Imaging of Lisfranc Injury

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Agenda

- Case Presentation
- Introduction
- Anatomy
- Lisfranc Injury
- Classification
- Imaging
- Treatment
Case Presentation

• 72M with Parkinson’s disease presents with R foot injury, sustained while walking
  – Severe pain, swelling, and inability to bear weight
  – Exquisite tenderness to palpation over 2nd tarsometatarsal joint, somewhat less tender over remaining tarsometatarsal joints
  – Plantar ecchymosis
  – Neurovascularly intact distally
  – No evidence of compartment syndrome
Radiograph

- Standing AP of bilateral feet
- Left:
  - No acute fracture or dislocation
- Right:
  - Widening between 1\textsuperscript{st} and 2\textsuperscript{nd} metatarsal bases
  - Loss of normal colinearity of medial border of 2\textsuperscript{nd} metatarsal with medial border of middle cuneiform
  - “Fleck” fractures around base of second metatarsal
  - Fractures of bases of first, second, and third metatarsals, medial and middle cuneiforms, and navicular, with intra-articular extension

\rightarrow Lisfranc Injury
Jacques Lisfranc

• Jacques Lisfranc de St. Martin (1790-1847)
  – French surgeon and gynecologist
  – While serving in Napoleon’s army, described an injury to the tarsometatarsal (TMT) joint in a soldier who fell from a horse with his foot caught in the stirrup
  – This unfortunate soldier sustained a vascular injury as well and underwent partial amputation of the foot at the TMT joint, which Lisfranc reportedly performed in under 1 minute

• “Lisfranc” eponym is currently applied to various structures of and injuries to the TMT joint complex

Anatomy: Lisfranc Joint Complex

Ligamentous Stability

Osseous Stability

Introduction: Lisfranc Injuries

- Range from mild sprains to severe dislocations
  - Associated with tarsal and metatarsal fractures
- ~0.2% of all fractures
- 20% are missed/misdiagnosed initially
  - Especially in polytraumatized patients
- Mechanism:
  - 2/3 are high energy (MVA, fall from height, industrial accident)
  - 1/3 are low energy (~4% of American football players per season)
  - Twisting, axial loading, and/or crushing
- High index of suspicion necessary
  - Goal: avoid sequelae of posttraumatic arthritis

Clinical Evaluation: Lisfranc Injuries

- Pain, midfoot swelling, variable deformity
- Unable to bear weight
- Plantar ecchymosis is pathognomonic
  - Plantar ecchymosis sign
- Diastasis between 1st and 2nd metatarsals
  - Gap sign
- Tender to palpation over dorsal TMT joints
- Stress testing for pain +/- midfoot instability
- Carful neurovascular exam is key
  - Dorsalis pedis artery passes between 1st and 2nd metatarsals, in danger during injury or treatment
  - Compartment syndrome is common, especially with high energy mechanisms

Radiographic Evaluation: Lisfranc Injuries

- **AP Radiographs**
  - Loss of normal colinearity of medial border of second metatarsal with medial border of middle cuneiform
  - Diastasis between first and second metatarsals >2.7mm (*)
  - Small bony fragments ("fleck sign" *) at base of second metatarsal or medial cuneiform, avulsed by disrupted Lisfranc ligament

Hatem SF. Radiol Clin N Am, 2008; BIDMC PACS
Radiographic Evaluation: Lisfranc Injuries

- Oblique Radiographs
  - Loss of normal alignment of 2nd-4th TMT joints

Hatem SF. Radiol Clin N Am, 2008; BIDMC PACS
Radiographic Evaluation: Lisfranc Injuries

- **Lateral Radiographs**
  - Dorsal displacement of the base of 2nd metatarsal
  - Flattening of the longitudinal arch (not seen here)

Hatem SF. Radiol Clin N Am, 2008; BIDMC PACS
Radiographic Evaluation: Lisfranc Injuries

• If there is clinical suspicion of Lisfranc Injury despite normal non-weight bearing radiographs, can obtain stress views:
  – Weight-bearing AP radiographs to stress joint complex
  – AP abduction and pronation stress view is rarely performed

