TREATMENT OF COMMON FOOT AND ANKLE INJURIES

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Orthopaedic Surgery

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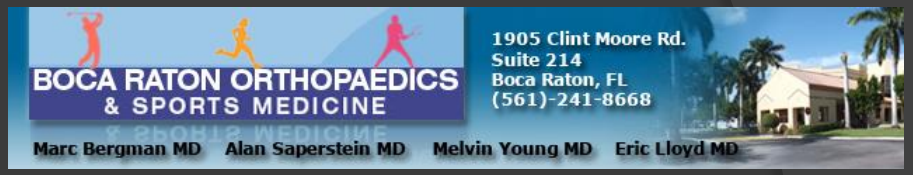
Disclosures

- I have no disclosures or financial interests

Current Practice

- Practicing at Boca Raton Regional Hospital since 2013
  - General Orthopaedics
    - Hip fractures
    - Upper and Lower Extremity Trauma
    - Sports
    - Deformity correction
- Treatment of Foot and Ankle Conditions



Education

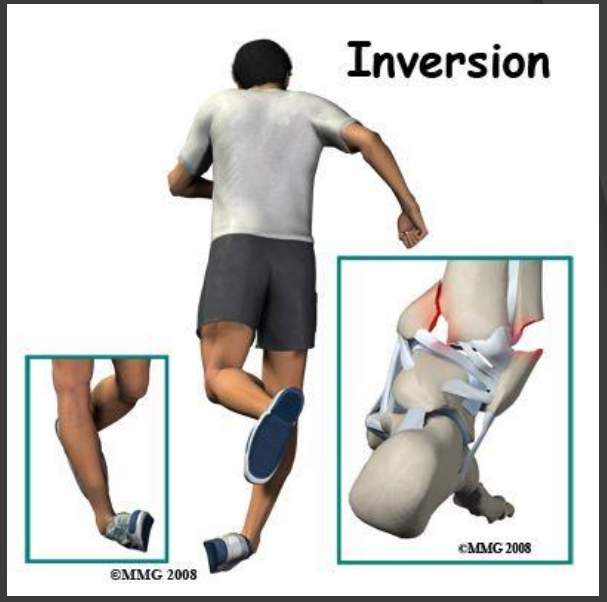
- Grew up in Southern California
- **Undergraduate Education**
  - University of California, Berkeley (2001)
- **Medical School**
  - Columbia University (2007)
- **Orthopaedic Internship and Residency**
  - University of Miami / Jackson Memorial Hospital (2012)
- **Foot and Ankle Fellowship**
  - Hospital for Special Surgery (2013)

Orthopaedic Surgery

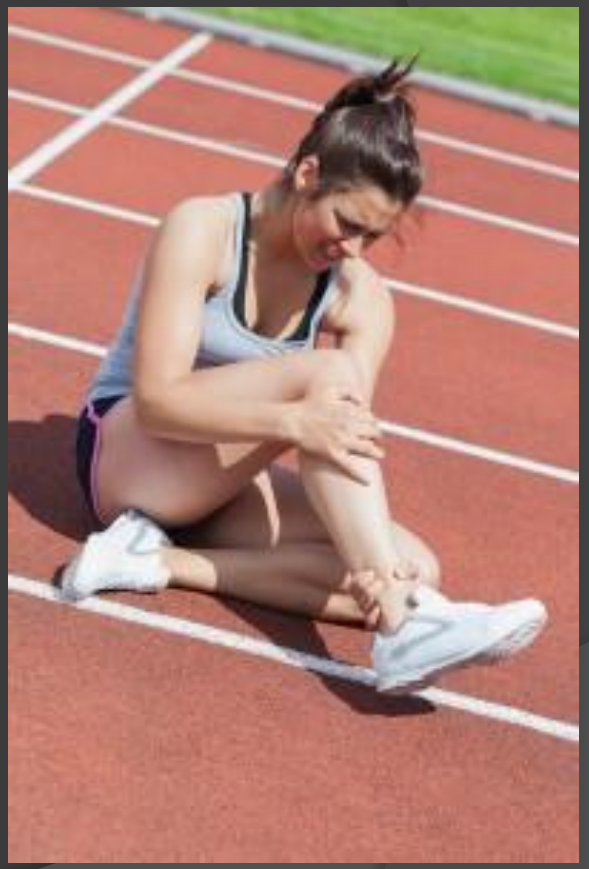
- Treatment of injuries and diseases of the musculoskeletal system
  - Bones
  - Joints
  - Ligaments
  - Tendons
  - Muscles
  - Nerves

Examples of Acute Orthopaedic Injuries

- Injury to Bone
  - Fractures
- Injury to Ligaments
  - Sprain
- Injury to Muscles
  - Strain
- Injury to tendons
  - Tear or Rupture



- Common foot and ankle injuries
- Review basic anatomy, physical examination, and special tests
- Compare conservative and surgical treatments
- Case Presentations

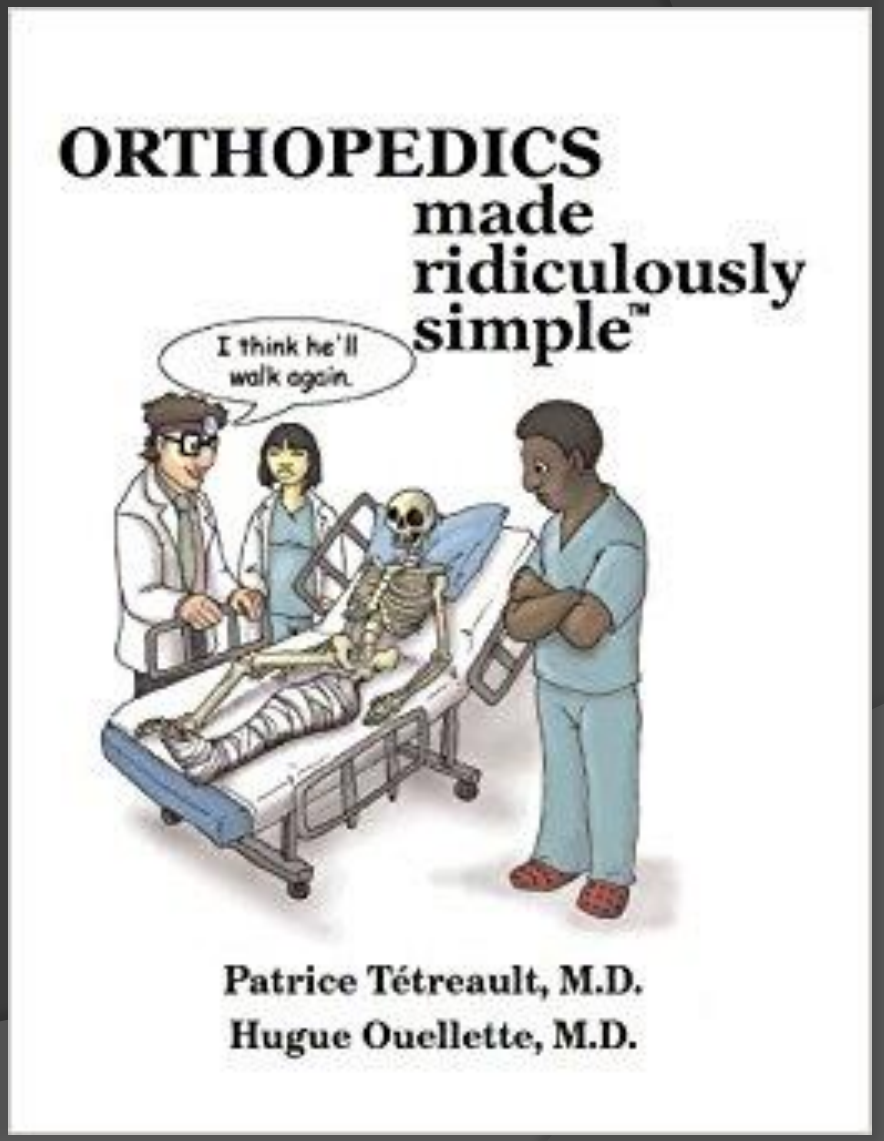


Objectives

- Name three commonly missed foot and ankle injuries
- Discuss the pros and cons of operative versus nonoperative treatment of Achilles ruptures
- Discuss treatment options for ankle fractures

Approach to the Ankle / Foot Injury

- History
- Physical Examination
- Imaging Studies
- Diagnosis
- Treatment Options



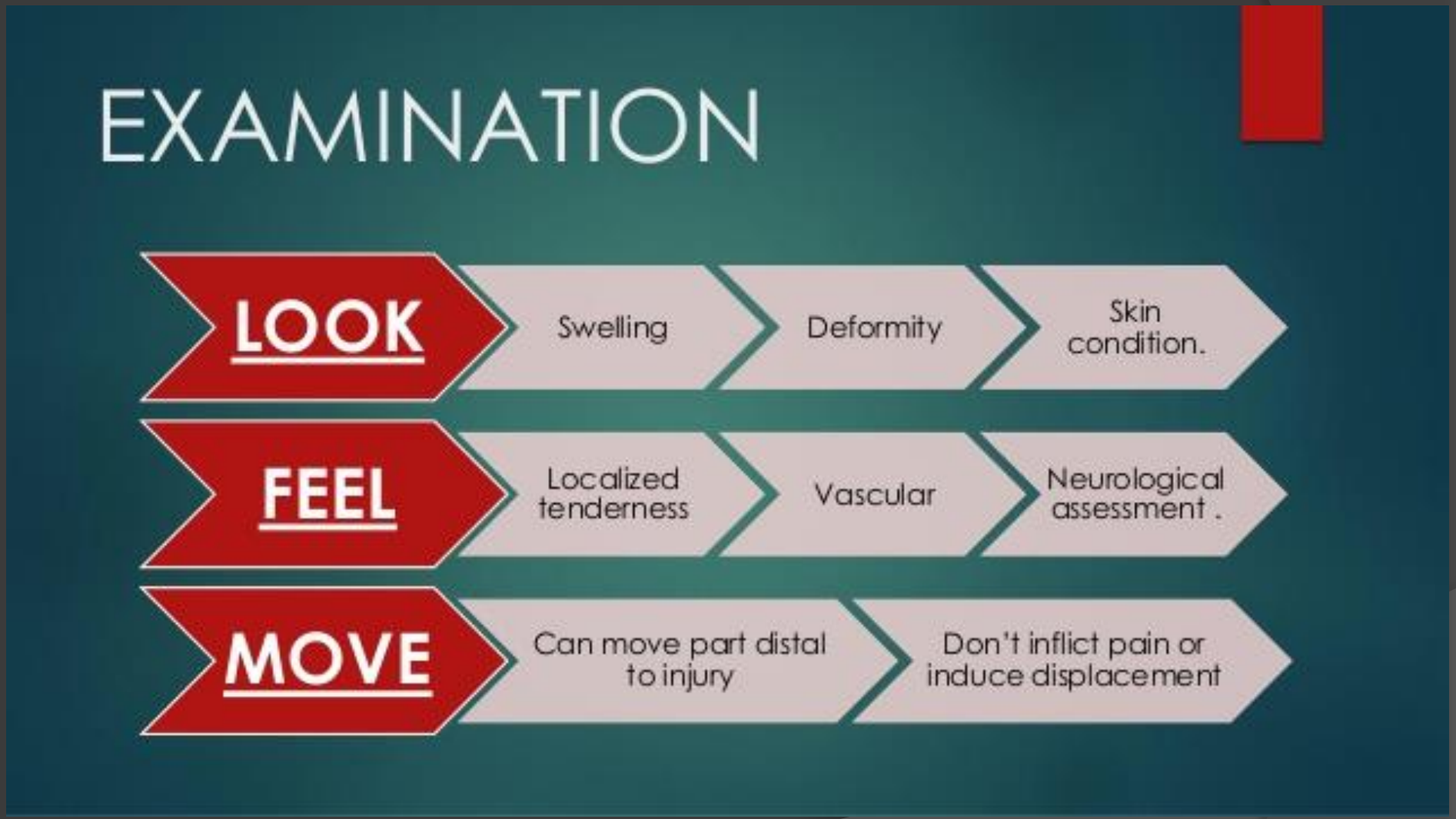
History

- Details
  - Trauma
  - Position of foot at the time of injury
  - Mechanism of Injury
  - Ability to ambulate after the injury
  - Sound during injury

History

- Location
  - Ask the patient to point with one finger to the area of maximal pain
- Radiation
- Quality (sharp, dull, ache)
- Severity
- Aggravating factors (weight bearing)
- Alleviating factors

Physical Exam Steps



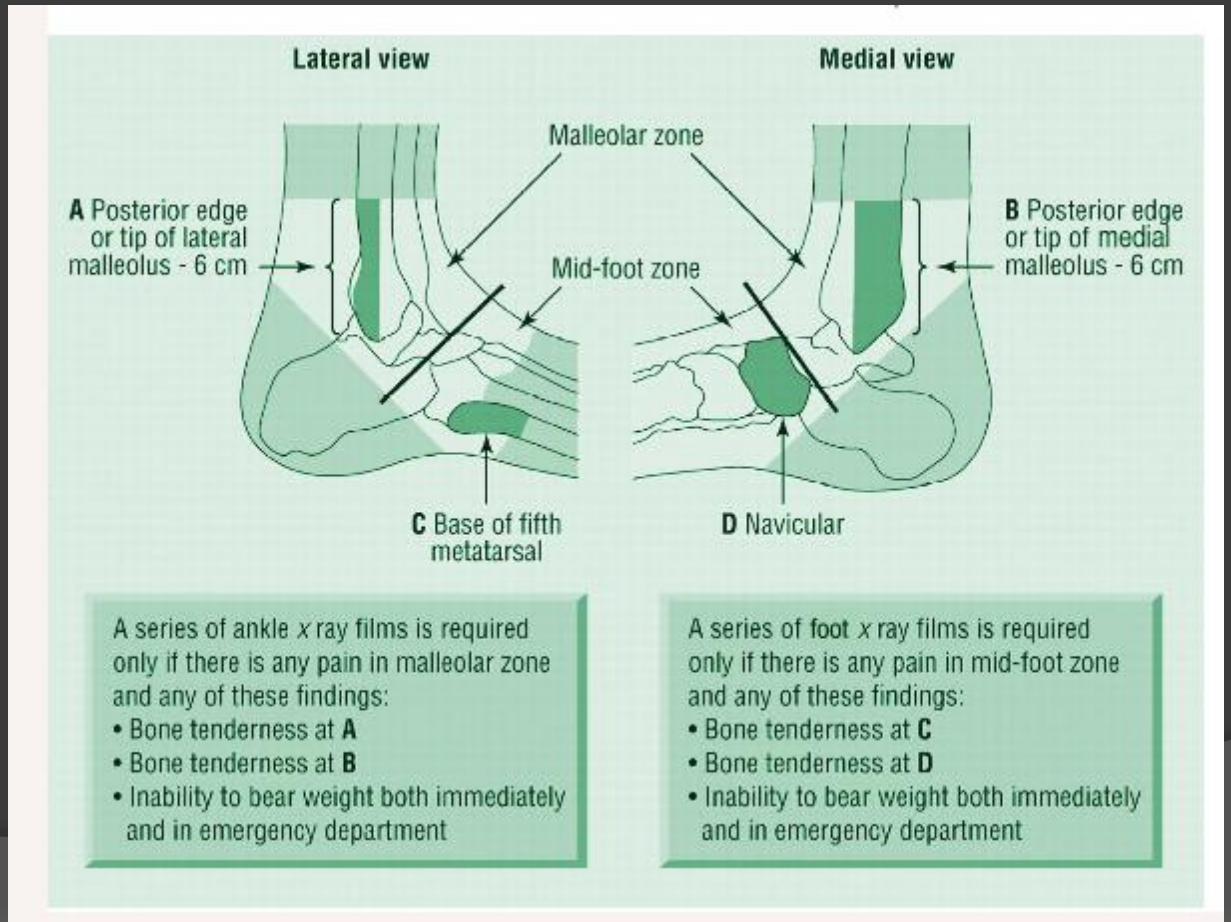
COMPARE to the other side

Physical Exam

- **Inspection:**
  - Swelling, Ecchymosis, Deformity
- **Range of Motion:**
  - Dorsiflexion, Plantarflexion
  - Inversion and Eversion
- **Deformity**
- **Strength**
- **Palpation:**
  - Medial and Lateral Malleolus
  - Base of 5th Metatarsal
  - Achilles Tendon
  - Midfoot
  - Proximal Fibula
- **Assess neurovascular status**

