

# Midfoot Trauma

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# Disclosure Statement



- I have no financial interests or affiliation concerning the material provided in this presentation
  - I will not discuss or promote non-FDA approved treatment options

# Learning Objectives

- Review signs and symptoms of midfoot fractures and trauma
- Discuss management and treatment strategies
- Recommend appropriate follow-up care for optimal outcomes

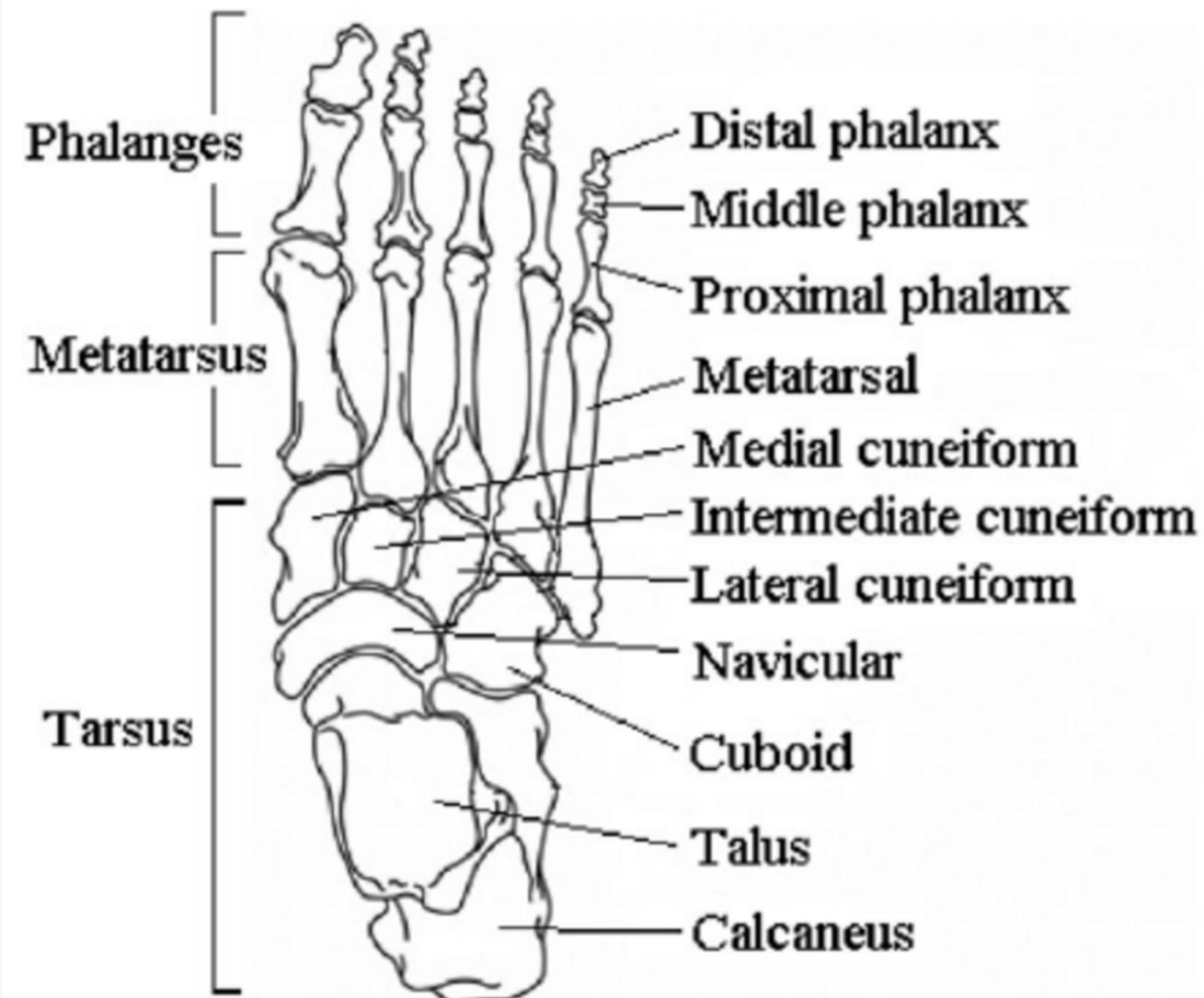
# Anatomy



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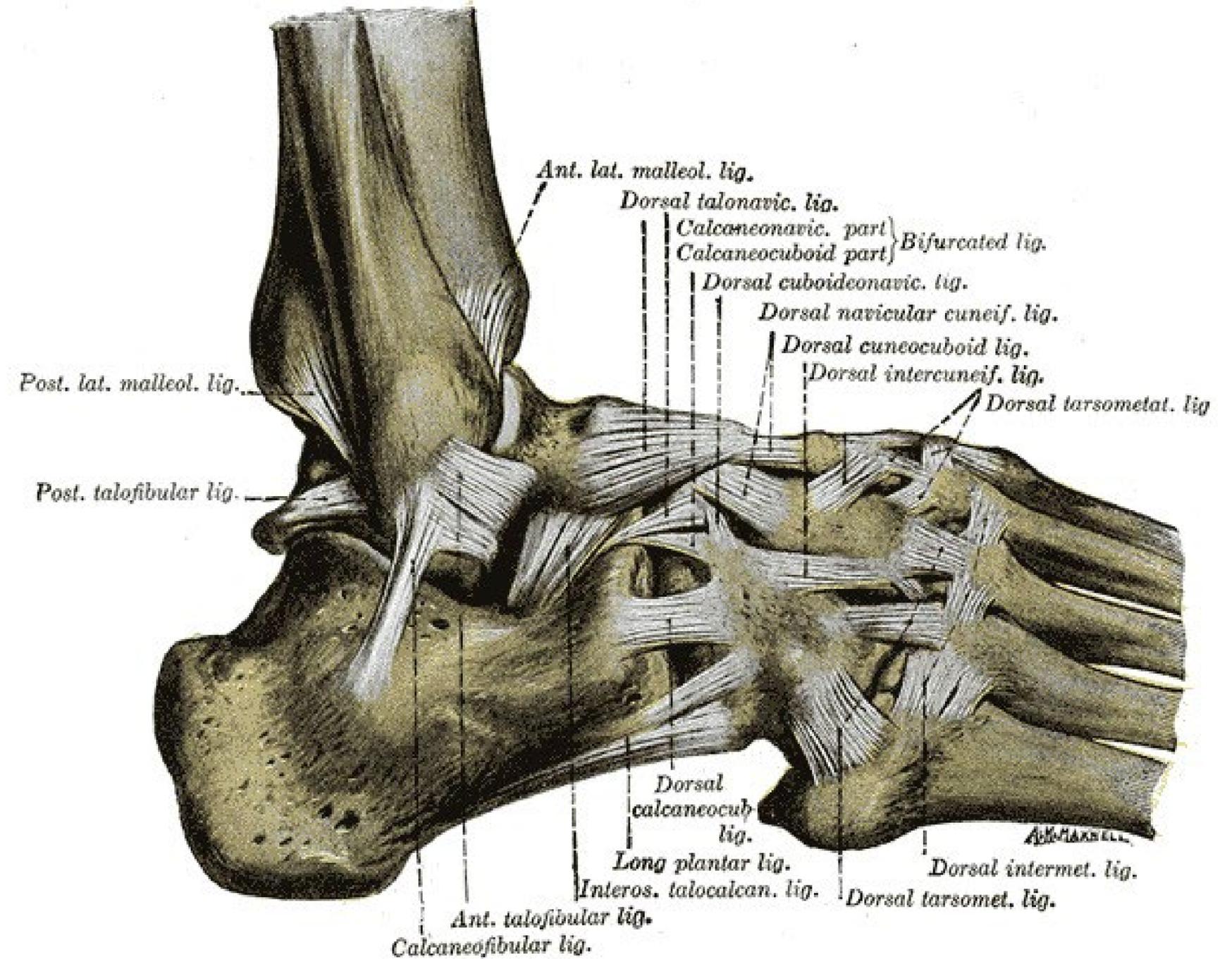
# Anatomy of the foot

