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Midfoot Fractures and Dislocations

Todd A. Irwin, M.D.
OrthoCarolina Foot and Ankle Institute
Associate Professor
Atrium Musculoskeletal Institute

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Disclosure

- Paid Consultant
  - Paragon28
  - Medline
  - GLW/Carbon-22
- Royalties
  - Paragon28
- Committees
  - Chair, AOFAS Post-Graduate Education Committee

- Nothing pertinent to this talk

The Significance of Foot Trauma

- Prospective comparison of polytrauma with or without foot trauma

SF-36 mean score LOWER with foot trauma

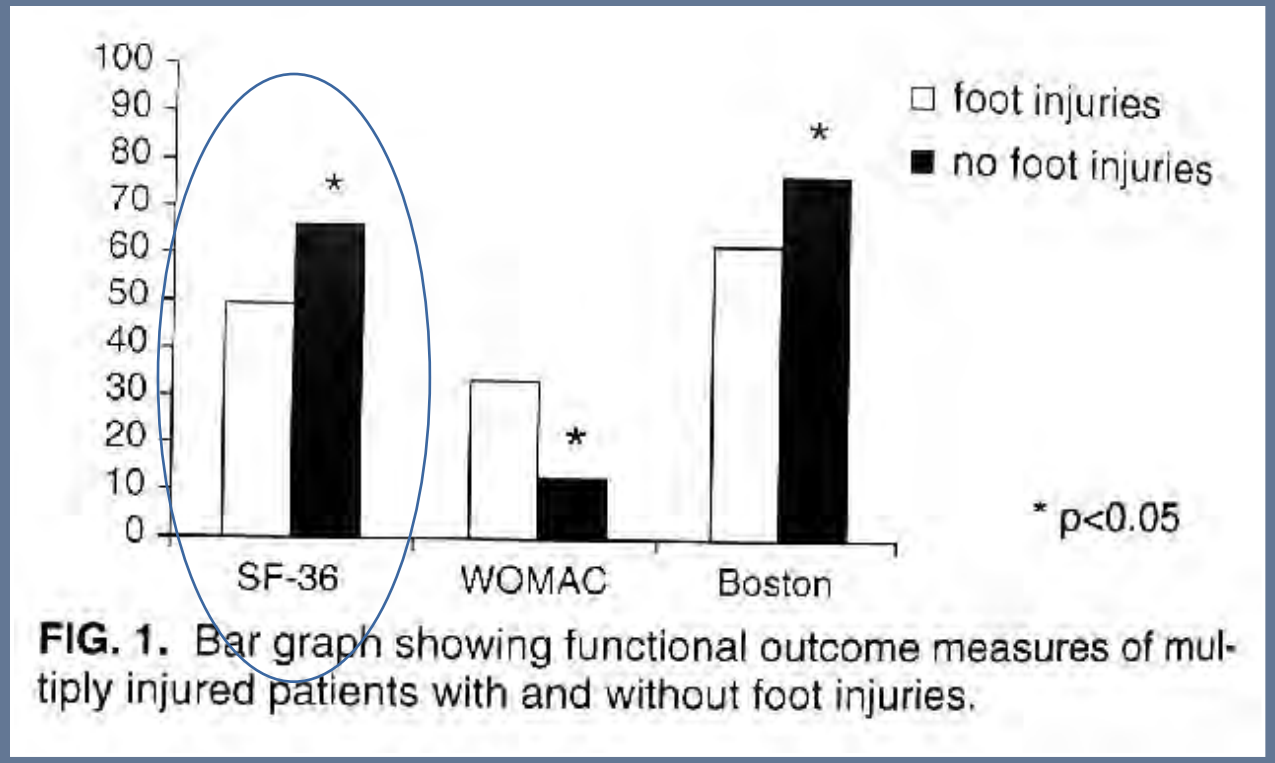

FIG. 1. Bar graph showing functional outcome measures of multiply injured patients with and without foot injuries.

Turchin et al, JOT, 1999

Midfoot Injuries

“Sporty”

“Not sporty”

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Midfoot Injuries

- Initial

- 1 week later

- 2 weeks later

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Lisfranc Injuries

- The Lisfranc joint or the tarsometatarsal (TMT) joint complex is named after Jacques Lisfranc de St. Martin
  - French field surgeon and gynecologist
    - Described an amputation thru the TMT joint
    - Secondary to a vascular injury from a soldier falling from a horse with his foot caught in the stirrup

