

Ankle Fractures

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Epidemiology

- Most common weight-bearing skeletal injury
- Highest incidence in elderly women
- Unimalleolar 68%
- Bimalleolar 25%
- Trimalleolar 7%
- Open 2%

History

- Consider the relevant factors of the injury
- Mechanism of injury ✓
- Time elapsed since the injury ✓
- Soft-tissue injury ✓
- Has the patient ambulated on the ankle? ✓
- Patient's age / bone quality ✓
- Associated injuries ✓
- Comorbidities ✓

Physical Exam

- Neurovascular exam ✓
- Note obvious deformities ✓
- Pain over the medial or lateral malleoli ✓
- Palpation of ligaments about the ankle ✓
- Palpation along course of the entire fibula ✓
- 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 ✓
- Examine the hindfoot and forefoot ✓

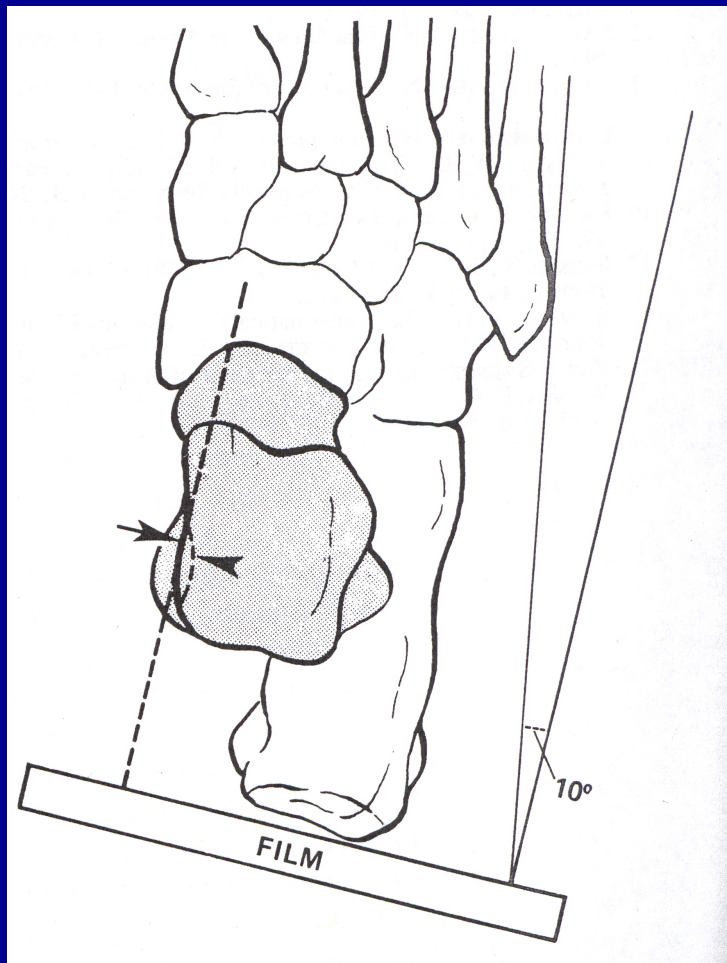
Radiographic Evaluation

- Plain Films

- AP, Mortise, Lateral views of the ankle
- Image the entire tibia to knee joint
- Foot films when tender to palpation
 - Common associated fractures are:
 - 5th metatarsal base fracture
 - Calcaneal fracture



Mortise View



10 degrees internal rotation of 5th MT with respect to a vertical line

Goergen JBJS 1977

Other Imaging Modalities

- **Stress Views**
 - Gravity stress view [Michelson CORR 2001]
 - Manual stress views
- **CT**
 - Joint involvement
 - Posterior malleolar fracture pattern
 - Pre-operative planning
 - Evaluate hindfoot and midfoot if needed
- **MRI**
 - Ligament and tendon injury
 - Talar dome lesions
 - Syndesmosis injuries