- There are 28 bones of the foot



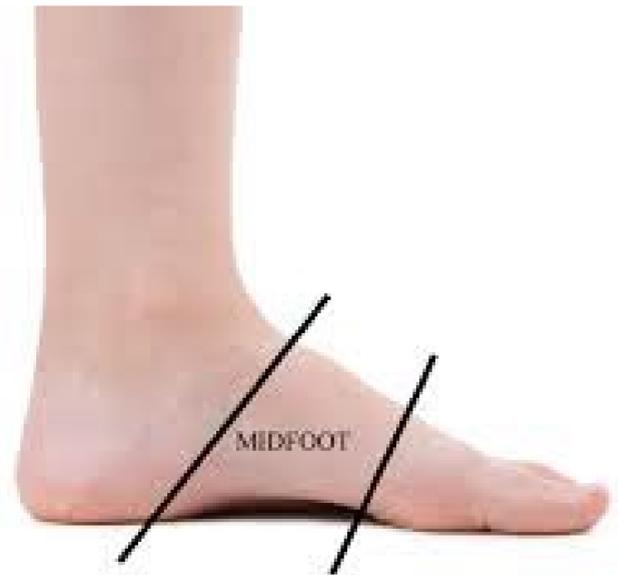
# Anatomy of the foot

- Ligaments are present at every joint
- Some are much more important than others based on the joints involved and role in maintaining alignment



# Anatomy of the foot

- Forefoot vs. Midfoot vs. Hindfoot



- Common Forefoot Trauma injuries include toe fractures, distal metatarsal fractures, and crush injuries
  - usually low energy, like kicking something or a simple misstep



# Anatomy of the foot

- Forefoot vs. Midfoot vs. Hindfoot



- Common Hindfoot Trauma injuries include calcaneal fractures, talus fractures, and joint sprains
  - usually higher energy, such as falls from height or car accidents



# Mechanism of Injury

- Midfoot trauma injuries can have many different mechanisms

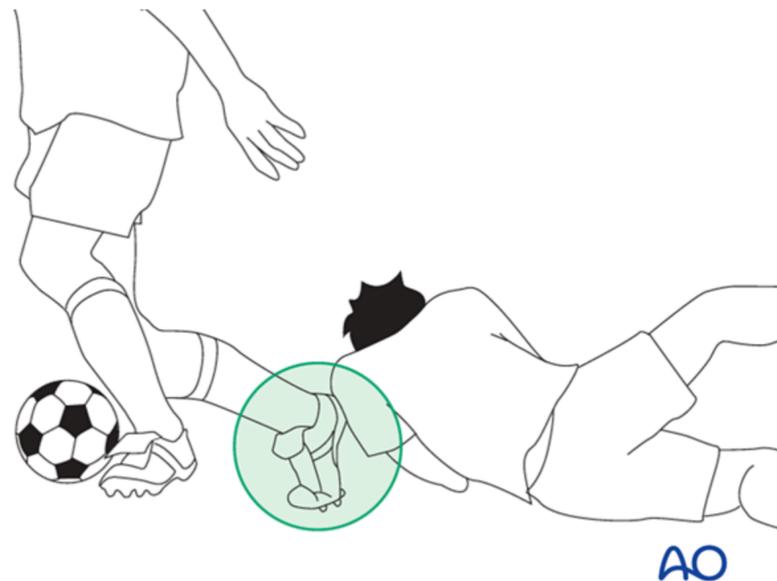
- Low energy

- Missteps, minor blunt trauma, minor sports injuries, sprains
- Fewer external signs of trauma



- High energy

- Car accidents, crush injuries, severe sports injuries, falls from height, penetrating trauma
- More swelling, bruising, and occasional deformity



# Evaluation and work-up



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# Evaluation and work-up

- History
  - How did the injury occur?
    - Low vs high energy
    - Other involved locations
  - What position was the foot in when it occurred?
    - Plantar vs dorsiflexed
    - Inverted vs everted
  - Could you weight bear on it after?
  - Any pain that has led up to this injury?
    - Possible stress fracture
  - Any previous injury to this area?
    - Old vs new injury on x-ray



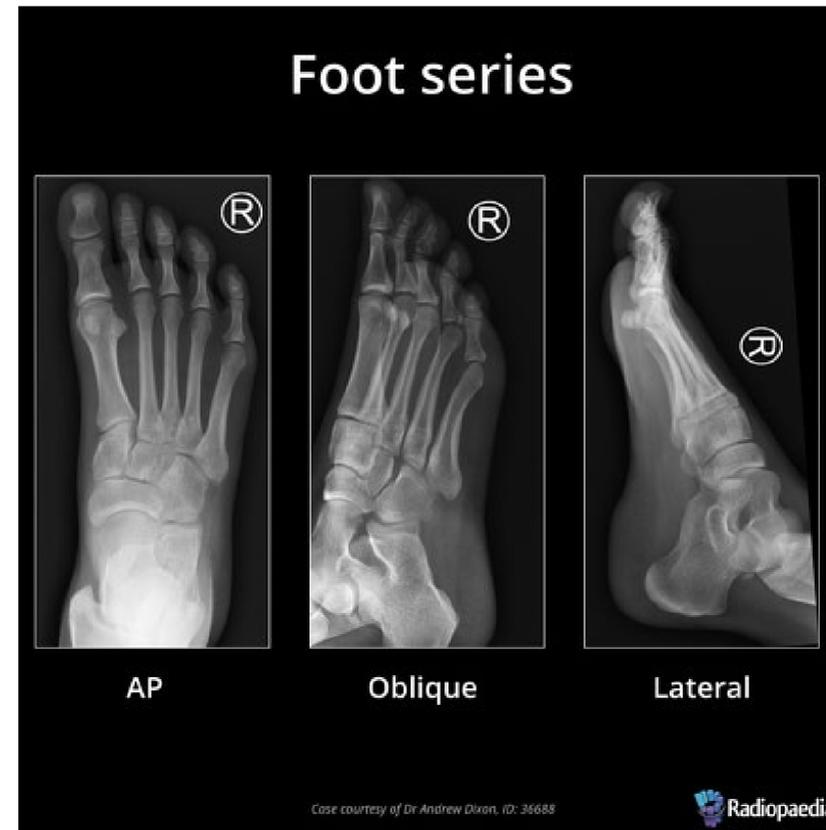
# Evaluation and work-up

- Exam
  - Inspection for general alignment
  - Open cuts/bleeding
  - Neurovascular status
  - Bruising and swelling pattern
    - Specifically plantar bruising
  - Range of motion toes, hindfoot, and ankle
    - Active and passive motion
  - Strength and toleration of resisted inversion, eversion, dorsiflexion, and plantarflexion
  - Pain with passive rotation of the midfoot
  - Pain with palpation of specific bony prominences and joints



