Treatment of Syndesmotic Injuries

Kenneth J. Hunt, M.D.
Stanford University
Department of Orthopaedic Surgery
Syndesmosis Injuries

My disclosures are up to date on AAOS web site

No disclosures pertinent to this topic
Introduction
Syndesmosis Injury (High Ankle Sprain)
High ankle sprain = Syndesmosis Injury

**Introduction**
Syndesmosis Injury (High Ankle Sprain)

High ankle sprain
- Inherently Stable
- Normal Mortise
- Able to WB

Syndesmosis disruption
- Unstable Injury
- Widened Mortise
- Disabling
Injuries to the Syndesmosis

- Anatomy
- Mechanism & Incidence
- Diagnosis
- Injury Kinematics
- Treatment Indications
Injuries to the Syndesmosis

–Anatomy
–Mechanism & Incidence
–Diagnosis
–Injury Kinematics
–Treatment Indications
Syndesmosis Anatomy

Transverse Ligament

Transverse Ligament

PITFL
Syndesmosis Anatomy

Deltoid Ligament
Syndesmosis Anatomy
Deltoid Ligament

Superficial

Deep
Injuries to the Syndesmosis

- Anatomy
- Mechanism & Incidence
- Diagnosis
- Injury kinematics
- Treatment Indications
Injury Mechanism

Ankle Eversion
Injury Mechanism

Ankle External Rotation
Injury Mechanism
Syndesmosis Injury (High Ankle Sprain)
Injury Mechanism
Associated with Fracture

• We most often see complete syndesmosis disruption with fractures
Injury Mechanism

Pronation External Rotation

http://www.youtube.com/
Incidence
Incidence of Syndesmosis Injury

Reported Incidence Increasing

- **West Point studies**
  - Hopkinson et al., (1990 FAI)
    - 1% of ankle sprains (15 in 3.5 yrs)
  - Waterman et al., (2011 AJSM)
    - 6.7% of all ankle sprains

- **NFL combine (2006)**¹
  - 15% of players reported history of syndesmosis injury

- **Predictive of long-term dysfunction**²

1. Kaplan et al., 2011 AJSM
2. Gerber et al., 1998
Incidence in Football

- NCAA Injury Surveillance System (ISS)
  - 2004 through 2009

![Pie chart showing incidence of knee injuries in football]

- Lateral: 64.2%
- Medial: 11.2%
- Syndesmosis: 24.6%

Hunt et al., 2013 CJSM
Incidence

Practice Vs. Competition

Hunt et al., 2013 CJSMD
Surgery Required, 3%

Conservative Management; 97%

Hunt et al., 2013 CJSM
Syndesmosis Injury
Associated with Fracture

- 12-17% of ankle fractures have syndesmotic injury
  - Mostly PER (Weber C)
    - Weening and Bhandari, 2005
    - Parikenen et al., 2011 JBJS

- In cases with no widening on static x-ray
  - 33% of Weber B injuries (SER)
    - Jenkinson et al. 2005 JOT
Classification

- No broadly accepted classification scheme
- West Point Grading System

<table>
<thead>
<tr>
<th></th>
<th>Grade I</th>
<th>Grade II</th>
<th>Grade III</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exam</strong></td>
<td>Pain with Squeeze or ER stress test</td>
<td>Pain with Squeeze or ER stress test</td>
<td>Pain with Squeeze or ER stress test</td>
</tr>
<tr>
<td><strong>Tenderness</strong></td>
<td>Mild</td>
<td>Moderate</td>
<td>Intense</td>
</tr>
<tr>
<td><strong>Weight Bearing</strong></td>
<td>Full</td>
<td>Difficult</td>
<td>Impossible</td>
</tr>
<tr>
<td><strong>Radiographs</strong></td>
<td>No mortise widening</td>
<td>No mortise widening</td>
<td><strong>Mortise Widening</strong></td>
</tr>
<tr>
<td><strong>Edema</strong></td>
<td>Minimal</td>
<td>Moderate</td>
<td>Diffuse</td>
</tr>
</tbody>
</table>

