Ligament Injuries in Athletes

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Disclosures

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Injury prevalence


• More common in females:
  – 13.6 vs 7.9 per 1,000
• Higher in children compared to adults
• Highest in indoor/court sports
• Order of prevalence
  – Lateral, syndesmosis, Medial
Prevalence of ankle injuries

- 30 – 63% depending on what you read

- Norwegian National Ballet
  - Ankle 34%, Lower leg 18%, Foot 11%

“The prevalence of injury is extremely high …being considerably higher than among elite athletes from Olympic sports. Future efforts to prevent injuries in this group are warranted”

HIGH PREVALENCE OF INJURIES IN THE NORWEGIAN NATIONAL BALLET. BJSM 2014
Where do the athletes go for help?

• PT/ATC: 76%
• Medical Doctor: 47%
• Massage: 29%
• Acupuncturist: 20%

Bowling, A: BMJ 1989
Type of sprains

Grade 1:

- Partial tear of the ATFL. CFL intact
  - Drawer test negative

- Rx
  - CAM boot, WBAT
  - Start rehab as tolerated. Emphasize Proprioception and peroneal strengthening
  - RTP 0-2 weeks
Grade 2

• Tear ATFL, CFL intact
  – Positive drawer, Negative talar tilt

  – Same protocol for treatment and rehab, but RTP might be as long as 4 weeks.
Grade 3

- ATFL and CFL – often a dislocation that self reduced.
- Very unstable (Compare to ACL and MCL of the knee)
- These are potentially serious injuries and severely impact the athlete’s ability to RTP
Surgical Versus Functional Treatment for Acute Ruptures of the Lateral Ligament Complex of the Ankle in Young Men. A Randomized Controlled Trial

Level 1
• Equal long term functional result
• Higher risk for DJD in acutely repaired group
If you repair....

- Never use Peroneal tendons
- Repair in such a way that rehab can start early

- Most common problem after a repair is loss of ROM and impingement
- Or recurrent instability if rehab to aggressive!
Lateral Ligament
What to do for Complicated Ankle Instability?
These cases

- Failed Brostrom
- Failed allograft/autograft
- Genetic laxity
  - EDS, Marfans etc
- ? Elite athletes
Personal experience

• Started with failed previous repairs
  – Did 20 without any complications and excellent stability

• Now
  – All revisions
  – All high level athletes
  – Increasing % for others
Advantage

• Very strong
• Much quicker rehab
  – FWB from day one
  – Cast for two weeks
  – Start rehab at 2 weeks, but stay in boot for 2-3 weeks
  – At 4-5 weeks – out of boot and full rehab
4 months after surgery
Syndesmosis Injuries

- Is it unstable?
- How long before I can play?
MRI

- ligament discontinuity - a wavy or curved ligament contour (criterion 1)
- or nonvisualization of the ligament (criterion 2)
  - Criterion 1 - an accuracy of 84%
  - Criterion 1 and 2 – accuracy of 97%

Oae K et al: Injury of the tibiofibular syndesmosis: value of MR imaging for diagnosis. Radiology. 2003 Apr;227(1)
Role of MRI

- Pre-op MRI in Weber B and C fractures
- Poor correlation with level of fracture
- IOM tear can be higher or lower than fracture
  - Usually higher
- Suggest fluoroscopic EUA to determine need for fixation

Howard et al: Magnetic resonance imaging as a predictor of return to play following syndesmosis (high) ankle sprains in professional football players. Sports Health 2012 Nov

- high degree of interobserver agreement (about extend of injury)

- no association between the extent of injury on MRI and the time to return to play
Sikka et al: Correlating MRI findings with disability in syndesmotic sprains of NFL players. FAI 2012
MRI Grading system

I  - Isolated AITFL

II - AITFL, IOL+ interossous membrane

III - AITFL, IOL, IOM, PITFL

IV - Above + Deltoid ligament
Predictors for Prolonged Disability

- Increased Injury Grade
- Proximal squeeze test!
### Playing time missed

<table>
<thead>
<tr>
<th>Injury Grade</th>
<th>Practices missed</th>
<th>Games Missed</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>.25</td>
</tr>
<tr>
<td>2</td>
<td>8.2</td>
<td>1.6</td>
</tr>
<tr>
<td>3</td>
<td>21.1</td>
<td>3.8</td>
</tr>
</tbody>
</table>

Sikka et al: Correlating MRI findings with disability in syndesmotic sprains of NFL players. FAI 2012
Treatment

Syndesmosis without fracture and no instability/diastases with stress

- WBAT
  - SLC helpful for 1-2w to settle down
  - Ankle brace/splint to limit ER
  - 15 step single limb hop test to determine when to return to sports
Cortisone injection?

