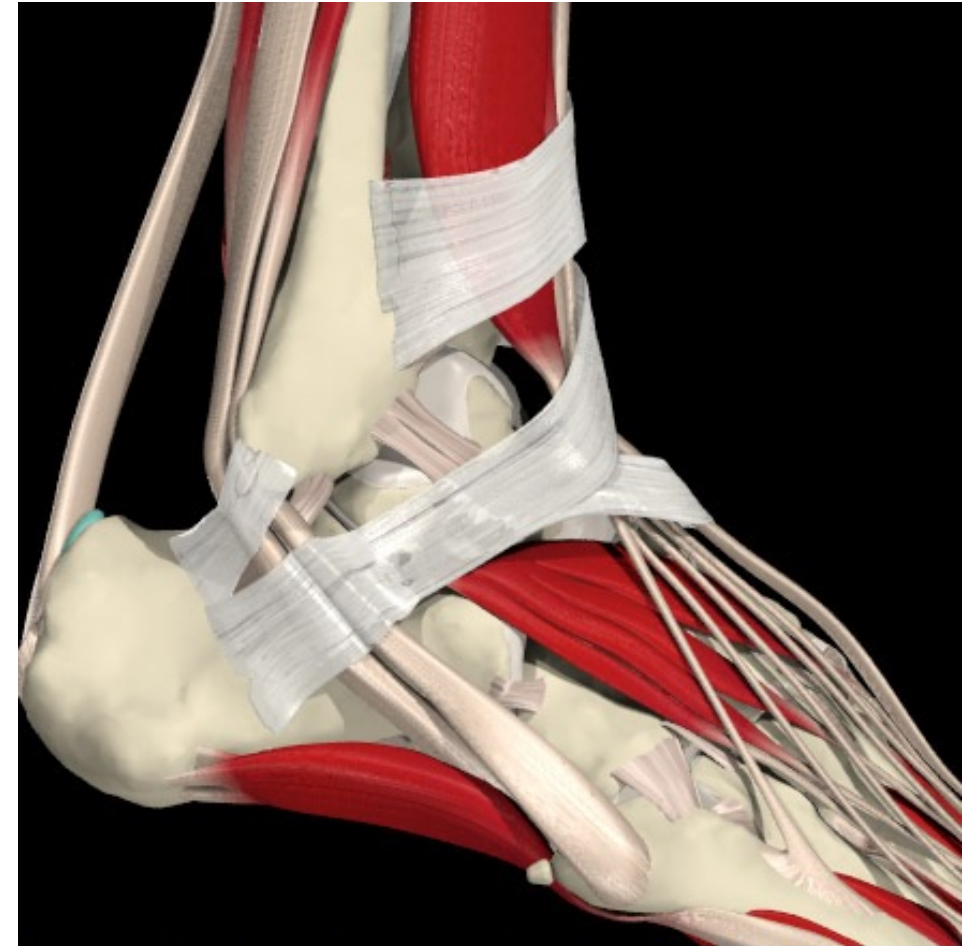
Cuboid Subluxation: Treatment

- Taping
 - Cuboid support
 - Low Dye
- Home exercise program
 - Self mobilization
 - Strength
 - Peroneals (neutral & pointe)
 - Piano scales
 - Toe flares
 - Tennis ball roll to mobilize midfoot / reduce cuboid