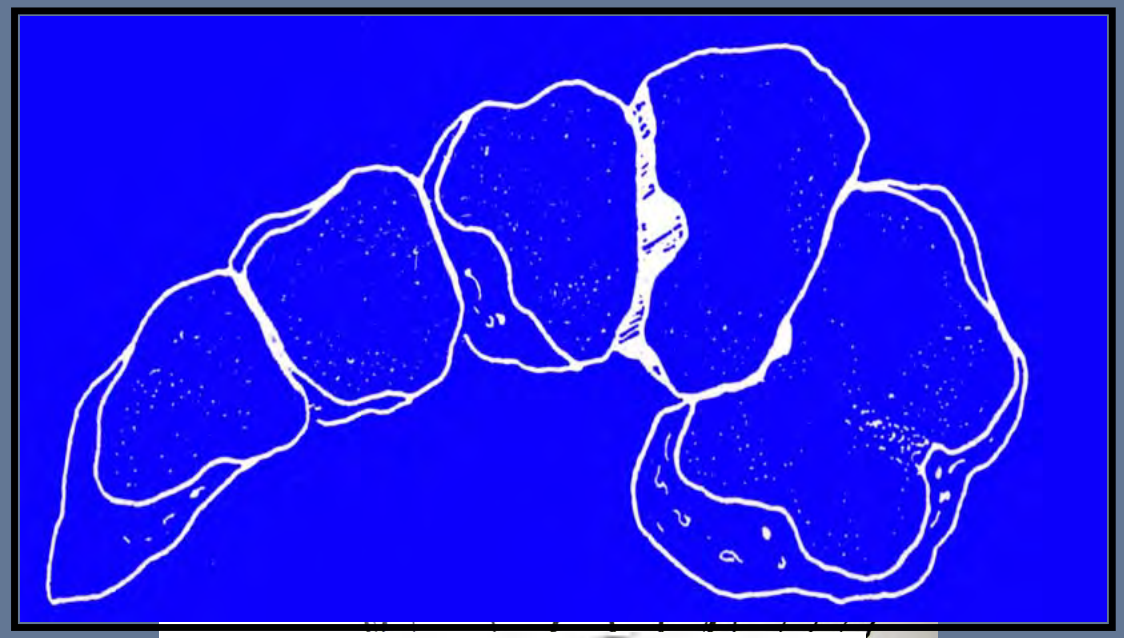
Anatomy

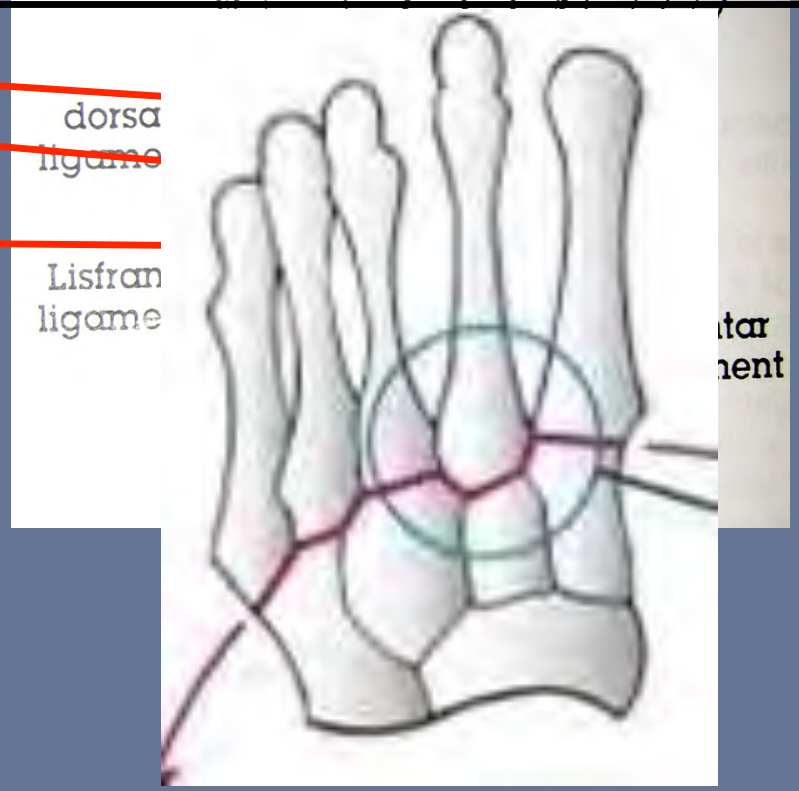
- **Lisfranc complex**
- **Medial cuneiform – 2nd metatarsal ligament**

(Solan et al. Foot Ankle Int 2001: 22(8) and de Palma et al. Foot Ankle Int 1997: 18(6)

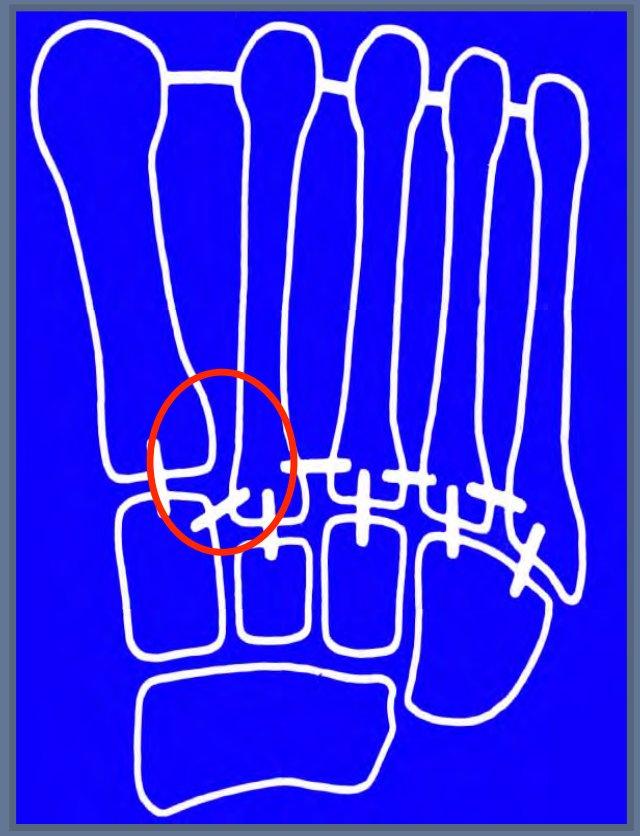
  - Dorsal ligament
  - Interosseous (Lisfranc ligament)
  - Plantar ligament (inserts into 2nd and 3rd metatarsal bases)

- Bony anatomy
  - Roman arch
    - Trapezoidal shape of cuneiforms
  - Keystone





Ligamentous Anatomy



No transverse ligament b/t 1st-2nd MT base

- Biomechanical evaluation (Solan et al. Foot Ankle Int 2001: 22(8))

	Stiffness(N/mm)	Strength(N)
• Dorsal	40 ± 9	170 ± 33
• Lisfranc	90 ± 3	449 ±58
• Plantar	62 ± 3	305 ± 38

