Medial ligament injuries and Spring ligament injuries of the ankle

Swedish FAS. Uppsala.

Thursday. February 4th, 2016

Bill Ribbans
How many components of the deltoid ligament are there?

a. 2
b. 4
c. 6
d. It depends who is counting!!
How many components of the deltoid ligament are there?

a. 2
b. 4
c. 6
d. It depends who is counting!!
Deltoid Ligament Anatomy

- 1st described 1822
- Sarrafin review (1993) – 13 different descriptions
- Not all constant – e.g. is tibionavicular no more than capsular thickening?
- Lack of descriptive consistency

Superficial
- Spans 2 joints – ankle and STJ or TNJ

Deep
- Spans 1 joints
- Shorter and thicker

Mistake on diagram
Tibiospring = tibionavicular
Deltoid Ligament Anatomy

Pau Golano dissection
**Spring (Calcaneonavicular) Ligament**

**Components**  
(Taniguchi, 2003; Patil, 2007)

- Superomedial (Sm):
- Inferoplantar (I)
- Third (T)

**Acetabulum Pedis**  
(Sarrafian, 1983)

- Fibrocartilage on its deep surface
- Intimately related to:
  - Tibialis posterior tendon
  - Tibiospring ligament
Should we consider the Deltoid and Spring Ligaments as a united complex?

5 structures

- **Tibiocalcaneonavicular**
  - Containing:
    - Tibiocalcaneal
    - Tibionavicular
    - Tibiospring
    - Medioplantar oblique

- **Superficial posterior tibiotalar**

- **Deep anterior tibiotalar**

- **Deep posterior tibiotalar**

- **Inferoplantar longitudinal**

Cromeens BP et al. FAI 2015.
Deltoid Ligament Function

- Function and activity of various components NOT consistently reported

- Deltoid requires considerable force to be disrupted
  - Stronger than lateral ligament complex under load
  - Weaker than elements of the syndesmosis

  - Tibiocalcaneal part = strongest

- Stufkens (2012):
  - dPTT = strongest; 2nd = TSL
Uppsala Question Time

The combined components of the deltoid ligament resist the following movements?

a. Varus angulation
b. Lateral translation
c. Anterior translation
d. ALL of the above
The combined components of the deltoid ligament resist the following movements?

a. Varus angulation
b. Lateral translation
c. Anterior translation
d. ALL of the above
## Deltoid Ligament Function

<table>
<thead>
<tr>
<th>Resistance to talar movement</th>
<th>Deep</th>
<th>Superficial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Valgus angulation (Close, 1956)</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Lateral translation</td>
<td>+++</td>
<td></td>
</tr>
<tr>
<td>Posterior translation</td>
<td>+++</td>
<td></td>
</tr>
<tr>
<td>External rotation (Rasmussen, 1983)</td>
<td></td>
<td>+++</td>
</tr>
</tbody>
</table>
## Role and Importance of the Spring Ligament

<table>
<thead>
<tr>
<th>Very Important</th>
<th>Not Important</th>
</tr>
</thead>
</table>
| Spring Ligament important in maintaining arch stability and as a sling for Talar head: | **Kitaoka (1997):**  
  - Less important than other structures in arch maintenance |
  - **Iaquinto (2010):**  
    - Contribution to arch stability:  
      - 8%: Spring Ligament  
      - 80%: Plantar Fascia |
| • Hollingshead (1954)                                                            | • Sectioning of SL ≠ immediate instability                     |
| • Davis (1996)                                                                   | • However, subsequent cyclical loading > deformity               |
| • Jennings (2008)                                                               |                                                                 |
Hintermann’s Classification of Deltoid Ligament Injuries (2003) (n=54)

<table>
<thead>
<tr>
<th>Lesion Type</th>
<th>Location</th>
<th>Ligaments involved</th>
<th>Incidence (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Proximal tear or avulsion</td>
<td>o Tibionaviccular</td>
<td>72%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Tibiospring</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Intermediate:</td>
<td>o Tibionaviccular</td>
<td>9%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Tibiospring</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>o (Spring)</td>
<td></td>
</tr>
<tr>
<td>III</td>
<td>Distal</td>
<td>o Tibionaviccular</td>
<td>19%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>o Spring</td>
<td></td>
</tr>
</tbody>
</table>