Understanding Ankle Fractures

- Classification systems
 - Lauge-Hansen
 - Weber
 - OTA
- Additional Anatomic Evaluation
 - Posterior Malleolar Fractures
 - Syndesmotic Injuries
 - Common Eponyms

Understanding Ankle Fractures

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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

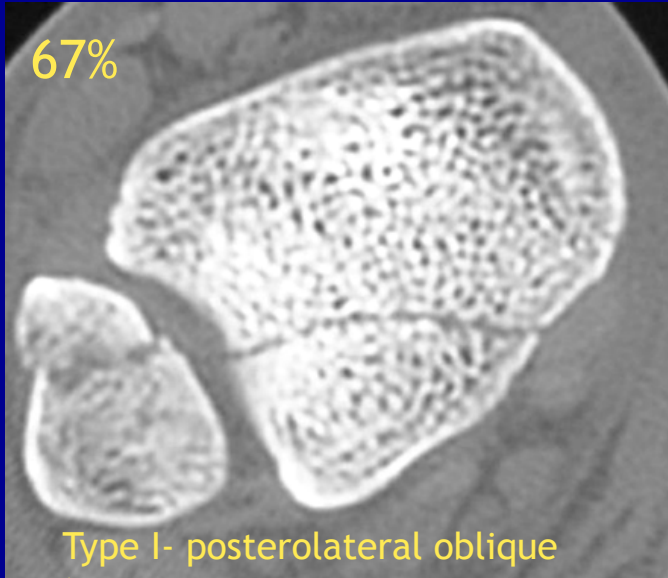


Understanding Ankle Fractures

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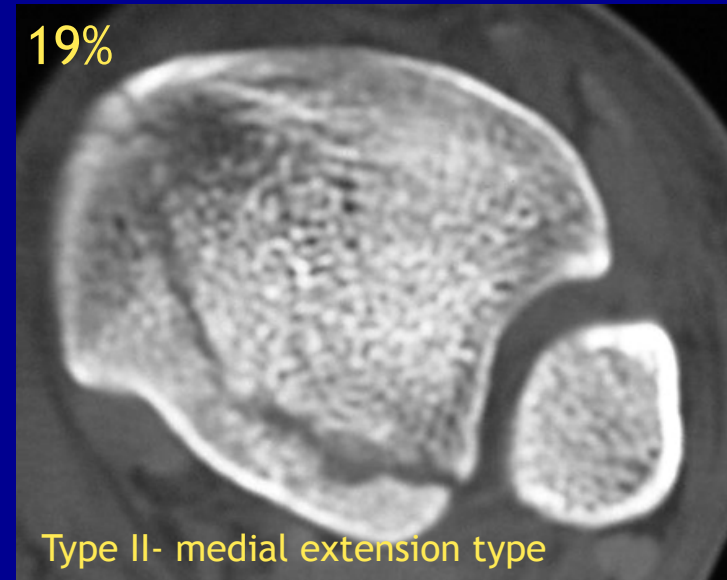
Posterior Malleolus Fracture

67%



Type I- posterolateral oblique type

19%



Type II- medial extension type

14%



Type III- small shell type

Understanding Ankle Fractures

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Syndesmotic Injury: Treatment



IF INSTABILITY PRESENT → OPERATIVE INTERVENTION

OBTAINING & MAINTAINING ANATOMIC REDUCTION
REDUCES LONG TERM DISABILITY & IMPROVES sMFA

Leeds JBJS 1984

Weening JOT 2005

Ankle Fracture Treatment

Nonoperative Treatment

- Indications:
 - Nondisplaced stable fracture with intact syndesmosis
 - Patient whose overall condition is unstable and would not tolerate an operative procedure
- Management:
 - Below the knee cast for 4-6 weeks
 - Follow with serial x-rays and transition to walking boot or short-leg walking cast

Nonoperative Treatment

- Clinical example

- SER injury

- Treated in walker boot WBAT

- Films 4 months post injury show healed stable mortise

- Less than 3 mm displacement of the isolated fibula fracture with a reduced ankle mortise does not require surgery