When to Obtain X-rays

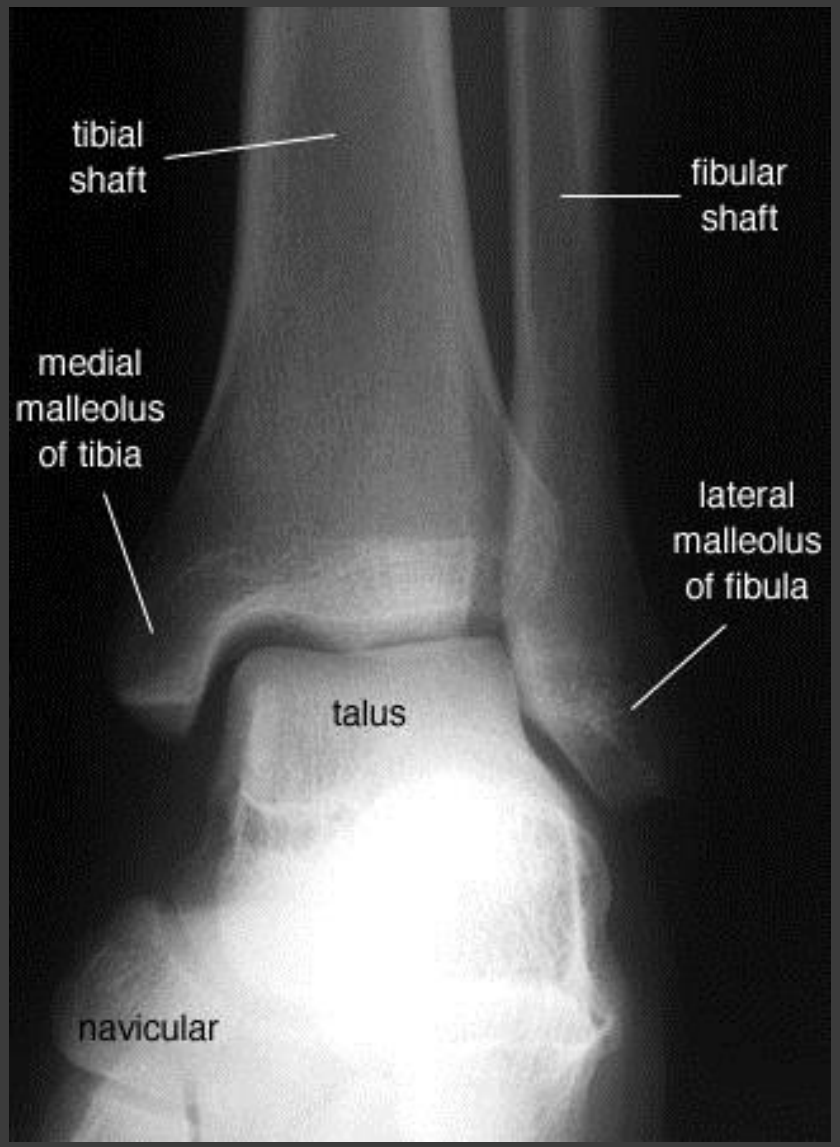
- Ottawa Ankle Rules: 98% sensitivity for fracture, decrease radiographs



- Obtain x-rays for persistent pain with initial negative xrays 7-10 days after the first set
- Do **not** apply rules if:
  - Age < 18 yo
  - Pregnancy
  - Multiple painful injuries
  - Compromised sensation

Radiographs

- 3 Views
  - A-P, lateral, mortise views – WEIGHT BEARING
- Looking for fracture, dislocation, abnormal widening of “clear space”
- Don’t forget to image the foot if clinically indicated

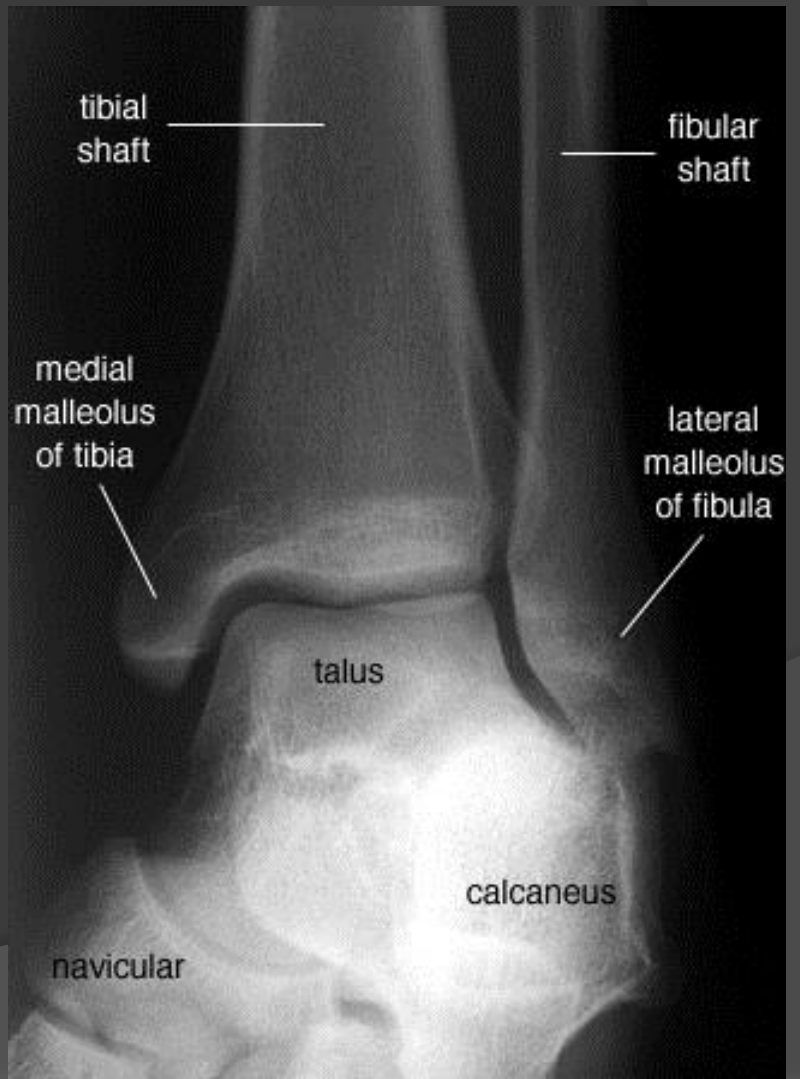


A-P View of Ankle

Radiographs

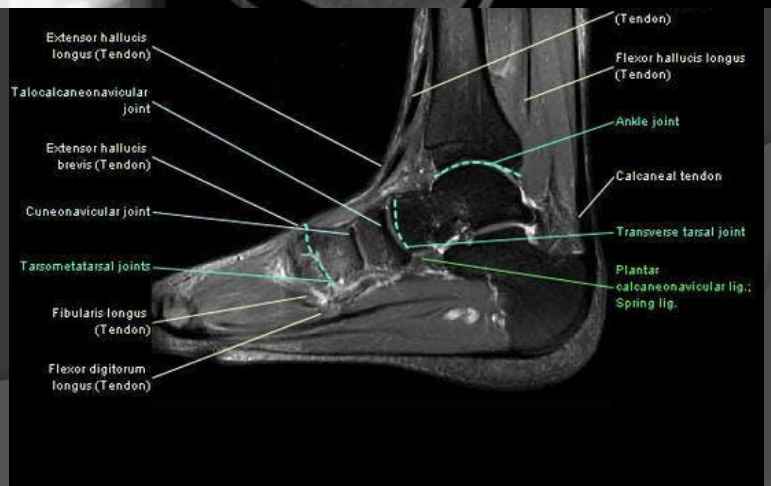
Lateral View of Ankle

Mortise View of Ankle



Further Diagnostic Studies

- Serial X-Rays
- CT Scan
  - Evaluation of displacement
- MRI
  - Occult fractures
  - Soft tissue injuries



Diagnosis

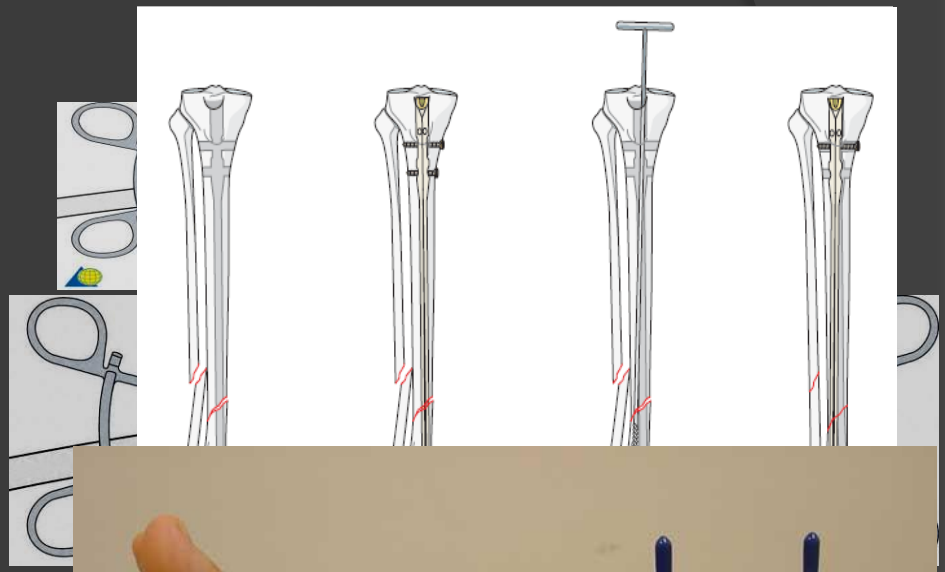
Treatment Options

Conservative Management versus Operative Treatment

- Factors
  - Age
  - Activity Level prior to Injury
  - Athlete
  - Medical Co-morbidities

Fracture Treatment Options

- Closed Reduction of Fracture
- Open Reduction and Internal Fixation (ORIF)
- Intramedullary Fixation
- External Fixation



Case Studies

- Discuss Differential Diagnosis
- Discuss Specific Injury
  - Anatomy
  - Special tests
  - Findings
  - Treatments

Case 1

- 35 year old woman sustained an ankle inversion injury while playing soccer. Able to bear weight after the injury. Pain is localized to the lateral ankle.
  - No bony tenderness
  - Significant swelling of lateral ankle
  - Good end point on anterior drawer and talar tilt test
  - TTP over anterolateral ankle
  - Neurovascularly intact

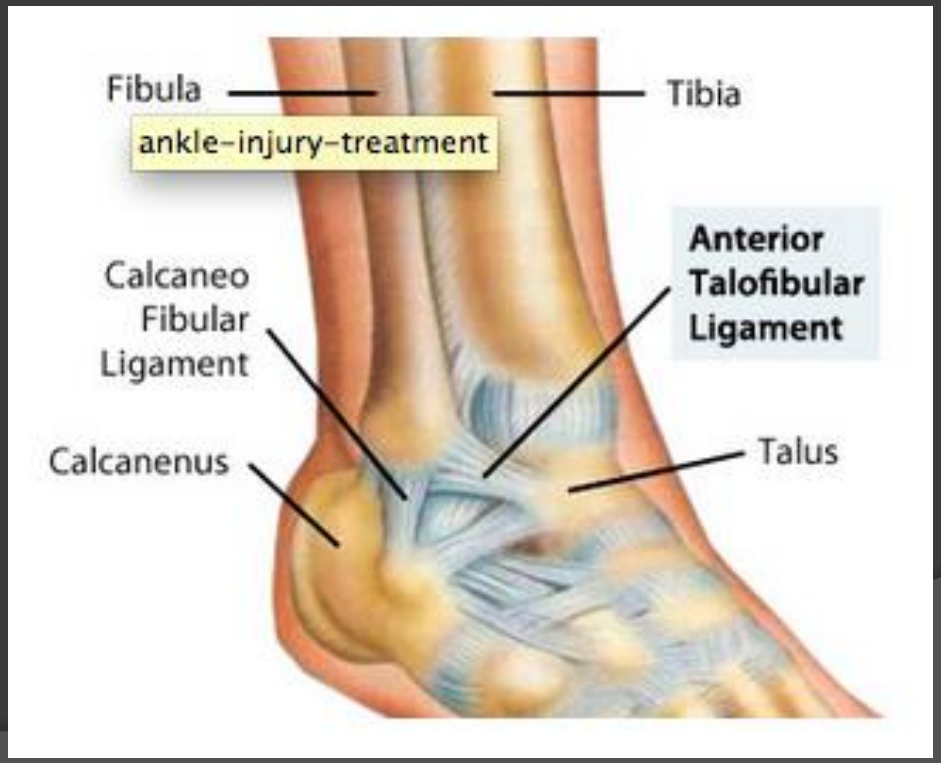
Clues for Differential Diagnosis

- Important clues from history and physical?
  - Inversion injury
  - Tenderness and swelling at anterolateral ankle, without tenderness at bony prominences
  - Able to weight bear
  - Good endpoint on anterior drawer

Diagnosis

Ankle Sprain

- **ATFL Injury**



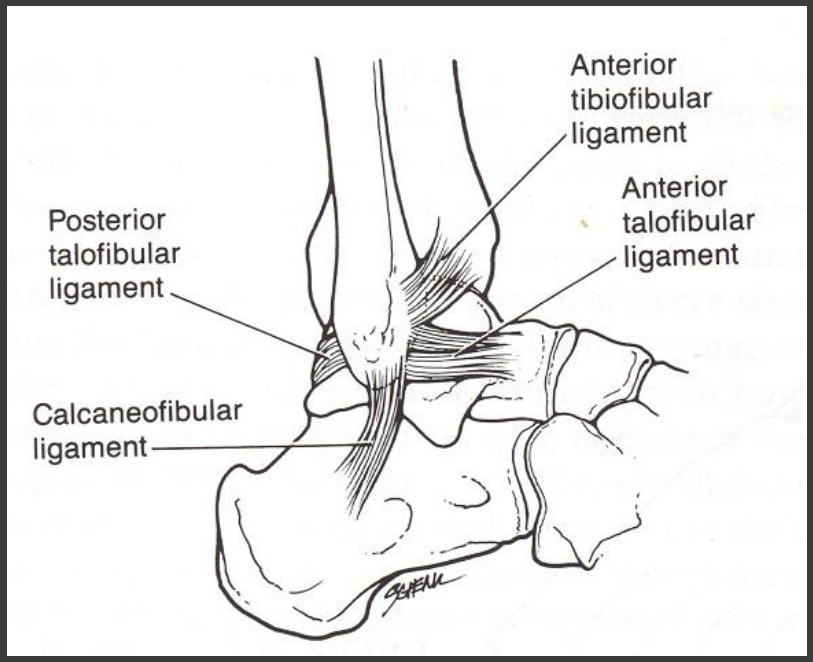
Ankle Sprains

Incidence of Ankle Sprains

- Estimated 1 million people present to physicians with acute ankle injuries each year
- Sprains account for 25% of all sports-related injuries
- Lateral ankle ligaments are the most commonly injured structures in young athletes (10 x more than medial structures)
- Many ankle sprains have potential to cause chronic problems
  - Instability
  - Pain