• CT
  – Improves detection and delineation of fractures, including degree of comminution, intra-articular extension, and interposed soft tissues that could impact reduction
  – Especially useful in high velocity injuries

• MRI
  – Allows direct visualization of integrity of the Lisfranc ligament and surrounding soft tissue structures
  – Especially useful in low velocity injuries and in the setting of equivocal radiographic studies

Hatem SF. Radiol Clin N Am, 2008; Watson TS, et al. JAAOS, 2010
CT vs. Plain Radiograph of Same Foot

Note the extensive comminution and intra-articular extension which are better seen on CT than plain radiograph.
Example of MRI of Lisfranc Injury

- Normal Lisfranc ligament in Box (image from Hatem 2008)
- Lisfranc injury with avulsed base of second metatarsal attached to intact Lisfranc ligament

Hatem SF. Radiol Clin N Am, 2008; BIDMC PACS
Classification of Lisfranc Injuries

• Useful for describing injury and standardizing terminology, but not useful for guiding treatment or prognosis

Quenu and Kuss (1909)
A) Divergent: metatarsals displaced in sagittal and coronal planes
B) Isolated: one or two metatarsals displaced from the others
C) Homolateral: all 5 metatarsals displaced in same direction

Classification of Lisfranc Injuries

- Myerson (1986) classification aims to describe common injury patterns and to attempt to aid in clinical decision making

Hatem SF. Radiol Clin N Am, 2008; Watson TS, et al. JAAOS, 2010;
Treatment of Lisfranc Injuries

• Goals:
  – Painless, stable foot in good anatomic alignment
  – Prevent posttraumatic sequelae of instability, deformity, and arthritis

• Nonoperative management:
  – Indicated for stable injuries, minimal displacement, and minimal fractures
    • 1st MT to 2nd MT base diastasis <2mm greater than contralateral side
    • TMT displacement <2mm greater than contralateral side
  – Relative contraindications include: Charcot feet, inflammatory arthritis, nonambulatory patient, severe medical comorbidity
  – Short leg cast or walking boot for 6-10 weeks
  – Initially non-weightbearing
  – Repeat weightbearing radiographs at 2 weeks after injury to ensure no osseous displacement or evidence of instability
  – Progress to weightbearing as tolerated and physical therapy

Treatment of Lisfranc Injuries

• Operative
  – Indicated for unstable injuries
    • Displacement of TMT or 1\textsuperscript{st}-2\textsuperscript{nd} MT joints $>2$mm compared to contralateral
  – Anatomic reduction and stable fixation is critical to clinical outcome
  – ORIF with screw fixation – most common
  – Some use percutaneous K-wires or screws in unstable, nondisplaced injuries
  – Primary arthrodesis may improve outcomes in primarily ligamentous injury

• Post-operative management
  – Non-weightbearing cast or boot for 6-8 weeks
  – Full weightbearing around 8 weeks post-operatively
  – K-wire fixation removed around 6 weeks
  – Screw fixation removed around 4-6 months, or left indefinitely

Example: ORIF of Lisfranc Injury

Left: pre-op radiograph showing Lisfranc injury
Middle: Screw fixation of medial and middle cuneiforms to the second and third metatarsal bases, respectively, reducing and stabilizing this Lisfranc injury
Right: Painful hardware has been removed. Post-traumatic TMT arthritis is seen.
Take Home Points for Radiologic Diagnosis of Lisfranc Injuries

- Commonly missed/misdiagnosed
  - High index of suspicion necessary
  - Imaging findings can be subtle
- Check for gap between 1\textsuperscript{st} and 2\textsuperscript{nd} MT bases
- Check alignment of MTs with associated tarsals
- Cannot adequately evaluate lateral TMT joints on an AP film
  - Must obtain oblique and lateral views
- Radiographs significantly underestimate subtle injuries and associated fractures. If high clinical suspicion, consider:
  - Stress films such as weightbearing (if patient can tolerate)
  - CT
  - MRI
References

- American College of Radiology. ACR Appropriateness Criteria. Acute Trauma to the Foot. 2010
- Rockwood, Green, and Wilkins’ Fractures, 7th Ed.
Acknowledgements

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