Operative Treatment: Surgical Indications

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



Operative Treatment: Initial Management

- If displaced → closed manipulative reduction (sedation may be necessary)
 - If reduced → Compression dressing, splint, elevate
 - If soft tissue appropriate → to OR for fixation
 - If swelling excessive [absent wrinkles, blisters] → continue elevation
 - If irreducible → to OR for reduction and provisional vs definitive stabilization
- Pain control



Open Ankle Fractures

- Treat with appropriate antibiotics pre-op and 48 hr post-op
- I & D with immediate ORIF if clean wound
- ORIF and Ex Fix if severe soft tissue damage present to allow for wound care
- Low grade open results similar to closed fractures
- High grade open results have increased cost, increased number of complications, and poorer overall outcomes

Soft Tissue Problems

- Dislocation with skin compromise
 - Immediate reduction required!
 - If the talus is not reduced beneath the plafond, there is increased pressure on the skin and increased risk of skin breakdown, that all may lead to wound breakdown and infection
 - 10% have skin slough when a timely reduction is not obtained



Ligamentous and Tendon Injuries About the Ankle

Ankle Sprains

- Most common ligamentous injury
- One sprain per day per 10,000 people
- 40% will have intermittent chronic problems (Garrick, Am J Sports Med, 1977)
- More common on the lateral aspect of the ankle

Ankle Sprain

- Differential Diagnosis
 - Syndesmotic Injury
 - Peroneal tendon subluxation
 - Posterior tibial tendon tear
 - Achilles tendon tear
 - 5th metatarsal base fracture
 - Midfoot injuries
 - Lateral talar process fracture
 - Anterior process of calcaneus fracture

Ankle Sprain

- History
 - Description of the injury
 - Position of the ankle during the injury
 - Able to continue to play or bear weight
 - Previous injury
 - Site of injury

Ankle Sprain

- Physical Exam
 - Palpation over medial and lateral malleoli
 - Palpation over deltoid ligament
 - Palpation over ATFL, CFL, and PTFL
 - Neurovascular exam
 - Anterior drawer test for ATFL
 - Talar tilt to assess CFL
 - Squeeze test to look for syndesmotic injury

Lateral Ankle Sprains

- Commonly missed diagnoses
 - Peroneal tendon injuries
 - Achilles injuries
 - FX's
 - Lateral process of talus
 - Anterior process of calcaneus
 - Fifth metatarsal
 - Lisfranc injuries
 - Osteochondritis dessicans

Lateral Ankle Sprains

- X-rays are based on careful physical exam
- MRI rarely indicated in the acute setting
- Consider stressing syndesmosis and Lisfranc joints if injury is suspected

Ankle Sprain Treatment

- RICE (Rest, Ice, Compression, Elevation) with ankle brace initially and protected weight bearing for Grade I and II
- ROM exercises
- Peroneal strengthening and proprioceptive training
- Bracing or taping for 4-6 weeks depending on activity
- Return to sports when able to cut without pain
- Severe sprain may require up to 6 months of protective bracing

Ankle Sprain Treatment

- Grade III sprain may require a walking boot or a cast for 4 - 6 weeks
- Extended period of protective bracing may be warranted
- Return to play criteria remain the same
- Need to be aware of possibility for syndesmosis injury (high ankle sprain)

Lateral Ankle Sprains

- Management surgical
 - Acute surgical repair not supported by literature
 - symptomatic chronic instability may require surgical intervention
 - Anatomic Brostrom repair favored over nonanatomic rerouting procedures

Medial Ankle Sprain

- 5% ankle sprains
- Forced eversion
- Injury to deltoid ligament
- May be associated with syndesmotic injury and/or Weber C fibula FX



Medial Ankle Sprain

- Tenderness/ swelling over deltoid
- External rotation test elicits pain in the deltoid and possibly in syndesmosis