Lateral Collateral Ligaments

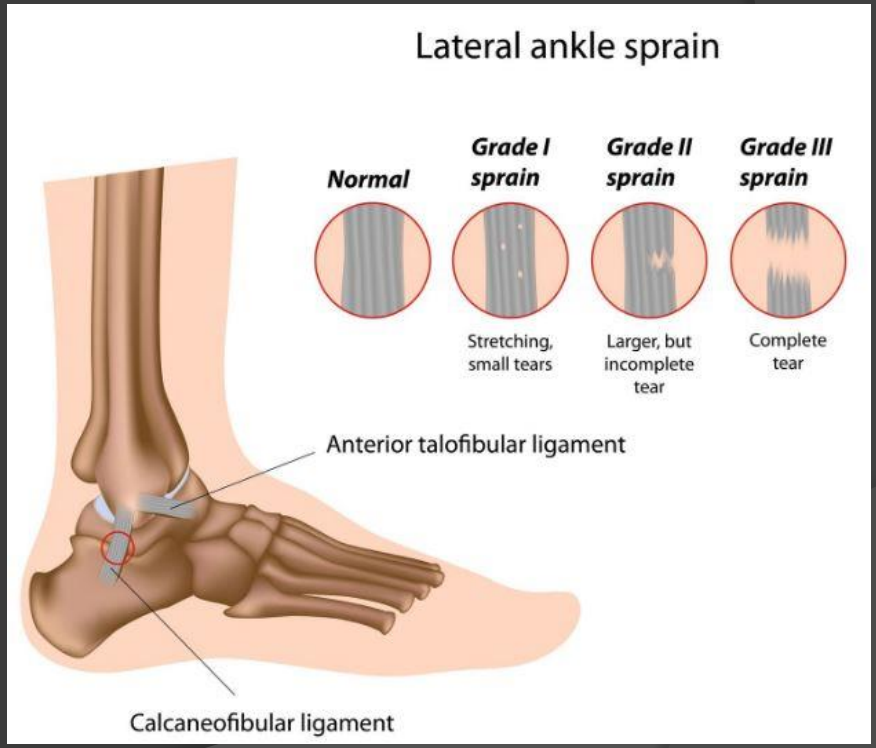
- Provide lateral stability to the ankle
- Anterior Talofibular Ligament
  - First injured in lateral sprain with plantarflexed ankle
- Calcaneofibular Ligament
  - Strongest lateral ligament
- Posterior Talofibular Ligament
- Anterior Tibiofibular Ligament



Classification

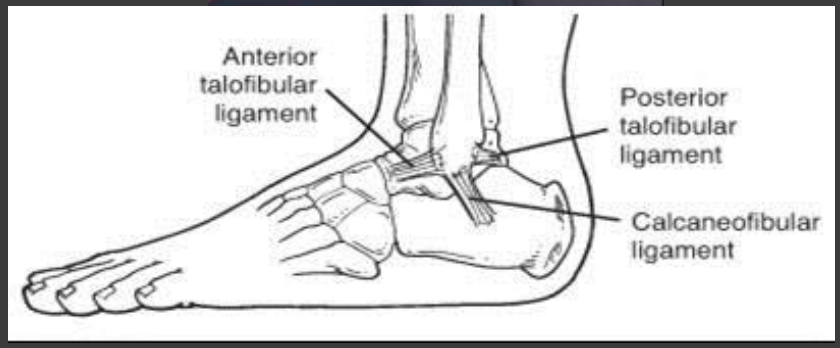
- Injuries classified into 3 grades

- Grade I
  - Partial tear without loss of structural integrity
- Grade II
  - Partial tear, with some degree of structural instability
- Grade III
  - Complete disruption of the ligament, with loss of structural integrity



Physical Exam

- Soft tissue swelling +/- ecchymosses anterior and inferior to the malleolus
- Tenderness anterior to distal fibula
- Differentiate from supramalleolar swelling/TTP which may indicate a fracture or syndesmotic injury

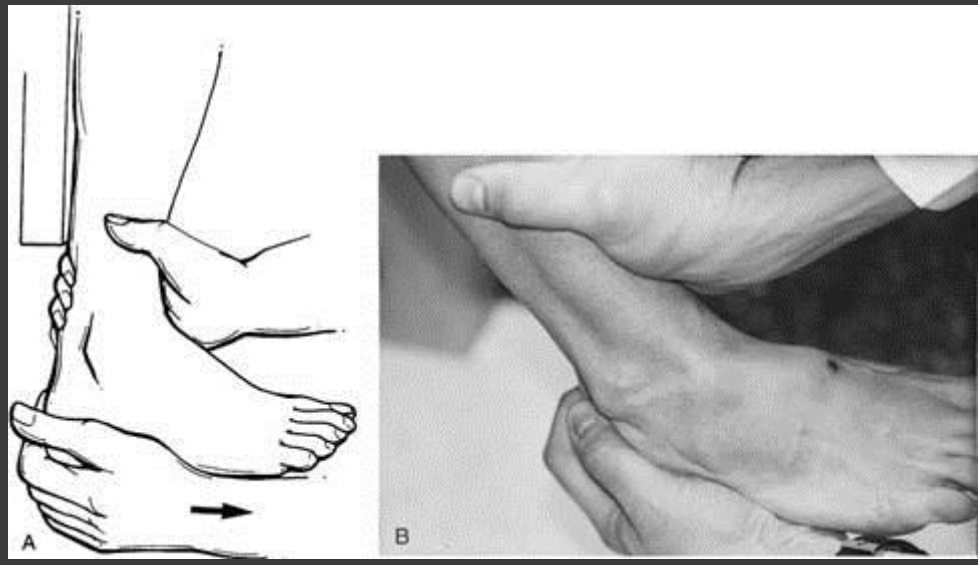


Special Tests

- Anterior drawer
- Talar tilt

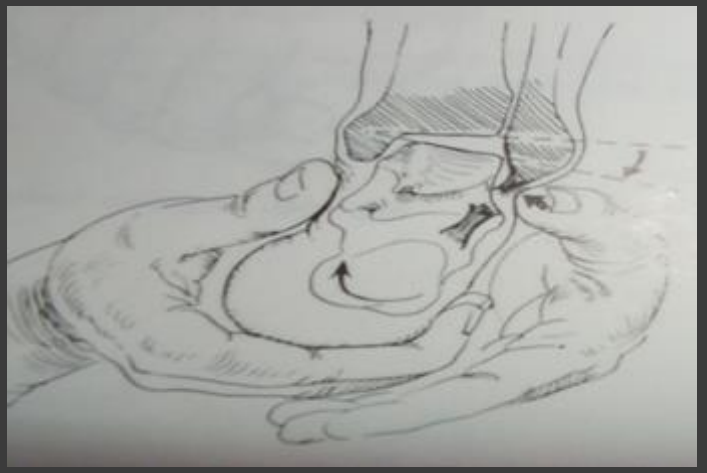
Anterior Drawer Test

- Tests integrity of ATFL
- Performed with the foot in a slightly plantar flexed position
- Evaluates anterior translation of the talus
- Compare to contralateral side



Talar Tilt

- Tests integrity of CFL
- Performed with foot neutral
- Positive talar tilt test usually indicates a Grade 3 sprain



Imaging Studies

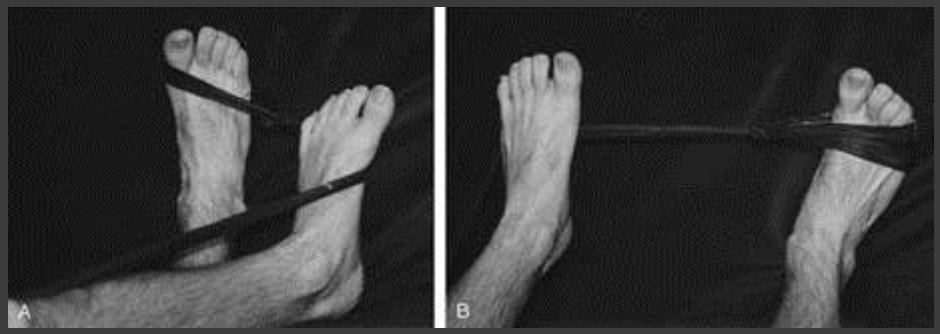
- For simple sprains, imaging is not necessary
  - Unless indicated by Ottawa Ankle Rules
- MRI recommended
  - Chronic ankle pain still symptomatic 4 months after injury
  - Medial ankle ecchymosis

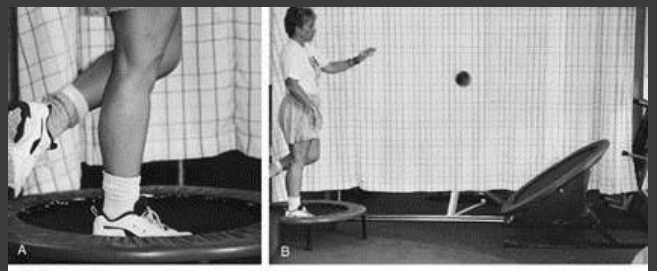
Treatment of Ankle Sprains

- PRICE
  - Protection – splint, walking cast/boot, crutches if unable to bear weight due to pain
  - Rest
  - Ice – 20 min every 2-3 hours
  - Compression
  - Elevation

Treatment – Functional Rehab

- Weight bearing as soon as tolerated
- Passive/active ROM
- Resistance exercises
- Proprioceptive Exercises





Time to Return to Activities

- Grade 1 Sprains
  - 3-5 days
- Grade 2 Sprains
  - 1-3 weeks
- Grade 3 Sprains
  - 2 – 3 Months
  - Ankle protection up to 6 months after injury

When to involve an Orthopaedist?

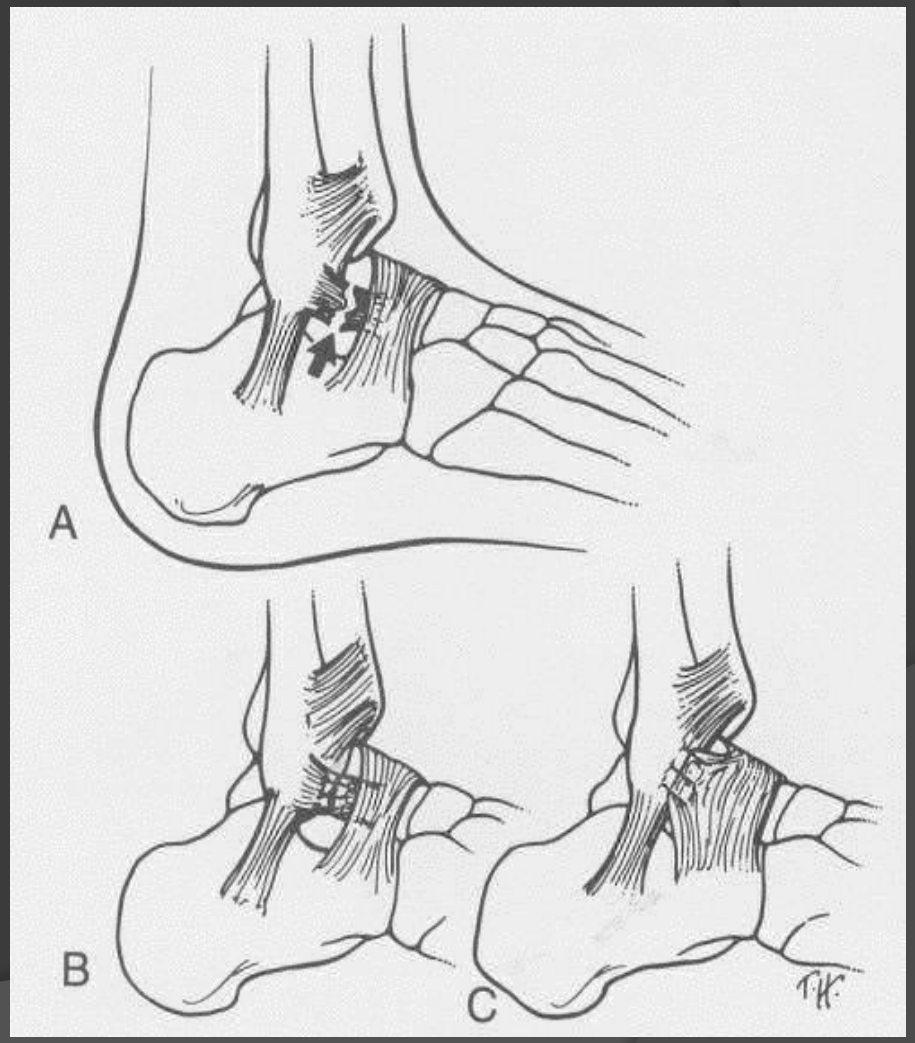
- Indicated for acute injuries when:
  - Severe laxity
  - Fracture
  - Medial ecchymossis
- In 10-20%, initial treatment is unsuccessful and orthopaedic referral should be considered

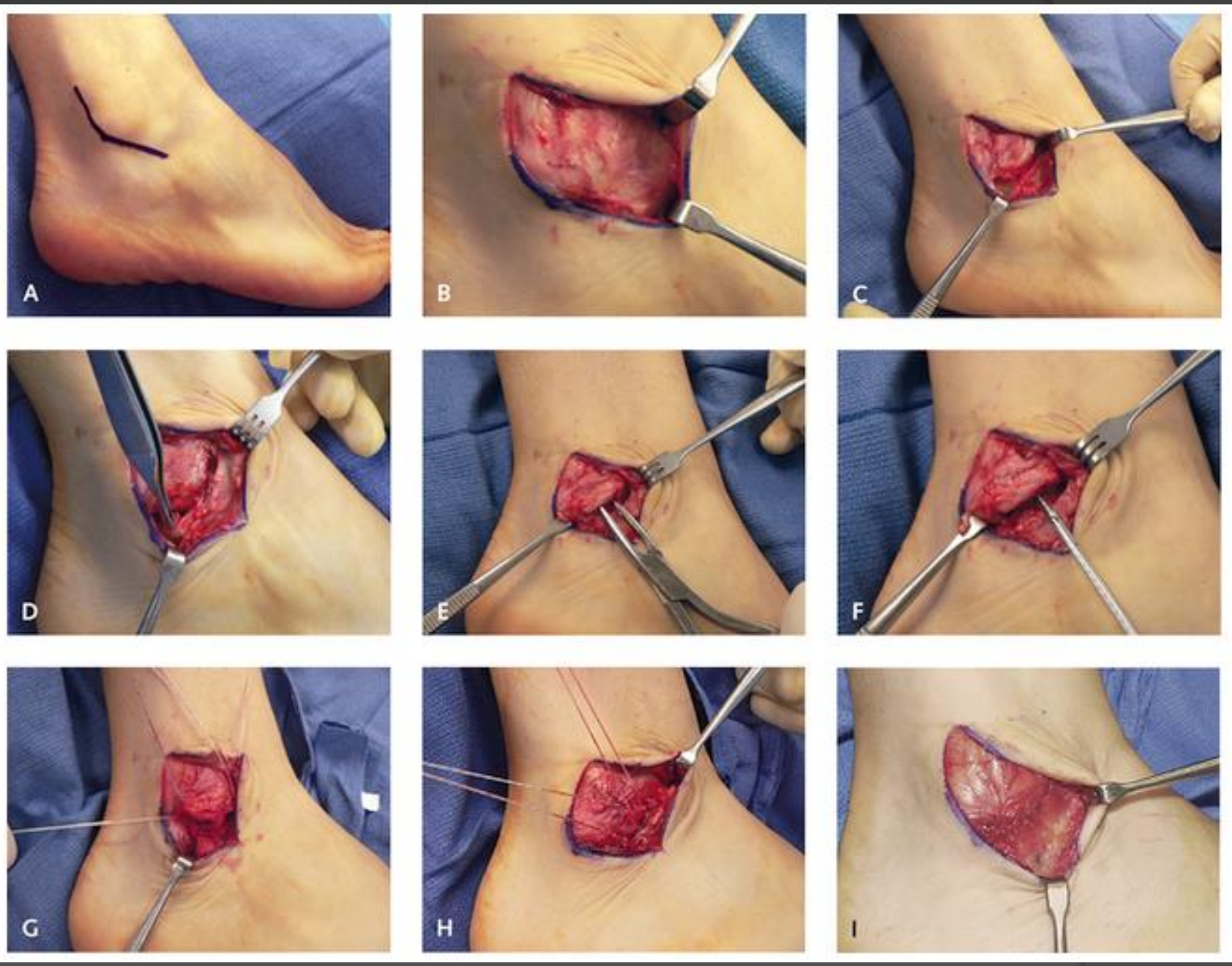
Surgery?