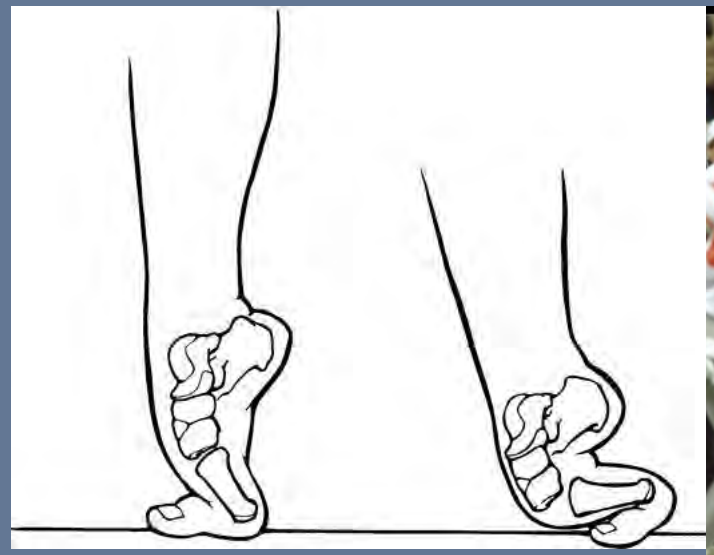
- Lisfranc ligament is stiffest and strongest overall

Anatomy

- 3 Column Model
  - Medial Column
    - Medial Cuneiform
    - 1st Metatarsal
  - Middle Column
    - Middle and Lateral Cuneiforms
    - 2nd and 3rd Metatarsals
  - Lateral Column
    - Cuboid
    - 4th and 5th Metatarsals

Diagnosis

- Indirect Mechanism of Injury
  - **Loading of plantarflexed foot**
    - Failure of weak dorsal ligaments
  - "Sporty"
  - Most common mechanism
    - Sports injuries
    - Football/Rugby
      - Tackled from behind



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Diagnosis

- Direct Mechanism of Injury
  - Loading or crushing of dorsum of foot
  - Significant soft tissue injury
    - Compartment syndrome
  - Open injuries

Diagnosis

- Clinical evaluation
  - Indirect may be subtle
  - Tenderness @ TMT
  - Swelling
  - Ecchymosis
    - Plantar indicates severe soft-tissue disruption
  - Pain at TMT joint 2°
    - PROM metatarsal heads
    - Weightbearing
    - Single limb rise

  - MUST HAVE HIGH INDEX OF SUSPICION!

Diagnosis

- Radiographic signs
  - AP view – 15^{o} cephalad tilt (Stein RE. Foot Ankle, 1983)
  - **MUST BE WEIGHTBEARING**
    - Medial border 2nd TMT
  - 30^{o} oblique view (Stein RE. Foot Ankle 1983)
    - Lateral border of 3rd TMT
    - Medial border 4th TMT

Diagnosis

- Radiographic signs
  - Dorsal TMT subluxation
  - Fleck sign

Diagnosis

- Radiographic signs
  - Medial border 2nd TMT, 4th TMT
  - Dorsal TMT subluxation
  - Fleck sign
  - MTP dislocation
  - Cuboid compression

Radiographic Findings

- Subtle – WEIGHTBEARING IS CRITICAL!

