The Spring in Your Step

High Resolution 3T MR Imaging of the Spring Ligament Complex

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Objectives

I. Normal anatomy of the spring ligament complex

II. Injury patterns
   ○ Sample cases

III. Treatment algorithm
I. Normal Anatomy

- **Description**
  - Spring ligament is composed of thick bands of tissue connecting the sustentaculum talus to the plantar aspect of the navicular.

- **Functions**
  - Important support structure and stabilizer of the medial arch of the foot.
  - Supports the talar head as part of the anterior talocalcaneonavicular joint.
Bands

- Superomedial (SM)
- Medial plantar oblique (MPO)
- Inferoplantar longitudinal (IPL)
- Tibial Spring (TS)
  - Part of the superficial deltoid ligament.
Superomedial (SM) Band

- **Attachments**
  - Medial sustentaculum talus to superomedial navicular bone over a broad attachment.
  - Forms the sling that articulates with talar head.
  - Deep to posterior tibialis tendon (PTT).

- **Thickness**
  - < 4mm

- **Optimal planes for visualizations**
  - Axial & coronal

Axial proton density (PD) Weighted Image
Superomedial (SM) Band

- Readily seen between the talar head/neck and PTT.
- Forms a sling to support the talar head.

Axial PD Weighted Image

Coronal PD Weighted Image
Gliding Zone

- Region between the SM band and PTT lined by synovial cells and containing fibrocartilage.
Medial plantar oblique (MPO) Band

- Attachments
  - Coronoid fossa of calcaneus to medial plantar navicular bone adjacent to navicular tuberosity.

- Thickness
  - < 4mm

- Optimal plane for visualization
  - Axial
Medial plantar oblique (MPO) Band

- Calcaneal coronoid process to medial plantar navicular.
Inferoplantar longitudinal (IPL) Band

- Attachments
  - Coronoid fossa of calcaneus to navicular bone inferior beak.
  - Arises anterior to the MPO band in the coronoid fossa.

- Thickness
  - < 4mm

- Optimal planes for visualization
  - Axial & sagittal

Axial PD Weighted Image
Inferoplantar longitudinal (IPL) Band

- Calcaneal coronoid process to inferior navicular beak.
Tibial Spring (TS) Band

- Attachments
  - From medial malleolus blending inferiorly with SM band.

- Optimal planes for visualization
  - Axial & coronal

- Part of superficial deltoid ligament.
Spring Ligament Recess

- Potential space between MPO and IPL bands.
- Lined by synovium.
- Communicates with talocalaneonaviculcclar joint.
- Should not be mistaken for a tear.

Coronal proton density Fat Saturation (PDFS) Weighted Image
Axial View - Normal Anatomy

- Posterior tibial tendon (PTT)
- Superomedial (SM)
- Tibial spring (TS)
- Inferoplar longitudinal (IPL)
- Medial plantar oblique (MPO)
Coronal View - Normal Anatomy

- Posterior tibial tendon (PTT)
- Superomedial (SM)
- Tibial spring (TS)
- Inferolateral longitudinal (IPL)
- Medial plantar oblique (MPO)
Sagittal View - Normal Anatomy

- Inferoplantar longitudinal (IPL)
- Medial plantar oblique (MPO)

Movie will begin automatically. Click outside of movie to advance to next slide.
II. Spring Ligament Injury

- MRI Findings
  - Thickening > 4mm
  - Increased Signal
    - IPL band can normally have intermediate intrasubstance signal due to interposed fat.
    - Gap/nonvisualization

- Associations
  - PTT pathology in >90%
  - Pes planovalgus
  - Sinus tarsi syndrome

- SM band is most commonly injured.
SM Band Thickening

- Axial PDFS showing thickening of the SM band and PTT tenosynovitis.
Torn TS and SM band

○ Coronal (left) & axial (right) PDFS showing complete tears of TS and SM.
Torn MPO

- Axial PDFS showing a partially torn MPO band with reactive navicular bone marrow edema.
Associations:
PTT

- Axial PD showing PTT split tear.
- Thickened SM band with some intermediate increased signal.
Associations:
Acquired Pes Planovalgus

- **Mechanism**
  - PTT pathology leads to abnormal loading of the spring ligament by the talar head. This results in:
    - Spring ligament failure.
    - Talar head rotation in a plantar and medial direction.
    - Calcaneus undergoing progressive valgus alignment.
Associations:
Acquired Pes Planovalgus

- Radiographic Signs
  - AP talocalcaneal angle > 45 degrees.
    - Angle formed by lines parallel to medial border of talus and parallel to lateral border of calcaneus.
  - Measured on weight bearing views.

>45˚ AP radiograph of the foot
Associations: Acquired Pes Planovalgus

- Radiographic Signs
  - Lateral talocalcaneal angle > 50 degrees.
    - Angle formed by lines bisecting the talus and parallel to the inferior border of the calcaneus.
  - Measured on weight bearing views.

Lateral radiograph of the foot
Associations: Acquired Pes Planovalgus

- MRI Signs
- Axial PD weighted image showing medial rotation with uncovering of the talar head.
Associations: Acquired Pes Planovalgus

- MRI Signs
- Hindfoot valgus angle
  - The angle between lines drawn through the long axis of the tibia and along the border of the calcaneal medial cortex.
    - Normal: 0-6°
    - Mild: 7-16°
    - Moderate: 17-26°
    - Severe: >27°
Associations:
Sinus Tarsi Syndrome

- Related to progressive failure of PTT and spring ligament.

- MRI Signs
  - Obliteration of normal tarsal sinus fat.
  - Increased tarsal sinus T2 signal.
  - Thickened or attenuated tarsal sinus ligaments.
Associations: Sinus Tarsi Syndrome

- MRI signs: Sagittal T1 showing normal (left) and obliterated (right) sinus tarsi fat.
Treatment Algorithm: Non-operative Management

- Reserved for cases with low likelihood of worsening pes planovalgus.
- Medial longitudinal arch support is emphasized.
  - Orthotics/boots play a central role.
Treatment Algorithm: Operative Management

- Primarily for cases with high likelihood of progression of pes planovalgus.
- Restore medical arch support.
  - Repair of associated PTT injuries
  - Imbrication/augmentation/reconstruction of the SM band
  - Calcaneal osteotomy
  - Lateral column lengthening procedure
  - Arthrodesis
Treatment Algorithm: Operative Management

- Procedural overview
  - Medial incision
  - Retract PTT
  - Identify SM band deep to PTT
  - Imbricate the attenuated component
  - Reconstruct/augment as necessary
Summary

- Knowledge of spring ligament anatomy and associated injury patterns is imperative.
  - Evaluate for associated PTT injury
  - Evaluate for pes planovalgus
  - Evaluate for sinus tarsi syndrome

- Of all spring ligament components, integrity of the SM band is the most important.

- Both non-operative and operative managements are viable depending on risk of pes planovalgus progression.
References


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