- Most patients respond to non-operative management
  - Physical Therapy
  - Physical Therapy
  - Physical Therapy
- Surgery is recommended when there is persistent pain or instability

Chronic Ligament Injuries

- Chronic ankle instability
  - Correction of functional deficits through PT may help stabilize the ankle and prevent surgery
  - Surgery with direct repair and augmentation of the lateral ligamentous structures (Brostrom)

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Case 2

- 23 year old male was playing rugby yesterday and was pulled backwards by another player while his right foot was planted. He has been able to bear weight since injury but with pain.

  - Mild ankle swelling
  - Pain with bearing weight
  - Anterior drawer normal
  - Talar tilt normal
  - Positive Squeeze Test
  - Neurovascularly intact

X-rays

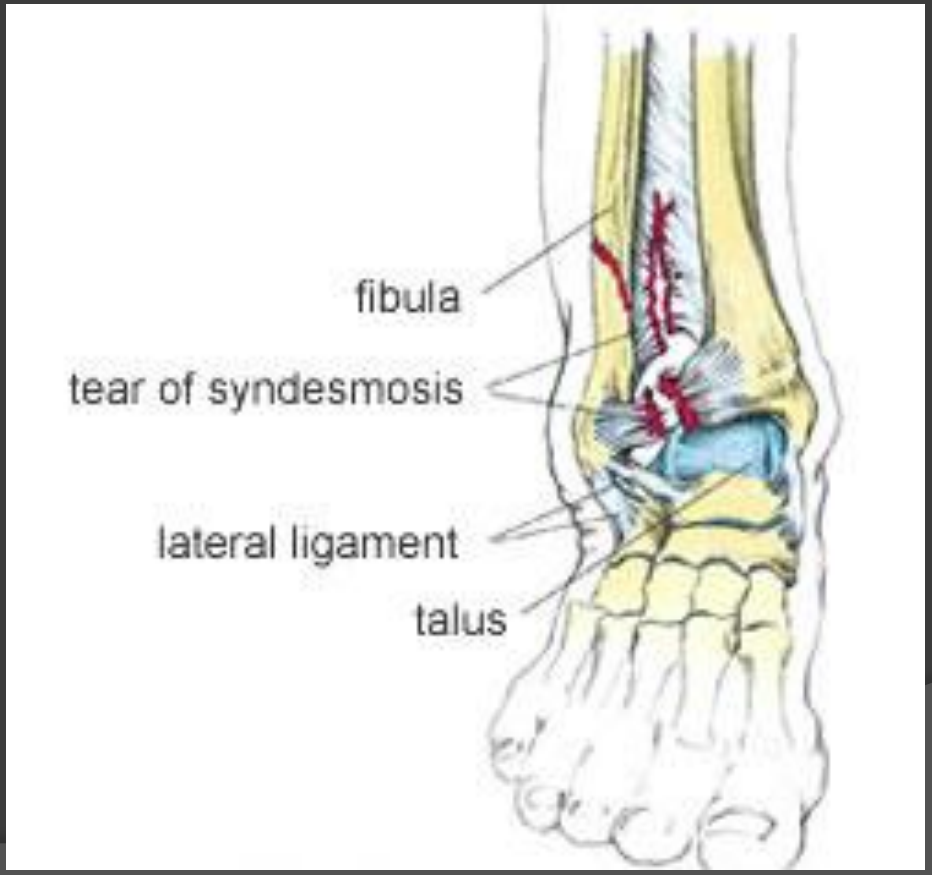
Differential Diagnosis

- What other studies may help the diagnosis?

Stress View

Diagnosis

- Syndesmotic Injury / High Ankle Sprain



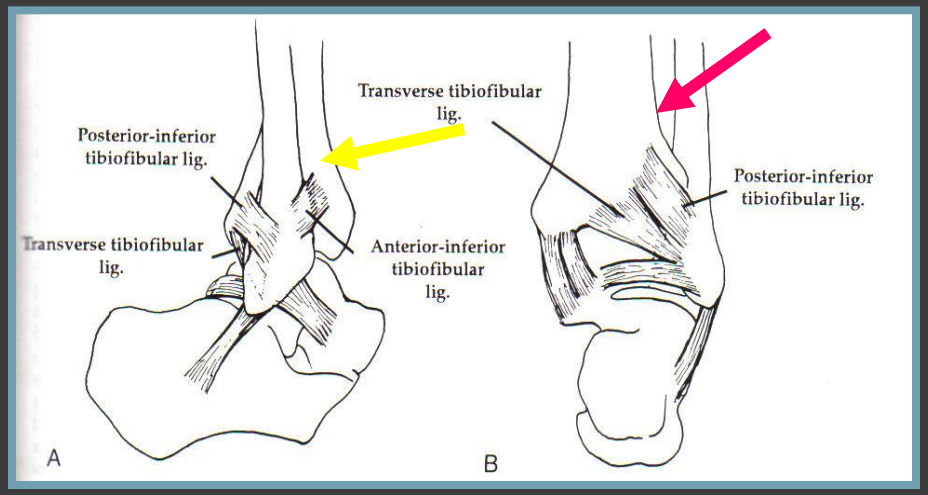
Syndesmotic Injury

- Less common and more easily misdiagnosed
- Stretching/tearing of syndesmosis
  - Referred to as a “high ankle sprain” because the ligaments are above, or higher, than the true ankle joint
- More common in collision sports

ANATOMY

90% of prevention of lateral displacement of the fibula is through three major ligaments

- Anterior Inferior Tibio Fibular ligament
  - AITFL
  - 35% of stability
- Posterior Inferior Tibio Fibular ligament
  - PITFL
  - 31% of stability
- Interosseous membrane
  - IOM
  - 22% of stability



Physical Examination

- Pain with External Rotation Test
- Positive Squeeze test
- Swelling and tenderness
  - Proximal to the lateral malleolus
    - Above the ankle joint

Special Tests

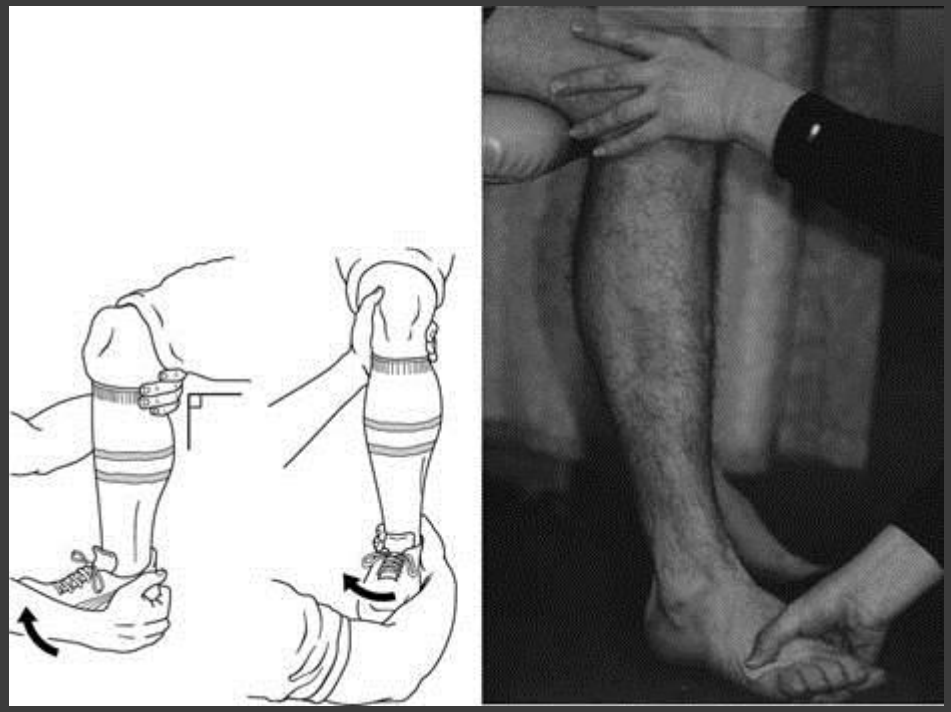
- Squeeze test
- External rotation

Squeeze Test

- Performed by squeezing the fibula and the tibia at the mid calf
- Abnormal if ankle pain at syndesmosis

External Rotation Test

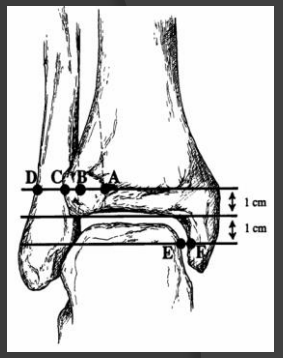
- Performed by ER the foot with the knee held at 90 degrees of flexion
- Abnormal if pain elicited in the distal syndesmosis



Imaging

Weight bearing a stress X-Ray – Possible widening of the space between tibia and fibula

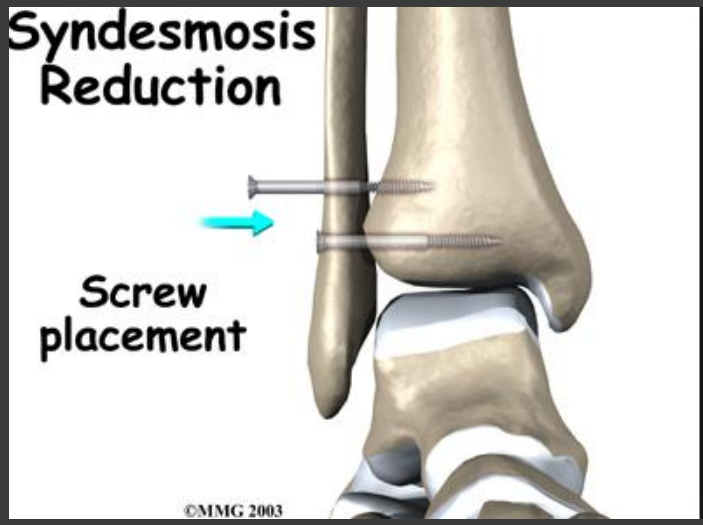
Syndesmotic Injury Treatment



- Type 1 Injury
  - Normal X-ray
  - Functional Rehab protocol, similar for simple sprains
- Type 2 Injury
  - X-ray shows > 6mm of tibiofibular clear space on a stress xray
    - NWB SLC x 4 weeks followed by CAM boot x 4 weeks
- Type 3 Injury
  - Frank diastasis on nonstress radiographs
  - Surgical stabilization required
- Can take twice as long to recover
  - Compared to lateral ankle sprain
  - 8 – 12 weeks for type 1 or 2

Stabilization Syndesmosis

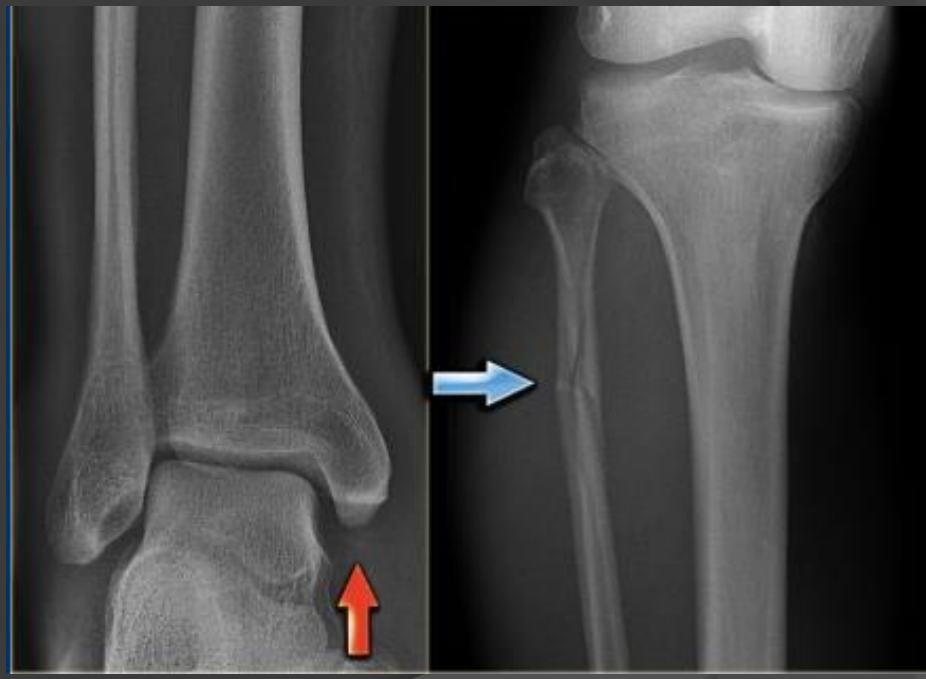
- Use screws or tightrope
- Reduce the syndesmosis with a large clamp under fluoro
- Place 1.5 cm proximal to the plafond



Why is it important to examine the knee if a person has an ankle injury?

Commonly missed Injury

- **Maisonneuve Fracture:**
  - Proximal Fibula Fracture that occurs with:
    - Avulsion fracture of medial malleolus
    - Rupture of deltoid ligament
  - Palpate proximal fibula on all ankle injuries



Case 3

- 27 year old male lacrosse player presents after an ankle injury. Occurred yesterday when his right foot was caught in a divot in the field and he fell forward. Seen in at a facility with a normal ankle X-Ray. Discharged with walking boot and crutches.
  - Significant swelling and ecchymosis of the midfoot
  - Neurovascularly intact
  - Tenderness over tarsometatarsal joints
  - Significant pain with weight-bearing
  - Next step?

Imaging of the Foot

Differential Diagnosis

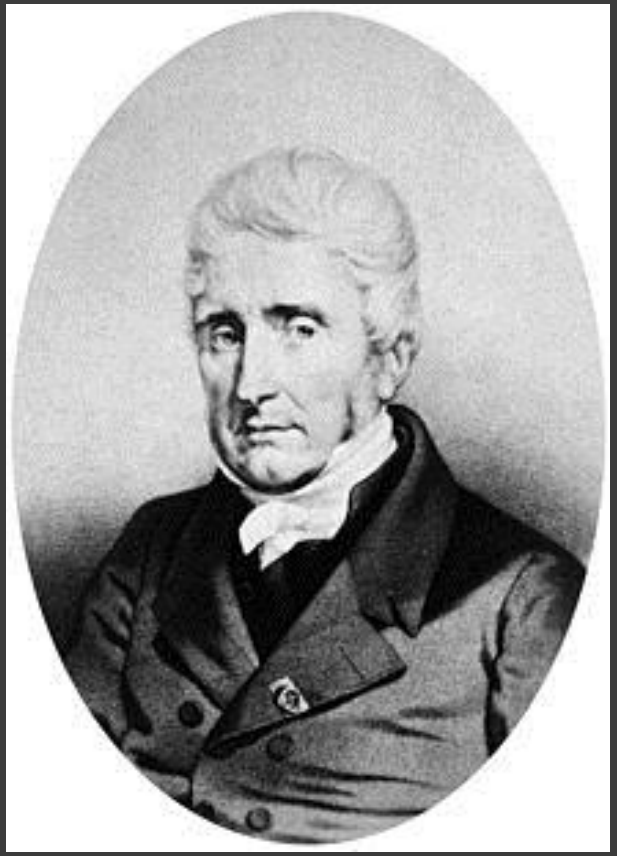
- What is abnormal in the prior x-ray?