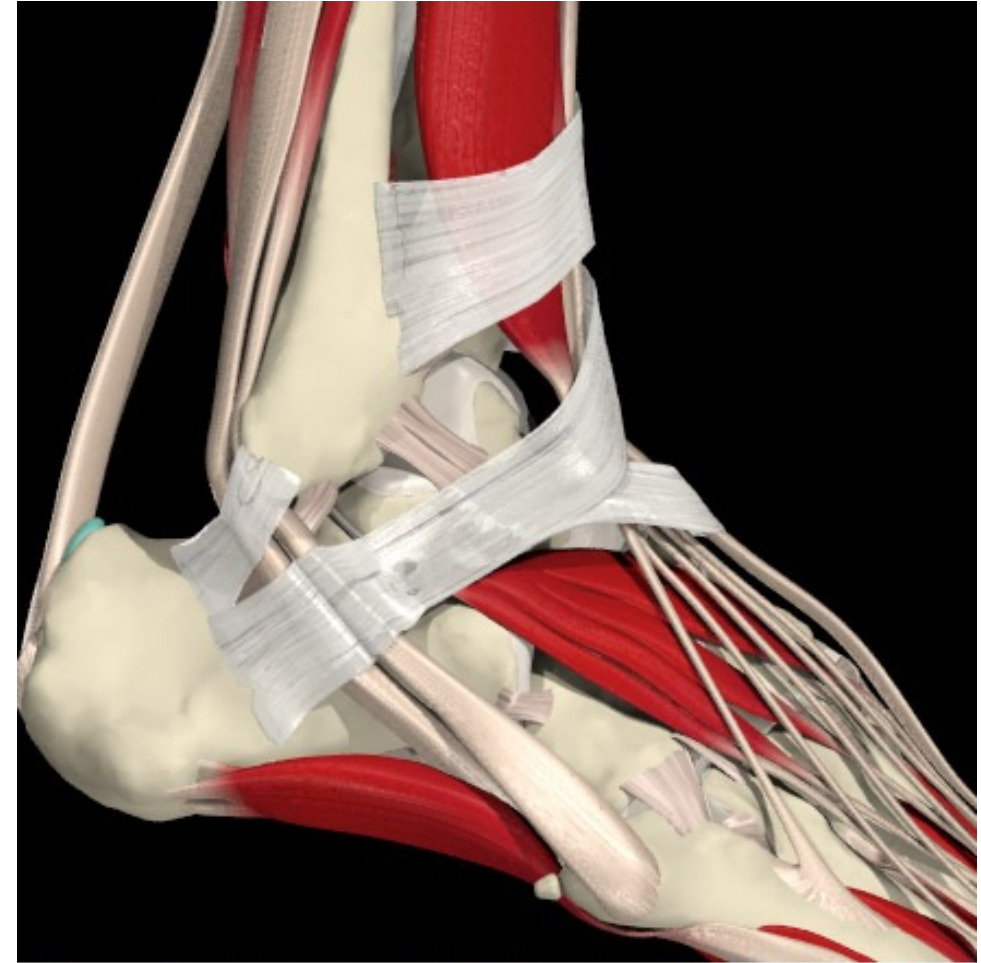
Significant Injury Masquerading as Simple Ankle Sprains: Tendons

- Peroneal tendon injuries
 - Subluxation
 - Longitudinal / In-Substance tears



Peroneal Tendon Injuries

- Peroneus longus and brevis held in place in a groove behind the lateral malleolus by the superior peroneal retinaculum
- Shallow groove may predispose to injury



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Peroneal Tendon Injuries: Subluxation

- Often forceful dorsiflexion – inversion injury
 - Initially described in skiers
 - Tear of peroneal retinaculum
 - Results in persistent pain and tendon instability
 - Examination: Provocative examination tests
 - Resisted eversion in various positions to provoke subluxation
-

Peroneal Tendon Injuries: Subluxation

- XRay may show avulsion fragment off posterolateral border of lateral malleolus
 - MRI may show retinacular tear
 - May respond to cast immobilization but frequently requires surgical repair especially if groove shallow or absent ligament
 - Khoury NJ, et al, Radiology, 1996, 200;833-841. Peroneus longus and brevis tendon tears: MR imaging evaluation
-

Peroneal Tendon Injuries: Longitudinal / In-Substance Tears

- Peroneus brevis develops longitudinal tear from impinging on posterior aspect of lateral malleolus with compression from peroneus longus and / or subluxation or dislocation
 - Acute injury occurs less commonly
 - Peroneus longus susceptible to chronic injury with tendinosis in older individuals
-

Peroneal Tendon Injuries:

Longitudinal / In-Substance Tears

- Examination shows tenderness with boggiess and sometimes crepitus over tendon sheaths, and pain on resisted function
 - MRI will show in-substance injury and tendon sheath swelling and fluid
 - May require surgical debridement and repair if conservative treatment ineffective
 - Khoury NJ, et al, Radiology, 1996, 200;833-841. Peroneus longus and brevis tendon tears: MR imaging evaluation
-

Significant Injury Masquerading as Simple Ankle Sprains: Ligaments

- Syndesmotic disruptions
- Maisonneuve fracture - dislocation



Significant Injury Masquerading as Simple Ankle Sprains: Ligamentous

- Undetected and untreated syndesmotic instability can lead to persistent ankle instability and accelerated OA of the ankle



