Ankle: Tendons and Ligaments

Suzanne S. Long, MD
William Morrison MD
Adam C. Zoga, MD, MBA
Angela Gopez MD

Sidney Kimmel Medical College
Philadelphia, PA, U.S.A.
LIGAMENTS

Ankle sprain: most common injury

- Ligamentous injury usually self-limited
- Conservative tx
- MRI for chronic pain, can be from:
  - Tenosynovitis, esp peroneal
  - Impingement, esp anterolateral
  - Sinus tarsi syndrome
  - OCD
  - Ankle / subtalar instability
ANKLE SPRAIN

- **85% Inversion Injury**
  - aka Supination Injuries
  - Lateral distraction injury
  - Impaction medially

- **15% Eversion**
  - aka Pronation Injuries
  - Accompanied by lateral malleolus fracture and/or syndesmosis injury
  - More severe injuries
ANKLE SPRAIN

- 85% Inversion Injury
  - aka Supination Injuries
  - Lateral distraction injury
  - Impaction medially

- 15% Eversion
  - aka Pronation Injuries
  - Accompanied by lateral malleolus fracture and/or syndesmosis injury
  - More severe injuries
Lateral Ligaments

- ATFL (anterior talofibular)
- CFL (calcaneal fibular)
- Syndesmosis
- PTFL (posterior talofibular)

- Tear in Progression!!
Anterior Talofibular (ATFL)
Ultrasound – normal ligament (ATFL)

- echogenic
- fibrillar

anterior talofibular ligament (ATFL)
ATFL sprain

- hypoechoic
- +/- thick
- loss of fibrillar pattern
LATERAL LIGAMENT INJURY

Inversion mechanism
Anterior talofibular – first injured
Calcaneofibular – second injured
Syndesmosis – more severe injuries
Posterior talofibular - almost never injured
ACUTE SPRAIN GRADING: ATFL

Complete tear – Grade 3

Partial tear - Grade 2 sprain

Edema - Grade 1 sprain
POSSIBILITIES

- Absent
- Normal
- Thickened

1 week
OLD ATFL INJURY

remote tear

scarring
CF LIGAMENT
USE OF AXIAL IMAGES

CALCANEOFIBULAR LIGAMENT

PERONEAL TENDONS
Normal Calcaneofibular Ligament (CFL)

peroneal tendons (anisotropy)
Calcaneofibular ligament tear - fluid extends from joint into peroneal sheath
PITFALLS

PERONEUS QUARTUS M.

SPLIT PERONEUS BREVIS T.
LIGAMENTS

- **Syndesmosis (tibiofibular ligaments)**
  - More severe ankle sprain
  - Anterior > posterior
  - If unrecognized: chronic pain, instability
  - Late: ossification at tib/fib interval
Tibiofibular Syndesmosis

Anterior Inferior Tibiofibular Ligament: inversion or eversion

Posterior Inferior Tibiofibular Ligament: eversion
(INFERIOR) TIBIOFIBULAR LIGAMENTS

AITF

PITF
Anterior Syndesmosis Tear
Syndesmosis Injury ("high ankle sprain")
FB player w/ Eversion Injury
Tibiofibular Syndesmosis

Subacute syndesmotic injury
LIGAMENTS

Medial (deltoid) ligament
- Strong, thick
- Superficial and deep portions
- Eversion injury
- Usually avulses bone instead of tearing
MEDIAL LIGAMENTS

- DEEP
- PTT
- SUPERFICIAL
- FDL
- FHL
Normal

Sprain w medial impaction
Professional football player - eversion mechanism

Deltoid ligament avulsion
Anatomic Concepts
Lisfranc Injuries

- Lisfranc injuries occur with high and low impact trauma
- Tenderness and swelling over their first and second tarsometatarsal joints, unable to bear weight
- Recognition is important because surgical stabilization may be necessary to prevent long term disability
16 y.o. pain after football injury - Lisfranc ligament sprain
Complete (C1-M2M3) disruption → screw fixation
The Sinus Tarsi

