Syndesmotic Sprains in Sports

Edward P. Mulligan, PT, DPT, OCS, SCS, ATC
Associate Professor and Residency Programs Director
University of Texas Southwestern Medical Center; School of Health Professions; Department of Physical Therapy
Dallas, TX

Ryan P. Mulligan, MD
PGY-5 Orthopedic Surgery Resident
University of Tennessee College of Medicine - Campbell Clinic
Memphis, TN

Emily F Middleton, PT, DPT, OCS, SCS, CSCS
Faculty Associate and Sports Residency Program Coordinator
University of Texas Southwestern Medical Center; School of Health Professions; Department of Physical Therapy
Richardson, TX

Neither the speakers, nor any of their family member(s), have any relevant financial relationships to be discussed, directly or indirectly, referred to or illustrated with or without recognition within the presentation

Presentation Objectives
1. Define and differentially diagnose tibfib syndesmotic instability and describe the anatomical pathology and typical mechanisms of injury
2. Conduct a comprehensive subjective history and objective examination to determine optimal treatment interventions
3. Describe the conservative and surgical intervention approach based on the diastatic presentation
4. Select and utilize appropriate self-report outcome and functional measurement tools for athletic ankle problems and implement return to sports activities and criteria

Anatomical Considerations
- Fibrous ligaments provide stable joint morphology and allow minimal motion

Bony Morphology
- Talocrural mortise is filled by a trapezoidal shaped talus which is 3-4 mm wider in the posterior portion
- Distal tibiofibular joint spreads and recoils with dorsi-plantarflexion

Bony Stability/Congruity
- Dependent upon variable concave depth of the tibia’s fibularis incisura
  - 40% have a shallow (< 4 mm) tibial incisura
- Depth is dependent upon the size of the anterior tibial tubercle which is larger and more prominent that posterior tubercle
- Shallow notch puts a bigger demand on the AITFL and allows posterior displacement of the fibula

Syndesmosis Ligamentous Anatomy
- AITFL – PITFL/TTFL – IOM
- AITFL most likely injured; PITFL less often involved
- 40-45% of diastatic restraint provided by PITFL/ITTL (restrains fibular posterior translation), 35% by AITFL (restrains fibular ER), and 20-25% by IOM (restrains fibular lateral translation)

Deltoid Ligament
- Strong medial stabilizer of the ankle mortise
- Limits external rotation of the talus and lateral displacement of the talus in the mortise

Normal Arthrokinematics
Distal tibfib joint acts as a spring to spread the mortise with dorsiflexion to accommodate the trapezoidal shape of the talus; then recoils when the joint returns to a plantarflexed position
- Dorsiflexion
  - Fibula glides proximally, translates posterolaterally, and externally rotates
- Plantarflexion
  - Fibula glides distally, translates anteromedially, internally rotates

- IOM provides some inherent elasticity allowing 1-2 mm of movement of the fibula on the tibia with dynamic movement

Pathoanatomical Arthrokinematics
- Excessive external rotation of the foot in dorsiflexion, particularly in weight bearing, challenges the ability of the syndesmotic ligaments to maintain the integrity of the mortise in a posterolateral direction
- Disruption and widening of the mortise makes it difficult to push off in the propulsive phase of gait and as little as a 1 mm lateral shift in the talus reduced tibiotalar articular contact by 40%

Pathology dictated by MOI (more details in next presentation)
- Pronation-External Rotation (Weber C)
- Supination-External Rotation (Weber B)
- Proximal Fibular Fractures (Maisonneuve)

Prevalence
- Estimated incidence of 0.38/1000 athletic exposures
- 5-10% of ankle sprains and 23% of ankle fractures involve the distal tibiofibular syndesmosis
  Kellet JJ, *Clinic J Sport Med*, 2011
- 15% prevalence of NFL combine football players
- 36 of 89 (40%) of rugby/ARF ankle sprains were syndesmotic in nature
- Variance due to inconsistent diagnostic criteria and the nature and intensity of the sporting activities in which epidemiological studies have evaluated their frequency
Epidemiology