- AOSSM meeting 2013: Mansour et al from Houston
  - 40% quicker return to play with a cortisone injection within 72 hours from injury
  - No reported complications

- Be VERY careful.....
Instability with stress, but no diastasis

- Fixation in athletes – improved rehab and RTP
- Arthroscopy/ EAU very helpful for subtle instabilities
- Scope those that don’t improve over 8-12 weeks
Unstable injuries

- Always repair
- Screws vs Tightrope/flexible fixation
What type of fixation?

• Always somewhat of a controversy

• In the end just do a good reduction and adequate fixation
Laflamme et al: A prospective randomized multicenter trial comparing clinical outcomes of patients treated surgically with a static or dynamic implant for acute ankle syndesmosis rupture. JOT. 2015, May

- Multicenter randomized double blind trial
- 70 patients
  - 34 Tightrope
  - 36 Screws
- 6 weeks NWB in cast
- Then same rehab protocol
Laflamme et al

- Olerud-Molander score higher in Tightrope group at all time intervals
- Implant failure in 36% of screw group, 0% in Tightrope
- Loss of reduction in 11% of screw group and 0% in Tightrope

➤ Better outcomes with flexible fixation
LaFlamme et al:

- Dynamic fixation result in better clinical and radiographic outcomes.
- The implant offers adequate syndesmotic stabilization without failure or loss of reduction.
- The reoperation rate is significantly lower than with conventional screw fixation.
Deltoid and Spring ligament injuries in Athletes
Spring ligament

- Deltoid ligament
- Tibionavicular fibers
- Tibiocalcaneal fibers
- Tibiotalar fibers
- Dorsal talonavicular ligament
- Dorsal cuneonavicular ligament
- Dorsal tarsometatarsal ligaments
- Tibialis posterior tendon (cut)
- Long plantar ligament
- Plantar calcaneonavicular ligament (spring ligament)
- Medial talocalcaneal ligament
- Medial malleolus

- Cuboid
- Navicular
- Plantar calcaneocuboid lig. (short plantar lig.)
Insufficiencies

• Most is conjunction with PTTD, but not what we’re talking about
Mechanism

- Pronation
- Extension force
- Supination
- Any combination
Classification

Gazdag and Cracchiolo (1997)

- Gr 1: Longitudinal tear
- Gr 2: Laxity without obvious tear
- Gr 3: Complete rupture
History

- Always significant force – immediate pain
- Could develop swelling pretty quickly
Exam

- “Neutral Heel, lateral push” test

Imaging

• Weight bearing x-rays
  – Look for joint sagging, avulsions etc
• MRI
  – Good for SMCNL on axial and coronal views
• WB CT
  – Look for fractures and instability
Case 1

• Injured in early June during OTC
  – No film, but direct pronation injury
  – Tried to practice, but increasing pain over the next hour
WB X-rays
MRI
Treatment

• NWB in cast for 3 weeks
• Start rehab including zero-gravity treadmill
• Custom rigid orthotic
• Started to practice at 8 weeks
• RTP after 12 weeks
  – Stable and (almost) pain free
Tryfonidis et al. Acquired adult flat foot due to isolated plantar calcaneonavicular (spring) ligament insufficiency with a normal tibialis posterior tendon. Foot Ankle Surg 2008

- 6-9 patients with a SMCNL injury treated successfully with conservative management
Case 2

- Hyper-inversion midfoot injury
  - Hobbled off but could not play
Severe swelling lateral side
MRI
WB CT scan
Treatment

- Cast x 4 weeks – NWB
- Boot x 4 weeks – WBAT
- Custom rigid orthotic
- Started very slow rehab at 4 weeks
- 12 weeks before he could play
• Couldn’t find anything about this injury
Case 3