Diagnosis

- Lisfranc Injury

Lisfranc's Joint Injuries

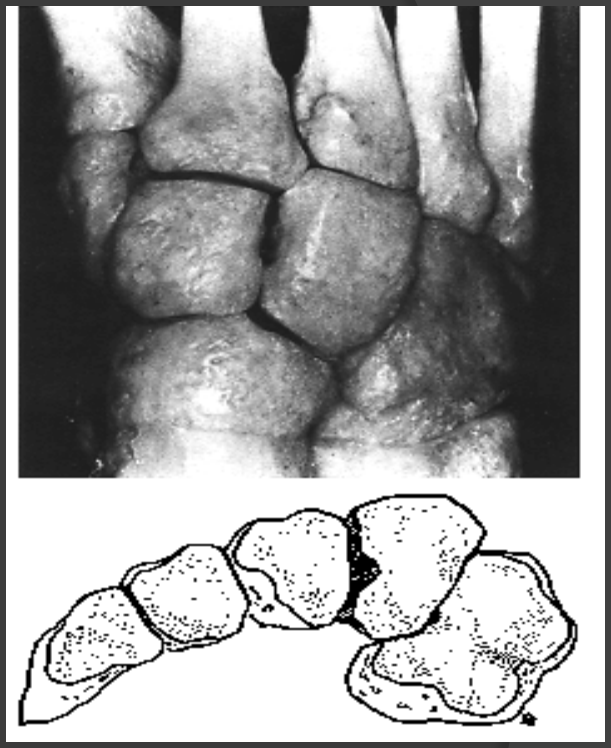
- Any bony or ligamentous injury involving the tarsometatarsal joint complex
- Named after the Napoleonic-era French surgeon and gynecologist
- Described amputations at this level without ever defining a specific injury

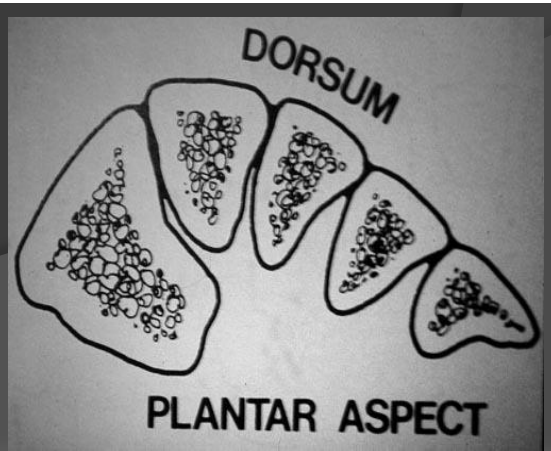


Jacques Lisfranc de St. Martin (1790-1847)

Anatomy

- Lisfranc's joint:
  - Articulation between the 3 cuneiforms and cuboid (tarsus) and the bases of the 5 metatarsals
- Osseous stability
  - Provided by the Roman arch of the metatarsals and the recessed **keystone** of the second metatarsal base



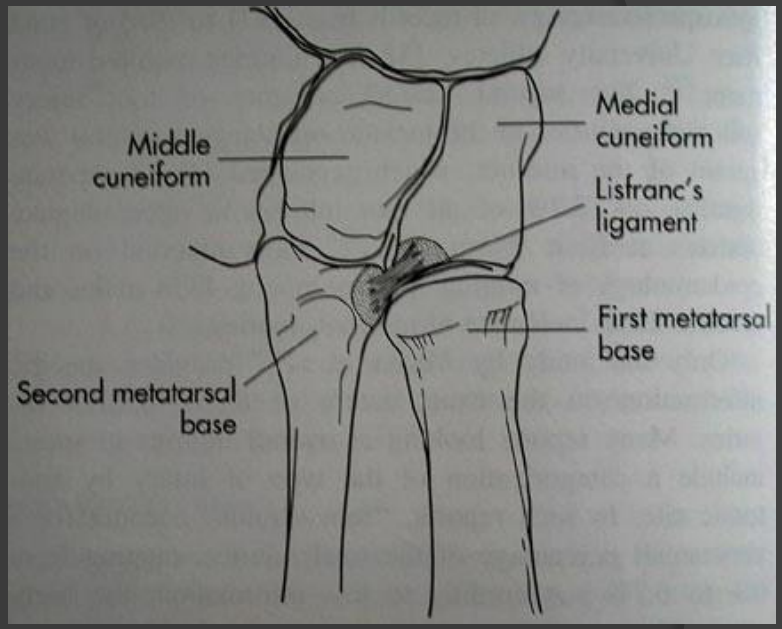


Lisfranc Ligament

- **Lisfranc Ligament:**

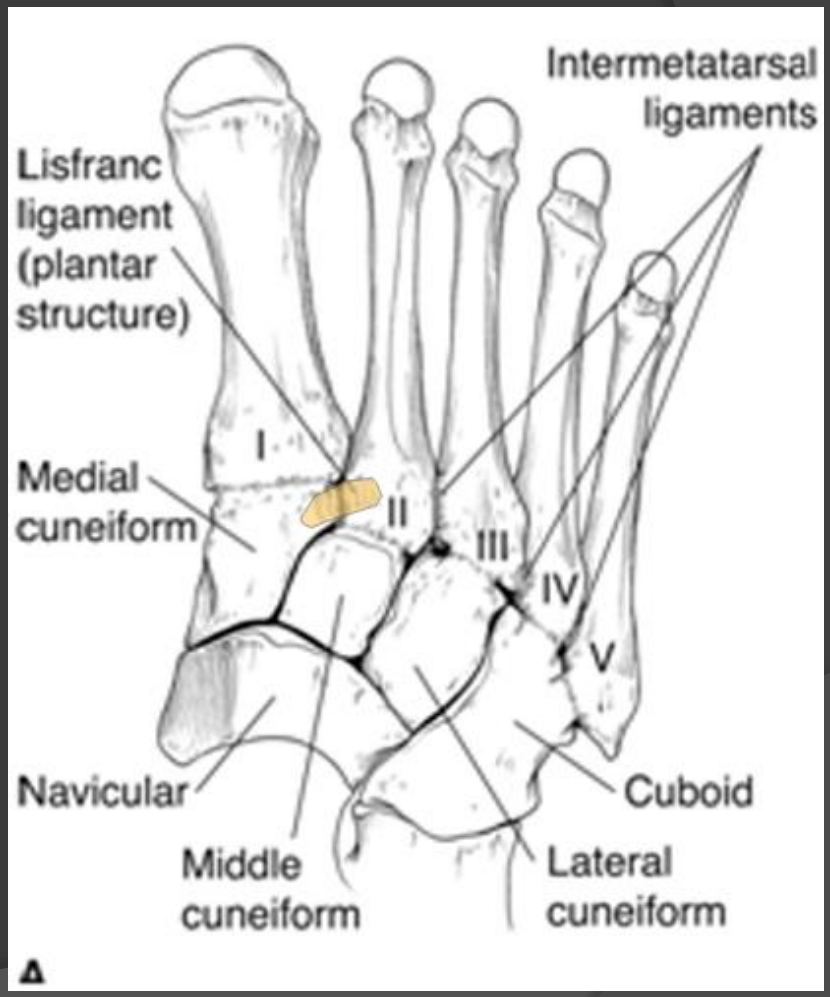
Base of 2nd Metatarsal → Medial Cuneiform

-Injury causes separation of the base of the 1st and 2nd metatarsals leading to forefoot instability



Lisfranc Injury

- Why is this area of the foot prone to injury?
  - Strong transverse ligaments connect the bases of the four lateral metatarsals
    - No transverse ligament exists between the 1st and 2nd metatarsal bases
      - Less support = increased risk of injury



Incidence

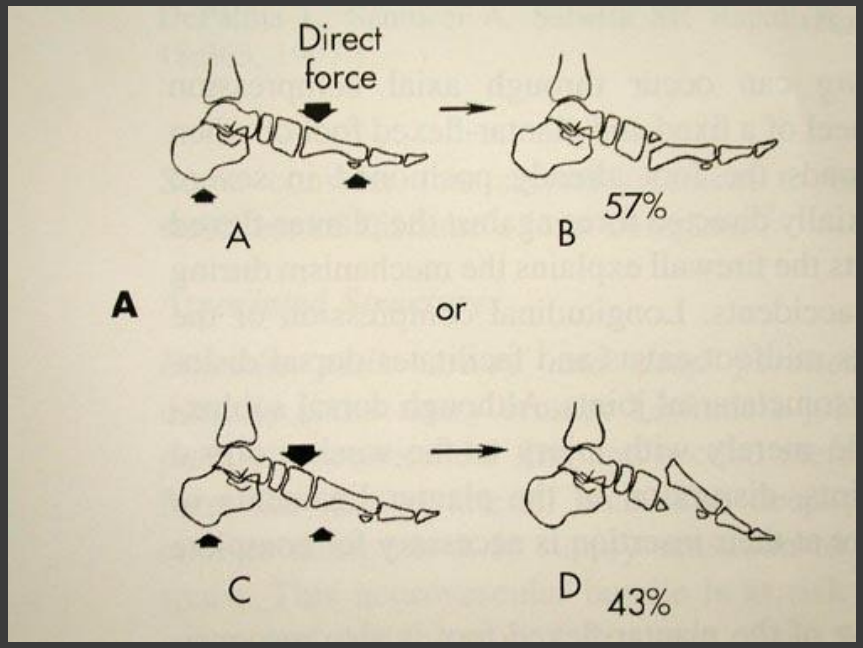
- Generally considered rare: 1 per 55,000 people per year or 15/5500 fractures
- **20% of Lisfranc's injuries may be overlooked**
  - Especially in polytrauma patients
- 40 % associated with other midfoot fractures or dislocations

Mechanisms of Injury

- Trauma
  - MVA, fall from height
- Direct Crush injuries
- Sports-related

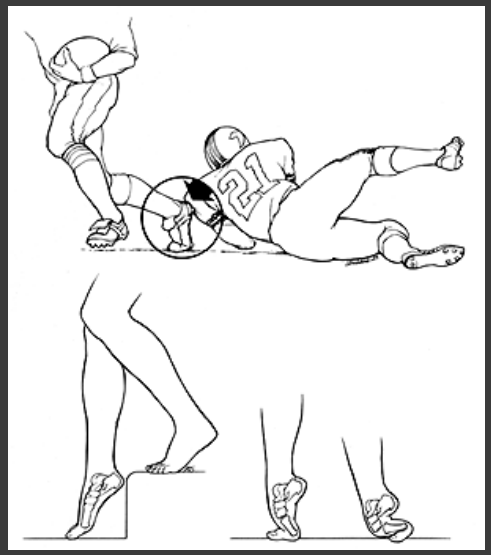
Mechanisms of Injury - Direct

- **Direct Injuries**:
- Force is applied directly to the Lisfranc's articulation.



Mechanism of Injury - Indirect

- Typical of athletic injury
- Axial loading to plantar flexed foot results in hyper-plantar flexion and ligament rupture
- Twisting injuries lead to forceful abduction of the forefoot

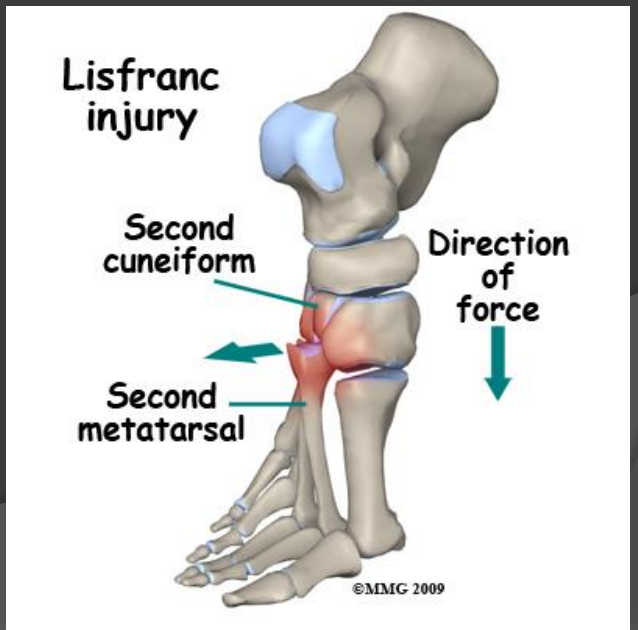


Posted at 10:43 AM ET, 11/15/2011

Matt Schaub reportedly out for season with Lisfranc injury

By Cindy Boren

Sunday wasn't Matt Shaub's day. (J. Meric / Getty Images)



Physical Exam Findings

- Midfoot pain with difficulty in weight bearing
- Swelling across the dorsum of the foot
- Deformity

Do Not Miss Compartment Syndrome

- The “5 P's"
  - Pain (out of proportion)
  - Pallor (pale skin tone)
  - Paresthesia (numbness feeling)
  - Pulselessness (faint pulse)
  - Paralysis (weakness with movements)

Radiographic Evaluation

- Standing views provide “stress” and may demonstrate subtle diastasis > 2 mm
  - *Not always possible with acute injury due to pain*
- Comparison views are very helpful
- If suspicion on X-ray, can obtain stress views, CT scan, MRI, or intraoperative stress views

(Left) In this non-weightbearing x-ray, the Lisfranc injury does not show any abnormal widening (arrow). **(Right)** The tear of the Lisfranc ligament is more evident in this weightbearing stress x-ray, showing a widening of the joint.