- common in high intensity, athletic activities that have frequent cutting and twisting demands or limited mobility in a boot
  - football, rugby, and lacrosse
  - hockey and skiing because foot is rigidly immobilized
    - 74% of NHL ankle injuries
- extent of the injury includes sprains, sprains with latent or frank diastasis, and/or fractures

Predicting Risk

- Age, body morphology, foot posture, ankle dorsiflexion ROM, and muscle strength could not predict risk for syndesmotic injuries in rugby and Australian rules football players
  

Mechanism of Injury

- forced external rotation of the foot on the tibia with the ankle in dorsiflexion
- high ankle sprains more likely to have direct impact force than lateral ankle sprain (self-imposed torsion)

Football Related Mechanisms of Injury: Lateral Inversion Lateral vs. Syndesmotic Sprain

- No significant difference in position, taping/bracing protection, playing surface, field condition, or time/place of injury – only mechanism of injury
  
  Osbahr DC et al, *Orthopedics*, 2013

Typical History

- If you listen carefully and thoroughly observe the patient – they will tell you precisely what their problem is
  - Mechanism of injury - Location of complaint - Weight-bearing function

Signs/Symptoms

- Less swelling and ecchymosis than traditional inversion sprains
- Symptoms located just proximal to the ankle joint axis
- Tibfib tenderness to palpation extending proximally along the IOM
- Painful and limited dorsiflexion mobility with empty end feel
- Antalgic gait with decreased stride length, shortened stance phase, and poor propulsion
- Boggy end feel to valgus stress suggests concomitant deltoid ligament involvement

Clinical Presentation

<table>
<thead>
<tr>
<th>Finding</th>
<th>SN</th>
<th>SP</th>
<th>+LR</th>
<th>-LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disproportionate Pain</td>
<td>65</td>
<td>79</td>
<td>3.05</td>
<td>0.45</td>
</tr>
<tr>
<td>Inability to hop</td>
<td>89</td>
<td>29</td>
<td>1.25</td>
<td>0.37</td>
</tr>
<tr>
<td>MOI</td>
<td>83</td>
<td>22</td>
<td>1.07</td>
<td>0.77</td>
</tr>
<tr>
<td>Inability to walk</td>
<td>89</td>
<td>21</td>
<td>1.13</td>
<td>0.51</td>
</tr>
<tr>
<td>Swelling at or above AITFL</td>
<td>47</td>
<td>42</td>
<td>0.81</td>
<td>1.27</td>
</tr>
<tr>
<td>Deltoid Ligament tenderness</td>
<td>43</td>
<td>35</td>
<td>0.66</td>
<td>1.64</td>
</tr>
<tr>
<td>Lunge and Twist</td>
<td>54</td>
<td>36</td>
<td>0.85</td>
<td>1.27</td>
</tr>
<tr>
<td>Posterior Impingement</td>
<td>58</td>
<td>51</td>
<td>1.20</td>
<td>0.81</td>
</tr>
</tbody>
</table>

- rule out based on MOI and functional ability; Increases suspicion with high pain levels

Palpatory Tenderness Location (hallmark sign)

- palpation of the AITFL has fair reliability and a positive predictive value of 70%
- 40% of inversion sprains will have some AITFL tenderness


Rule Out Fractures with Ottawa Fracture Clinical Decision Rules

- Excellent screening tool because of high sensitivity that renders a very low negative likelihood ratio
  
  Rule
  1. Inability to weight bear four steps
  2. Localized tenderness at posterior edge of medial or lateral malleolus, base of 5th met, or navicular

Heightened Suspicion

- 4x as likely to have syndesmotic injury if tibiofibular ligaments are tender to palpation or if athlete reports a dorsiflexion-external rotation mechanism of injury


