

The Spring in Your Step

High Resolution 3T MR Imaging of the Spring Ligament Complex

Hythem Omar, MD
Mina Hanna, MD
Lena Omar, MD
Daniel Moore, MD
Gina Cho Sims, MD
George Liu, DPM
Avneesh Chhabra, MD

 **SOUTHWESTERN**
MEDICAL CENTER

Objectives

- I. Normal anatomy of the spring ligament complex
- II. Injury patterns
 - Sample cases
- III. Treatment algorithm

I. Normal Anatomy

- Description

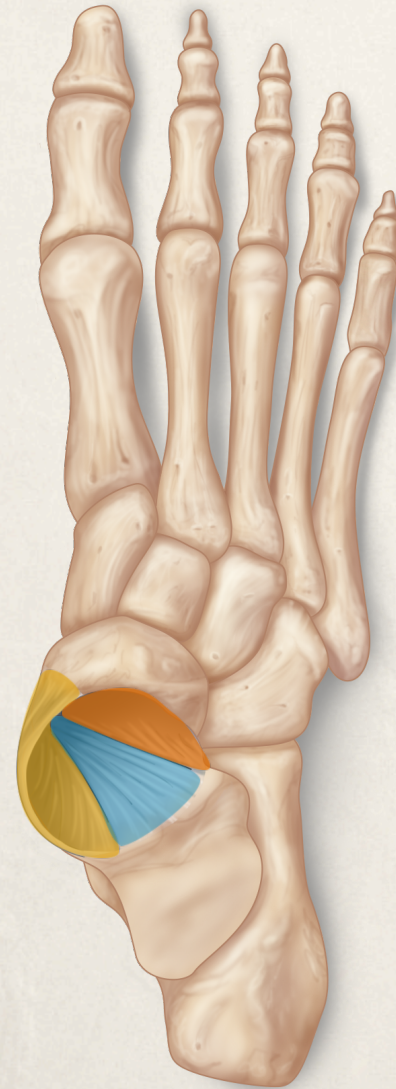
- Spring ligament is composed of thick bands of tissue connecting the sustentaculum talus to the plantar aspect of the navicular.