Based on clinical and intraoperative findings

**Deltoid Ligament Injuries**

**“An Association Classification”**

<table>
<thead>
<tr>
<th>Acute</th>
<th>Chronic</th>
</tr>
</thead>
<tbody>
<tr>
<td>• <strong>Isolated</strong> Deltoid injuries</td>
<td></td>
</tr>
<tr>
<td>• Associated with ankle fractures</td>
<td></td>
</tr>
<tr>
<td>• <strong>Combination</strong> ligament injuries with:</td>
<td></td>
</tr>
<tr>
<td>o Lateral collateral ligaments</td>
<td></td>
</tr>
<tr>
<td>o Syndesmotic ligaments</td>
<td></td>
</tr>
<tr>
<td>o Spring ligament</td>
<td></td>
</tr>
<tr>
<td>• <strong>Secondary</strong> to acute injuries</td>
<td></td>
</tr>
<tr>
<td>• <strong>Combination</strong> injuries with:</td>
<td></td>
</tr>
<tr>
<td>o TPT insufficiency</td>
<td></td>
</tr>
<tr>
<td>and/or</td>
<td></td>
</tr>
<tr>
<td>o Insidious Spring ligament injury</td>
<td></td>
</tr>
</tbody>
</table>

Deltoid Ligament Injuries – Sports

Impact and Jumps Sports
including:

- Soccer
- Rugby Union and League
- American Football
- Basketball
- Long Jump/Triple Jump
- Dance

Natural History of acute Deltoid Ligament Injuries

• Well-documented for:
  – Lateral ligament injuries
  – Syndesmotic injuries

• Paucity of information on Deltoid ligament injuries

Level 5 evidence mainly (Expert Opinion)
• Often delay in diagnosis – may occur with other ligament injuries
• Usually more severe than appear initially
• Take much longer to recover from than lateral injuries
• “4-6 months to completely recover “
  (Peter Mangone, AOFAS Sports Foot and Ankle. Houston. 2013)
Deltoid Ligament Injuries

% of all ankle sprains?

- 3% - Broström (1964)
- 4% - Gerber (1998)
- 7% - Jackson (1974)
# Epidemiology – European Soccer

Ankle injuries = 13% of all injuries

1 professional club with 1st team squad of 25 players would expect 1 medial ligament injury every 2 years

<table>
<thead>
<tr>
<th>Injury</th>
<th>Nos</th>
<th>%</th>
<th>Mean lay off (days)</th>
<th>Injury Burden (no. of lay off days per 1000 hours)</th>
<th>Rates of injury per 1000 player hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALL ankle</td>
<td>1080</td>
<td>N/A</td>
<td>15.9</td>
<td>16.3</td>
<td>1.022</td>
</tr>
<tr>
<td>Sprain / Ligaments</td>
<td>729</td>
<td>67.5%</td>
<td>15.4</td>
<td>10.6</td>
<td>0.690</td>
</tr>
<tr>
<td>Medial ligament injury</td>
<td>72</td>
<td>9.9% of ligaments</td>
<td>13.6</td>
<td>0.9</td>
<td>0.068 (1:14,705 hours)</td>
</tr>
</tbody>
</table>

1743 players in 10 countries and 23 clubs followed for 11 years. 4375 player seasons. Waldén et al. BJSM. 2013
### Epidemiology – American Football

- 72% sustained Foot and Ankle Injuries
- 1.24 injuries/player injured
- 13% required surgery for Foot and Ankle injuries

#### Ankle Ligament injuries in 320 players (Total F&A injuries = 287 in 231 players)

<table>
<thead>
<tr>
<th>Ligament</th>
<th>Players (injuries)</th>
<th>% of players</th>
<th>% surgery rate following injury</th>
<th>Offence</th>
<th>Defence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lateral</td>
<td>100 (115)</td>
<td>31.3%</td>
<td>2.6% (=3)</td>
<td>53%</td>
<td>47%</td>
</tr>
<tr>
<td>Syndesmotic</td>
<td>47 (50)</td>
<td>14.7%</td>
<td>0.0%</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>Medial</td>
<td>7 (7)</td>
<td>2.2%</td>
<td>14.3% (=1)</td>
<td>100%</td>
<td>0%</td>
</tr>
</tbody>
</table>
Deltoid Ligament Injuries

Mechanism of Injury

INJURIES USUALLY INVOLVE ONE OF MORE OF THE FOLLOWING MECHANISMS:

- Eversion
- Pronation
- External Rotation
- Abduction
Deltoid Ligament Injuries

Combination Injuries - Ligaments

**Lateral Ligament Injuries**
- 40% with instability and lateral and medial pain had deltoid injury (Hintermann, 2002)
- 72% MRI evidence of deltoid ligament injury in patients requiring lateral ligament reconstruction (Crim, 2011)
- Buchhorn (2011) reported series of 81 patients in 2 year period requiring combined lateral and medial repair for chronic rotational instability

**Syndesmosis Injuries**
- Always check for medial symptoms in combination with a high ankle sprain even in the absence of a fracture (Miller, 1995)
- External rotation injuries > potential injury to both syndesmosis and deltoid complexes (McCollum, 2013)

**Spring Ligament**
- Rarer
- Usually combination of spring ligament and tibionavicular ligament (Hintermann, 2003)
Deltoid Ligament Injuries
Combination Injuries - Fractures

Ankle Fractures

- Supination-ER – most common
- Pronation-ABd
- Pronation-ER

(Manual or Gravity) External Rotation Stress Radiograph Test = Gold Standard
(vd Bekerom, 2009)

Always assess Deltoid Ligament
Deltoid Ligament Injury Evaluation

**History**

**Acute History**
- History of trauma
  - usually eversion, external rotation and/or abduction mechanism
- Feeling of a “pop”
- Pain, swelling and bruising on medial side

**Chronic History**
- History of acute injury
- Persistent swelling
- Feeling of “instability” – especially medially on uneven surfaces, slopes, “running a curve”
- Change in “foot appearance”

**Hintermann (2003):**
- Medial gutter pain (98%)
- TPT pain (27%)
- Anterior border of lateral malleolus pain (25%)
Deltoid Ligament Injury Evaluation Examination

- Pattern of swelling and bruising

- Tenderness:
  - Medial
  - Check for additional lateral and syndesmotic ligament and osseous involvement

- Foot position
  - Increasing hindfoot valgus and pronation
Deltoid Ligament Injury Evaluation

- TPT intact (?)
  - Deformity correction of TPT activation
  - TPT contraction allows single stance tiptoe and deformity correction

- Clinical stress testing
  - Valgus and varus
  - External rotation
  - Anterior Drawer
  - Posterior Drawer
## Deltoid Ligament Injury – Drawer Tests

<table>
<thead>
<tr>
<th>Drawer Test</th>
<th>Ligament Tested</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anterior</td>
<td>Superficial</td>
<td>More ER on damaged side</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Usually normal foot IR around SDL when</td>
</tr>
<tr>
<td></td>
<td></td>
<td>anteriorly translated</td>
</tr>
<tr>
<td>Posterior</td>
<td>Deep</td>
<td>Relaxed with patient prone and foot</td>
</tr>
<tr>
<td></td>
<td></td>
<td>hanging over end of couch</td>
</tr>
</tbody>
</table>
Deltoid Ligament – Plain Radiography

To exclude other injuries:
- Fractures
  - Assessment of stability, e.g. widening of medial clear space
- Syndesmotic lesions
- Avulsion injuries
- Medial malleolus
- Talus
- Osteochondral lesions

Development of secondary degenerative changes
Assessment of foot and ankle alignment

Which views?
- AP wb
- Mortise
- Lateral wb
- Hindfoot alignment (Saltzman, 1995)
Deltoid Ligament – Stress Radiography

Combination Injuries

To corroborate clinical findings in cases of:
- Isolated injuries
- Fractures
- Syndesmotic injury
- Combined medial & lateral instability

Location:
- Out-patients
- Operating Room under GA

Gold Standard?
- Supination-ER Fxs - YES (vd Bekerom, 2009)

What stresses and/or position?
Fractures +/- syndesmotic disruption
- Manual ER (patient supine) (vd Bekerom, 2009)
- Gravity (Gill, 2007)
On performing a valgus stress test of the ankle joint, beyond what value would you consider deltoid ligament laxity likely?

a. 3°  
b. 5°  
c. 10°  
d. 20°
On performing a valgus stress test of the ankle joint, beyond what value would you consider deltoid ligament laxity likely?

a. 3°
b. 5°
c. 10°
d. 20°
Gold Standard ?

- Chronic Deltoid injuries – NO
  (Hintermann, 2004)

Location:
- Out-patients
- Operating Room under GA
Deltoid Ligament Ultrasound

Normal deltoid ligament running between tibia and talus with more superficial fibres appearing more echogenic and deeper fibres hypoechoic.