- Slow or delayed recovery after 2 weeks should prompt the clinician to assess for latent syndesmotic instability if previously unsuspected

FAAM - Functional Ankle Activity Measure

- Region specific outcome tool to assess level of function
  - 21 question ADL scale
  - 8 optional questions for sports scale
    - Running
    - Jumping
    - Landing
    - Starting/Stopping Quickly
    - Cutting/Lateral Movements
    - Technique Normality
    - Sport Participation
    - % pre-injury function

- Construct/Content Validity for wide variety of lower leg, foot, and ankle pathologies
  - Reliable (ICC = 0.87 - 0.89 with 2-4 point SEM)
  - Responsive (MDC = 9-12 points on 84 pt. scale)

FADI - Foot Ankle Disability Index

- region specific expansion of the FAAM for the general population (any age or pathology)
- composed of a 26-item ADL and an 8-item sports subscales
  - Four pain related items and 22 activity related items.
  - Using a 5-point Likert scale (0 to 4) yields a total score of 104 points
  - The FADI Sport (for higher functioning populations) has 8 activity related items scored on the same scale yielding a total of 32 points
- ICCs for FADI and FADI Sport range from 0.84 - .94 range
- Overall MDC is ± 4.5 points; MDC for the FADI Sport is ± 6.6
- Overall SEM is ± 2.6 points; MDC for the FADI Sport is ± 5.3

Hale SA et a, *J Athl Train*, 2005
Syndesmotic Special Tests

- **Dorsiflexion-External Rotation Test (DERT)**
  - Stabilize tibia (not fibula), maximal dorsiflexion, and externally rotate (abduct) the foot to reproduce familiar syndesmotic pain
  - SP – 85%; SN – 20% using MRI confirmation as reference standard

  Candal-Couto *J, Injury*, 2004

<table>
<thead>
<tr>
<th>Test</th>
<th>SN</th>
<th>SP</th>
<th>+LR</th>
<th>-LR</th>
</tr>
</thead>
<tbody>
<tr>
<td>DERT (Kappa reliability = 0.75) Alonso A, <em>J Orthop Sports Phys Ther</em>, 1998</td>
<td>71</td>
<td>63</td>
<td>1.93</td>
<td>0.46</td>
</tr>
<tr>
<td>Palpation Tenderness (K = 0.36) Alonso A, <em>JOSPT</em>, 1998</td>
<td>92</td>
<td>29</td>
<td>1.29</td>
<td>0.28</td>
</tr>
<tr>
<td>Squeeze Test (K = 0.50) Alonso A, <em>JOSPT</em>, 1998</td>
<td>26</td>
<td>88</td>
<td>2.15</td>
<td>0.84</td>
</tr>
<tr>
<td>Dorsiflexion Lunge Compression (K = 0.36) Alonso A, <em>JOSPT</em>, 1998</td>
<td>69</td>
<td>41</td>
<td>1.18</td>
<td>0.74</td>
</tr>
</tbody>
</table>


- **Crossed Leg Test**
  - Figure 4 sitting with mid-fibula resting on thigh
  - Gentle force to medial knee by the examiner
  - Positive test if it reproduces pain in the area of the distal syndesmotic area
  - Selection and spectrum biased study showed positive test in 7 of 9 subjects

  Kiter E et al, *Foot Ankle Int*, 2005

- **Additional Manual Stability Tests:**
  - Cotton (shuck) Test
    - medial/lateral stress to detect increased mortise instability
  - A/P (drawer) fibular translation on fixed tibia
  - deltoid (medial collateral) ligament stress test
    - Valgus Stress - eversion of the talus/calcaneus