# Evaluation and work-up

- Imaging
  - Traditional 3 view series



- Occasionally need an internal oblique view



# Common Injuries



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# Common Injuries

- **Proximal Metatarsal fractures**
  - 5<sup>th</sup> Metatarsal injuries
- Midfoot sprains
  - Lisfranc injuries
- Tarsal fractures
  - Navicular fractures

# Proximal Metatarsal Fractures

- Review of Anatomy



# Proximal Metatarsal Fractures

- Treatment varies greatly based on which bone and where the fracture occurs
- **First Metatarsal**
  - Very important for weightbearing
  - Cannot tolerate much deformity
  - Often times requires surgery
- **2<sup>nd</sup>-4<sup>th</sup> Metatarsals**
  - Less important for weightbearing
  - Deformity is well tolerated
  - Infrequently need surgery
- **5<sup>th</sup> Metatarsal**
  - Most common
  - Treatment varies based on location



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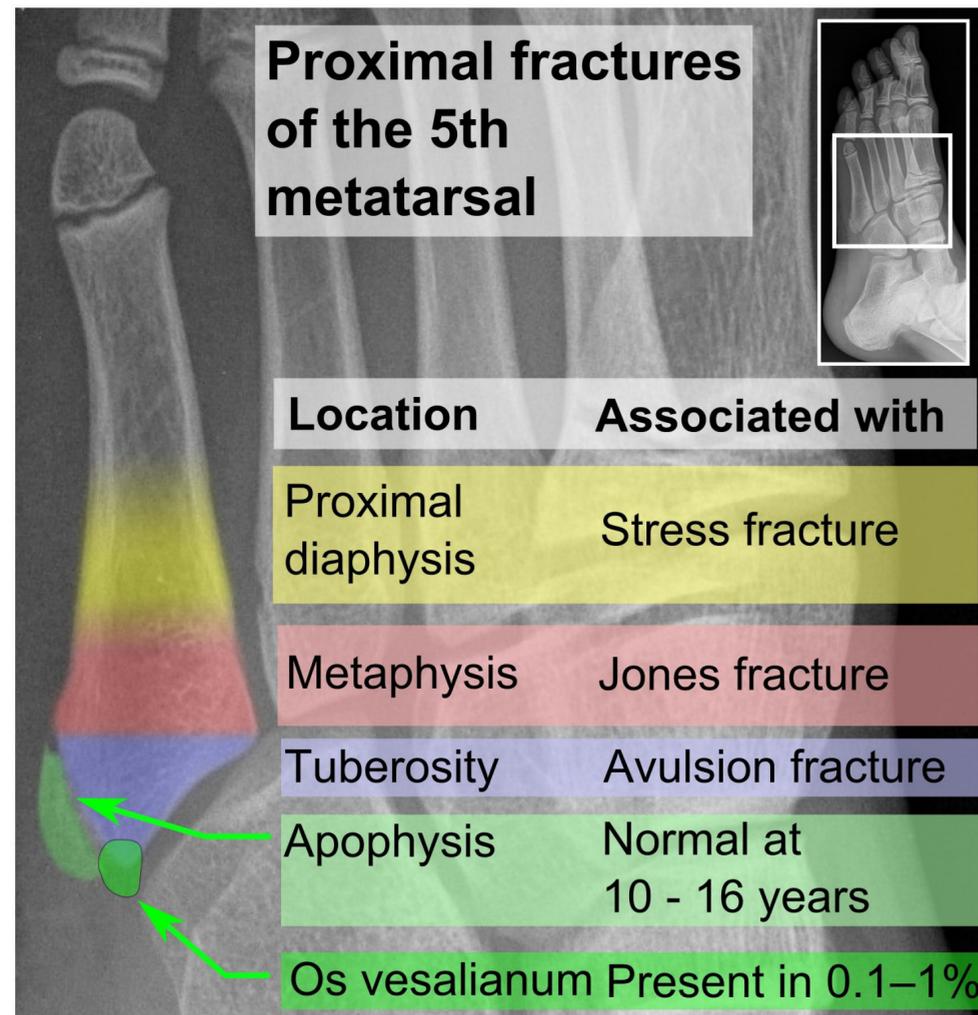
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- **5<sup>th</sup> Metatarsal**
  - Most common
  - Treatment varies based on location, or *zone of injury*



# 5<sup>th</sup> Metatarsal fractures zones of injury <sup>7,8</sup>

**Proximal fractures of the 5th metatarsal**

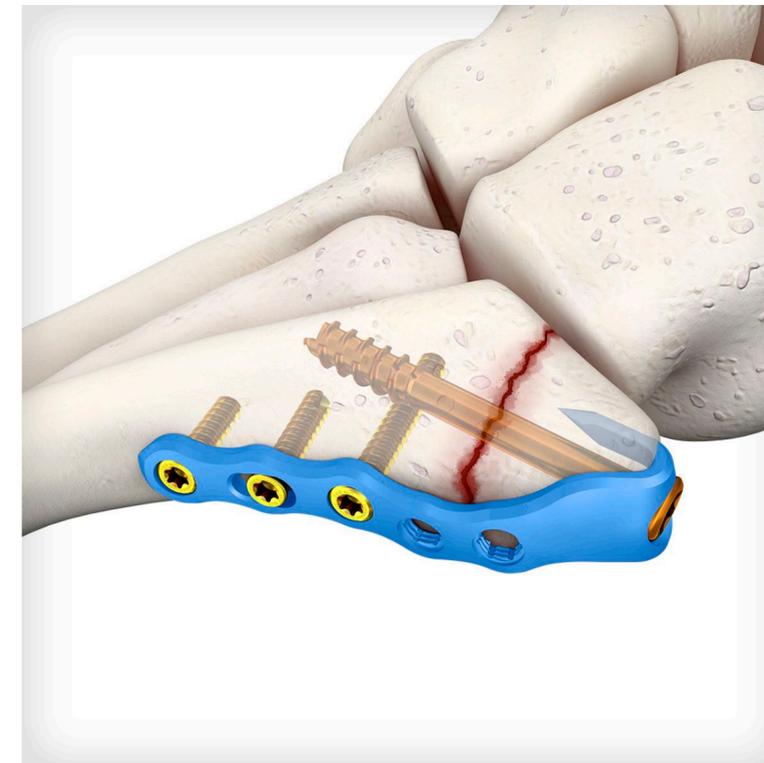
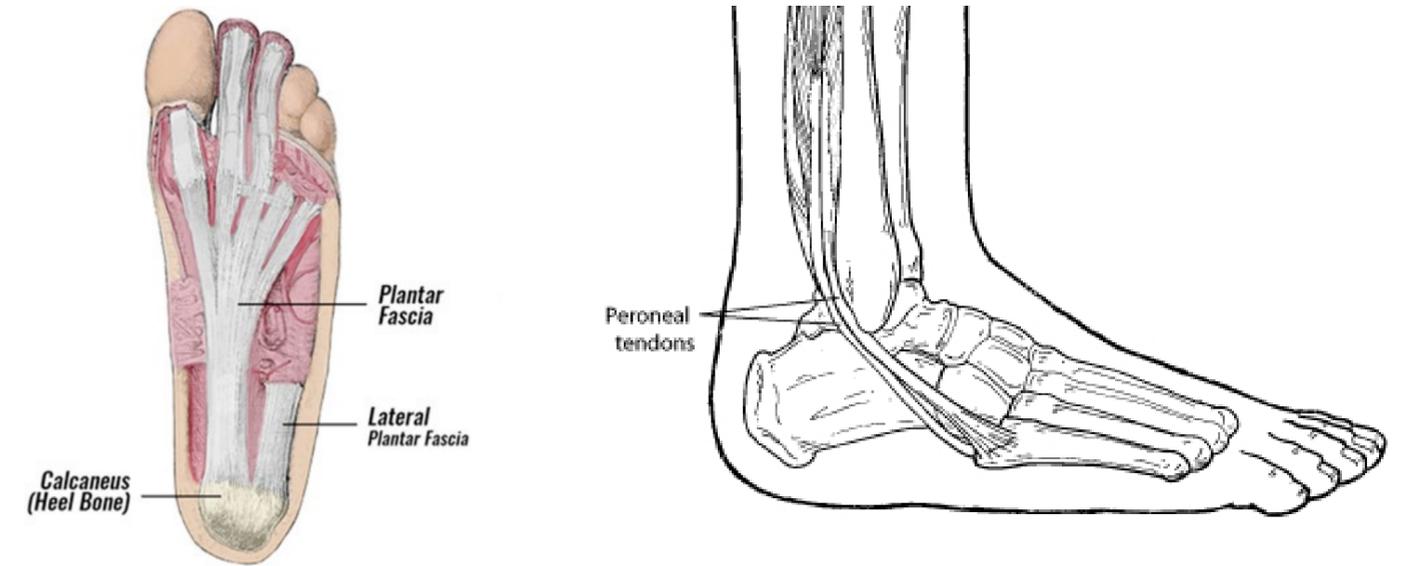