Medial Ankle Sprain

- AP/LAT/OBLIQUE ankle x-rays to assess mortise and syndesmosis
 - Medial joint space widening
 - Syndesmotic widening
 - Presence fibula FX
- Consider external rotation stress x-rays if syndesmotic disruption is suspected

Medial Ankle Sprain

- **Management**

- **Stable (no talar subluxation)**

- Similar to lateral sprains

- RICE, early wgt bearing, early ROM, functional brace, functional rehab

- **Unstable (talar subluxation)**

- No talar subluxation is acceptable
 - Anatomic reduction and surgical stabilization of syndesmosis

Chronic Lateral Ankle Instability

- Persistent mechanical instability of the talocrural joint
- Develops after acute rupture in up to 20% of patients
- Related to functional lateral ankle instability
 - Defined by: frequent sprains, diff running on uneven surfaces, diff jumping or cutting
 - Related to: previous ankle sprain, chronic ankle instability, peroneal weakness
- Treatment: supervised rehabilitation program focusing on peroneal strengthening, proprioception, and coordination

Surgical Indications: Chronic Ankle Instability

- Continued instability or recurrent injury despite supervised rehabilitation and functional bracing (Semirigid pneumatic ankle brace).
- Surgical treatments
 - *Evans Procedure*- recon using entire P.Brevis
 - *Watson-Jones*: entire P.Brevis anatomic recon ATFL
 - *Chrisman-Snook*: recon ATFL and CFL using split P. Longus graft
 - *Modified Brostrom* procedure: direct repair of ligament, modified by Gould such that inferior ext retinaculum is used to reinforce repair

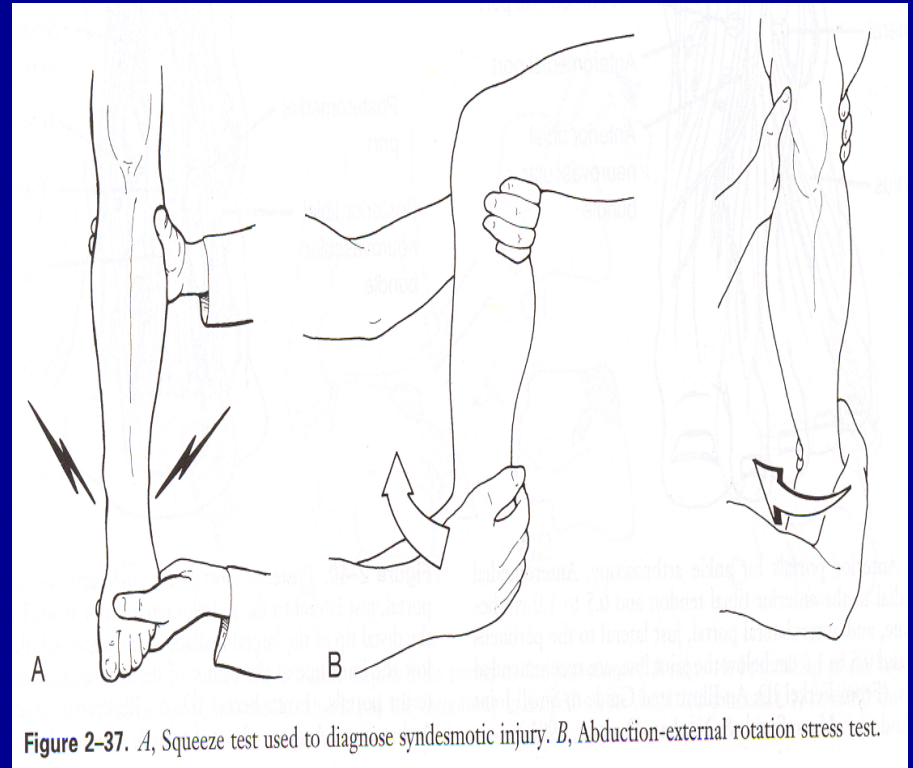
Syndesmosis Injury

- 10% of ankle sprains
- Rupture of the interosseous ligaments between the tibia and fibula with or without fibular fracture
- Medial malleolar fracture or deltoid ligament rupture
- Persistent instability and gap in the joint after bimalleolar fixation