- Functions

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

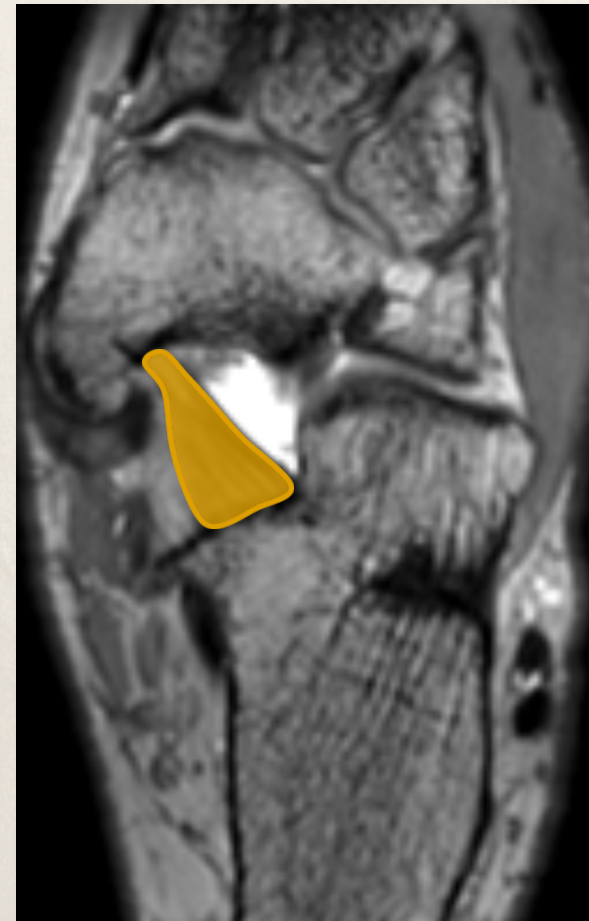
Bands

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



Superomedial (SM) Band

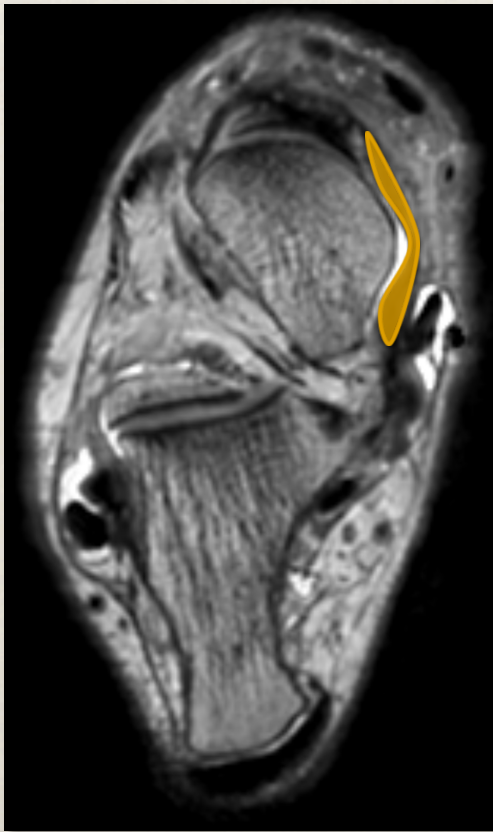
- Attachments
 - Medial sustentaculum talus to superomedial navicular bone over a broad attachment.
 - Forms the sling that articulates with talar head.
 - Deep to posterior tibialis tendon (PTT).
- Thickness
 - < 4mm
- Optimal planes for visualizations
 - Axial & coronal



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.



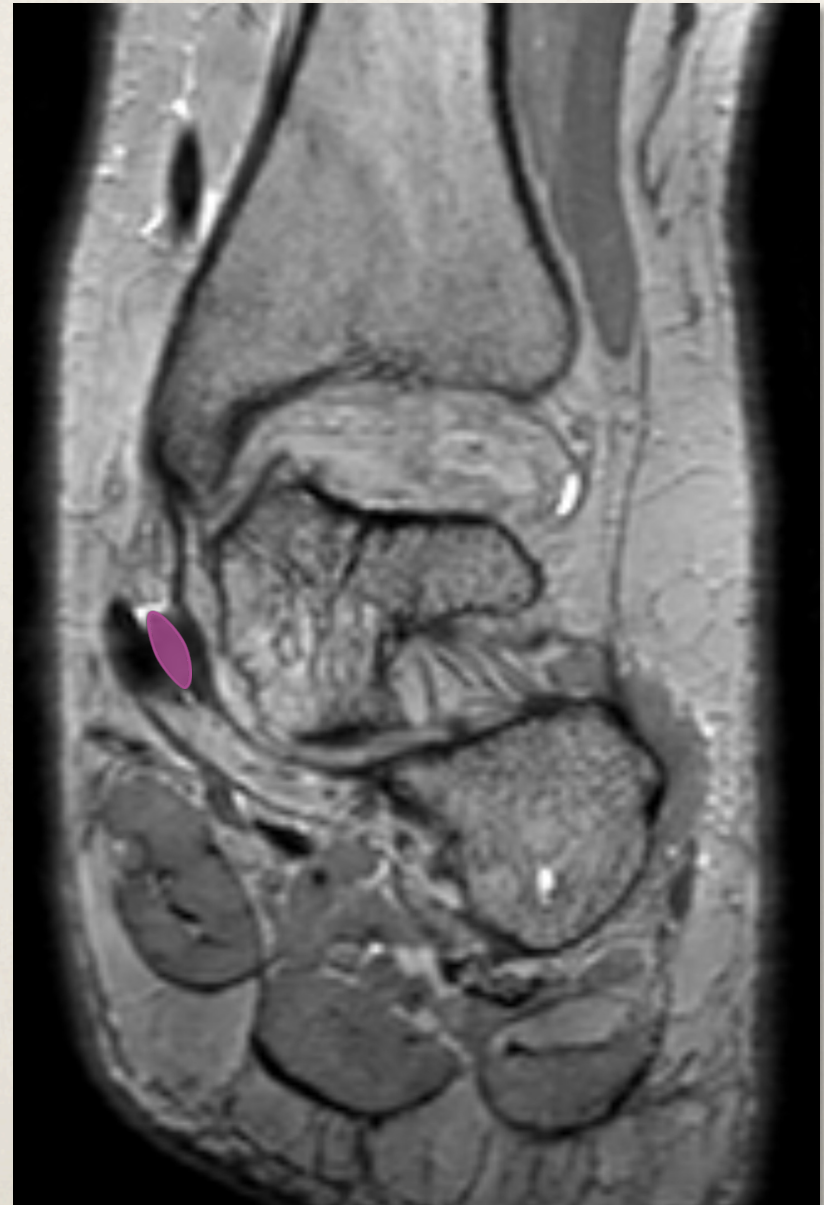
Axial PD Weighted Image



Coronal PD Weighted Image

Gliding Zone

- Region between the SM band and PTT lined by synovial cells and containing fibrocartilage.