Location	Associated with
Proximal diaphysis	Stress fracture
Metaphysis	Jones fracture
Tuberosity	Avulsion fracture
Apophysis	Normal at 10 - 16 years
Os vesalianum	Present in 0.1–1%



# 5<sup>th</sup> Metatarsal fractures

- Zone I injuries <sup>11</sup>
  - Low energy
  - Avulsion fracture
  - Occur due to the pull of the lateral plantar fascia band on the base of the metatarsal
  - Treatment is usually non-operative
    - Boot or post-op shoe for 6 weeks, weightbearing as tolerated
  - Surgery if the joint surface is involved and has more than 2 mm of stepoff
    - ORIF with either plate and screws, or screws alone
    - Non-weightbearing for 2-6 weeks post op



# 5<sup>th</sup> Metatarsal fractures

- Zone III injuries <sup>11</sup>
  - Overuse or stress injuries that develop slowly
    - Higher incidence in patients with high arches
  - Usually have x-ray findings that suggest chronic injury
    - Thickening of the lateral/plantar cortex
  - Treatment can vary depending on the individual
    - Important to refer on
    - Non-operative treatment for lower demand patients
      - Cast or boot, non-weightbearing for 6-10 weeks
    - Surgery for most of them
      - Intramedullary screw
      - Occasional need for bone grafting



# 5<sup>th</sup> Metatarsal fractures

- Zone II injuries – Jones Fractures
  - Occur at the meta-diaphyseal junction, where the blood supply is poor
  - High rate of delayed or nonunion



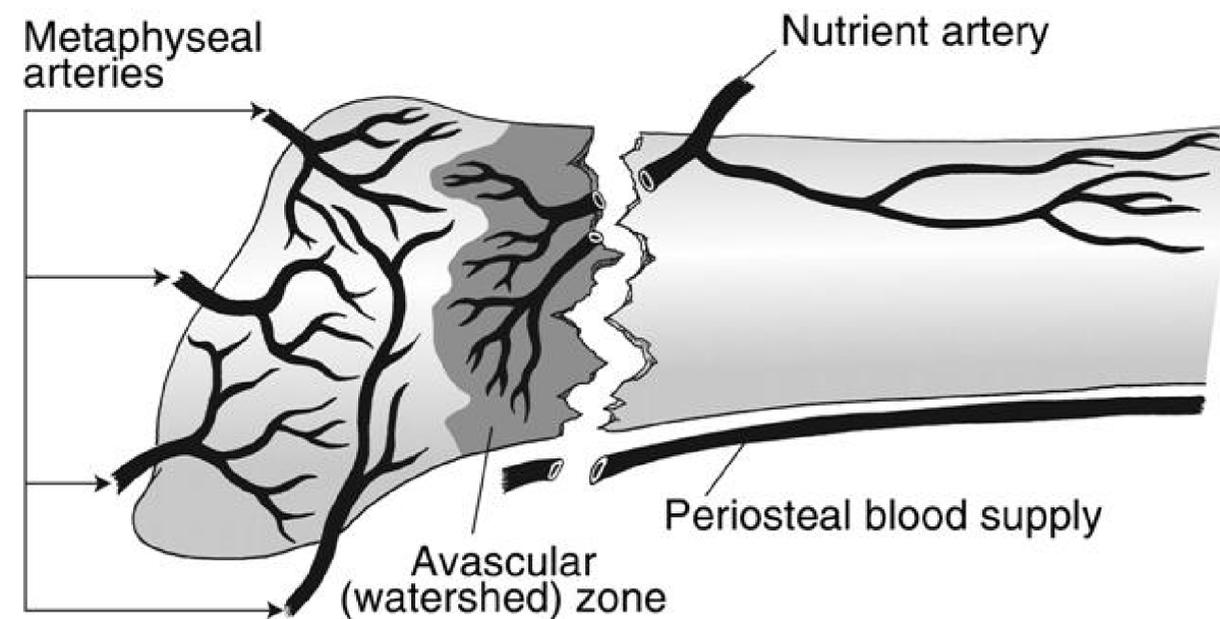
# Who the heck is Jones?

- Sir Robert Jones, 1857-1933
- Welsh orthopedic surgeon
- Early proponent of the use of x-rays
- First described the Jones fracture in 1902



# Jones Fractures

- Mechanism of Injury
  - Sudden force onto the side of the foot with the heel raised and foot inverted
- Blood supply limits healing potential
  - Watershed area 1.5 cm to 2.5 cm from the proximal end of the 5<sup>th</sup> metatarsal <sup>11</sup>



# Jones Fractures

- Exam findings
  - Normal alignment
  - Swelling
  - Bruising
  - Pain at that fracture site
    - Not at the tip or the distal tendon site
  - Maintained ability to evert
- X-rays
  - Standard 3 views



# Jones Fractures

- Treatment
  - Can be managed with a non-weightbearing cast until healed, typically 6-10 weeks
    - Typically reserved for low demand or high comorbidity patients
  - Most are treated with an intramedullary screw for quicker/more predictable healing <sup>8,9</sup>
    - Union rate for non-operative treatment is 50-76%
    - Union rate for surgical treatment is 90-97%
    - Time to radiographic union can vary from 6-20 weeks. It tends to be much more predictable and quicker following surgery.