Syndesmotic Sprains: Classification

- Syndesmotic injury associated with diastasis without fracture
- Latent syndesmosis injury:
 - Appeared normal on an unstressed radiograph and abnormal or widened on external rotation stress mortise radiograph
- Complete injury:
 - Widened syndesmosis on unstressed radiographs

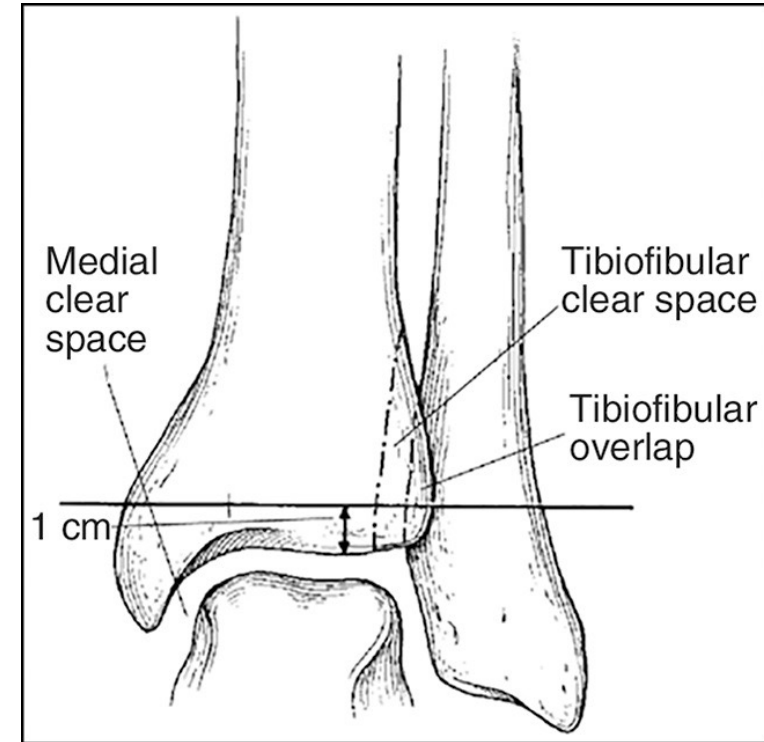
- Edwards GS, DeLee JC: Ankle diastasis without fracture. *Foot Ankle Int* 1984; 4:305-312
-

Syndesmotic Sprains: Exam

- Many diagnostic tests
- Little agreement on optimum diagnostic exam tests
- Diagnostic sensitivity and specificity were very low and only the squeeze test showed a clinically important result.
- Squeeze
 - Best of a bad lot
- External rotation
- Anterior Drawer and Forced Dorsiflexion: Very Painful!

Syndesmotic Sprains: “Classic” Radiographic Criteria:

- The normal overlap between the fibula and the anterior process of the tibia > 6 mm, or greater than 1 mm on the mortise view
- Medial Clear space on either view is normally less than 6 mm and less than or equal to tibial plafond – talus clear space
 - No evidence to support these diagnostic criteria
- Harper MC, Keller TS: A radiographic evaluation of the tibiofibular syndesmosis. *Foot Ankle Int* 1989; 10:156-160.
- Van Heest TJ and Lafferty PM. Injuries to the Ankle Syndesmosis. *J Bone Joint Surg (Am)* 2014;96:603-13



MRI Correlation with Xray

- MRI showed medial clear space measurement greater than 4 mm correlated with disruption of the deltoid and the tibiofibular ligaments
 - No association between the tibiofibular clear space and overlap measurements on radiographs with syndesmotic injury on magnetic resonance imaging scans.
 - Nielson JH et al. Radiographic Measurements Do Not Predict Syndesmotic Injury in Ankle Fractures: An MRI Study. Clin Orthop Relat Res 2005; 436:216-221
-

Medial Clear Space – Check It!