Coronal PD Weighted Image

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



Axial PD Weighted Image

Medial plantar oblique (MPO) Band

- Calcaneal coronoid process to medial plantar navicular.



Axial PD Weighted Image



Sagittal PD Weighted Image

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

Infero-plantar longitudinal (IPL) Band

- Calcaneal coronoid process to inferior navicular beak.



Axial PD Weighted Image



Sagittal PD Weighted Image

Tibial Spring (TS) Band

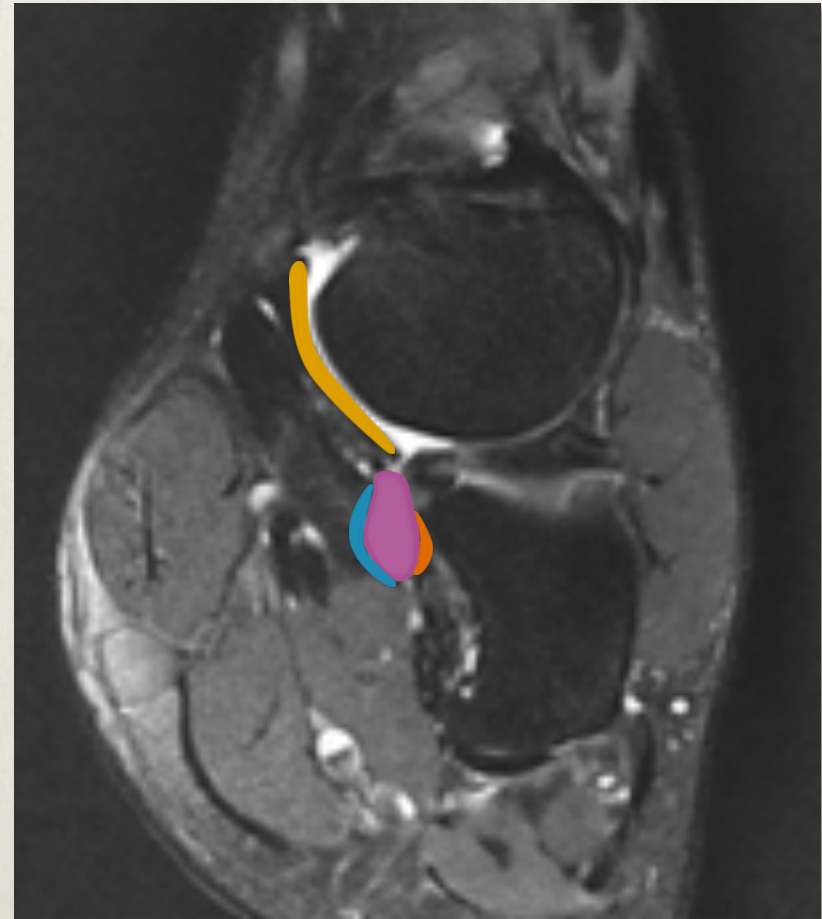
- Attachments
 - From medial malleolus blending inferiorly with SM band.
- Optimal planes for visualization
 - Axial & coronal
- Part of superficial deltoid ligament.