Injury Severity Influence on Management

<table>
<thead>
<tr>
<th>Clinical Presentation</th>
<th>Grade I Sprain without diastasis</th>
<th>Grade II Sprain with latent diastasis</th>
<th>Grade III Sprain with frank diastasis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Symptoms</td>
<td>Mild point tenderness over TF ligaments</td>
<td>Point tenderness extends proximally to the IOM</td>
<td>Significant tenderness and unable to WB</td>
</tr>
<tr>
<td>Stability</td>
<td>Mild laxity – stable end point</td>
<td>Moderate laxity – soft end point</td>
<td>Notable laxity – absence of end point</td>
</tr>
<tr>
<td>Radiograph Imaging</td>
<td>Stable with stress</td>
<td>Mild laxity with stress but not evident on x-ray</td>
<td>Instability and/or fracture evident on x-ray</td>
</tr>
</tbody>
</table>

**Management Indications**

<table>
<thead>
<tr>
<th>Weight Bearing</th>
<th>WB to tolerance</th>
<th>Progress to WB over 1-2 days</th>
<th>14-21 days NWB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immobilization</td>
<td>0-3 days</td>
<td>3-7 days</td>
<td>7+ days</td>
</tr>
</tbody>
</table>
Injury Grade Pathology

- **Type I** – sprain without diastasis
  - Partial AITFL tear, anterior deltoid ligament, and distal IOM

- **Type II** – sprain with latent diastasis
  - Tear of AITFL, anterior and deep deltoid ligament, and IOM

- **Type III** – frank diastasis
  - Complete disruption including AI and PITFL

**General Injury Management Recommendations** (Level V evidence)

<table>
<thead>
<tr>
<th>General rehabilitation management strategies.</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Emphasis</strong></td>
<td><strong>Joint protection and control of initial inflammatory response</strong></td>
<td><strong>Restoration of strength, mobility, and neuromuscular control.</strong></td>
</tr>
<tr>
<td><strong>Symptom Management</strong></td>
<td><strong>Protection: boot, posterior splint, and/or stirrup brace</strong></td>
<td><strong>Contrast Thermal Therapy</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Ice</strong></td>
<td><strong>Intermittent Compression</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Compression wrap</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Elevation with retrograde massage</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Progression Criteria</strong></td>
<td><strong>Pain-free ambulation</strong></td>
<td><strong>Normal gait pattern</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Pain and swelling under control</strong></td>
<td><strong>Pain-free activities of activities of daily living including low-level plyometrics (gentle hop for 10 repetitions)</strong></td>
</tr>
<tr>
<td><strong>Fitness Maintenance</strong></td>
<td><strong>Upper body ergometer</strong></td>
<td><strong>Cycling on “tall” seat or NuStep with limited knee flexion to minimize dorsiflexion stress</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Aquatic therapy</strong></td>
<td></td>
</tr>
<tr>
<td><strong>ROM</strong></td>
<td></td>
<td><strong>Use outcome measurement tools and/or functional tests to determine readiness to play</strong></td>
</tr>
<tr>
<td><strong>Manual Therapy</strong></td>
<td><strong>Grade I–II joint mobilization for pain control at tibiofibular, talocalcral, or subtalar joints</strong></td>
<td><strong>Grade III–IV joint mobilization to increase mobility at joints that demonstrate restricted mobility</strong></td>
</tr>
<tr>
<td><strong>Therapeutic Exercise</strong></td>
<td><strong>Proximal hip/knee strengthening</strong></td>
<td><strong>Early</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Foot intrinsic muscle strengthening</strong></td>
<td><strong>4-way elastic tubing exercises within pain-free range of motion and dorsiflexion</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Later</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Short foot exercises</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Progression from bilateral flat foot to unilateral full arc heel raises</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Non-weight bearing squats (shuttle, total-gym, leg press) progressing to decline retro squats to front squats</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Lunges</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Lateral step ups</strong></td>
</tr>
<tr>
<td><strong>Proprioceptive Activities</strong></td>
<td><strong>Bilateral progressing to unilateral balancing activities</strong></td>
<td><strong>Dynamic balancing activities and increasing plyometric overloads</strong></td>
</tr>
</tbody>
</table>