• Tackled from behind. Ended up at the bottom of a huge pile.
  – Obvious severe pain
  – Could not walk
Imaging

- Obviously unstable TN and CC joints
- Complete ligamentous disruption and a Cuboid fracture
Day 1
Treatment

• Hinterman and Saxby reported direct pants over vest repair of the spring ligament.
“Salvage”

- Direct Spring ligament repair with suture anchors
- CC fusion
9 months later
Never played again...
Summary

• True Spring ligament sports injuries are rare
• If confirmed – always a serious injury.
• Complete tear is probably a career ending injury
• There is no classification system yet
Baxter et al: Reconstruction of the Medial Talonavicular joint in Simulated Flatfoot Deformity. FAI 2015
Hintermann et al: Deltoid Ligament injuries: Diagnosis and management. Foot Ankle Clinics 2006

- Deltoid injuries more common than generally believed
- Could be due to pure eversion injuries, but also in combination with lateral rotation of the foot in relation to the tibia
- Might be seen in combination with ankle fractures
Classification

- Type 1 – Proximal tear (close to med mall)
- Type 2 – mid-substance tear
- Type 3 - Distal tear or avulsion of Deltoid and Spring ligament
Personal experience

• “Grade1”
  – Superficial Deltoid – almost always the anterior portion (tibionavicular)
  – Very common – as common as lateral sprains

• Treatment
  – Tape, rehab
  – No loss of time
Grade 1
“Grade 2”

- More complete superficial rupture
- May include the Spring ligament extensions
- Deep Deltoid is intact

- Treatment
  - Same but could take 3-4 months to recover
“Grade 3”

- Complete Deltoid disruption
- Could be in combination with ankle fractures
- Almost always needs a repair
Isolated Deltoid

- Severe eversion injury
- Clinical test
  - Hindfoot valgus corrects when toe walking
- MRI confirms
- Treatment
  - Brostrom like repair
Deltoid in combination with a ankle fracture

- “that exploration of the medial side of the ankle and repair of the deltoid ligament are not necessary....”
- 90% did well
Simple Weber B ankle fracture

USA junior female soccer player
Never did well. Always medial pain and “instability”
Hardware out
Hardware out. No better
Hsu et al: Repair of Acute Superficial Deltoid Complex Avulsion During Ankle Fracture Fixation in NFL Players. FAI 2015, Nov

- Ankle scope/debridement
- ORIF Fibula
- Syndesmosis fixation
- Deltoid repair

- All 14 players return to running and cutting by 6 months
- 13 (86%) return to NFL
Summary

- High index of suspicion
- Do stress X-rays if needed
- New studies show Arthroscopy is most sensitive to show instability
- Treat early
Peroneal retinacular tear
History

• Uncommon disorder
• First described by Monteggia in a ballet dancer in 1803
• Sports most commonly associated with peroneal subluxation/dislocation
  – Skiing, ice skating
  – Football
  – Basketball
  – soccer
Anatomic predisposition

- Pes Planus
- Hindfoot valgus
- Lax peroneal retinaculum
- Shallow fibular groove
Mechanism of injury

- Sudden forceful Dorsiflexion of the everted foot is the most common
- Usually a strong reflex contraction of the peroneal tendons
- It is the contraction of the peroneal tendons that will cause the retinaculum to tear
Examination

• Localized tenderness behind lateral malleolus and along Peroneal tendon sheath
• Always test ankle ligaments
• Pain/apprehension with eversion
• Resisted active eversion with the foot dorsiflex
  – Could be done with patient sitting or in prone position knee bend 90 degrees
Symptoms

- Pain/tenderness behind lateral malleolus
- Fatigue pain in ankle/foot
- Sometimes a feeling of “ankle giving out”
Special tests

- X-rays – not helpful
- MRI – seldom shows the subluxation, but could show the injury to the retinaculum, and any associated tendon injury
- Real time ultrasound will show subluxation
Treatment

Acute – Non operative

– SLC with foot PF and inverted for 4-6 weeks
– 50% success rate

• Probably OK for recreational athlete, but questionable for a serious athlete
Surgical