Medial clear space <4mm



Medial clear space >4mm

Syndesmotic Sprains: Imaging

- Syndesmotic instability detected by external rotation stress radiographs
 - Lateral stress radiographs showed posterior displacement of the fibula relative to the tibia and were superior to mortise view stress radiographs
 - Xenos JS et al, JBJS, 1995, 77(6):847-856, The tibiofibular syndesmosis. Evaluation of the ligamentous structures, methods of fixation, and radiographic assessment
-

Syndesmotic Sprains: Imaging

- Gravity stress mortise view of the ankle
 - Ankle positioned horizontally, lateral side down
 - Lateral shift of $>2\text{mm}$ and valgus tilt of $\geq 15^\circ$
 - Documents destabilizing deltoid ligament damage with lateral malleolar fractures
 - Equivalent to manual stress views in assessing instability
- ? Role in evaluating syndesmotic injury without fracture

- Michelson JD et al Diagnosing Deltoid Injury in Ankle Fractures: The Gravity Stress View Clin Orthop Relat Res 2001. 387:178-182
- Gill JB et al Comparison of Manual and Gravity Stress Radiographs for the Evaluation of Supination-External Rotation Fibular Fractures JBJS (A). 2007;89:994-999

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 / Tibia side up
- Gravity widens mortise



Syndesmotic Sprains: Treatment

- Paucity of literature and low level of evidence
 - No clear guidelines are available to help the clinician assess the severity of injury, choose an imaging modality to visualize the injury, make a decision in terms of operative versus nonoperative treatment, or decide when the athlete may return to play
 - Jones MH and Amendola. Clin Orthop Relat Res. 2007;455:173-5. Syndesmosis sprains of the ankle: a systematic review.
 - Williams GN, Jones MH and Amendola. Am J Sports Med. 2007;35(7):1197-207. Syndesmotic ankle sprains in athletes.
-

Syndesmotic Sprains: Treatment

- Four most important considerations
 - ❑ Early recognition of the injury and its severity,
 - ❑ Accurate assessment of the degree of (in)stability and any other associated pathology,
 - ❑ Prompt reduction and stabilization of all unstable injuries along with treatment of any associated pathology as indicated,
 - ❑ Progressive rehabilitation focusing on full range of motion and return of normal strength
 - Hunt KJ, et al. High ankle sprains and syndesmotic injuries in athletes. *J Am Acad Orthop Surg.* 2015;23(11):661–73.
-

Syndesmotic Sprains: Treatment

- Grade 1 Injuries
 - Treated with prolonged bracing and rehabilitation
 - Latent / Grade 2 Injuries
 - ?Prolonged conservative
 - Some authors report surgery reduces time to play
 - Frank / Grade 3 Injuries
 - Surgical stabilization
 - Bioabsorbable syndesmotic compression “Tightrope”
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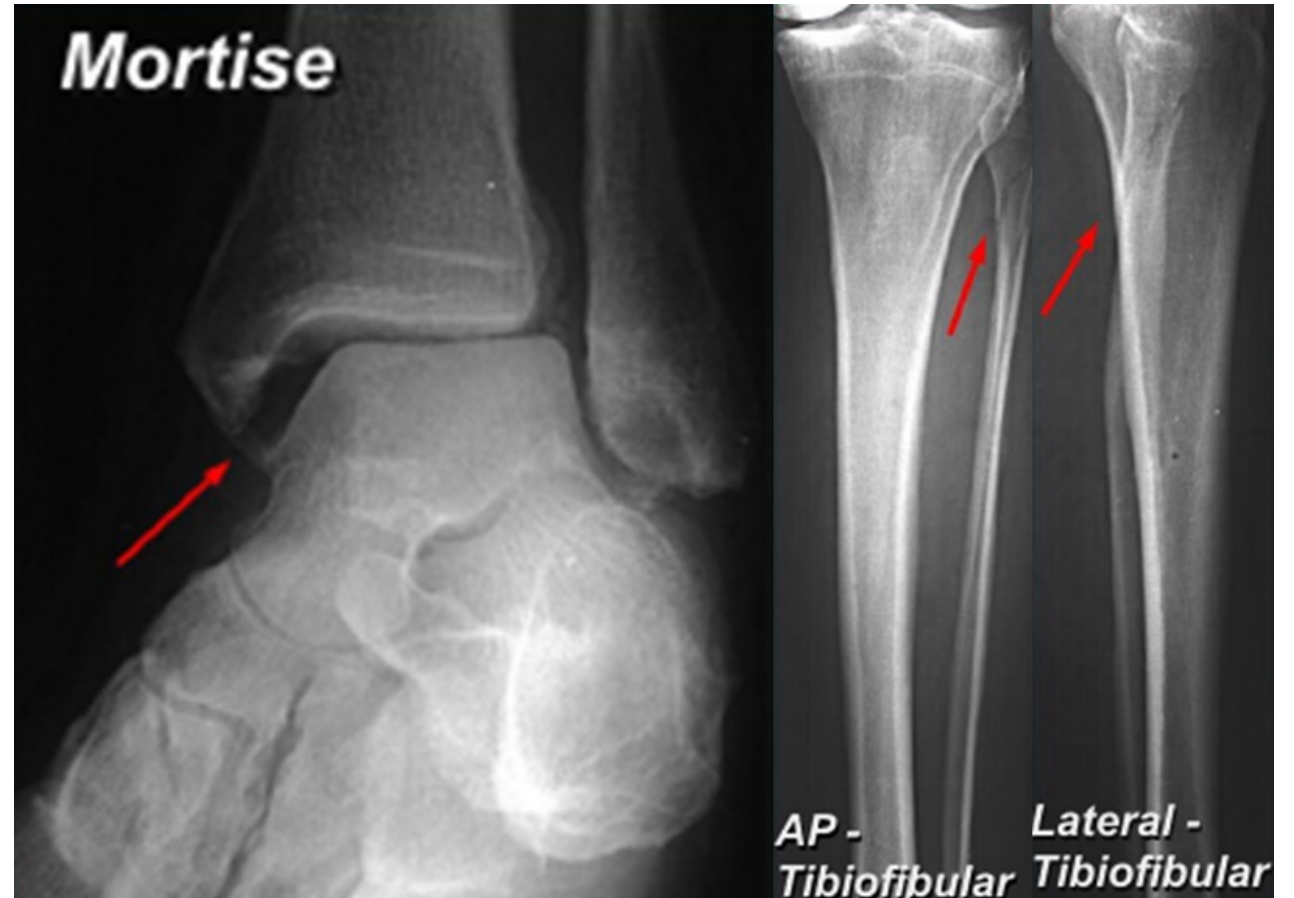
Ankle Fracture - Dislocations:

Maissonneuve Fracture

- Maissonneuve – “*Missed and Sued*”
 - Syndesmosis tear
 - Interosseus membrane tear
 - Fracture of proximal fibula
 - Detect with
 - Squeeze test
 - Xray of full lower leg if suspicious
 - Usually requires surgical stabilization of mortise
 - Most commonly performed with bio-absorbable, flexible fixation “Tightrope” which remains in place
 - Previously syndesmotic screw more common, but had to be removed after 4-6wks
-

Maisonneuve Fracture

- Fracture may be more proximal than standard ankle XRay will detect



Chronic / Persistent Symptoms

- Inadequate / incomplete rehab
 - Meniscoid lesion
 - Prolonged symptoms from acute injury
 - Missed fractures
 - Cuboid subluxation
 - Peroneal tendon injury
-

Persistent Symptoms: Incomplete Rehab

- Common reason for persistent problems is that the patient didn't rehab properly
 - Strength – emphasize peroneus longus / brevis
 - Balance and proprioception
 - Joint mobility
 - Loss of talo-crural / subtalar motion
 - Progressive functional agility program
 - Initially in Brace
 - Later without brace
 - Late without brace with ball handling

Meniscoid Lesion

- Entrapment of the capsule between the talus and the lateral malleolus causing synovitis / fibrosis involving ligaments and lateral gutter “Scar Ball”
 - Radiographs often normal, but may show calcification or heterotopic bone in the syndesmosis
 - Treatment is Physical Therapy &/or corticosteroid injection initially, and if that fails to resolve the problem, arthroscopic debridement
-

Persistent Symptoms

- Missed fractures and peroneal tendon injuries can produce chronic pain
 - MRI can detect these conditions
 - Cuboid subluxation should always be ruled out with chronic lateral midfoot pain
 - Careful, specific examination should demonstrate classic clinical findings
-

Summary

- The “simple” ankle sprain is not always so simple
 - A high index of suspicion is needed for ankle sprain mimics including occult fractures and dislocations, instability, tendon injuries and cuboid subluxation
 - Further imaging is necessary in patients with prolonged unwillingness / inability to weight bear
 - Ankle sprains should improve with adequate rehabilitation – failure to improve necessitates further investigation
-

Thank You! Any Questions?