*No temporal criteria for progression with non-operative interventions; however, the phase of healing and tissue tolerance constraints should be recognized and honored.*


**Injury Management Guidelines (Phased Rehabilitation)**

- **Phase I**
  - Protected weight bearing and/or immobilization
  - POLICE
- **Phase II**
  - When pain/edema controlled; minimal antalgic gait
  - Proprioceptive exercise; protected arc ROM
• Phase III
  o (for those returning to activities of risk)
  o Strengthening
  o Sport specific drills

Acute Management – Phase I
• Weight-bearing status dictated by symptom severity and degree of diastasis
• Immobilization in stirrup orthosis
• Heel lifts to decrease dorsiflexion demand
• Management of swelling
  o Compression/Elevation/Ice
  o Kinesio taping ineffective

Nunes GS, J Physiother, 2015

Progressive Weight-Bearing
• Body weight unloading minimized as gait normalizes
• Coronal to sagittal to transverse plane progression

ROM Considerations
• Plantarflexion – max tension on AITFL
• Dorsiflexion – max tension on PITFL
  o Both PITFL and AITFL tensioned with dorsiflexion (even without axial load)
  o 1-1.25 mm intramalleolar separation
• Axial Load
  o Greater tension on PITFL than AITFL
• Gait
  o 2.4 mm distal translation and between 0.2-0.4 mm AP translation

Rammelt S, Foot Ankle Clin, 2008

Unique Considerations in Motion and Strength Restoration
• Squat modification
• Limited arc squats/leg press
• Tall seat cycling
• Pronation control
• Proprioception restoration
• Imaging and Surgical Intervention
Imaging and Surgical Intervention

Ryan P. Mulligan, MD
PGY-5, University of Tennessee College of Medicine
Campbell Clinic – Memphis, TN
2016-17 Foot/Ankle Fellowship
Duke University – Durham, NC

Imaging Confirmation

<table>
<thead>
<tr>
<th>Radiographic Finding</th>
<th>View</th>
<th>Measured at:</th>
<th>Normal Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tibiofibular clear space</td>
<td>A/P</td>
<td>1 cm above the tibial plafond</td>
<td>&lt; 6 mm or &lt; than 44% of the fibular width</td>
</tr>
<tr>
<td>Tibiofibular overlap</td>
<td>A/P</td>
<td>1 cm above the tibial plafond</td>
<td>&gt; 6 mm or &gt; 24% of the fibular width</td>
</tr>
<tr>
<td></td>
<td>Mortise</td>
<td></td>
<td>&gt; 1mm</td>
</tr>
<tr>
<td>Medial clear space</td>
<td>Mortise</td>
<td>At the level of the talar dome</td>
<td>&gt; 4 mm or &gt; 2mm than uninvolved side</td>
</tr>
</tbody>
</table>

A - Lateral fibular border
B - Lateral tibial border
C - Medial fibular border
D - Lateral border of posterior tibial malleolus (incisura fibularis)
E - Medial talar border
F - Lateral medial malleolus border

CD - Tibiofibular clear space
BC - Tibiofibular overlap
EF - Medial clear space

Increased medial clear space (> 5mm) indicative of deep deltoid ligament involvement

Stress X-ray

- Gravity or external rotation stress will differentiate frank diastasis (evident on static x-ray) from latent diastasis (evident on stress x-ray)
- Diastasis primarily occurs with posterior fibular displacement as seen on lateral views
Role of CT, MRI, and US

Diagnostic Accuracy

<table>
<thead>
<tr>
<th>Diagnostic Accuracy (compared to arthroscopy)</th>
<th>SN</th>
<th>SP</th>
<th>Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radiograph</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard AP</td>
<td>44</td>
<td>100</td>
<td>64</td>
</tr>
<tr>
<td>Mortise View</td>
<td>58</td>
<td>100</td>
<td>71</td>
</tr>
<tr>
<td>MRI</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AITFL</td>
<td>100</td>
<td>93</td>
<td>96</td>
</tr>
<tr>
<td>PITFL</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>


MRI Reliability

<table>
<thead>
<tr>
<th>Table 1. Interrater reliability of categorical variables.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure</td>
</tr>
<tr>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>AITFL</td>
</tr>
<tr>
<td>PITFL</td>
</tr>
<tr>
<td>Syndesmotic membrane</td>
</tr>
</tbody>
</table>

*AITFL, anterior inferior tibiofibular ligament; PITFL, posterior inferior tibiofibular ligament; CI, confidence interval.