Coronal PD Weighted Image

Spring Ligament Recess

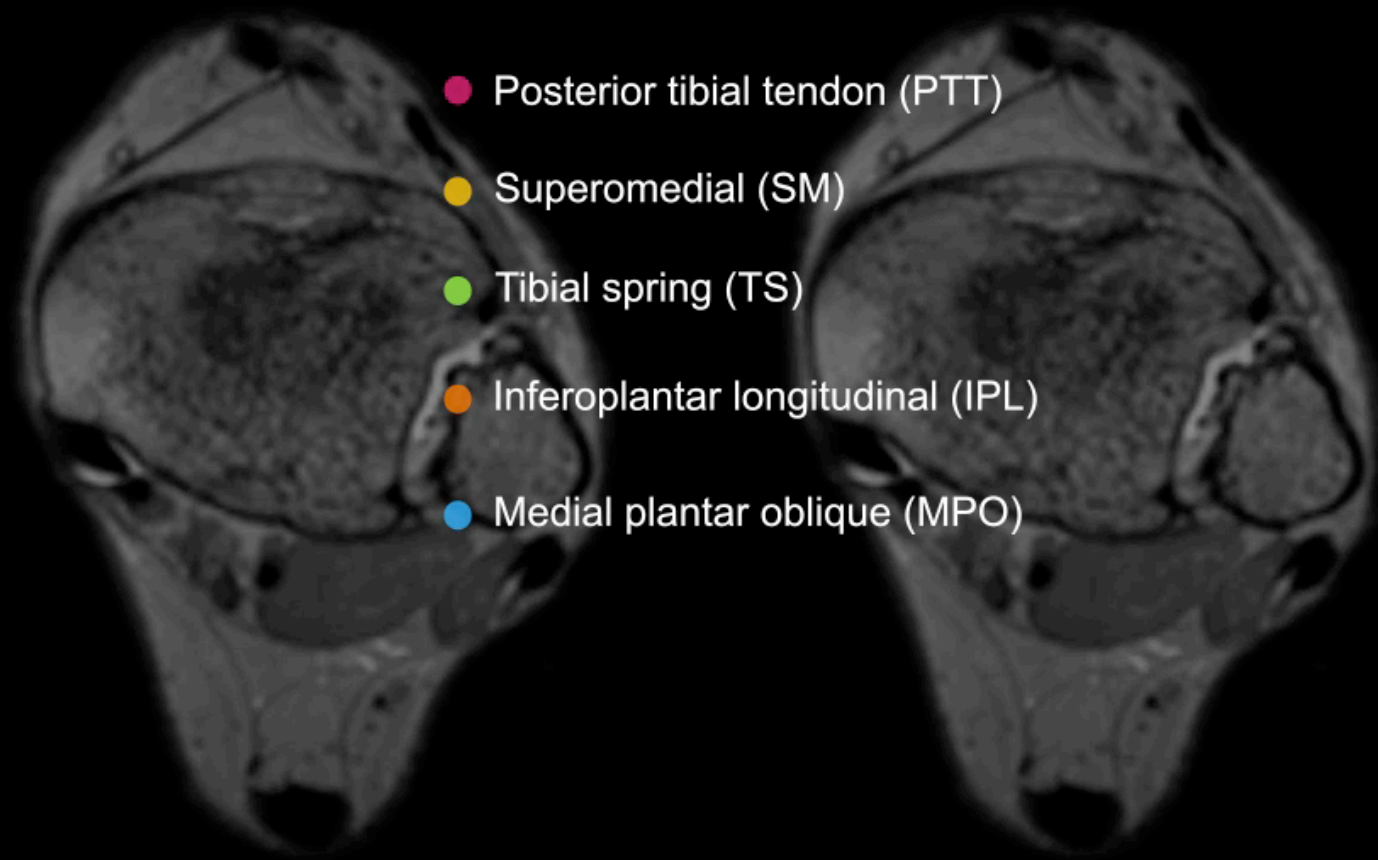
- Potential space between MPO and IPL bands.
- Lined by synovium.
- Communicates with talocalcaneonavicular joint.
- Should not be mistaken for a tear.



● SM ● MPO ● IPL ● Spring Ligament Recess

Coronal proton density Fat Saturation (PDFS) Weighted Image

Axial View - Normal Anatomy



Movie will begin automatically.

Click outside of movie to advance to next slide.

Coronal View - Normal Anatomy

- Posterior tibial tendon (PTT)
- Superomedial (SM)
- Tibial spring (TS)
- Inferopantar longitudinal (IPL)
- Medial plantar oblique (MPO)

Movie will begin automatically.

Click outside of movie to advance to next slide.

Sagittal View - Normal Anatomy

- Inferoposterior 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.