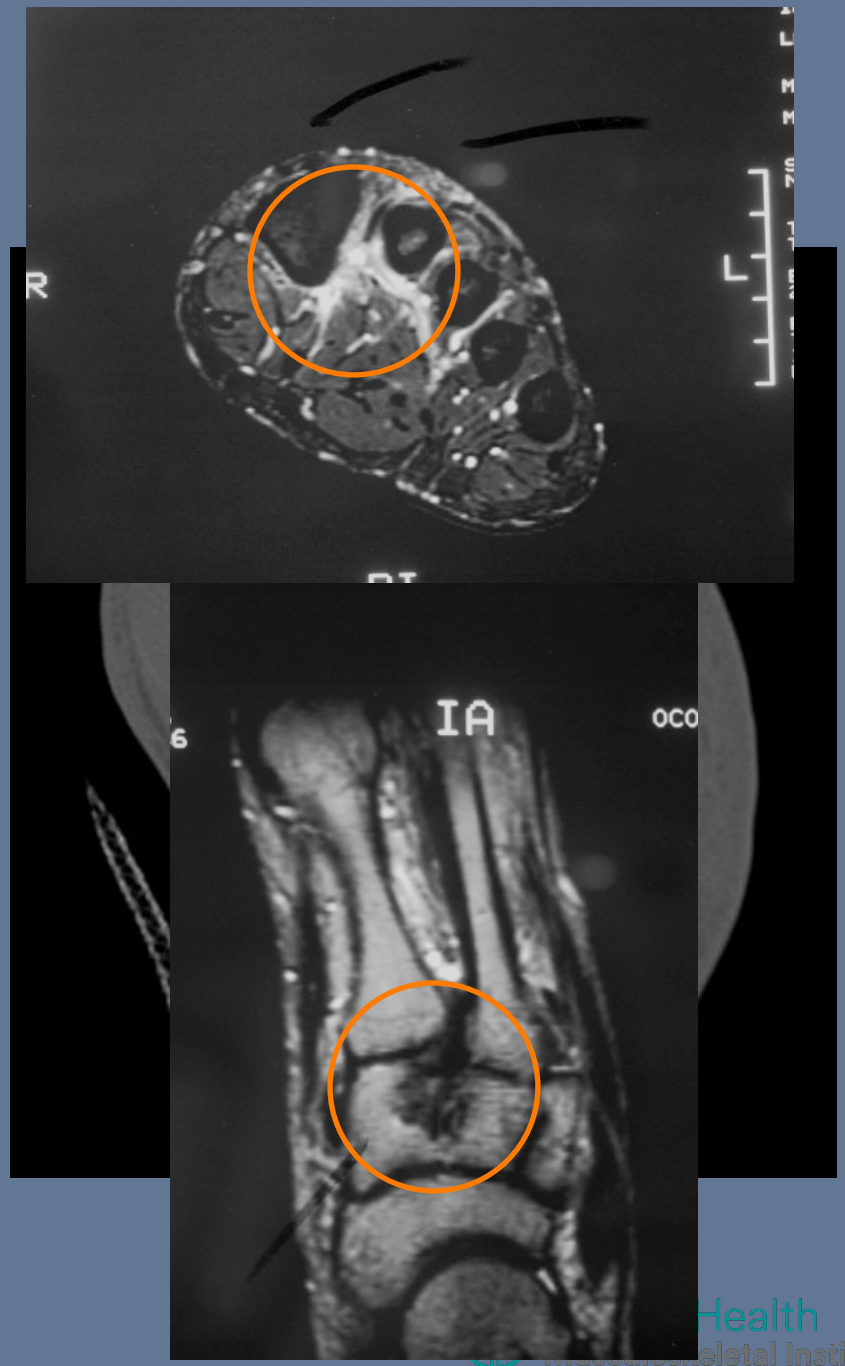
Comparison view

Diagnosis

- Proximal variant
  - AKA “Longitudinal Lisfranc”
  - Forces transmit through intercuneiform jt
  - Exit Naviculocuneiform jt
  - Unstable 1st ray

Diagnosis

- CT
  - My ”go-to” study
- MRI
  - Subacute/unclear
- Exam under anesthesia
  - Less common, but useful



Treatment

- Stable midfoot sprain
  - Likely dorsal ligamentous injury
  - No diastasis/instability
  - Boot immobilization

Surgical Indications

- 1-2 mm displacement
- Unstable pattern confirmed by stress
- Open fracture
- Neurovascular compromise

ORIF (with or without Primary Arthrodesis) = Treatment of Choice

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ORIF Outcome

- 48pts, 4.5 yr f/u
  - 25% develop OA
  - 12% required fusion
  - **Best result with anatomic reduction**
  - Purely ligamentous injuries did worse
    - **Hansen,** 2000

Other Treatment Options

- Nonoperative Treatment in Cast
  - Poor results – High rate of DJD
  - Consider if nondisplaced but use with caution
  - Close f/u

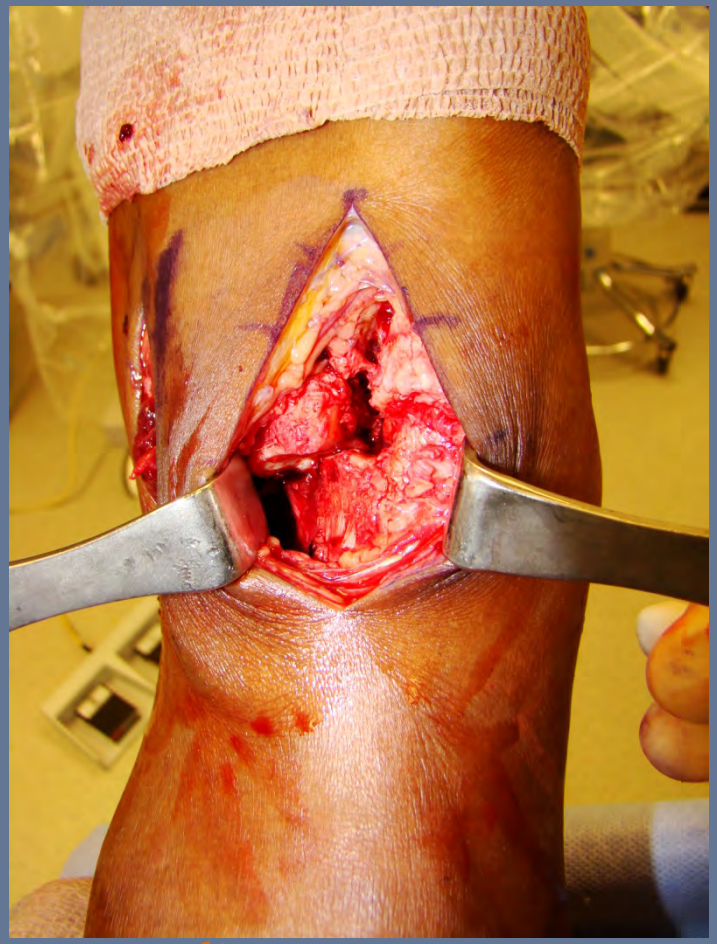
- Percutaneous Fixation
  - Wrong Answer
  - Cannot visualize joints – non anatomic reduction – DJD

- Tarsometatarsal Arthrodesis
  - More prevalent as primary treatment

Surgical Technique

- Anatomic reduction
  - ORIF (not percutaneous)
  - 1 or 2 dorsal incisions
    - Medial
      - 1st IM space
      - Access to 1st-2nd TMT
    - Lateral
      - 4th TMT
      - Access to 3rd thru 5th TMT

Surgical Technique



Avoid neurovascular bundle

Surgical Technique

- Fixation
  - Proximal to distal
  - Medial to lateral
    - Home-run screw
    - Screw fixation
    - Dorsal plate fixation
    - Suture button

Lateral Column Fixation

- K-wire utilized for 4th and 5th TMT
  - Lateral Column is mobile
  - Prevents Stiffness
  - Remove at 6 weeks.