Fleck Sign

- Fleck Sign
  - Myerson *FAI* 1986
  - Avulsion fx
    - Lateral to Medial cuneiform
    - Medial to 2nd MT

Treatment

- Early recognition is the key to preventing long term disability
  - Strongly recommend involvement of an orthopaedic surgeon
- Anatomic reduction is necessary for best results
- ***Goal: obtain or maintain anatomic reduction***

Nonoperative Treatment

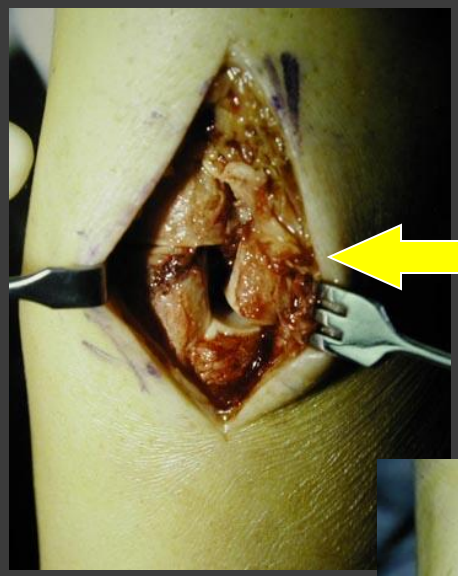
- For injuries with normal weight bearing or stress x-rays (no diastasis)
  - NWB in a CAM boot for 4 to 6 weeks
  - Then WBAT in CAM boot for next 4 to 6 weeks
  - Total treatment 2 to 3 months
  - Semi-Rigid/Rigid arch support

Operative Treatment

- For injuries with any diastasis
  - Unstable injuries may progress to partial or total dislocation of the tarsometatarsal joint complex

Operative Treatment

- Goal to reduce and stabilize lisfranc joints



Right foot - 2nd met. Base unreduced

Post Traumatic Arthritis

- Present in most, but may not be symptomatic
  - Related to initial injury and adequacy of reduction
  - Treated with arthrodesis

Return to Play

- Return to play at 4 to 6 months
- Upon return to play, stiff soled shoes with orthosis is recommended

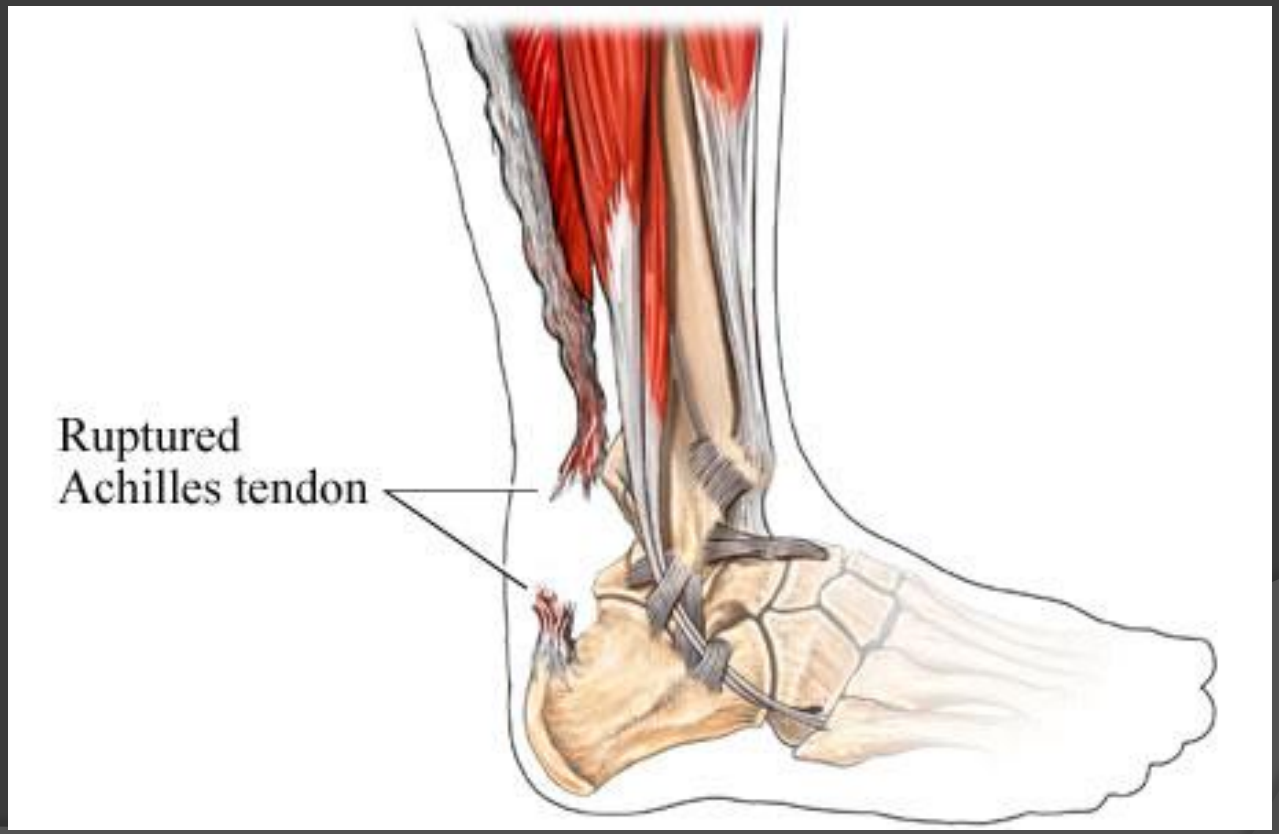
Case 4

- 45 year man was playing tennis when he heard a loud pop and felt like someone kicked the back of his left leg.
  - Pain with weight bearing
  - Soft tissue swelling and ecchymossis in posterior ankle
  - Weakness with plantar flexion of his foot

Differential Diagnosis

Diagnosis

- Achilles Rupture



Epidemiology

- Incidence (per 100,000 people/year)
  - Acute Achilles tendon ruptures: 4.2-18
  - ankle fractures: 184
  - knee OA: 240
- Substantial source of cost/disability
  - Affects adults in productive years

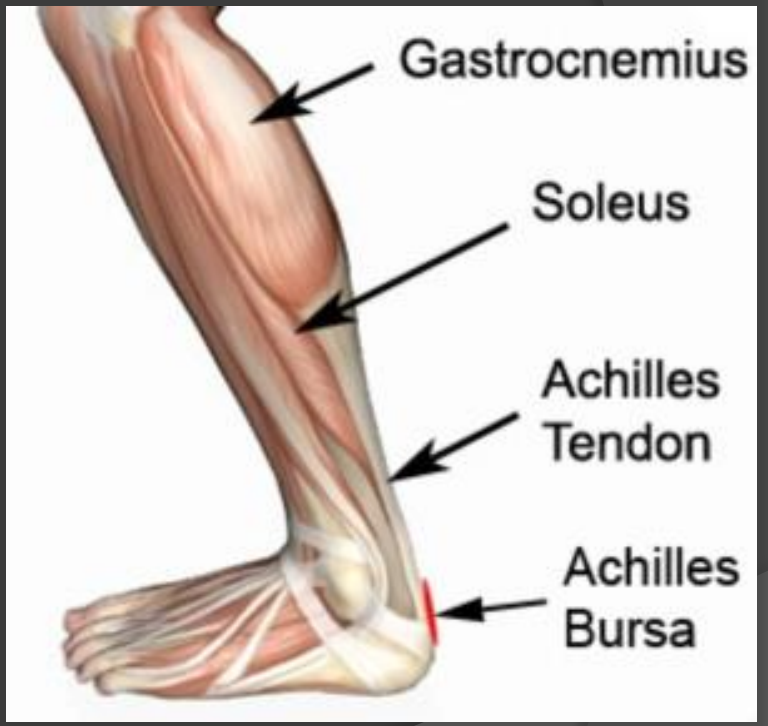
Epidemiology

The Profile

- Male > Female
  - 1.7:1 – 12:1
- 30's-40's
- Occasional athlete
  - "Weekend Warrior"

Anatomy

- Achilles is the common tendon of the gastrocnemius and soleus muscles
  - Provides the attachment to the calcaneus
  - Relative avascular portion 2-6 cm proximal to the insertion



Tendon Pathology

- Age:
  - ↓ vascularity at 2-6cm proximal to insertion
  - ↓ matrix elasticity
- Metabolic risk factors:
  - Local or PO steroids
    - Decreased healing potential
  - Fluoroquinolones
  - Inflammatory arthritis

25% of acute ruptures had some symptoms of Achilles inflammation

- Leppilahti, CORR 1998

Drug Safety and Availability

Postmarket Drug Safety Information for Patients and Providers

Index to Drug-Specific Information

Approved Risk Evaluation and Mitigation Strategies (REMS)

Postmarketing Safety Evaluation of New Molecular Entities: Final Report

Drug Safety Information for Healthcare Professionals

Information for Healthcare Professionals: Fluoroquinolone Antimicrobial Drugs [ciprofloxacin (marketed as Cipro and generic ciprofloxacin), ciprofloxacin extended-release (marketed as Cipro XR and Proquin XR), gemifloxacin (marketed as Factive), levofloxacin (marketed as Levaquin), moxifloxacin (marketed as Avelox), norfloxacin (marketed as Noroxin), and ofloxacin (marketed as Floxin)]

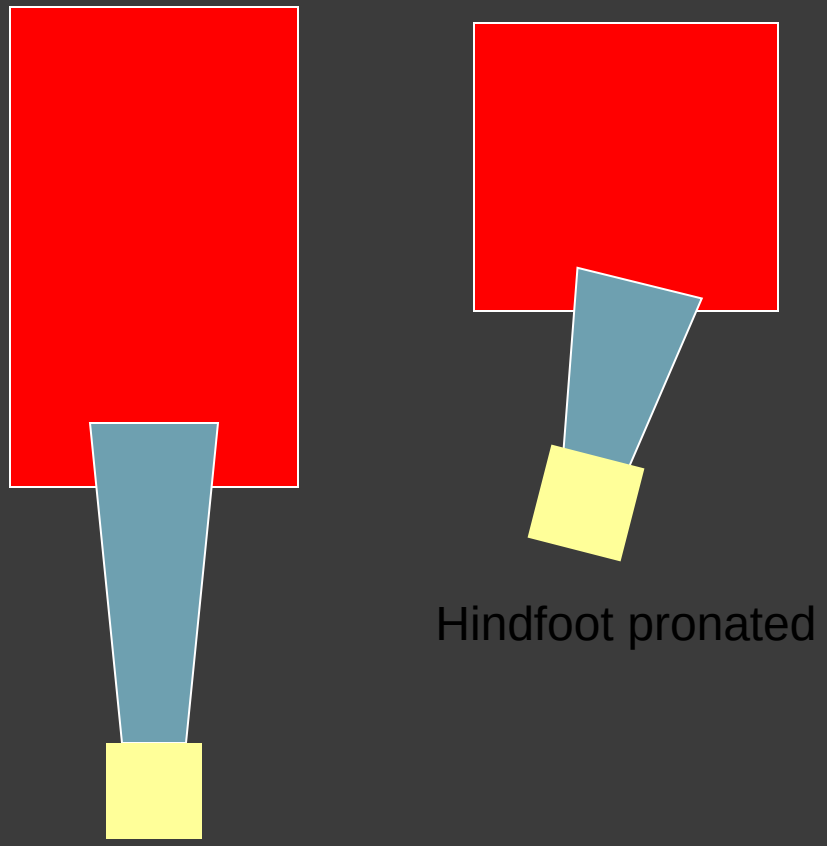
FDA ALERT [7/8/2008]: FDA is notifying the makers of fluoroquinolone antimicrobial drugs for systemic use of the need to add a boxed warning to the prescribing information about the increased risk of developing tendinitis and tendon rupture in patients taking fluoroquinolones and to develop a Medication Guide for patients. The addition of a boxed warning and a Medication Guide would strengthen the existing warning information already included in the prescribing information for fluoroquinolone drugs.

Fluoroquinolones are associated with an increased risk of tendinitis and tendon rupture. This risk is further increased in those over age 60, in kidney, heart, and lung transplant recipients, and with use of concomitant steroid therapy. Physicians should advise patients, at the first sign of tendon pain, swelling, or inflammation, to stop taking the fluoroquinolone, to avoid exercise and use of the affected area, and to promptly contact their doctor about changing to a non-fluoroquinolone antimicrobial drug.

Selection of a fluoroquinolone for the treatment or prevention of an infection should be limited to those conditions that are proven or strongly suspected to be caused by bacteria.

This information reflects FDA's current analysis of data available to FDA concerning fluoroquinolone antimicrobials. FDA intends to update this sheet when additional information or analyses become available.

But even “healthy” tendons rupture…



Hindfoot pronated

Sudden, eccentric loading of an assymetrically stretched tendon

Sports w/ rapid pushoff

“Stored energy” builds up and is suddenly released during early impact

Mechanism of Injury

- Forefoot pushoff w/ knee extended (53%)
  - Ex: sprint starts, jumping sports
- Sudden, unexpected dorsiflexion (17%)
  - Ex: foot slips into hole
- Violent dorsiflexion of plantar foot (10%)
  - Ex: fall from height

History

- “I felt a pop or a snap”
  “It was like somebody kicked the back of my leg”
  “I couldn’t put any weight on it after”
- Additional Questions to ask:
  - Antecedent symptoms
  - Medication history
- Many patients still have plantar flexion strength secondary to accessory muscles

25% missed by first examining doctor

Palpable defect

Resting tension

Thompson / Squeeze test

Imaging

Mainly Adjuncts to clinical exam in acute setting

Management of Achilles Ruptures

- Restore musculotendinous length and tension
- Optimize gastro-soleous strength and function
- Avoid ankle stiffness

Surgery or No Surgery?

Conservative Management

- Risk of rerupture is ~10-30%
- Decreased plantar flexion strength

Operative Management

- Risk of rerupture is ~2%
- Skin infections ~ 5%
- Deep infection ~ 1%

Treatment Pendelum

- Conservative Management versus Operative Fixation
- 1920-1959
  - Good results with surgery popularized
- 1972
  - Cast immobilization (Lea and Smith)

    95% satisfactory results

Lancet: “it is doubtful whether operative repair … can still be justified”

Is Operative Treatment of Achilles Tendon Ruptures Superior to Nonoperative Treatment?

A Systematic Review of Overlapping Meta-analyses

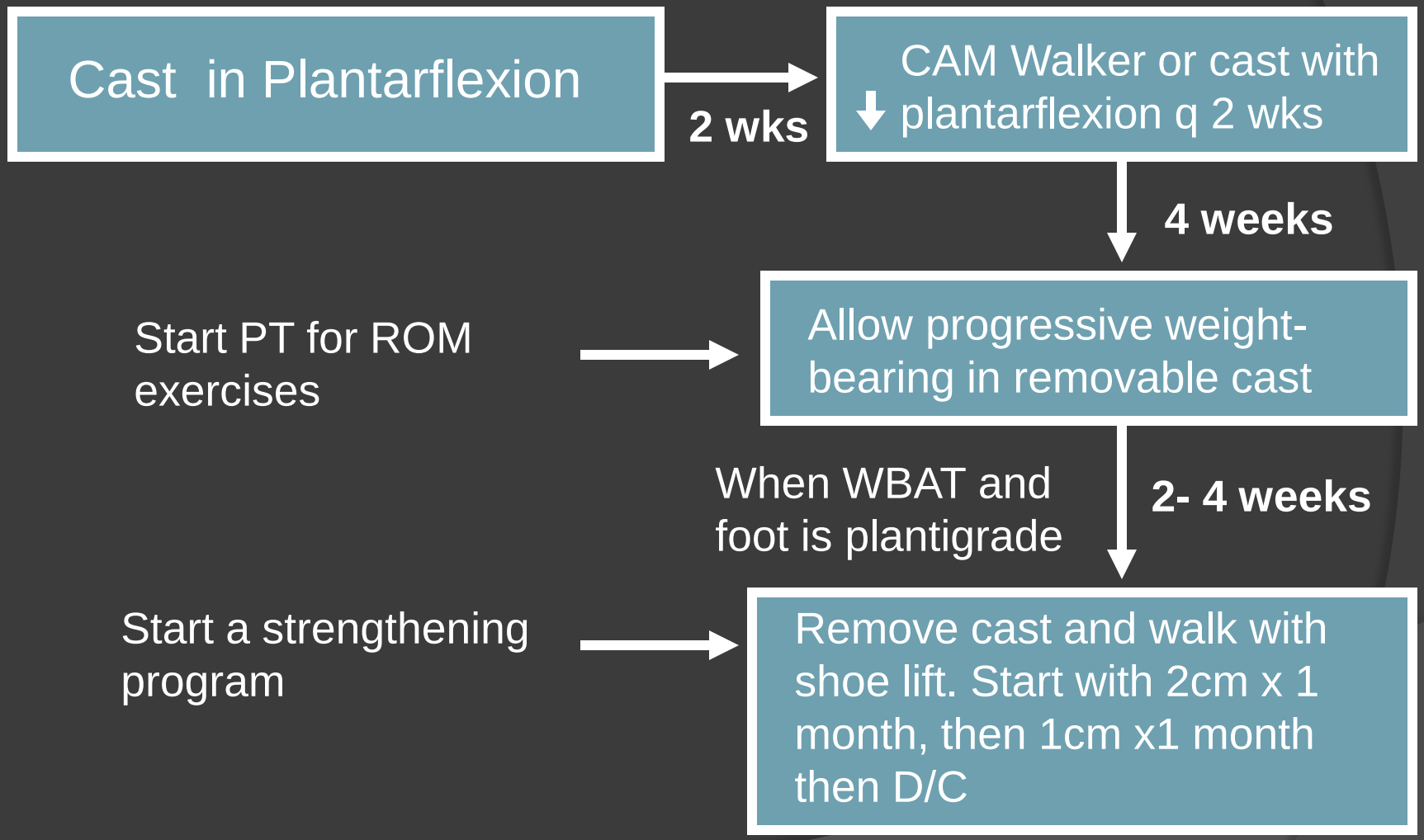
Brandon J. Erickson, MD*, Randy Mascarenhas, MD, FRCSC, Bryan M. Saltzman, MD, ... Show all authors