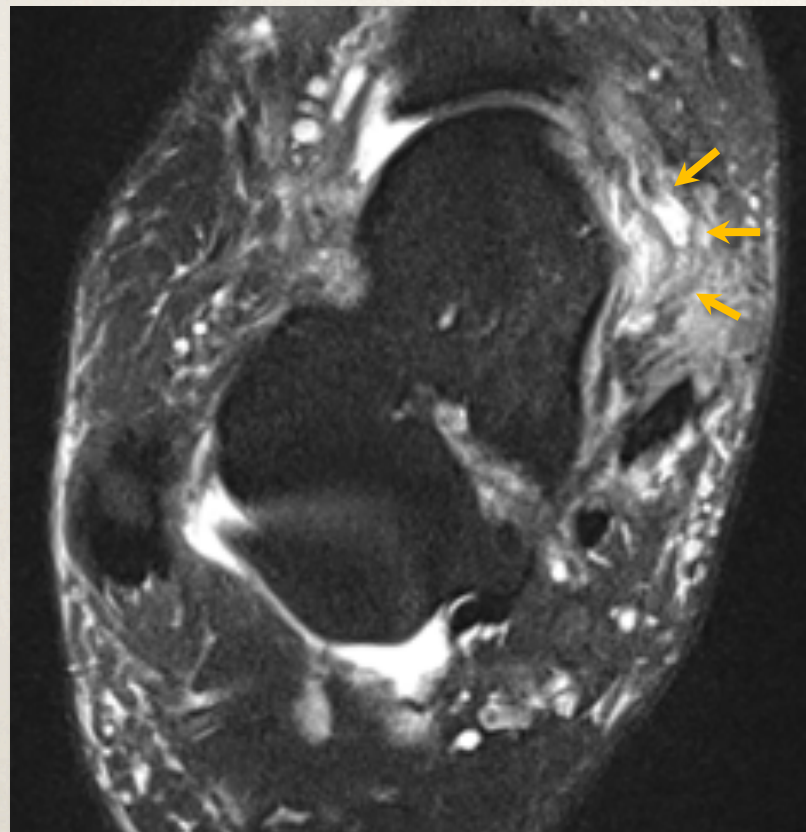
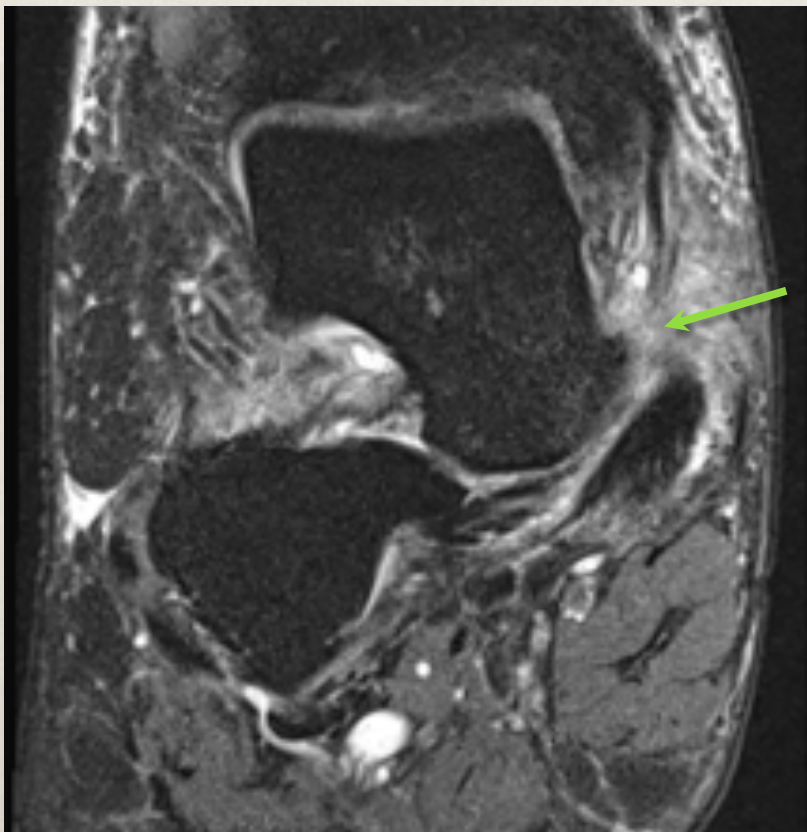
SM Band Thickening