- Do NOT fuse 4th and 5th

Surgical Technique

- Lateral column shortening
  - External Fixation
    - Restore length vs. provisional

Surgical Technique

- Lateral column shortening
  - External Fixation
    - Restore length vs. provisional
  - Bridge plating
  - ORIF Cuboid

Prognosis

- Depends on accuracy of reduction
- Expect long rehab (> 1 yr)
- Midfoot pain/stiffness avg 1.3 yrs postop
- 0-58% incidence of post-traumatic arthritis

TMT fusion vs. ORIF

- Primary midfoot fusion vs. ORIF (prospective, random)
  - 20 fusions, 20 ORIF, 3.5 yr f/u
  - AOFAS scores higher in fusions
  - 5 pts in ORIF group required later fusion
    - **Ly**, 2006

TMT Fusion vs. ORIF

- Primary arthodesis vs. ORIF
  - 32 fractures and fx-dislocations
  - No significant diff in SF-36 or SMFA
  - ORIF group
    - Increased secondary surgeries
    - Only 1/14 ORIF required salvage fusion
    - Henning et al, FAI 2009

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Primary Arthrodesis versus Open Reduction and Internal Fixation for Low-Energy Lisfranc Injuries in a Young Athletic Population

Grant Cochran, MD[1], Christopher Renninger, MD[1], Trevor Tompane, MD[1], Joseph Bellamy, MD[2], and Kevin Kuhn, MD[1]

- Military population, 14 PA and 18 ORIF
- Return to full duty: PA – 4.5 mo; ORIF – 6.7 mo
- Fitness test:
  - PA – 9 sec slower than preop
  - ORIF – 39 sec slower than preop

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DOI: 10.1177/1071100717719532
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Outcomes of Lisfranc Injuries in an Active Duty Military Population

Michael P. Hawkinson, MD[1], David J. Tennent, MD[2], Jeffrey Belisle, MD[2], and Patrick Osborn, MD[3]

- 171 low energy Lisfranc in military population
- No diff between PA and ORIF
- Salvage arthrodesis poorer outcomes

Primary Arthrodesis

- Indications:
  - Significant intraarticular comminution
  - Primarily ligamentous?
  - Ligamentous laxity?
  - Advanced Age?

  - Any Lisfranc injury????

  - What about the younger athlete?
    - Controversial, no consensus

Chronic/Post-traumatic

- Deformity
  - Pes Planovalgus
- Surgery
  - Re-alignment TMT/Midfoot Fusion
- Must restore alignment

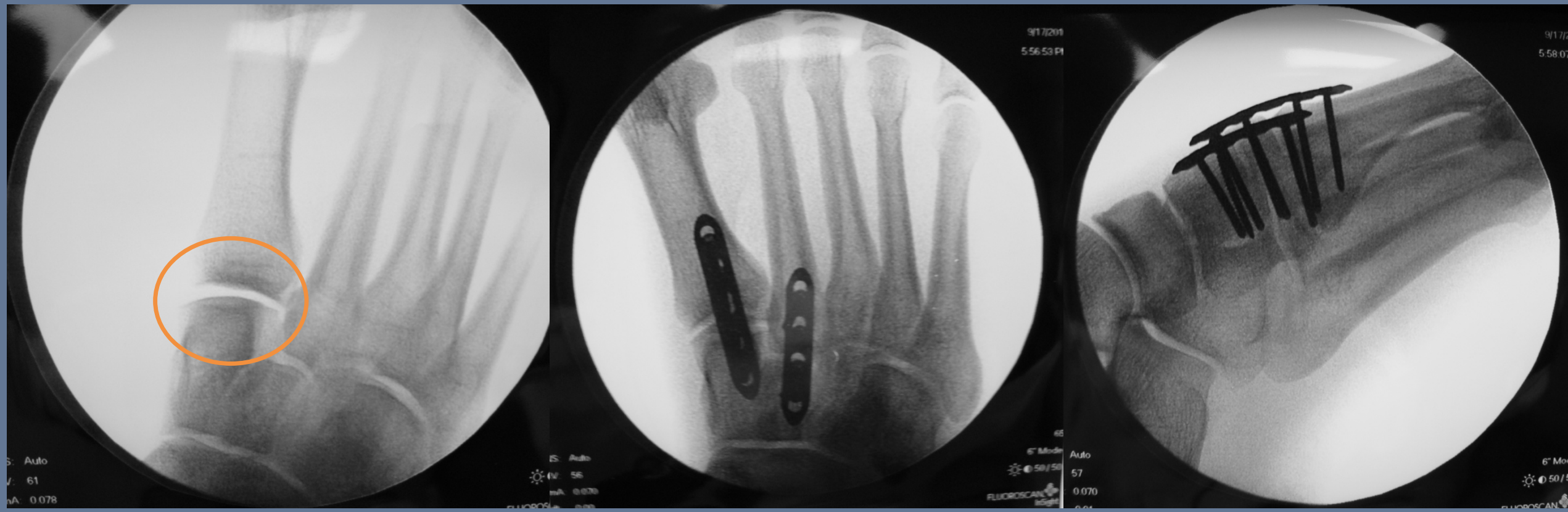
Case Example - ORIF

- 20 y old college student pregaming prior to college football game

Weight bearing view

Case Example - ORIF

Dorsal plate fixation



Initial Displacement Does Not Affect Loss of Reduction After Lisfranc Fracture Dislocations

Matthew T. Pigott, MD, Ronit Shah, BS, Jason Chan, MD, Todd A. Irwin, MD, James R. Holmes, MD, and Paul G. Talusan, MD

- 45 patients treated with ORIF (35 screws, 10 dorsal plates)
- All had hardware removed
- 89% with anatomic reduction
- 31% had final displacement > 2 mm, but only 1 went on to arthrodesis