Syndesmosis Exam

- Squeeze Test
 - Squeeze the syndesmosis above the ankle → pain
- Abduction-External Rotation Stress Test
 - Further instability with external rotation (may be shown with x-ray)



Syndesmotic (High) Ankle Sprains

- AP/LAT/OBLIQUE ankle x-rays
 - Syndesmotic widening
 - Medial joint space widening
 - Presence of fibula FX
- External rotation stress x-rays
 - Severe pain associated with normal x-rays
- Must get tib/fib x-rays to rule out high fibula fracture



Syndesmosis Injury

- Treatment
 - Non-displaced without fracture
 - May consider casting for 6 weeks (high ankle sprain)
 - Surgical treatment with syndesmotic screws/tightrope
 - Displaced
 - Surgical treatment with syndesmotic screws/tightrope

Achilles Tendon Rupture

- History
 - Acute pain in the back of the ankle with contraction, no antecedent history of calf or heel pain
 - Average age 35
 - Steroids, fluorquinolones, and chronic overuse may predispose to rupture
- Pathology
 - Rupture occurs 3-4 cm above the Achilles insertion in a watershed area

Achilles Tendon Rupture

- Physical Exam

- Tenderness over achilles tendon
- Palpable defect
- Positive Thompson's test
- Needle test- needle inserted midline 10cm proximal to the superior aspect of the calcaneus moves towards the foot when the calf is squeezed



Achilles Tendon Ruptures

- Surgical repair
 - Younger active patients
- Nonoperative treatment
 - Older sedentary patients
 - Patients with increased risk of soft tissue complications
 - IDDM
 - Smokers
 - Vascular disease

Indications of Non-Operative Versus Operative Treatment

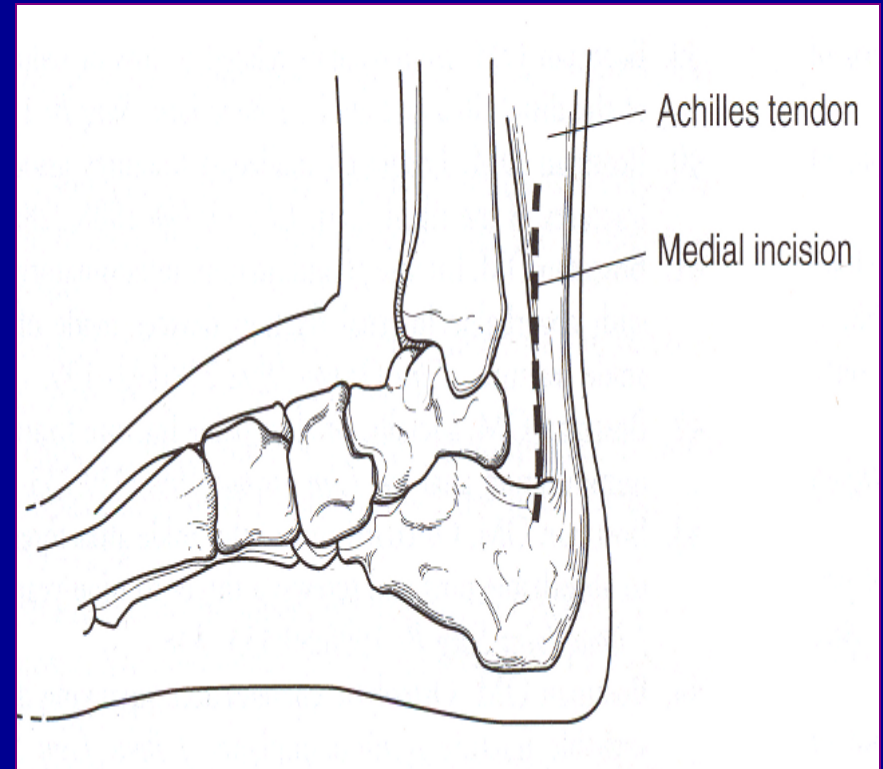
- Indications:
 - Non-Operative Tx may be indicated for older patients with minimally displaced ruptures
 - Non-Operative may be indicated for patients who are at an increased operative risk due to age or medical problems
 - Note that younger patients w/ expectations of participating in sports such as basketball may not be good candidates for non operative Tx