<table>
<thead>
<tr>
<th>Table 2. Interrater reliability of continuous measurements.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measurement</td>
</tr>
<tr>
<td>-----------------------------------------------------------</td>
</tr>
<tr>
<td>Proximal extent of syndesmotic edema</td>
</tr>
<tr>
<td>Proximal extent of syndesmotic injury</td>
</tr>
<tr>
<td>Width of syndesmotic separation</td>
</tr>
</tbody>
</table>

*ICC, intraclass correlation coefficient; CI, confidence interval.

Substantial agreement on diagnosing IOM and PITFL; fair agreement on AITFL


- Substantial agreement on extent of syndesmotic injury and edema but only fair agreement on width of separation.
- No correlation between extent of injury and time loss (contrary to x-ray imaging findings)
Lambda Sign
- High intensity signal on coronal MRI that resembles the Greek letter lambda
- SN – 75 ; SP – 85 to ≥ 2 mm of diastasis on stress during arthroscopic exam
- Not an independent instability but may help predict which subjects might benefit from an surgical predictor of syndesmotic intervention or specialist referral
  
  Ryan P, *Foot Ankle Int*, 2014

CT Scan
- straight line connecting the antero-lateral surface of the fibula with the anterolateral tubercle of the tibia at level of the ankle syndesmosis
- reliable indicator of diastasis
- tibiofibular line displacement should be less than 2 mm
  
  Gifford PB et al, *Foot Ank Int*, 2014

| Table 1. Results for the Normal and Injured Ankle Groups Including Number in Each Group and the Average and Standard Deviation of Tibiofibular Line (TFL) Displacement (P < .0001). |
|---|---|---|
| Normal ankles | 150 | 0 mm | 0.5 |
| Injured ankles | 30 | 8 mm | 4.0 |

Danis-Weber Ankle Fracture Classification

<table>
<thead>
<tr>
<th>Type</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>Below talar dome</td>
<td>At level of talar dome</td>
<td>Above ankle joint</td>
</tr>
<tr>
<td>Fracture Nature</td>
<td>Transverse</td>
<td>Spiral</td>
<td>Maisonneuve</td>
</tr>
<tr>
<td>Ligament Status</td>
<td>Syndesmosis Intact</td>
<td>Widening syndesmosis; deltoid may be torn</td>
<td></td>
</tr>
<tr>
<td>Med. Malleolus</td>
<td>Maybe fractured</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ORIF</td>
<td>Occasional</td>
<td>Variable</td>
<td>Probable</td>
</tr>
</tbody>
</table>

![Images of abnormal and normal MRI scans](image-url)

![Images of Danis-Weber Ankle Fracture Classification](image-url)
Lauge-Hansen Fracture Classification