Various options depending upon the pathology
– Retinaculum repair
– Groove deepening procedure

• 80-90% good and excellent results (return to previous level of activity- pain-free)
Anterior impingement Syndrome

- Happens in full DF – Pliés

- Etiology
  - Soft tissue impingement
  - Bone spurs
  - Cartilage injury
  - Recurrent instability
Treatment

- MRI
- Injections might help for soft tissue stuff
- In the end a arthroscopic debridement is needed
<table>
<thead>
<tr>
<th>Intervention/Weeks Post Sx</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
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<tbody>
<tr>
<td>Modalities for effusion, tissue healing, pain, nerve desensitization</td>
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<td>x</td>
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<tr>
<td>Gait Training</td>
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<td>Low level intrinsic foot strength</td>
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<tr>
<td>AROM (with calcaneus blocked from posterior impingement)</td>
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<tr>
<td>Stationary Bike (Elliptical wk 6+)</td>
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<tr>
<td>Proprioceptive Progressions (en releve wk 6+; en pointe wk 8+)</td>
<td>x</td>
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<td>Proximal n.m. re-ed (Coordination of hip ER + TA + adductors)</td>
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<tr>
<td>Stretch: Gastroc, Soleus, FHL</td>
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<tr>
<td>Scar mobilization (can also perform joint mobilization and PROM if needed)</td>
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<tr>
<td>Elastic band PREs-emphasize full ROM with high reps, low wt (yellow or red band)</td>
<td>x</td>
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<tr>
<td>Closed chain re-ed of plié and releve; start PWB on Reformer or total gym → standing eccentric → unilateral</td>
<td>x</td>
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<tr>
<td>Dynamic Training: Include 2 foot → 2 foot, 2 foot → 1 foot, 1 foot → 2 foot, 1 foot → 1 foot</td>
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</tbody>
</table>
## Rehabilitation Goals & Time Frames

<table>
<thead>
<tr>
<th>Phase</th>
<th>Weeks post Sx</th>
<th>Goals for the Dancer</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1-2</td>
<td>Pain/Swelling Control Protection</td>
<td>Suture removal 10-14 days WBAT with boot</td>
</tr>
<tr>
<td>2</td>
<td>3-6</td>
<td>Pain/Swelling Control/Nerve desensitization Scar remodeling Protect FHL/Protect from overpronation (tape/orthotics if needed) Normalize Gait Full ROM (Pass Novella’s Screen) Demonstrate proper biomechanics locally and proximally on basic functional tasks of plié and releve</td>
<td>Initiate PT</td>
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<tr>
<td>3</td>
<td>6+</td>
<td>Full Strength and Endurance (25 unilateral releves) Good Proprioception (30 sec eyes closed balance) Pass functional tests for pointe (recommended even if not en pointe): Topple test, Airplane test, Sauté test Pass functional tests for general sport (90% involved:uninvolved on unilateral long jump &amp; triple hop)</td>
<td>Modified return to class at 6 weeks Functional Testing 8+ weeks Return to performance 9-12 weeks Return to premorbid activity levels at 6 months</td>
</tr>
</tbody>
</table>
Pointe Functional Tests

- **Topple Test.** Pass = 1 success; # of trials undefined.
  - [video](http://youtu.be/FoVF9CUV2H0)
  - Single pirouette turned out with clean landing to 4th

- **Airplane Test.** Pass = 4 successful/5 attempts
  - [video](http://youtu.be/DAcJ2nihD0M)
  - Pelvis stable & neutral in all 3 planes
  - No hopping, no touching hand or foot down

- **Sauté Test.** Pass = 8 successful/16 sautes
  - [video](http://youtu.be/stUFfrdXj1M)
  - Performed in parallel with arms crossed
  - Fully pointed foot (plantarflexed)
  - Land on the X
  - Good pelvofemoral control
Novella’s Screen
Special Considerations

• The above guidelines can also be used with a conservative/non Sx Os Trignoum or posterior ankle impingement. Cam boot can be utilized for protection. Week by week guidelines may vary based on functional milestones.

• Extensive neuromuscular re-education of the foot and proximal musculature is necessary for safe return to releve. The dancer has likely never had good neuromuscular control through full range of releve before.
Thank you