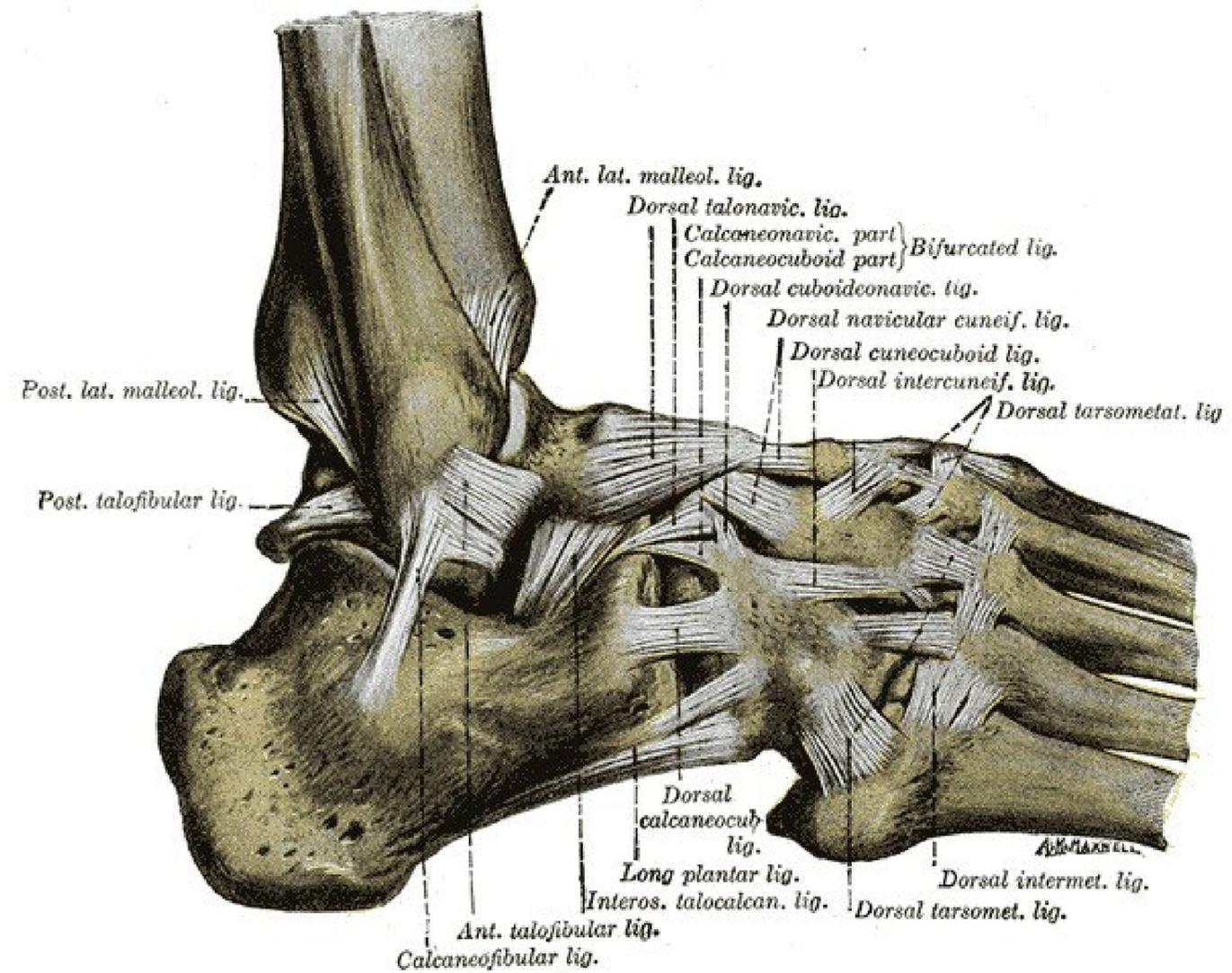
# Questions regarding Jones fracture?

# Common Injuries

- Metatarsal fractures
  - 5<sup>th</sup> Metatarsal injuries
- **Midfoot sprains**
  - Lisfranc injuries
- Tarsal fractures
  - Navicular fractures

# Midfoot Sprains

- Review of Anatomy



# Midfoot Sprains

- Common Exam findings
  - Swelling
  - Difficulty with weightbearing
  - Plantar bruising
  - Pain with midfoot prono-supination



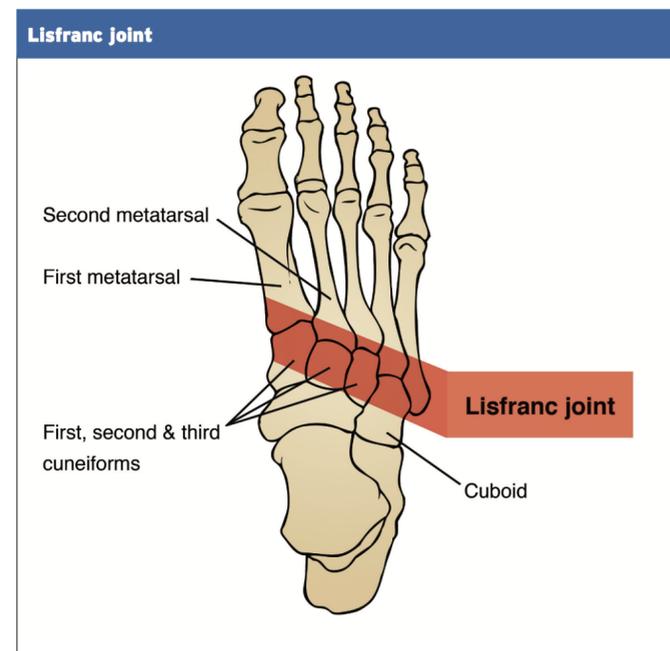
# Midfoot Sprains

- **Minor Sprains**
  - Lateral tarsometatarsal joints
  - Talonavicular joint
  - Calcaneal-cuboid joint
  - Treatment with immobilization in a boot and WBAT for 4-6 weeks
- **Lisfranc Injuries**
  - Varying mechanisms
  - Destabilize the midfoot architecture
  - Require surgery to stabilize