Gerber et al., 1998 FAI
Syndesmosis Injuries
Physical Examination

• Gait
Syndesmosis Injuries
Physical Examination

• Gait

• Palpation
  – Tender over syndesmosis
  – Deltoid ligament
  – Malleoli
  – Check proximal fibula
    • (Maisonneuve)
 Syndesmosis Injuries

Physical Examination

• Gait
• Palpation
• Squeeze test
  – Produces pain in syndesmosis
  – Very reliable (Hopkinson)
 Syndesmosis Injuries
 Physical Examination

• Gait
• Palpation
• Squeeze test
• External rotation test
  – Sitting and standing
  – Produces pain in syndesmosis
Syndesmosis Injuries
Physical Examination

- Gait
- Palpation
- Squeeze test
- External rotation
- Hook test
  - Lateral Heel Translation
Syndesmosis Injuries
Physical Examination

- Gait
- Palpation
- Squeeze test
- External rotation test
- Hook test
- Heel rise test
  - Decreased strength
  - Pain with push-off

Spaulding S. 1995. FAI
Syndesmosis Injuries

Physical Examination

- Gait
- Palpation
- Squeeze test
- External rotation test
- Hook test
- Heel rise test
- Stabilization test

Williams, Amendola 2007 AJSM
Radiographic Analysis

- WB x-rays
  - Three views
Radiographic Analysis
Stress Radiographs


Tib-Fib Clear Space
(< 5mm is Normal)

MCS

>2 mm

>2 mm
Radiographic Analysis
Stress Radiographs
Syndesmosis Injury
Diagnostic studies

• Radiographs are not reliable to detect injury
Syndesmosis Injury

Diagnostic studies

- Radiographs are not reliable to detect injury
- Intraoperative stress radiography

<table>
<thead>
<tr>
<th>Test</th>
<th>Sensitivity</th>
<th>Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Rotation Stress</td>
<td>0.58</td>
<td>0.96</td>
</tr>
<tr>
<td>Hook Test (Lateral Translation)</td>
<td>0.25</td>
<td>0.98</td>
</tr>
</tbody>
</table>

Mild and Moderate Injuries much more difficult to detect

Parakininen et al., 2011 *J Bone Joint Surg Am*
Syndesmosis Injury

Diagnostic studies

• Radiographs are not reliable to detect injury
• Intraoperative stress radiography
• MRI more sensitive and accurate

Hermans et al., 2012 *Skeletal Radiology*. 41:787-81
Syndesmosis Injury
Diagnostic studies

Arthroscopy
Syndesmosis Injury

Diagnostic studies

- **Accuracy**
  - AP x-ray 63%
  - Mortise x-ray 71%
  - MRI 96%
  - Arthroscopy 100%

Takao et al. 2003 JBJS Br
Injuries to the Syndesmosis

- Anatomy
- Mechanism & Incidence
- Diagnosis
- Injury Kinematics
- Treatment Indications
Syndesmosis Ligaments
Relative Importance

Disruption of the Ankle Syndesmosis: Biomechanical Study of the Ligamentous Restraints

Ogilvie Harris et al. 1994

- 35% for the AITFL
- 33% for TL
- 22% for IOL
- 9% for the PITFL
Syndesmosis Injury
Stress Radiography vs. Kinematic Data

Cadaveric model used to determine:

1) Radiographic widening
2) Rotational and linear displacement
of the talus and the fibula relative to the tibia
with sequential syndesmosis ligament injury

Hunt et al., 2012 AOSSM
Hook test (lateral translation)

- Widening of syndesmosis and medial clear space only significantly different after release of PITFL and deltoid
- No significant rotation of talus or fibula

* * p<0.5

Syndesmosis Injury
Stress Radiography vs. Kinematic Data

**Syndesmosis Widening**

**Medial Clear Space widening**
Hook test (lateral translation)

- Widening of syndesmosis and medial clear space only significantly different after release of PITFL and deltoid
- No significant rotation of talus or fibula
- High correlation between x-ray and kinematics