- Fat signal is normal
- Contains five ligaments, arterial anastomosis and nerve
Sinus Tarsi Syndrome

• Lateral pain, tenderness, hindfoot instability
• Association with ankle sprains / lateral ligament injury, tibialis posterior tendon dysfunction
PLANTAR FASCIITIS

- Plantar heel pain (esp medial) upon walking (in am)
- Chronic repetitive trauma with microtears
- Acute: edema around proximal plantar aponeurosis
- Chronic: Dark; diffuse thickening
- If severe / longstanding: stress fracture-like appearance
Plantar Fasciitis Ultrasound

- thick plantar fascia (>4mm), tender
- hypoechoic, +/- anechoic interstitial tearing
- +/- vascular flow
TENDONS
TENDON PATHOLOGY

PREDISPOSING FACTORS

- Following ligament injury
- Chronic overuse, age
- Metabolic
  - obesity
  - diabetes
  - chronic renal failure
  - hyperlipidemia
  - collagen vascular diseases
  - steroid / fluoroquinolone therapy
  - gout
PERONEAL TENDONS

Pathology usually associated with recurrent or severe ankle sprains
PERONEAL TENOSYNOVITIS

- More fluid than tendon = abnormal
- Synechiae = abnormal
PERONEAL SPLIT

Peroneus longus migrates into brevis, first flattening it with ‘boomerang’ shape finally splitting it
Symptoms: chronic lateral retromalleolar pain / snapping, occasional sx of instability
Peroneal Tendon Dislocation
Peroneal Tendon Dislocation / Relocation
DISTAL PERONEAL PATHOLOGY: Painful Os Peroneum Syndrome ("POPS")

- Pain, tenderness over cuboid
- Peroneal tenosynovitis / tear (esp distal)
- Edema / necrosis / fragmentation of os peroneum
Painful Os Peroneum Syndrome ("POPS")
ACHILLES

• Peritendinitis
  – “Acute Achilles tendinitis”
  – Weekend athletes
  – Edema around Achilles tendon
  – Edema in Kager’s (pre-Achilles) fat
ACHILLES

- Continued stress -> chronic tendinosis
  - Tendon thickened, losing concavity on axial images
  - Low signal: hypoxic
  - Intermediate signal: mucoid
- Tears
  - Watershed zone (5 cm from insertion)
  - Insertional
  - Myotendinous junction
CHRONIC TENDINOSIS

Diffusely low signal: Hypoxic degeneration

WATERSHED ZONE
Achilles Tendinosis Ultrasound
ACHILLES TENDINOSIS

Mucoid degeneration
Achilles Tendinosis Ultrasound

LONG AXIS
LEFT ACHILLES

SHORT AXIS
LEFT ACHILLES
TEAR: LOCATION

- Insertional
- Myotendinous junction
- Midsubstance (watershed)

*Estimate cross-sectional %*
COMPLETE TEAR

Measure gap
POST-OP ACHILLES

Repair with FHL transfer
HAGLUND SYNDROME

- Upturned post calcaneal tubercle
- Retrocalc bursitis
- Retro Achilles bursitis
- Insertional Achilles tendinosis / tear
Ankle
Flexor Tendons

Navicular
Talus
Superomedial Calcaneonavicular ligament
PTT
FDL
FHL
POSTERIOR TIBIALIS TENOSYNOVITIS
PTT TEAR / DYSFUNCTION

- Typically middle age / elderly females, diabetics
- Painful acquired flatfoot
- MRI: *PTT normally 2 times thickness of adjacent flexor digitorum longus tendon*
  - Thinning or thickening = pathology
  - complete tear uncommon
PTT / spring ligament dysfunction results in deformity
Posterior Tibial Tendon: Dynamic Stabilizer

- Function
  - Support medial arch of the foot
  - Invert foot
  - Plantarflex ankle
Posterior Tibial Tendon: Dynamic Stabilizer