First Published April 17, 2015 | Others

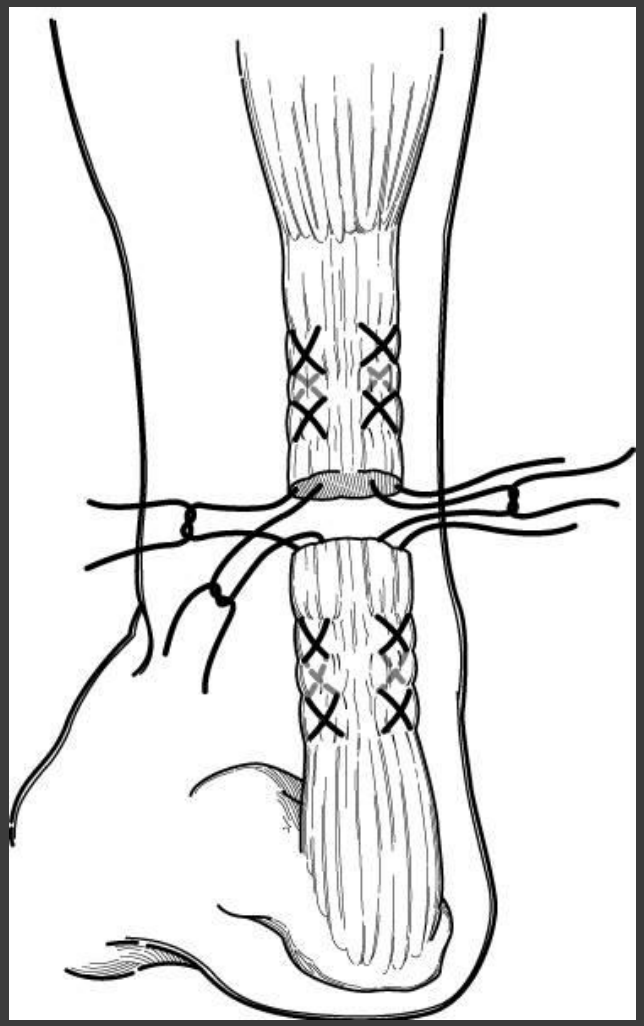
Conclusion:

Operative treatment of Achilles tendon ruptures decreases rerupture rates but increases the risk for minor complications when compared with nonoperative treatment. Additionally, surgical treatment may allow earlier return to work.

Conservative Management



Surgical Management

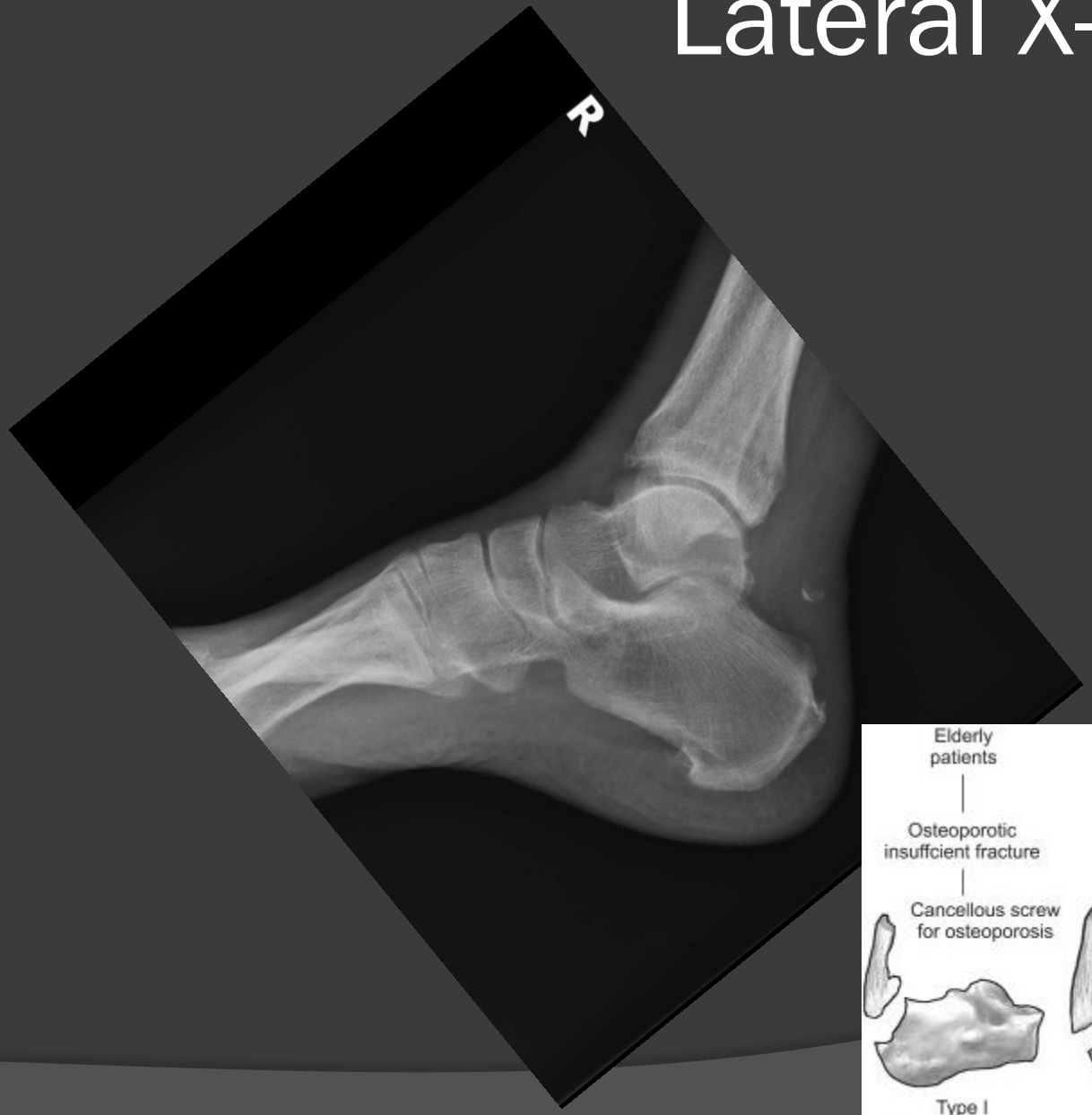


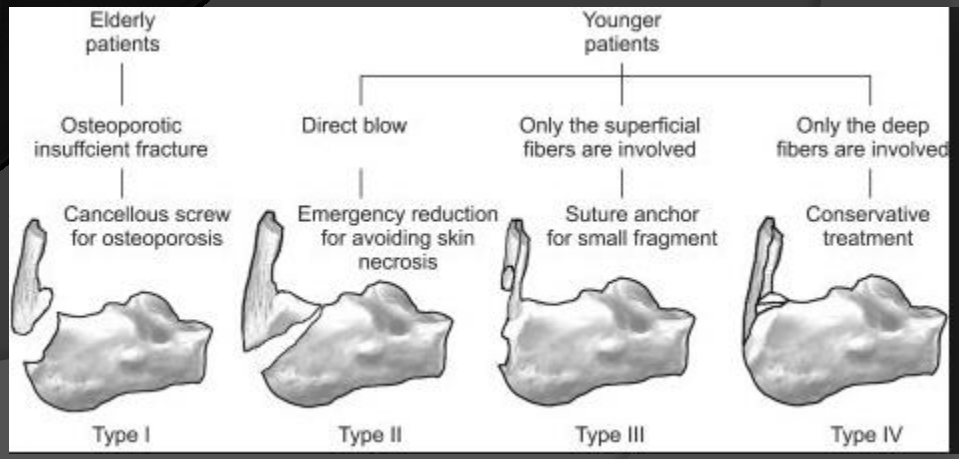
Patient Factors

- Nonoperative Management
  - Elderly, less active, comorbidities
  - Short-leg walking boot w/ heel lift
  - NWB for 4 weeks; ROM/functional rehab
- Operative Management
  - Active patients
  - Accept risks of infection, wounds

Why obtain a Lateral Xray of a suspected achilles rupture?

Lateral X-Ray





Beware Large Avulsion Fragments

- Masquerade as calcaneus fracture or achilles rupture

Skin Compromise

- Skin compromise requires immediate surgical treatment

Case # 5

- 93 year old woman trips over a curb and injures her right ankle.
  - Laceration over medial ankle
  - Unable to weight bear


R
PGC


R
PGC

Diagnosis

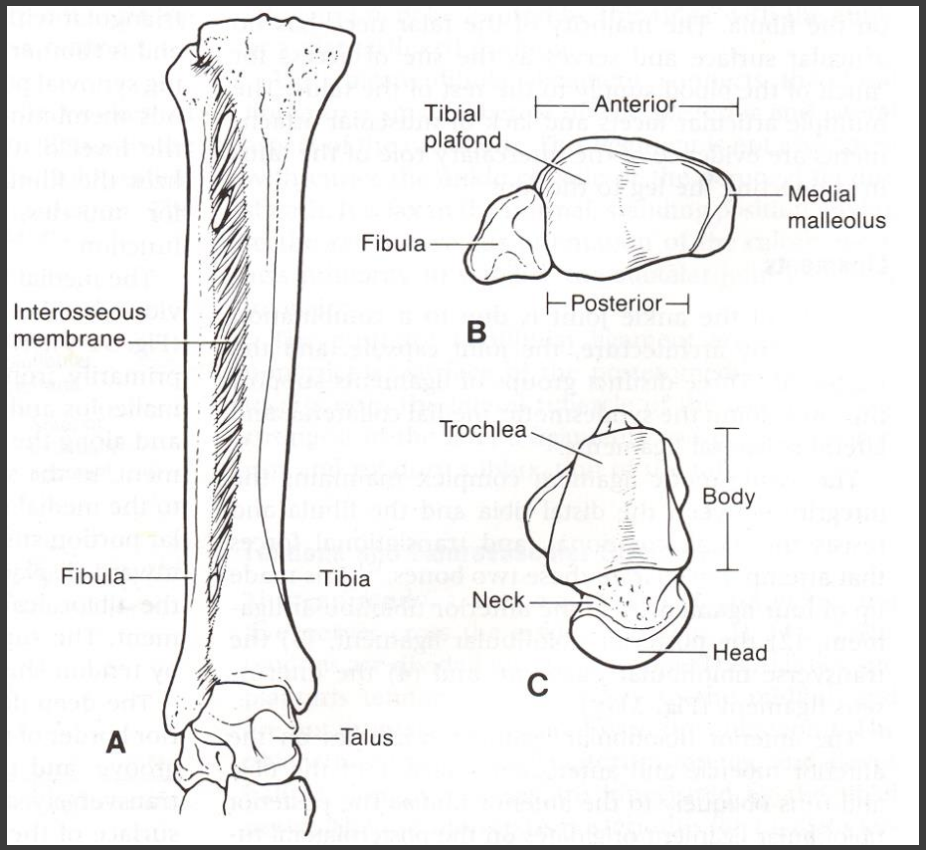
- Open bimalleolar ankle fracture

Epidemiology of Ankle Fractures

- Most common weight-bearing skeletal injury
- Incidence of ankle fractures has doubled since the 1960's
- Highest incidence in elderly women
- Unimalleolar 68%
- Bimalleolar 25%
- Trimalleolar 7%
- Open 2%

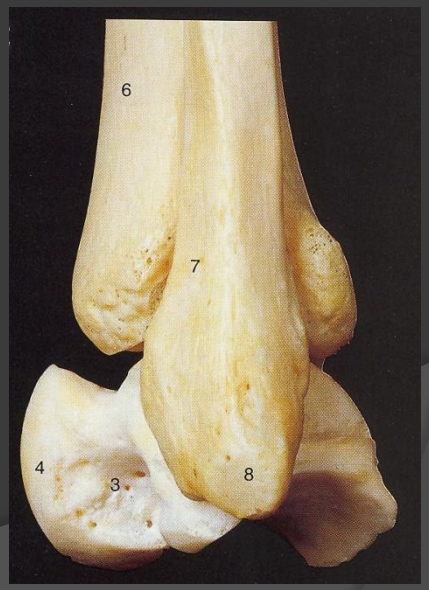
Ankle Anatomy

- Distal fibula and distal tibia form a bony mortise that allows talar dorsiflexion and plantarflexion



Ankle Anatomy and Biomechanics

- 1 mm of lateral talar shift decreases tibio talar contact 42%
- Increase incidence of arthritis



Physical Exam

- Neurovascular exam
- Note obvious deformities
- Pain over the medial or lateral malleoli
- Pain at the ankle with side to side compression of the tibia and fibula (5cm or more above the joint) may indicate a syndesmotic injury