Syndesmosis Injury
Stress Radiography vs. Kinematic Data

Syndesmosis Widening

- Kinematic
- Radiographs

Medial Clear Space widening

- Kinematic
- Radiographic

*p<0.5
Syndesmosis Injury
Stress Radiography vs. Kinematic Data

**External Rotation**
- Syndesmosis widens after PITFL release
- Medial clear space widens after PITFL release
- Radiographic values lower

*\( p<0.5 \)*
Syndesmosis Injury
Stress Radiography vs. Kinematic Data

External Rotation

- Talus external rotation increased significantly after AITFL sectioning
- Fibular external rotation increased significantly after AITFL and IOL

*T*p<0.5

Talus Rotation

Fibula Rotation
**Syndesmosis Injury**
Stress Radiography vs. Kinematic Data

**Point 1**: Stress radiography not a reliable indicator of mild or moderate syndesmosis injuries. Particularly External Rotation Stress

Hunt et al., 2012 AOSSM
Point 1: Stress radiography not a reliable indicator of mild or moderate syndesmosis injuries.
**Point 1:** Stress radiography not a reliable indicator of mild or moderate syndesmosis injuries.
Syndesmosis Injury
Stress Radiography vs. Kinematic Data

Point 1: Stress radiography not a reliable indicator of mild or moderate syndesmosis injuries.
MRI likely more reliable
Syndesmosis Injury
Stress Radiography vs. Kinematic Data

**Point 1**: Stress radiography not a reliable indicator of mild or moderate syndesmosis injuries.

**Point 2**: Significant rotation of talus and fibula occur during external rotation, even with moderate syndesmosis injury.
Injuries to the Syndesmosis

- Anatomy
- Mechanism & Incidence
- Diagnosis
- Injury Kinematics
- Treatment Indications
Syndesmosis Injuries
Surgical Indications

• General Points
  – Most ligamentous injuries treated conservatively
    • Complete ligamentous injuries treated surgically
  – Most fractures treated surgically
  – Very little prospective outcomes data
    • Primarily Grade “B” and “Insufficient” Evidence
    • Almost all on fracture-associated
Syndesmosis Injuries

Surgical Indications

- **Conservative treatment**
  - Mild and moderate high ankle sprains

- **Surgical Stabilization**
  - Clear widening of medial clear space
    - Standing x-ray
    - Stress x-ray
  - Disruption of PITFL and Deltoid
    - MRI scan
  - Most fractures with syndesmosis injury
Syndesmosis Injuries
High Ankle Sprain
Syndesmosis Injuries
High Ankle Sprain

• Examination
  – Syndesmosis TTP
  – Pain with ER
  – Pain with Hook test
  – Pain with squeeze
  – No instability
  – Able to heel rise
Syndesmosis Injuries

High Ankle Sprain
Syndesmosis Injuries
High Ankle Sprain

• Treatment course
  – CAM boot until pain-free
  – Transitioned to brace
  – On field progression
  – Bracing and taping

• Returned to play 3 weeks
In cases requiring stabilization

- 2 fixation Options:

Screws

Suture Buttons
Syndesmosis Injuries
Surgical Indications

• In cases requiring stabilization
  – 2 fixation Options:

Evidence-based Approach to Treatment of Acute Traumatic Syndesmosis (High Ankle) Sprains

Annuziato Amendola, MD,* Glenn Williams, PhD, PT, ATC,† and Dan Foster, PhD, ATC‡

Ankle Syndesmotic Injury

JAAOS, 2007

Charalampos Zalavras, MD, PhD
David Thordarson, MD

No mention of suture button

Screws

Suture Buttons
• Outcomes with screws
• Level IV Retrospective, 39 patients
  – Functional status similar to US norms
  – Anatomic reduction of syndesmosis
    • Only predictor of outcome
  – Not associated with outcome:
    • Age
    • Number of cortices
    • Screw removal
    • Medial mal fx

Weening and Bhandari. 2005 JOT
Syndesmosis Injuries
Screw Fixation Options

• Outcomes with screws
• Screw material?
  • No diff between steel and titanium\(^1\)
• 3 or 4 cortices?
  • No diff in pain, motion or biomechanics\(^2\)
• Screw diameter?
  • No biomech advantage 4.5 over 3.5\(^3\)
• Number of screws?
  • Two more stable than one
• Screw removal?
  • Most retained screws loosen or break, ? symptomatic