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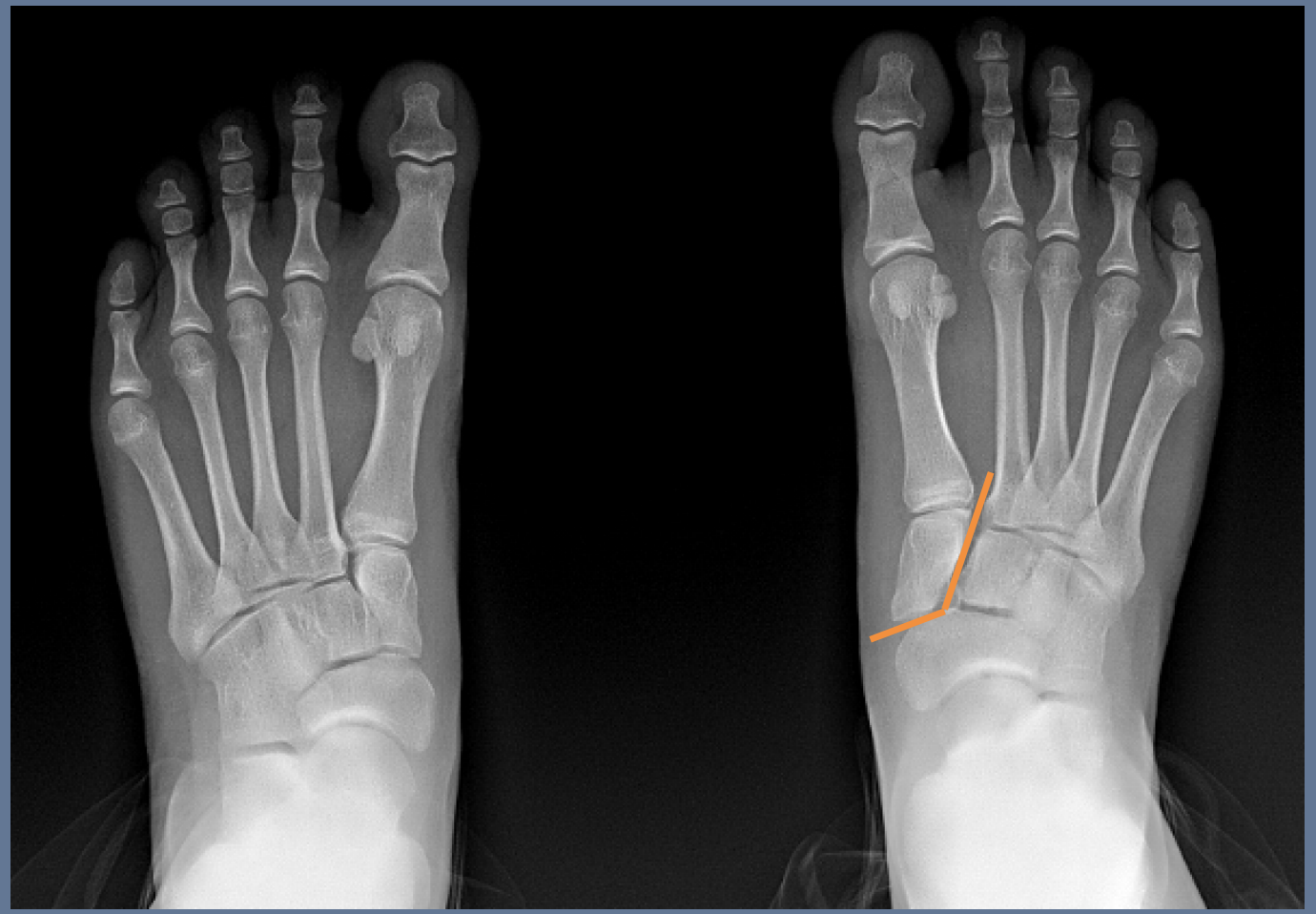
Case Example – Longitudinal Lisfranc

- 15 yo female, skeletally mature, tripped on some stairs



Case Example – Longitudinal Lisfranc

- 3 months postop

Injury Pattern in Ligamentous Lisfranc Injuries in Competitive Athletes

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2019, Vol. 40(2) 185–194

DOI: 10.1177/1071100718802264
journals.sagepub.com/home/fai

David A. Porter, MD, PhD[1], Adam F. Barnes, BS[1], Angela Rund, Med, ATC[1], and Madison T. Walrod[1]

- 82 patients
- Proximal extension occurred in 50% of patients

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Case Example – Primary Arthrodesis

- 56 y old female with DM, fibromyalgia
  - Mechanism: “Stepping into my pants”

Case Example – Primary Arthrodesis

Provisional pin fixation

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Case Example – Primary Arthrodesis

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64 yo female, fall at work

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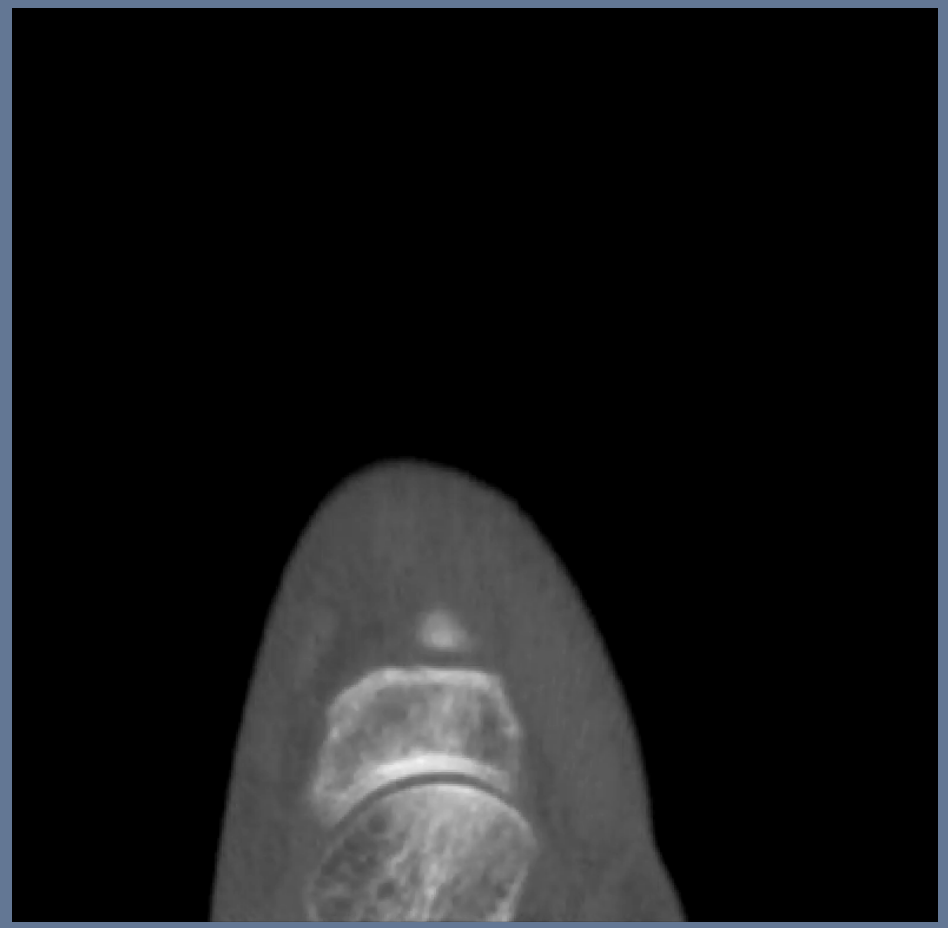