Thickened heterogeneous abnormal deltoid

Doppler signal demonstrating hyperaemia
MRI of the Deltoid Ligament Complex

- Better quality MRI > improved understanding of complex abnormalities
- Identifies involved individual components (Chhabra, 2010) and allows for better management planning (conservative and surgical)
Grade 2/3 disruption of the superficial ligament fibres between the medial malleolus and talar head/spring ligament

Coronal PD FSE and T2 Fat Sat anterior talar dome
Grade 2/3 disruption of the superficial ligament fibres between the medial malleolus and talus/calcaneum

Grade 1/2 disruption of the deep ligament fibres between the medial malleolus and talus with underlying bone bruising

Coronal PD FSE and T2 Fat Sat mid talar dome
## Clinical Grading of acute isolated Deltoid Ligament sprains and $M_x$

<table>
<thead>
<tr>
<th>Grade</th>
<th>Tenderness</th>
<th>Swelling</th>
<th>Bruising</th>
<th>Instability (Clinical/Screening)</th>
<th>Rx</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Mild</td>
<td>+</td>
<td>+</td>
<td>None</td>
<td>Immobilisation</td>
</tr>
<tr>
<td>II</td>
<td>Moderate</td>
<td>++</td>
<td>++</td>
<td>Mild</td>
<td>Immobilisation – longer than Grade I</td>
</tr>
<tr>
<td>III</td>
<td>Severe</td>
<td>+++</td>
<td>+++</td>
<td>Definite</td>
<td>Immobilisation and/or Consider Surgery</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Timing (weeks)</th>
<th>Protection</th>
<th>WB status</th>
<th>Physiotherapy</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-2</td>
<td>Boot or cast</td>
<td>NWB/TDWB</td>
<td>• Reduce swelling</td>
</tr>
<tr>
<td>2-4</td>
<td>Functional bracing</td>
<td>Progressive WB as pain allows</td>
<td>• Active and active assisted ROM</td>
</tr>
</tbody>
</table>
| 4-6/8         |                 |                   | • Increasing ROM  
                • Proprioceptive training |
# Conservative Rx of acute isolated deltoid ligament injuries

<table>
<thead>
<tr>
<th>Timing (weeks)</th>
<th>Protection</th>
<th>WB status</th>
<th>Physiotherapy</th>
</tr>
</thead>
</table>
| 6-8 +         | Functional bracing + Medial support orthotic in sports shoe | FWB | • Functional Testing for RTS, e.g.  
• Single hop test  
• Single leg stance  
• Single heel raise |
| RTS           | Medial posted orthotic for 4-6/12 |           |               |
Decision making for Surgical Rx of Deltoid Ligament Injuries

Initial Arthroscopy?

Site of tear and Quality of Tissue

Repair
• What equipment?

Reconstruction
• Options?
• Autograft
• Allograft
• Synthetic

What other structures need looking at?
e.g. Lateral ligaments, Spring ligament, Syndesmosis

Are any additional osseous procedures required?
Is an initial ankle arthroscopy going to aid management of the problem?

• Hintermann:
  - look for intra-articular pathology
  - Grade Deltoid instability

Deltoid Ligament Injury Evaluation
Role of Ankle Arthroscopy

Benefits:
- Inspection and management of any associated intra-articular pathology, e.g. OCD talar lesions
- Inspection of medial ligaments
- Buchhorn (2011):
  - ligament continuity;
  - tension under stress;
  - evidence for proximal changes, e.g. periosteal reaction, avulsions;
  - tibiotalar distance under pronation stress

- Grading of instability (Hintermann, 2003)

<table>
<thead>
<tr>
<th>Grading</th>
<th>Definition</th>
<th>5mm arthroscope introduction into tibiotalar space</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stable</td>
<td>o No or minimal talus translocation</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>o Opening of tibiotalar space ≤2mm (as measured by 2mm hook)</td>
<td></td>
</tr>
<tr>
<td>Moderately unstable</td>
<td>o Tibiotalar space opens BUT ≤5mm</td>
<td>Yes</td>
</tr>
<tr>
<td>Severely unstable</td>
<td>o Talus moves easily out of ankle mortise</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>o Easy access to posterior joint structures without excessive traction</td>
<td></td>
</tr>
</tbody>
</table>

Hintermann B, 2003; Buchhorn T, 2011.