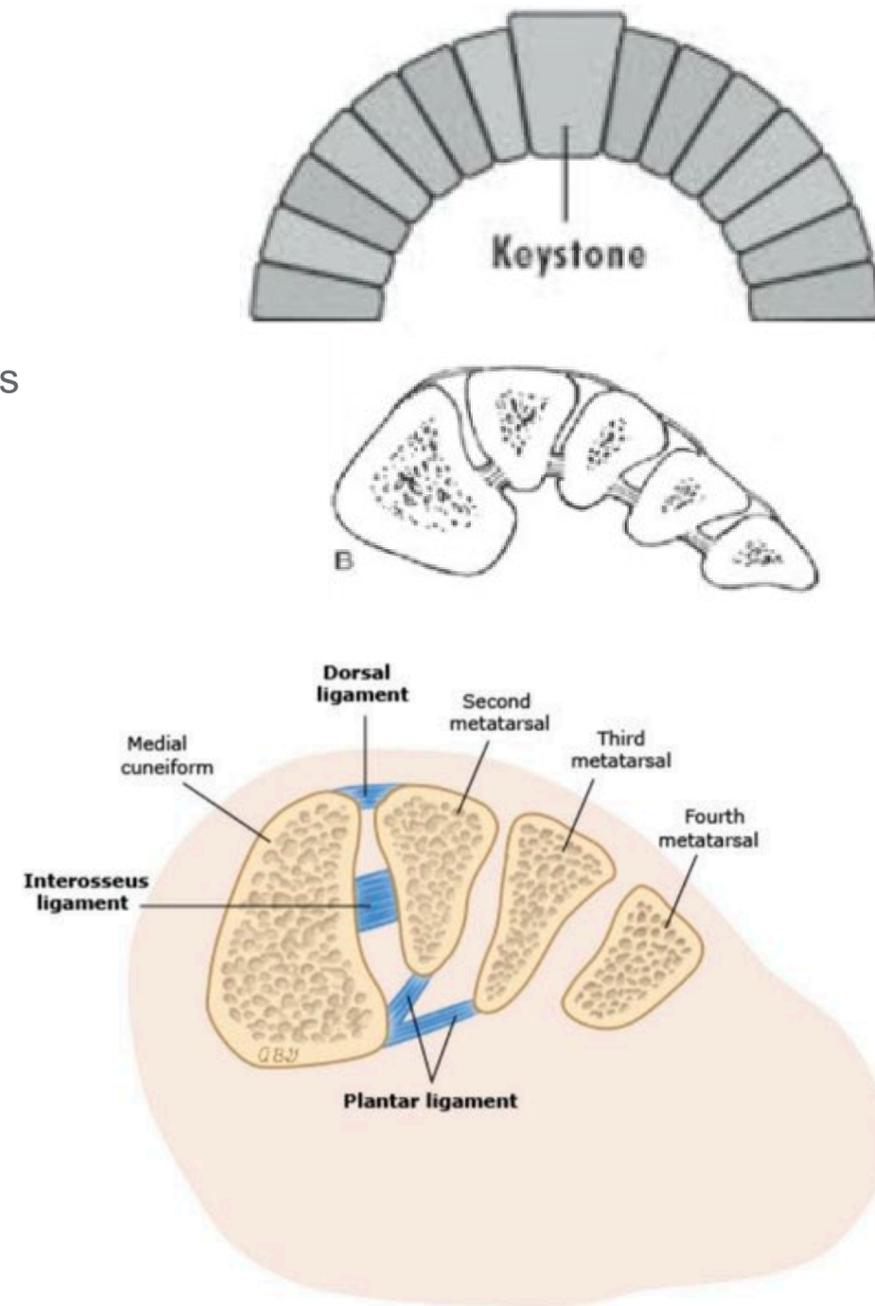
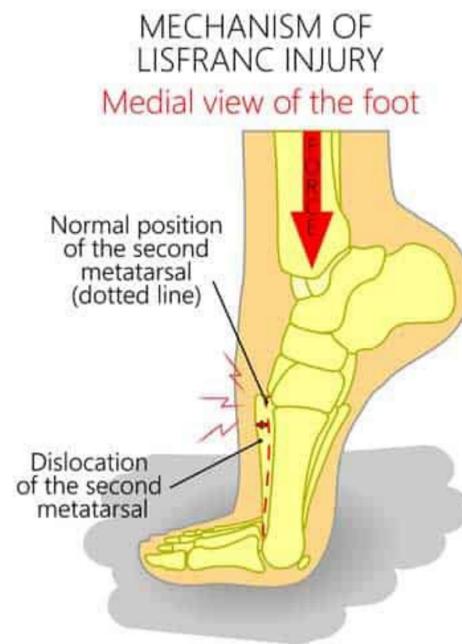
# Lisfranc injuries

- Who is Lisfranc?
  - Jacques Lisfranc de Saint Martin, 1787-1847
  - French surgeon
  - Noticed this pattern of injury in calvary men in 1815 after falling from horses. Some would develop vascular compromise of foot and require an amputation through the tarsal-metatarsal joints. This joint complex became know as the Lisfranc joint complex.



# Lisfranc Injuries

- Mechanism of Injury
  - Several possible mechanisms, but axial load on a plantarflexed foot is most common.
  - Can also happen with falls from height, crush type injuries, and severe midfoot twisting injuries



# Lisfranc Injuries

- Common Exam findings
  - Swelling
  - Plantar bruising
    - Often present
  - Pain with midfoot pronosupination
    - May not tolerate due to pain
  - Visible deformity may be present
    - If significantly displaced



# Lisfranc Injuries

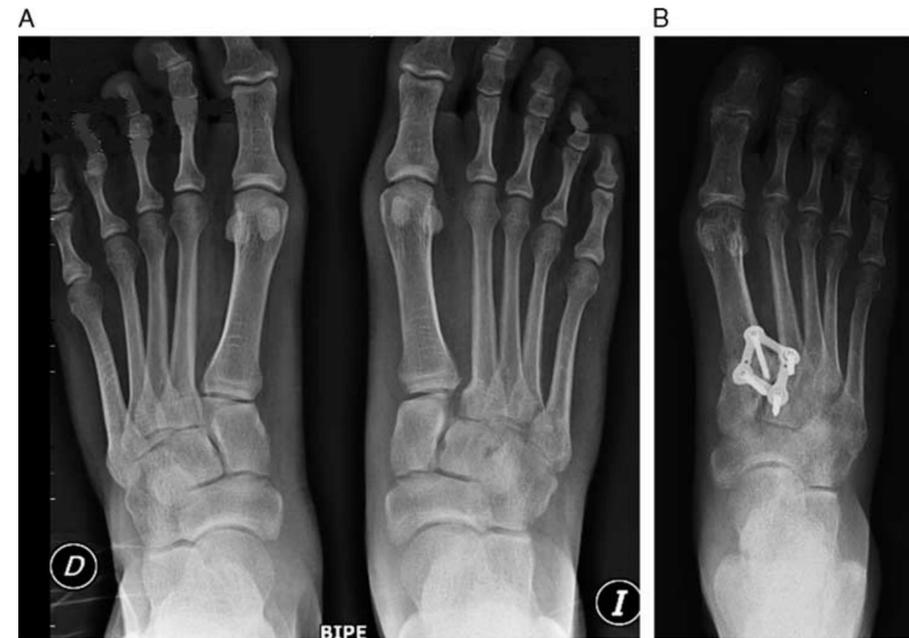
- X-ray findings
  - Can vary depending on severity
  - Weight bearing images are very important
  - Contralateral x-rays can help for subtle injuries



# Lisfranc Injuries

- Treatment is typically surgical in order to re-align the joints and ensure that they stay in place while the ligament heals.

- Many surgical options exist
  - Open Reduction Internal Fixation (ORIF)



- Primary Arthrodesis (Fusion)



# Lisfranc Injuries

- Post-operative protocol
  - Weeks 0-2: Splint and non-weightbearing
  - Weeks 2-6: Boot and non-weightbearing
  - Weeks 6-12: Boot and weightbearing as tolerated
  - Week 12: return to regular shoe wear, progress activity level as tolerated
  - Weeks 16-24: discuss possible hardware removal

# Lisfranc Injuries

- High rate of post-traumatic arthritis, even with anatomic reduction and fixation
  - Kuo et al<sup>4</sup>., 25% arthritis development. Up to 40% in pure ligamentous injuries
- This can lead to the need for fusion at a later date to treat the arthritis.
  