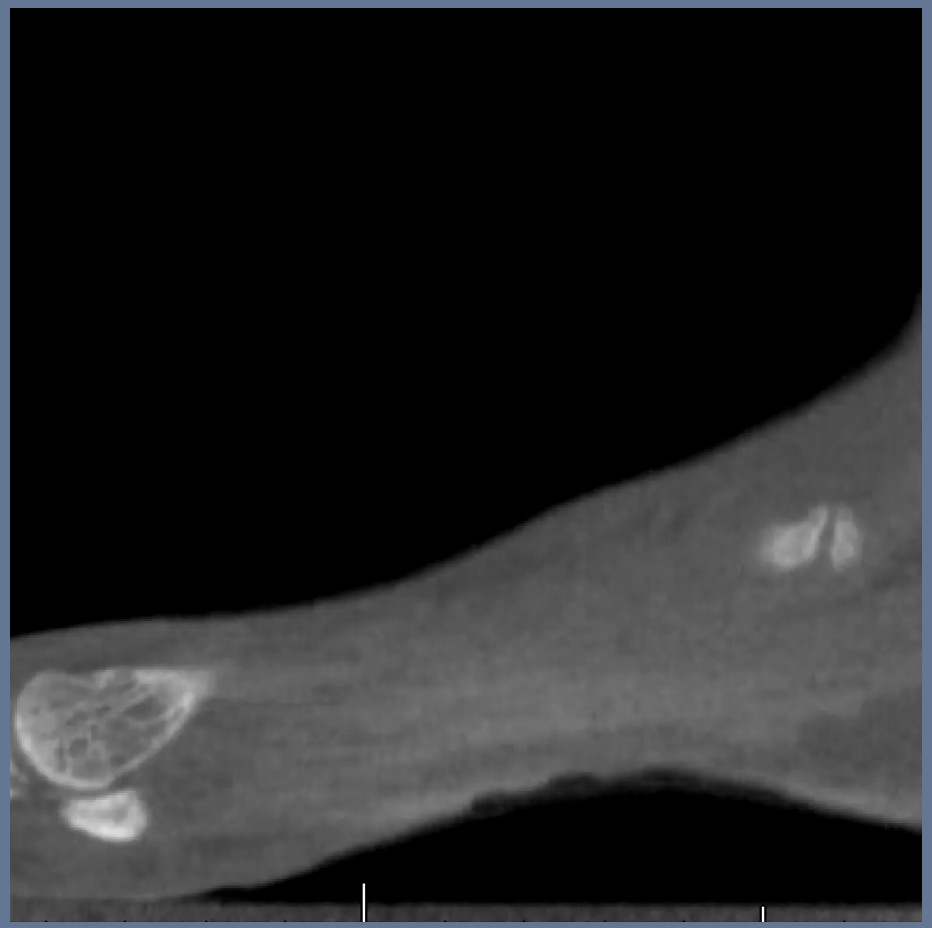

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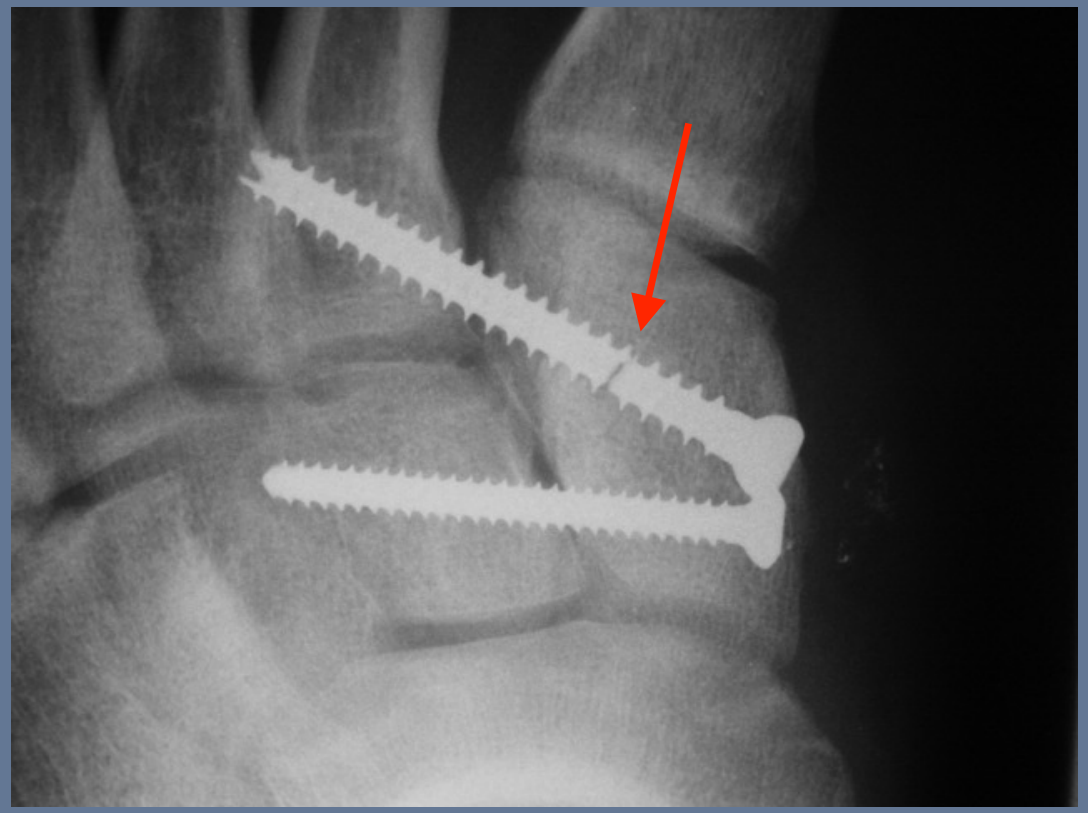
64 yo female, fall at work