- If torn or stretched: arch collapses
Spring Ligament Tear
Posterior Tibial Tendon Failure - Radiographs

- Hindfoot valgus
- Overpronation/Forefoot abduction
- Arch collapse
- Pes planus
MR IMAGING SIGNS OF PTT DYSFUNCTION

Uncovering of medial talar head

Fibulocalcaneal abutment

Hindfoot valgus

Also: pes planus, arch collapse
Subtendinious BME - can be a sign of overlying tendinosis, pain
Non-articular spur medial malleolus - associated with chronic PT Tosis
- Accessory navicular ossicle
- PTTosis
- Edema at os
FLEXOR HALLUCIS LONGUS

- Communicates with ankle joint
- Can have a large amount of fluid in asymptomatic people

Synechiae = tenosynovitis
TARSAL TUNNEL SYNDROME

- Fibro-osseous tunnel analogous to carpal tunnel tunnel
- Limited by flexor retinaculum
- Mass effect impinges on nerve
  - tenosynovitis
  - ganglion
  - prominent vessels
  - true mass
- Nerve impingement can simulate plantar fasciitis (Baxter’s nerve)
RHEUMATOID ARTHRITIS

Mass effect from synovitis

Nerve swelling
ANTERIOR TIBIALIS TEAR

• Uncommon
• Tibialis anterior functions during swing phase of gait, keeps foot from dragging
• Tears in elderly, also athletes in kicking sports
• Often presents as a tender mass
Tibialis Anterior Tendon Tear (full thickness)

- Retracted tendon
- Distal tendon
- Torn, retracted tendon

Longitudinal

Transverse
## Ankle-Routine

<table>
<thead>
<tr>
<th>Seq.</th>
<th>FOV</th>
<th>Matrix/ Nex</th>
<th>Slice</th>
<th>TR</th>
<th>TE</th>
<th>TI</th>
<th>Flip</th>
<th>ETL</th>
<th>BW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sag T1 SE Non FatSat</td>
<td>16-18</td>
<td>256 x 192 1</td>
<td>3/1</td>
<td>400-800</td>
<td>Minimal</td>
<td></td>
<td></td>
<td></td>
<td>16</td>
</tr>
<tr>
<td>Sag STIR</td>
<td>16-18</td>
<td>256 x 192 3</td>
<td>3/1</td>
<td>&gt;1500</td>
<td>40</td>
<td>150</td>
<td>90</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>Axial PD FSE Non FatSat</td>
<td>14-16</td>
<td>512 x 256 2</td>
<td>4/1</td>
<td>3000</td>
<td>40</td>
<td></td>
<td>8</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Axial T2 FSE FatSat</td>
<td>14-16</td>
<td>256 x 256 2</td>
<td>4/1</td>
<td>&gt;2000</td>
<td>70-80</td>
<td></td>
<td>8</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>Coronal T2 FSE FatSat</td>
<td>14</td>
<td>256 x 256 3</td>
<td>3/1</td>
<td>&gt;2000</td>
<td>70-80</td>
<td></td>
<td>8</td>
<td>16</td>
<td></td>
</tr>
</tbody>
</table>

[www.bone.tju.edu](http://www.bone.tju.edu)
Ankle-Axial Imaging Plane

Relevant Anatomy

Axial Imaging Plane
Prescribe plane parallel to axis of calcaneus. Scan ankle from distal tibia through subcutaneous soft tissues (include plantar fascia).

Tibia
Talus
Calcaneus
Black band is plantar fascia

www.bone.tju.edu
Ankle-Coronal Imaging Plane

Relevant Anatomy

Coronal Imaging Plane
Prescribe plane perpendicular to axial imaging plane. Scan ankle from calcaneus through metatarsal bases.
Ankle-Sagittal Imaging Plane

Relevant Anatomy

Sagittal Imaging Plane
Prescribe plane with line parallel to talus. Cover ankle from medial through lateral malleolus.

www.bone.tju.edu