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



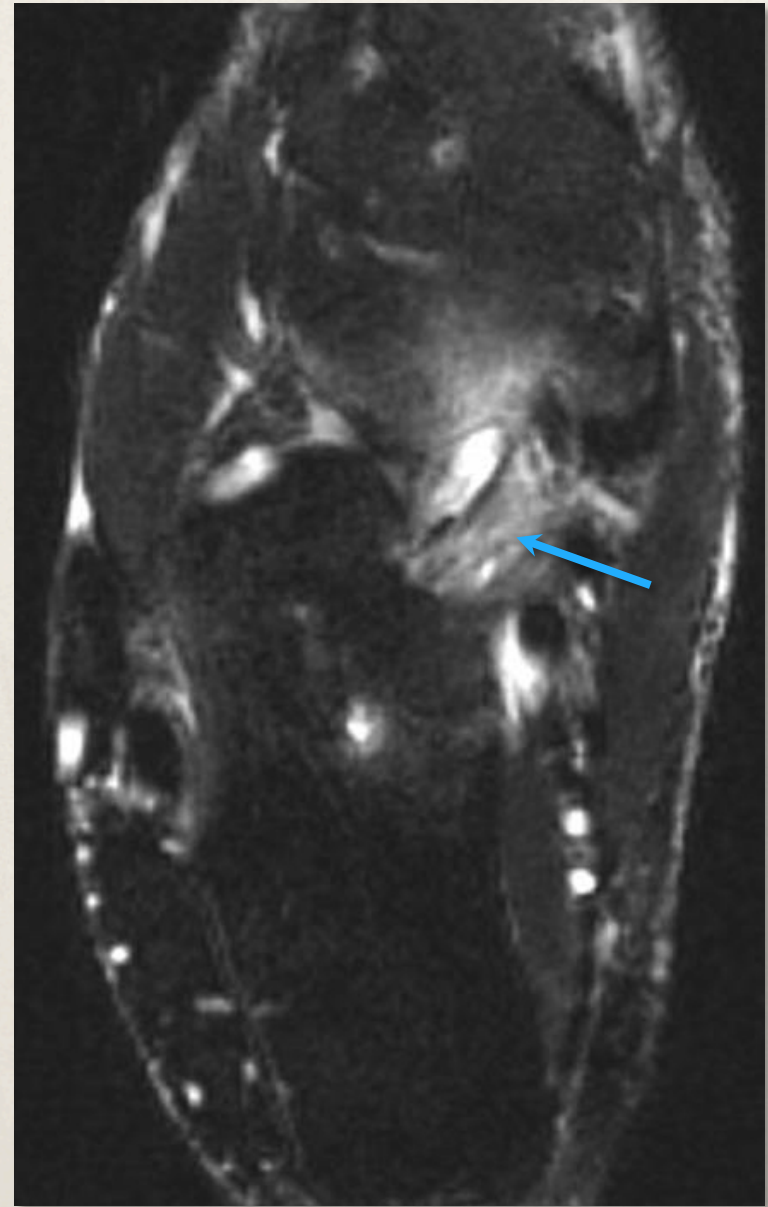
Torn TS and SM band

- Coronal (left) & axial (right) PDFS showing complete tears of **TS** and **SM**.