Management of Non-Operative Tx

- Short leg cast strategy (SLC)
 - SLC is applied w/ ankle in plantarflexion
 - Cast is brought out of equinus over 8-10 weeks
 - Walking is allowed (in the cast) at 4-6 weeks
 - Alternatively, consider using functional brace starting in 45 degrees of flexion
 - Following casting, a 2 cm heel lift is worn for an additional 2-4 months
- Long leg cast (LLC)
 - Initial LLC in gravity equinus for 6 weeks, followed by short leg cast for 4 weeks

Achilles Tendon Rupture

- Surgical treatment
 - Preferred for athletes
 - Medial incision avoids the sural nerve
 - Percutaneous vs. Open treatments described
 - Isolate the paratenon as a separate layer



Chronic Achilles Tendon Rupture

- History

- Remote hx trauma, post pain, gradual improvement of symptoms, palpable tendon defect.
- No hx trauma, gradual thickening of tendon, AM startup pain, pain ascending/descending stairs.

- Physical Exam

- “Hatchet” posterior calf at site of defect at resolution of swelling
- Positive Thompson test
- Weakened plantar flexion



Tibial Plafond Fractures

Topic Outline

- Introduction
- Incidence
- Local anatomy and mechanism
- Classification
- History and complications
- Treatment techniques
- Results
- Summary and Conclusions



The Spectrum of Fracture



The Spectrum of Soft Tissue Injury



The Soft Tissue Injury!!

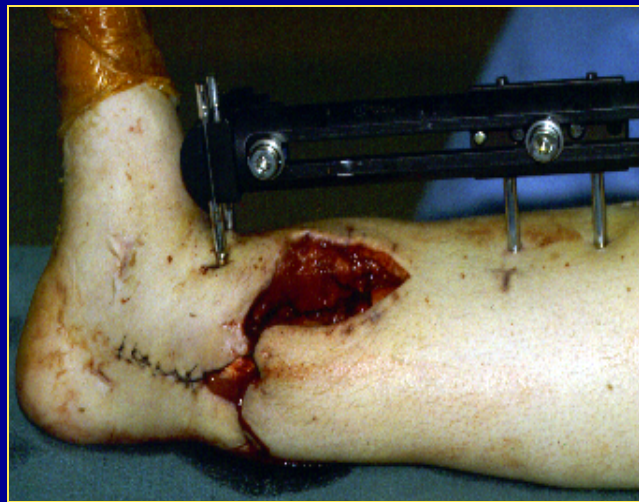
Red Blisters



Clear Blisters



Open Fracture



Tibial Plafond Fractures - Results

General Comments

- Terrible Injuries
- “Excellent Results” are rarely achieved
- Fair-Good results are the norm
- Outcomes are impossible to predict
- Treatment complications must be avoided