2. Nousianen et al. JOT Br 2008
3. Thmopson & Gesink. 2000. FAI
Syndesmosis Injuries
Screw Fixation Options

Outcome after fixation of ankle fractures with an injury to the syndesmosis
THE EFFECT OF THE SYNDESMOSIS SCREW

• Level IV - Retrospective Review, 52 pts

Hamid et al. 2009 JBJS Br
Screw Removal

Syndesmosis Injuries

- Meta-analysis of 7 studies
  - Screw retention/removal does **not** impact clinical outcomes
  - Remove screws if prominent or limited ROM
  - Minimum 12 weeks post-op

Schepers T. 2011 AOTS.
Syndesmosis Injuries
Purported Advantages of Suture Button

• So what about the “Tightrope” (suture button)?

Can this solve the hardware dilemma?
Syndesmosis Injuries
Purported Advantages of Suture Button

- Flexible Fixation may be better for ligament
  - Less rigid, micro-motion allows ligament healing
- Easy to use
- No need for routine removal
  - No visual failure
  - Low profile

- Used in 10% of syndesmosis repairs in US
  - Bava et al. 2010 Am J Orthop
Syndesmosis Injuries
Suture Button Evidence

**Tightrope**
- AOFAS: 89.1
- Removal: 10%
- Earlier return to work

**Screws**
- AOFAS: 86.3
- Removal: 52%
- Longer f/u (42 mo)

Similar outcomes
Similar complication rates

Schepers et al. 2012. SICOT

Acute distal tibiofibular syndesmosis injury: a systematic review of suture-button versus syndesmotic screw repair
Tim Schepers
International Orthopaedics (SICOT)
Syndesmosis Injuries
Suture Button Evidence

- Clinical outcomes:
  - Level III Retrospective Cohort, 32 patients
    - Suture-button vs. 3.5 screws
  - Suture Button:
    - Better AOFAS scores
    - Faster return to work – 2.8 months vs 4.6 months
    - Reduction maintained (CT scan)
    - No additional surgery

Thornes et al. CORR 2005
Syndesmosis Injuries
Suture Button Evidence

• Clinical outcomes:
  – Level II Prospective Cohort study, 46 patients
    • Suture-button vs. single screw
  – Results:
    • No difference in outcomes
      – AOFAS
      – FADI
    • Syndesmotic reduction (CT)
      – 21.7% malreduced in screw group
      – 0% malreduced in Suture button group
      – Only independent predictor of the clinical outcome

Naqvi et al. AJSM 2012
Syndesmosis Injuries
Case Example

- Collegiate soccer player
  - External rotation injury
  - Unable to ambulate
  - Pain over deltoid and fibula
Syndesmosis Injuries
Case Example
Syndesmosis Injuries
Case Example
Syndesmosis Injuries
Case Example
Take Away Points

• Surgery rare for purely ligamentous injuries
  – Common for fractures

• Radiographs not reliable for moderate injuries

• Reduction of syndesmosis is key

• Screws and suture buttons both effective
  – Suture button may provide advantages
  – More evidence needed
Thank You
Syndesmosis Injuries
Elite Athletes

• *In the elite athlete*...
  – Addition of fibular plate
    • May allow for earlier and safer return to play
    • May protect from stress risers, after screw removal
    • Less implant cut-through
Syndesmosis Injuries
Elite Athletes

- Collegiate Running Back
- Planted foot
- Internal rotation of tibia
  - Significant pain and swelling
  - Pain with ambulation
Syndesmosis Injuries
Elite Athletes
Syndesmosis Injuries
Elite Athletes
Syndesmosis Injuries
Elite Athletes

- Screw removal
  - 14 weeks post-op
  - Replace with tightrope
Syndesmosis Injuries
Elite Athletes

• WBAT in boot
• Begin rehab
• Training 2 weeks post-HWR
  (4 months post-injury)