Imaging

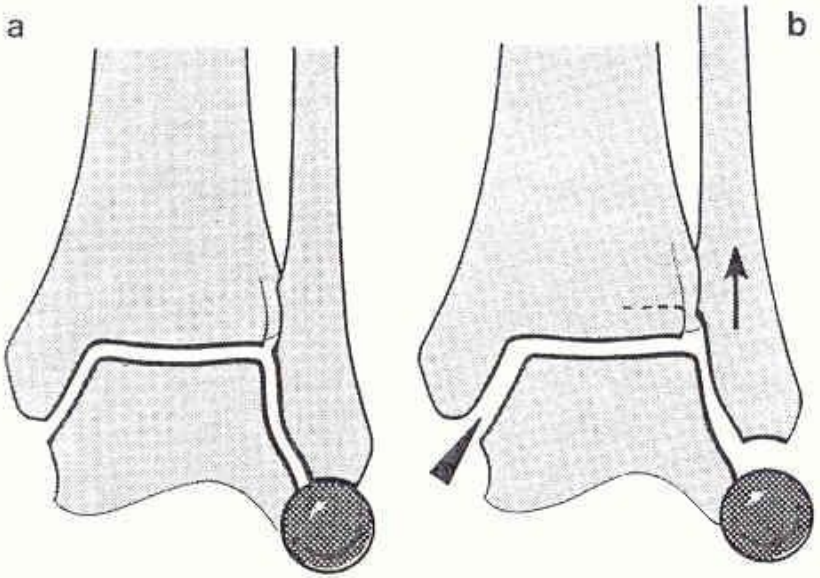
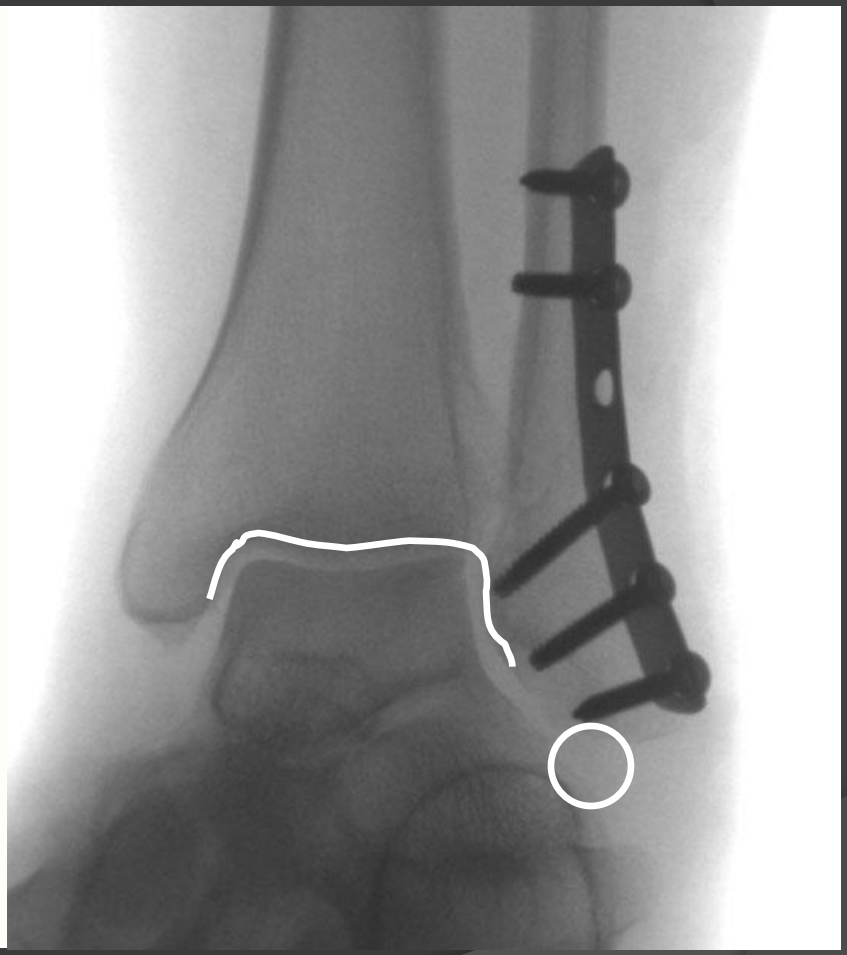


Fig. 3 a and b. The radiology of the sprung mortice
a. Sprung mortice:
1. Irregular width of joint space; widening medially;
2. "Spike" of fibula too proximal;
3. *Broken line* from the lateral part of the articular surface of the talus to the distal fibula
b. Normal ankle joint



FIBULAR LENGTH:
1. Shenton's Line of the ankle
2. The dime test

Weber SICOT 1981

Classification of Ankle Fractures

Classification systems

- Lauge-Hansen
- Weber

Lauge-Hansen

- Based on cadaveric study
- First word: position of foot at time of injury
- Second word: force applied to foot relative to tibia at time of injury

Types:

Supination External Rotation
Supination Adduction
Pronation External Rotation
Pronation Abduction

Weber Classification

- Based on location of fibula fracture relative to mortise.

  - Weber A fibula distal to mortise
  - Weber B fibula at level of mortise
  - Weber C fibula proximal to mortise

- Concept - the higher the fibula the more severe the injury

Treatment Based on Stability Stable versus Unstable

- The ankle is a ring
  - Tibial plafond
  - Medial malleolus
  - Deltoid ligaments
  - calcaneous
  - Lateral collateral ligaments
  - Lateral malleolus
  - Syndesmosis
- Fracture of single part usually stable
- Fracture > 1 part = unstable

Nonoperative Treatment

- Indications:
  - Nondisplaced
  - Stable fracture
- Management:
  - CAM boot 6 weeks
  - Functional rehab

Operative Treatment: Surgical Indications

- Instability
  - Talar subluxation
- Malposition
  - Joint incongruity
  - Articular stepoff


7.73 mm



For our patient…

Tenuous Skin envelope


200 mm
200 mm

Traditional ORIF

- Not possible secondary to the friable soft tissue envelope and skin

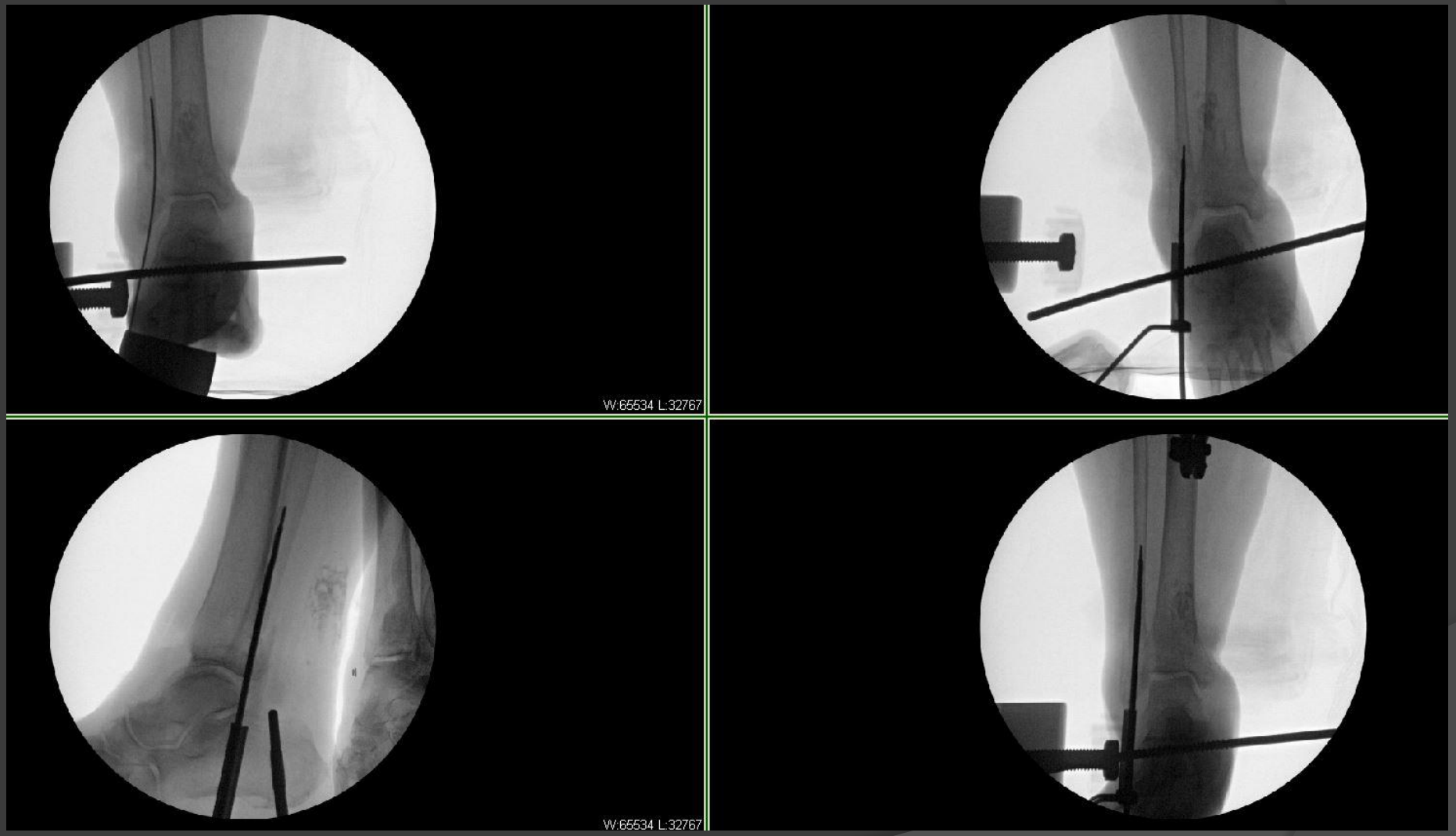
Options

1) Treat definitively in external fixator

2) Remove ex-fix and place splint

3) Attempt ORIF

4) Minimally invasive approach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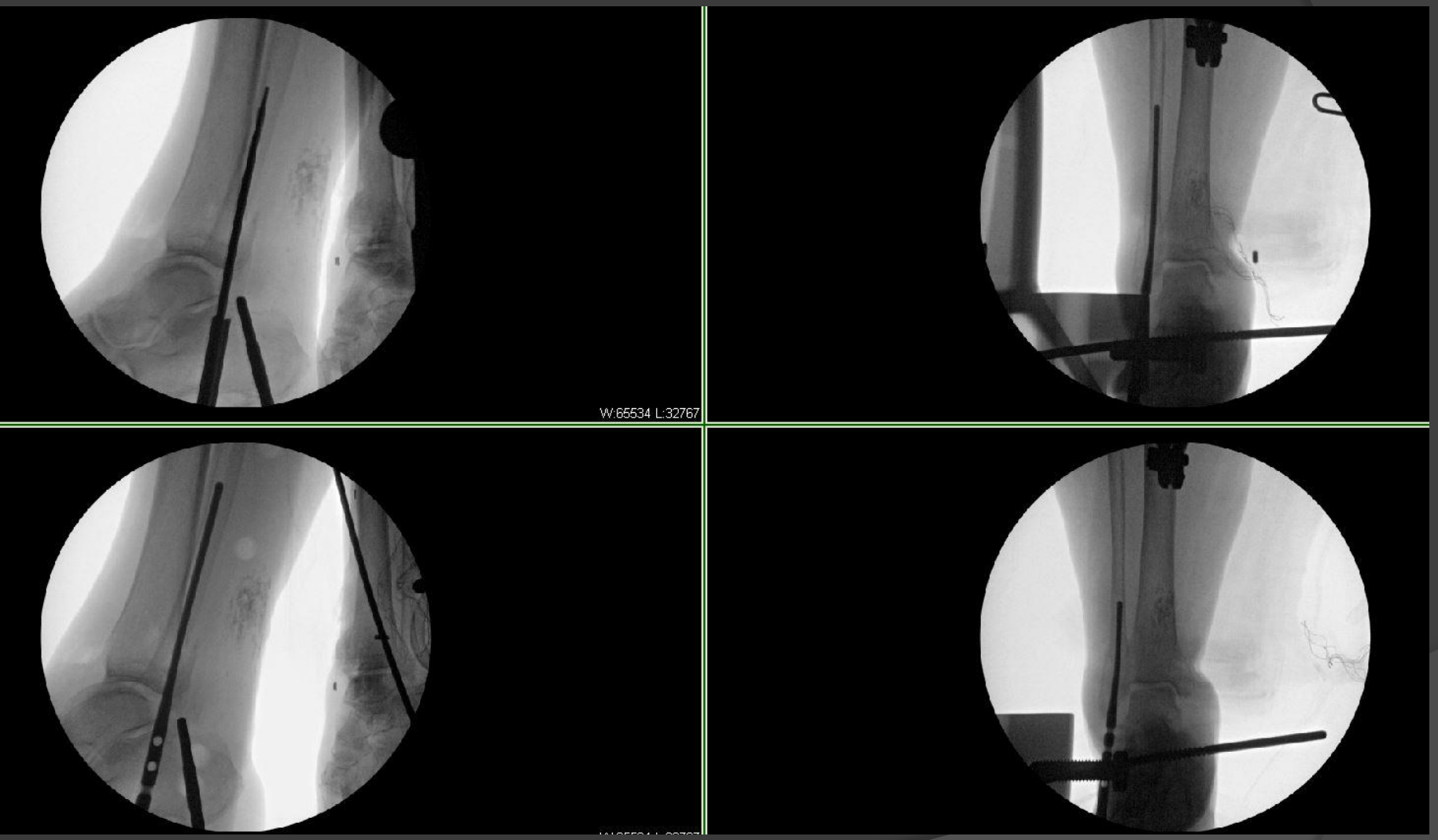
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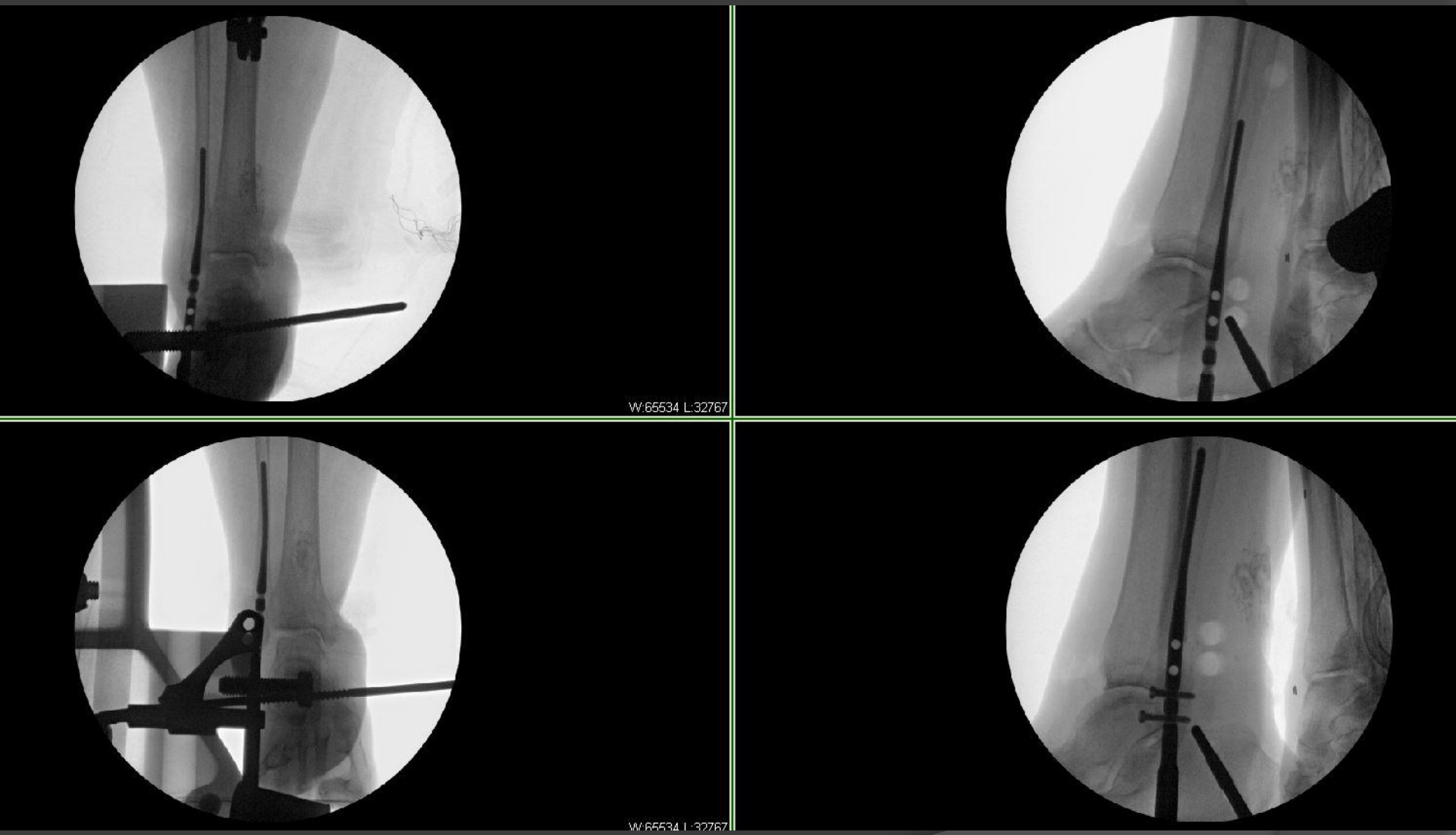
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R

Thank You


Easy, Mr. Gundersen. We just fire it up to check if the anesthesia has you fully asleep yet.
Bizek