- 1 year postop

Hardware Removal?

- Screw removal at 4-6 months
  - Non-athlete – remove only if symptomatic?
  - Inform about possible screw breakage



Post operative Management

- Splint, NWB x 2 wks
- Boot, NWB x 4 wks (Cast in primary fusion)
- WB Boot x 4-6 wks
    - May need longer in primary fusion
    - Screw removal around sports schedule
        - Allow 6-8 wks downtime

Lateral Lisfranc with Cuboid Fracture

- 58 yo female who slammed her foot on the brakes

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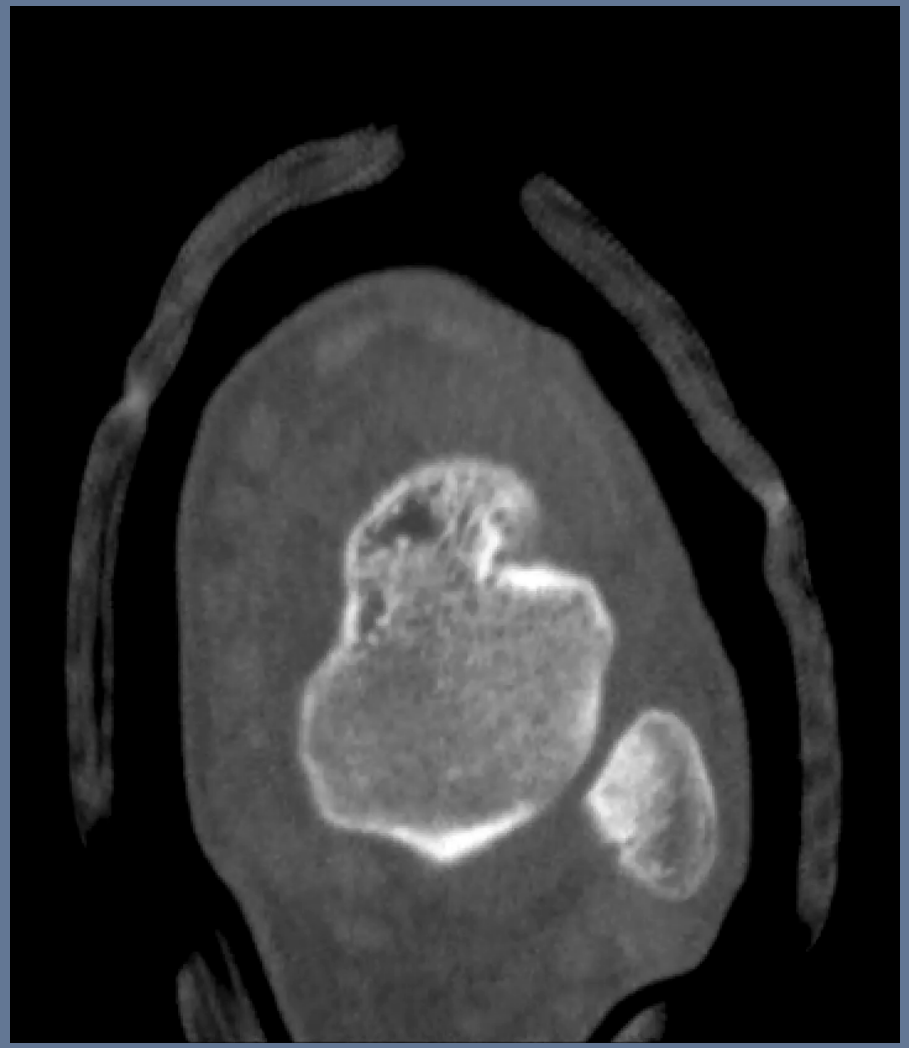
Lateral Lisfranc with Cuboid Fracture

- 6 wks postop
- 3 mo postop

Navicular fracture

- 12 yo female, mother accidentally drove over the patient's foot

Navicular fracture



Navicular fracture

- 3 mo postop

Summary

- Lisfranc Ligament – Medial cuneiform to 2nd metatarsal
- Plantarflexed Foot and Sports = Lisfranc Injury
- Radiographs – Must be WB. Subtle = Still Broken
- Treatment = Open Reduction and Internal Fixation
- Alternate Treatment = Midfoot Fusion
- Best Answer for the Test = ORIF
- Chronic/DJD – Realignment Midfoot Fusion

Thank you

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