<table>
<thead>
<tr>
<th>Foot-Position - Applied Stress</th>
<th>Class</th>
<th>Sequence</th>
</tr>
</thead>
</table>
| Supination - Adduction        | SA    | 1. Anterior talofibular ligament sprain or distal fibular avulsion  
                                |       | 2. Vertical medial malleolus and impaction of anteromedial distal tibia |
| Supination - External Rotation| SER   | 1. Anterior tibiofibular ligament sprain  
                                |       | 2. Lateral short oblique fibula fracture (anteroinferior to posterosuperior)  
                                |       | 3. Posterior tibfib ligament rupture or avulsion of posterior malleolus  
                                |       | 4. Medial malleolus transverse fracture or disruption of deltoid ligament |
| Pronation - Abduction         | PA    | 1. Medial malleolus transverse fracture or disruption of deltoid ligament  
                                |       | 2. Anterior tibiofibular ligament sprain  
                                |       | 3. Transverse comminuted fibular fracture above level of the syndesmosis |
| Pronation - External Rotation | PER   | 1. Medial malleolus transverse fracture or disruption of deltoid ligament  
                                |       | 2. Anterior tibiofibular ligament disruption  
                                |       | 3. Lateral short oblique or spiral fracture of fibula (anterosuperior to posterosuperior) above the level of the joint  
                                |       | 4. Posterior tibfib ligament rupture or avulsion of posterior malleolus |

General Operative Indications
- Open Fractures
- Any talar displacement
- Displaced medial or lateral malleolar fracture
- Bimalleolar fracture
- Posterior malleolar fracture
  - 25% of > 2mm step-off - controversial
- Unstable syndesmosis

Why Does Talar Displacement Matter?
- Lateral translation of 1-2 mm, shortening of 2 mm, and 5° of ER results in non-physiological pressure redistribution
- Diastasis of > 2 mm is considered a pre-arthritic deformity
- Increased widening of the ankle mortise by as little as 1 mm decreases the contact area of the tibiotalar joint by 42%, causing significant ankle instability


Operative Treatment of Syndesmosis Injuries
- **Indications**
  - Syndesmosis injuries associated with ankle fractures
    - often diagnosed intra-operatively
  - Distal tibiofibular diastasis with persistent symptoms despite conservative treatment
Operative Treatment of Syndesmosis Injuries

- **General Principles**
  - Fix fractures to correct length alignment and rotation of the fibula
  - Stress after fracture fixation
  - Hook or external rotation stress


- **Reduction**
  - Should be visualized as intra-operative fluoroscopy and radiographs are unreliable
  - Reduction clamps (and ultimately screws) placed in plane of syndesmosis to avoid iatrogenic malreduction
  - Clamps placed at 15 and 30° angulation from axial plane overcompress and externally rotate the fibula
  - Do not have to place in maximal dorsiflexion to prevent overcompression


Fixation Variables to Consider

- **1 vs. 2 screws**
  - 2 screws are biomechanically stronger but offer no functional difference

  **Xenos JS et al, J Bone Joint Surg, 1995**  
  **Wilkeroy AKB et al, J Orthop Trauma, 2004**

- **vs. 4.5 mm screws**
  - 4.5 is biomechanically stronger but 3.5 is more commonly used

  **Hansen M et al, J Foot Ankle Surg, 2006**

- **3 vs. 4 cortices**
  - No difference in functional outcome

  **Wilkeroy AKB et al, J Orthop Trauma, 2004**  
  **Haines P et al, J et al, J Orthop Trauma, 2010**

  - 4 cortex purchase easier to remove if screw breaks but can be irritating if the screw is too long

- **Trans vs. Supra syndesmotic placement**
  - No difference in functional outcome

  **Hansen M et al, J Foot Ankle Surg, 2006**

  - Usually suprasyndesmotic placement to avoid penetrating articular cartilage of distal tibfib joint

- **Screw Type**
  - No difference in functional outcomes between stainless steel and titanium or metal vs. bioabsorable

  **Beumer A et al, Injury, 2005**  
  **Ahmad J et al, Foot Ankle Int, 2009**  
  **Hovis WD et al, J Bone J Surg, 2002**  
  **Kaukonen JP et al, J Orthop Trauma, 2005**  
  **Thordarson DB et al, Foot Ankle Int, 2001**  
  **Sinisaari IP et al, Foot Ankle Int, 2002**
• **Suture Button Fixation**
  o Similar AOFAS outcome scores at 12 and 28 months
  o Earlier return to work
  o Less need for hardware removal
  o More expensive than screw fixation (unless you return to OR for screw removal) based on systematic review by Schepers T, *Int Orthop*, 2012
  o Personal Preferences
    • Use as additional fixation to single screw in widely displaced syndesmosis
    • Prevents diastasis after screw removal