- So what if we just fuse it to start????
  - Ly and Coetzee et al.<sup>5</sup>, randomized trial comparing fusion to plate fixation
    - Better functional outcomes and return to activity in the fusion group, as well as lower rate of secondary surgery
  - Henning et al.<sup>6</sup>, similar randomized comparison to Ly and Coetzee
    - Equivocal outcomes regarding function, higher rate of secondary surgery in the plate fixation group
    - Most of the secondary surgeries are for elective plate removal

The jury is still out on fusion vs. ORIF

# Questions on Lisfranc injuries?

# Common Injuries

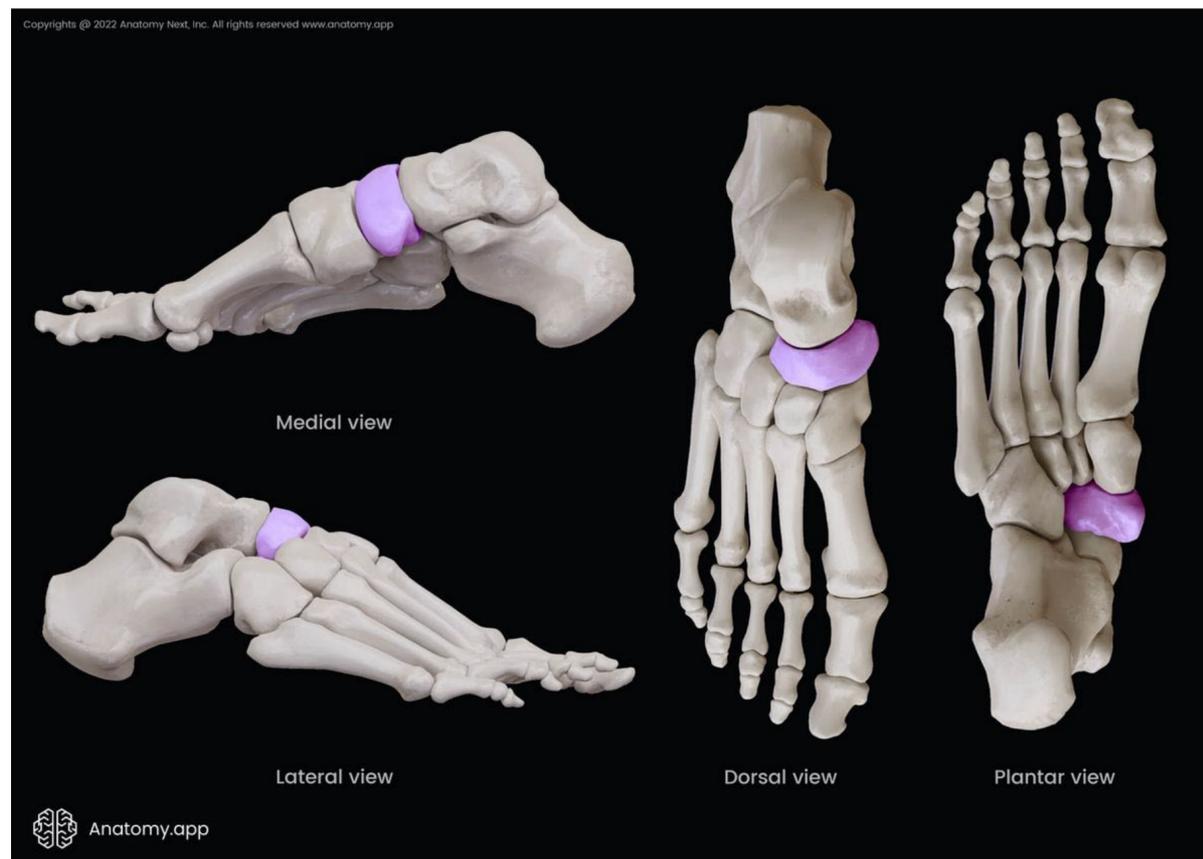
- Metatarsal fractures
  - 5<sup>th</sup> Metatarsal injuries
- Midfoot sprains
  - Lisfranc injuries
- **Tarsal fractures**
  - Navicular fractures



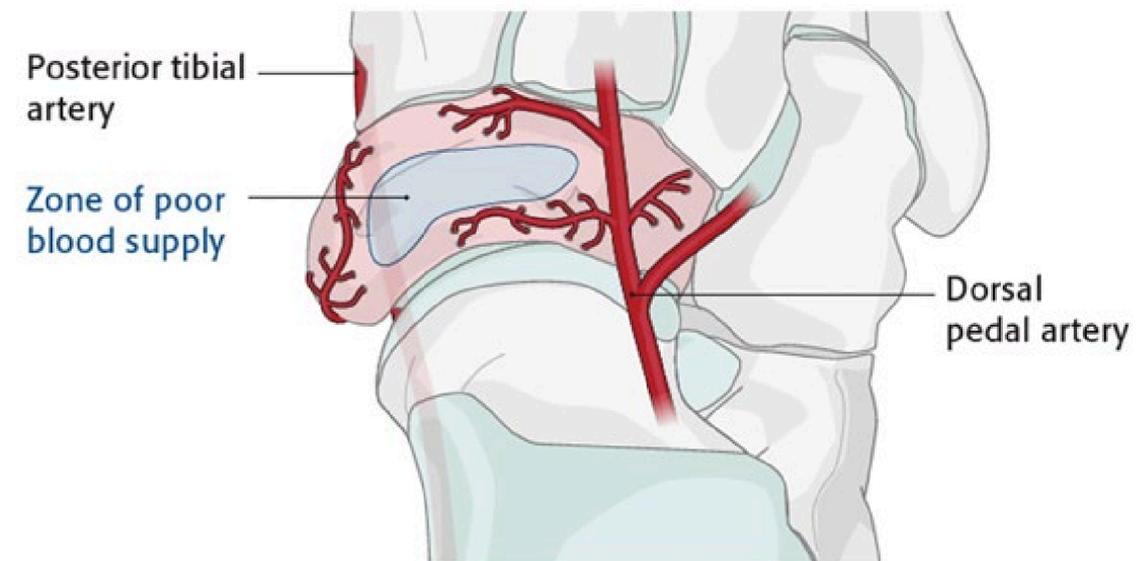
# Navicular Fractures

- Anatomy

- Articulates with the talus, cuneiforms, cuboid and calcaneus
- The talonavicular articulation is critical to maintain inversion and eversion range of motion
- The blood supply to the central portion is poor, making it susceptible to stress fractures



