Anatomy

Membrana interossea
Lig. tibiofibulare ant.
Lig. tibiofibulare interosseum
Lig. tibiofibulare post.
Fibula
Clinical series:

- 238 Weber B, 39% syndesmotic injury
  - Stark et al. JOT 2007

- 7 Weber B fx with syndesmosis injury
  - Ebraheim et al, CORR 2003

- 38 pts, 37% unpredicted syndesmotic injuries
  - Jenkinson et al, JOT 2005
Diagnosis

- Injury radiographs
  - 70 ankle fractures with MRI
  - TFCS, TFO (AP), and TFO (mort)

  poor correlation to ligament injury

Nielson, Gardner, Lorich. CORR 2005
Diagnosis

- Cotton test
- External rotation stress
• Conclusions:
  – Don’t rely on level of fibular fracture
  – Can’t rule out if injury X-rays are negative
  – Common (~40%) in Weber B patterns
  – Stress every ankle fracture intraop
Malreduction

• **25** closed ankle fractures
  – 60% PER, 40% SER
  – 44% had post mal

• **13** patients (52%) incongruity on CT
  – Avg difference: 3.6 mm (2.0 – 8.0 mm)
  – 4 with abnormal X-ray measurements

Gardner et al, FAI 2006
Malreduction

- 68 ankle fx w/ synd injury
- CT scans and outcomes at 2 yrs
- 39% malreduced
- Predictor of poor outcome

Sagi et al, JOT 2012
Malreduction

- Variable incisura morphology

Flat vs Concave
Malreduction

• Variable incisura morphology

Cherney, Gardner et al. FAI 2016

“shallow” (n=8): 75% anterior translation
“deep” (n=24): 0% anterior translation
Malreduction

Causes

• Incisura incompetence
Malreduction

- Incisura incompetence
Malreduction

- Fibular malreduction
Malreduction

Causes

- Wrong clamp vector
Malreduction

- Wrong clamp vector
Malreduction

- Wrong clamp vector

Phisitkul et al. JBJS-Am 2012
Malreduction

- Wrong clamp vector
Medial Clamp Tine Positioning Affects Ankle Syndesmosis Malreduction

Christopher T. Cosgrove, MD, Sara M. Putnam, MD, Steven M. Cherney, MD, William M. Ricci, MD, Amanda Spraggs-Hughes, MA, Christopher M. McAndrew, MD, MSc, and Michael J. Gardner, MD
Malreduction

Causes

• Screw obstruction
**Malreduction**

- Anatomic fibula reduction
- Dime sign
- Compare to other side

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*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
Malreduction Prevention

• Open reduction with direct visualization
Malreduction

Prevention

Gifford et al, FAI 2014
Malreduction Prevention

Normal ankle
Malreduction

Problems with open reduction:

• 149 pts, posterior mal ORIF when present, synd open reduction: **16% malreduction**
  
  Miller et al, FAI 2009

• 68 patients, bilateral post-op CT’s, of those with open reduction: **15% malreduction**
  
  Sagi et al, JOT 2012
Malreduction

- TRUE TALAR DOME LATERAL
- Compare posterior malleolus profile

Summers et al. JOT 2013
Malreduction

• Intraop 3D CT?
  – Sixteen patients
  – Anterior fibular translation distance malreduced in 31%

Prevention

Davidovitch et al, JBJS 2013
Malreduction

The Measurement and Clinical Importance of Syndesmotic Reduction After Operative Fixation of Rotational Ankle Fractures

Stephen J. Warner, MD, PhD, Peter D. Fabricant, MD, MPH, Matthew R. Garner, MD, Patrick C. Schottel, MD, David L. Helfet, MD, and Dean G. Lorich, MD

Investigation performed at the Orthopaedic Trauma Service, Hospital for Special Surgery and New York Presbyterian Hospital, New York, NY

• 154 syndesmotic injuries
• Nearly all within 2 mm of contralateral side
• No correlation to outcomes at min 1 year
Malreduction Threshold

Functional Outcomes of Syndesmotic Injuries Based on Objective Reduction Accuracy at a Minimum 1-Year Follow-Up

Steven M. Cherney, MD,* Christopher T. Cosgrove, MD,† Amanda G. Spraggs-Hughes, MA,† Christopher M. McAndrew, MD,† William M. Ricci, MD,† and Michael J. Gardner, MD†

- 48 syndesmotic injuries
- Postop bilateral CT scans
- Functional outcomes at 1 year min
- No differences in outcomes between 1.5mm, 2 mm, and 3 mm malreductions
• Cadaver study, no soft tissue injury created
• Authors’ conclusion = NO
Malreduction

- Two cadaver studies
  - Soft tissue injuries created
  - CT scans used to assess
  - Clamp reductions

"All clamping positions resulted in over-compression of the syndesmosis"

"Both clamp ... reductions showed significant over-compression of the syndesmosis"

Phisitkul et al. JBJS-Am 2012

Miller et al, JOT 2013
Malreduction

Over-compression

- Clinical study – prospective observational
  - 27 patients, bilateral postop CT scans
  - 44% were over-compressed (> 1mm)

Cherney, Gardner, et al. JOT 2016
Malreduction

Over-compression
Malreduction

Over-compression
Malreduction

Over-compression
Increased Reduction Clamp Force Associated With Syndesmotic Overcompression

Jacob Haynes, MD¹, Steven Cherney, MD¹, Amanda Spraggs-Hughes, MA¹, Christopher M. McAndrew, MD, MSc¹, William M. Ricci, MD¹, and Michael J. Gardner, MD¹
Malreduction

Over-compression
• Many acceptable permutations
  – 3.5 mm vs 4.5 mm screws
    • 4.5 screw heads prominent
    • No biomechanical advantage to larger screw

Thompson & Gesink, FAI 2000
Fixation

- 3 vs 4 cortices
  - Prospective randomized, 64 pts
  - One 4.5 screw (4 cortices), vs two 3.5 screws (3 cortices)
  - No functional difference at 1 year

Hoiness & Stromsoe, JOT 2004
Fixation

- RCT – Finland
- 43 pts, Weber C/synd
- Screw vs suture
- CT scans
- 2 year follow-up
- No difference in malreduction or functional outcomes

• 70 pts randomized
• Screw vs TightRope
• Red’n: Clamp/fluoro
• Better clinical and radiographic results with TightRope at all time points

Laflamme M, et al. JOT 2015
• 108 patients randomized to screws vs tightrope
• 3 months CT; functional outcomes at 1 yr
• Using 2 mm threshold for malreduction:
  – 39% malreduced with screws
  – 15% malreduced with TightRope
• No difference in functional outcomes

Sanders D, COTS. OTA Highlight 2017
• Syndesmosis injuries are possible (common?) in all ankle fracture patterns
• Easy to malreduce
  – Talar dome lateral comparison invaluable
  – Careful clamp positioning
    • Don’t squeeze as hard as you can!
  – Open reduction more accurate?
  – Manual squeeze more accurate?
• Malreduction has an impact on outcome
  – Threshold not clear
• Many unanswered questions
Thank You