• **Posterior Malleolar Fractures**
  o 10 cadaveric fractures stabilized with posterior malleolus vs. syndesmotic fixation
    • Posterior malleolar fixation was 70% pre-fracture stiffness vs. 40% with syndesmotic fixation
    • Consequentially, some surgeons choose to fix posterior malleolar fractures instead or in addition to syndesmotic fixation regardless of size or displacement

**Surgical Complications**
• Malreduction
  o Post-traumatic arthritis is rare with reduction and fixation
• Diabetic patients – 3.4x more likely to have malunion, non-union, or Charcot arthropathy
• Wound healing problems (4-5%)
• Deep Infections (1-2%)
  o Up to 20% in diabetic patients
• Obese patients
  o 15% failure vs. 2%
• Heterotopic ossification

**Post-Op Medical Management**
• 2-4 weeks splint/cast followed by boot immobilization
  o Varies based on perception of patient compliance
  o ROM can begin when out of splint/cast
• 10-12 weeks NWB in ankle fractures with syndesmotic injury
• Refer to Physical Therapy
• Post-op Medical Management

**Screw Removal**
• All patients given option for removal at 3-4 months when returning to unrestricted activities
  o Recommended, but not required
  o Most screws eventually break if not removed but often asymptomatic
  o Much more difficult to completely remove if broken
• Screw Removal is Controversial
  o Generally favored by foot/ankle surgeons but not by trauma specialists
Post-op Care, Functional Testing, Return-to-Play, Bracing/Taping, and Prognosis

Emily Middleton, PT, DPT, OCS, SCS, CSCS
Faculty Associate and Sports Residency Program Coordinator
University of Texas Southwestern Medical Center; School of Health Professions; Department of Physical Therapy
Richardson, TX

Post-Op Rehab Details

Formula that forecasts the time to return to play is:

- \[ 5 + (0.93 \times \text{tenderness length in cm}) + 3.72 \text{ days} \] - Nussbaum ED, et al, *Am J Sports Med*, 2001
- \[ 1.05 + 1.29 \times \text{palpation height (cm)} + (6.25) \times \text{player position} \] - Miller B, *Sports Health*, 2012

Estimated Time Loss

- Grade I (no diastasis) – 2-4 weeks
- Grade II (latent diastasis) – 6-8 weeks
- Grade III (frank diastasis) – 12-16 weeks

Osbahr *Orthopedics* 2013 survey of NFL team docs

Contrary to prediction rules of extent of proximal involvement

- MRI is reliable in assessing pathological involvement of the AITFL, PITFL, and IOM but the severity of ligamentous and syndesmotic disruption did not predict recovery times

Functional Testing

- Dorsiflexion Lunge
- Hop Tests
- Star Excursion Balance

Return to Play

- Taylor – AJSM, 1992 - 31 days
- Sman, 2014 article – 62 days
- Miss more games and received more treatment sessions, and delayed recovery – Sman, *J Sci Sport Med*, 2014
- 7 vs. 15 days time loss in study of NFL players (all Grade I and II injuries) - Osbahr DC et al, *Orthopedics*, 2013

Syndesmotic Prognosis as compared to lateral ligament sprains

- Median time to complete recovery
  - 15 days lateral ankle sprain vs.62 days for syndesmotic sprain
- Variables that predicted delayed return at 6 month follow-up
  - High FABQ (sport)
  - Decreased vertical jump
  - Dorsiflexion lunge ROM and SEBT did not predict slower recovery

Return to Activity when:
- Pain-free dorsiflexion ROM
- Pain-free single leg hop
- Restoration of plantarflexion power
- Tolerance to rotational stress

Bracing/Taping Considerations
References