Tibial Plafond Fractures - Results *Terrible Injuries*



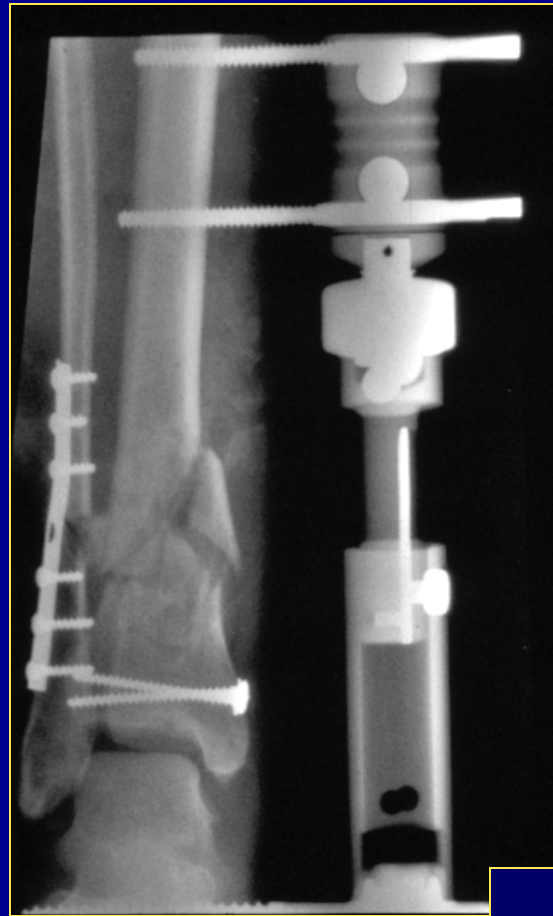
Bone



Soft Tissue

Tibial Plafond Fractures

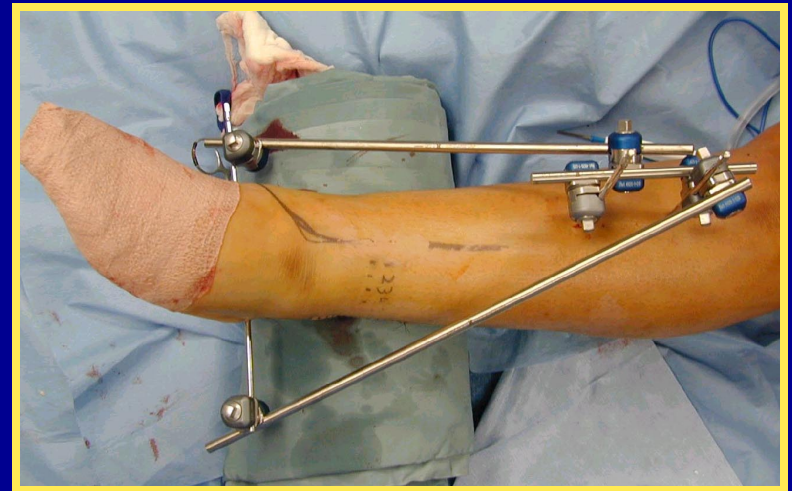
Excellent results are only rarely achieved



Unusually good!

Reduction: Ligamentotaxis

- External fixator
- Femoral distractor
- Manual traction
- Well placed clamps



Fractures and Dislocations of the Mid-foot Including Lisfranc Injuries

Lisfranc's Joint Injuries

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

Incidence

- Generally considered rare (1 per 55,000 people per year or 15/5500 fractures)
- As index of suspicion increases, so does incidence
- Approximately 20% of Lisfranc's injuries may be overlooked (especially in polytraumatized patients)

Mechanisms of Injury

- Trauma: motor vehicle accidents account for one third to two thirds of all cases (incidence of lower extremity foot trauma has increased with the use of air bags)
- Crush injuries
- Sports-related injuries are also occurring with increasing frequency

Diagnosis

- Requires a high degree of clinical suspicion
- 1. 20% misdiagnosed
- 2. 40% no treatment in the 1st week
- Be wary of the diagnosis of “midfoot sprain”

Clinical Findings

- Midfoot pain with difficulty in weight bearing
- Swelling across the dorsum of the foot
- Deformity variable due to possible spontaneous reduction



Clinical Findings

- Ecchymosis may appear late
- Local tenderness at tarsometatarsal joints
- Gentle stressing plantar/dorsiflexion and rotation will reveal instability



Clinical Findings

- Check neurovascular status for compromise of dorsalis pedis artery and/or deep peroneal nerve injury
- Asses for possible **COMPARTMENT SYNDROME**