## Schematic diagram of blood supply



AO

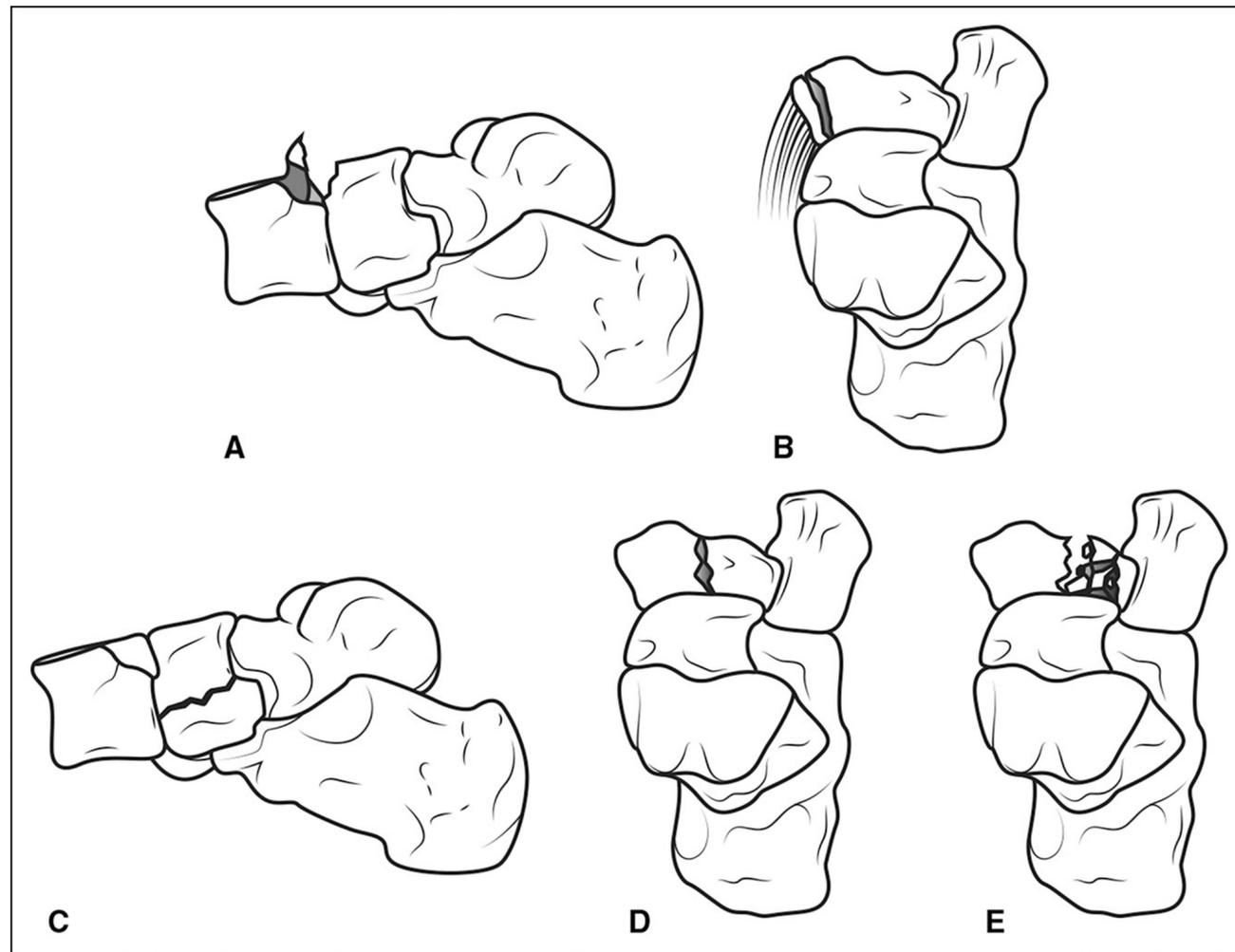
# Navicular Fractures

- Radiographic evaluation
  - Traditional 3-view x-rays
    - AP, lateral, and external oblique
  - Internal rotation oblique view to help visualize tuberosity fractures
  - CT for complex or incompletely visualized fractures



# Types of Navicular fractures

- Avulsion fractures (A), Tuberosity fractures (B), and Body fractures (C-E) <sup>16</sup>



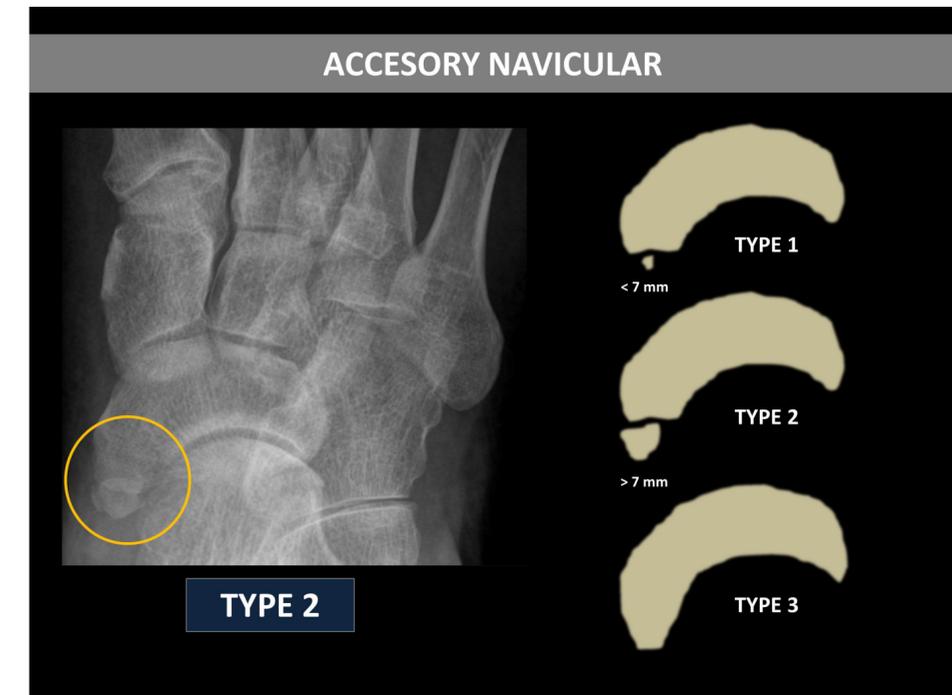
# Navicular Fractures

- Avulsion fractures <sup>12</sup>
  - Common
  - From forced plantar flexion
  - Treated as a sprain with immobilization
  - Only need surgery if they involve more than 25% of the joint surface



# Navicular Fractures

- Tuberosity Fractures <sup>12</sup>
  - Important to distinguish from an accessory navicular bone
  - From forced eversion and subsequent pull of the posterior tibialis tendon
  - Important to get an internal oblique x-ray
  - Most are treated with immobilization and non-weightbearing for 6 weeks
  - Surgery if more than 5 mm of displacement or joint surface involvement



# Navicular Fractures

- Stress fracture <sup>12</sup>
  - First described by Towne in 1970
  - Most common in basketball and track athletes, particularly sprinting and jumping.
  - Chronic aching pain with activity
  - Delayed appearance on x-ray
  - Require CT scan to determine completeness of fracture



# Navicular Fractures

- Stress fracture <sup>12</sup>
  - Treatment
    - Nonoperative treatment requires immobilization and a minimum of 6 weeks of non-weightbearing
      - 96% union rate, but 4.9 month average for return to sport <sup>13</sup>
    - Surgical fixation investigated for possible quicker healing and earlier return to sport
      - No functional or pain score differences between the 2 groups <sup>14</sup>
      - For displaced and complete fractures, surgical group did heal faster and return to sport sooner <sup>15</sup>



# Questions about Navicular fractures?

# Summary



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# Summary

- Metatarsal fractures –post op shoe and WBAT
  - 1<sup>st</sup> metatarsal fracture are rare, but often times need surgery
  - Mid to distal fractures of 2<sup>nd</sup>-5<sup>th</sup> metatarsals heal well
  - Proximal 5<sup>th</sup> metatarsal fractures are treated based on zone of injury
- Jones fractures – boot and NWB
  - Zone 2 proximal 5<sup>th</sup> metatarsal fractures
  - Poor healing based on blood supply, often times treated with an intramedullary screw
- Midfoot sprains – boot and NWB
  - If plantar bruising is found, assume that it is a Lisfranc injury
  - Weight bearing x-rays, advanced imaging if stability isn't clear
  - Surgery of all unstable injuries
- Navicular fractures – boot and NWB
  - Differentiate tuberosity, avulsion, and stress fractures
  - Stress fractures may require surgery if complete and in a competitive athlete

# References



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