Radiographic Evaluation

- AP, Lateral, and 30° Oblique X-Rays are mandatory
- AP: The medial margin of the 2nd metatarsal base and medial margin of the medial cuneiform should be aligned



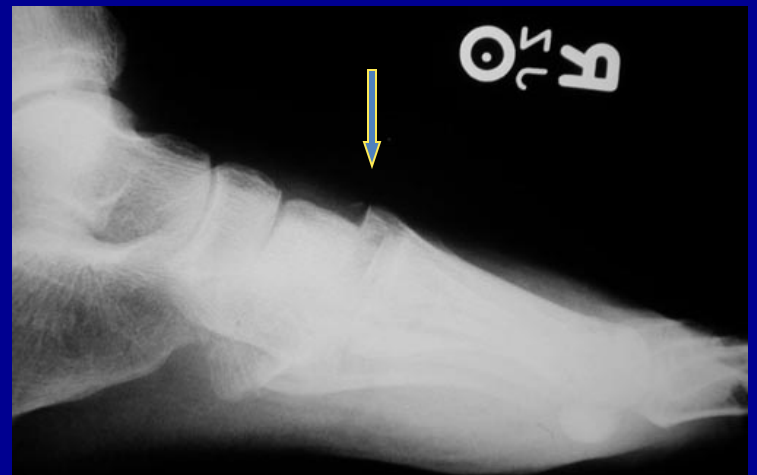
Radiographic Evaluation

- Oblique: Medial base of the 4th metatarsal and medial margin of the cuboid should be aligned



Radiographic Evaluation

- Lateral: The dorsal surface of the 1st and 2nd metatarsals should be level to the corresponding cuneiforms

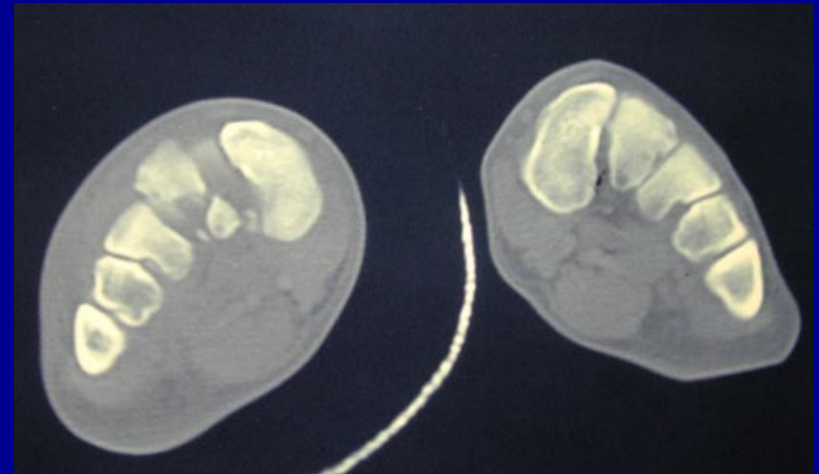


Radiographic Evaluation

- Standing views provide “stress” and may demonstrate subtle diastasis
- Comparison views are very helpful
- Associated fractures:
 1. Base of 2nd metatarsal
 2. Avulsion navicular
 3. Isolated medial cuneiform
 4. Cuboid

Radiographic Evaluation

- Additional imaging:
 - 1. True stress views or fluroscopy
 - 2. CT Scans
 - 3. Bone scan – for persistent pain with no radiographic findings
 - 4. If suspicious: repeat x-rays and keep looking



Treatment

- Early recognition is the key to preventing long term disability
- Anatomic reduction is necessary for best results: displacement of $>1\text{mm}$. or gross instability of tarsometatarsal, intercuneiform, or naviculocuneiform joints is unacceptable
- Goal: obtain or maintain anatomic reduction
-

Treatment

- Nonoperative: for nondisplaced injuries with normal weightbearing or stress x-rays

- Short leg cast
- 4 to 6 weeks nonweight bearing
- Repeat x-rays to rule out displacement as swelling decreases
- Total treatment 2-3 months