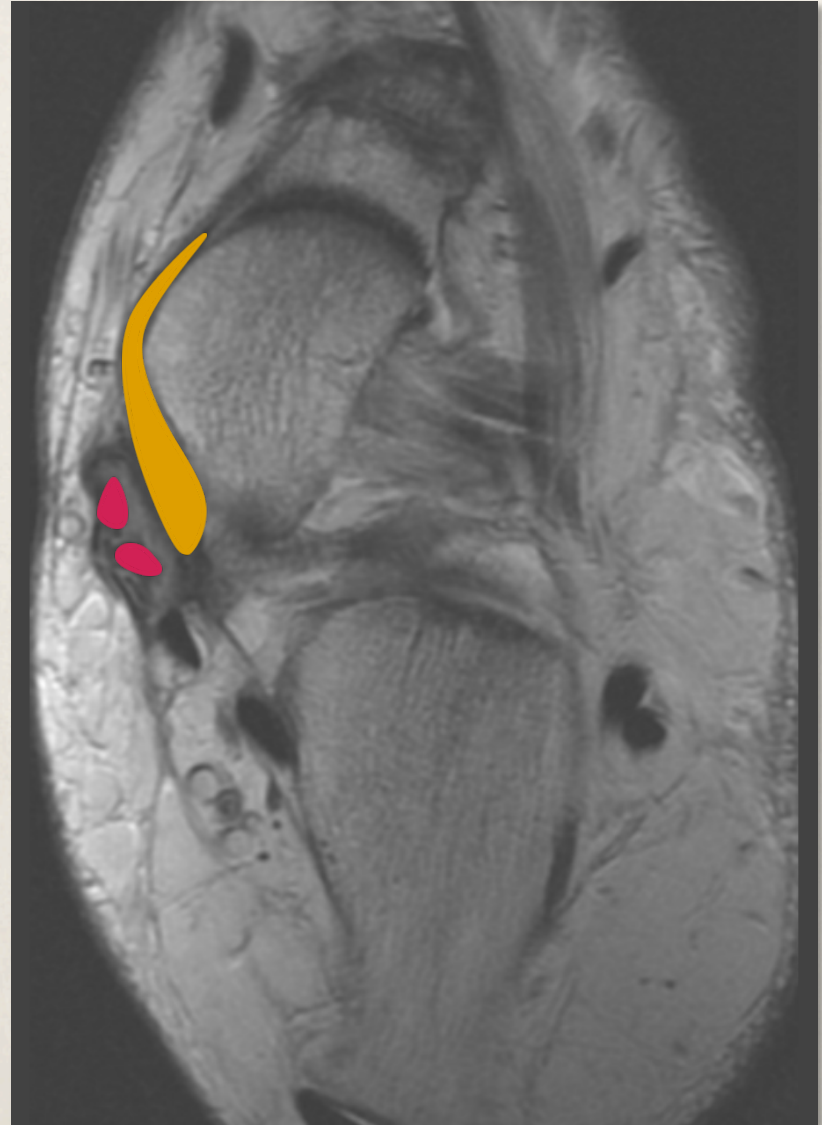
Torn MPO

- 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.

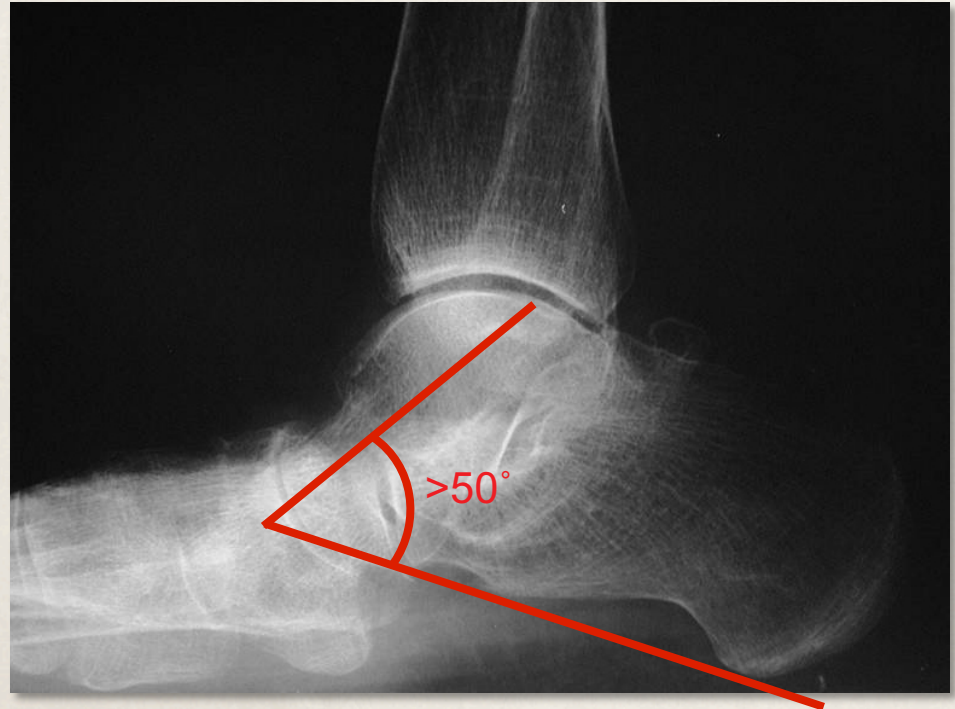


AP radiograph of the foot

Associations:

Acquired Pes Planovalgus

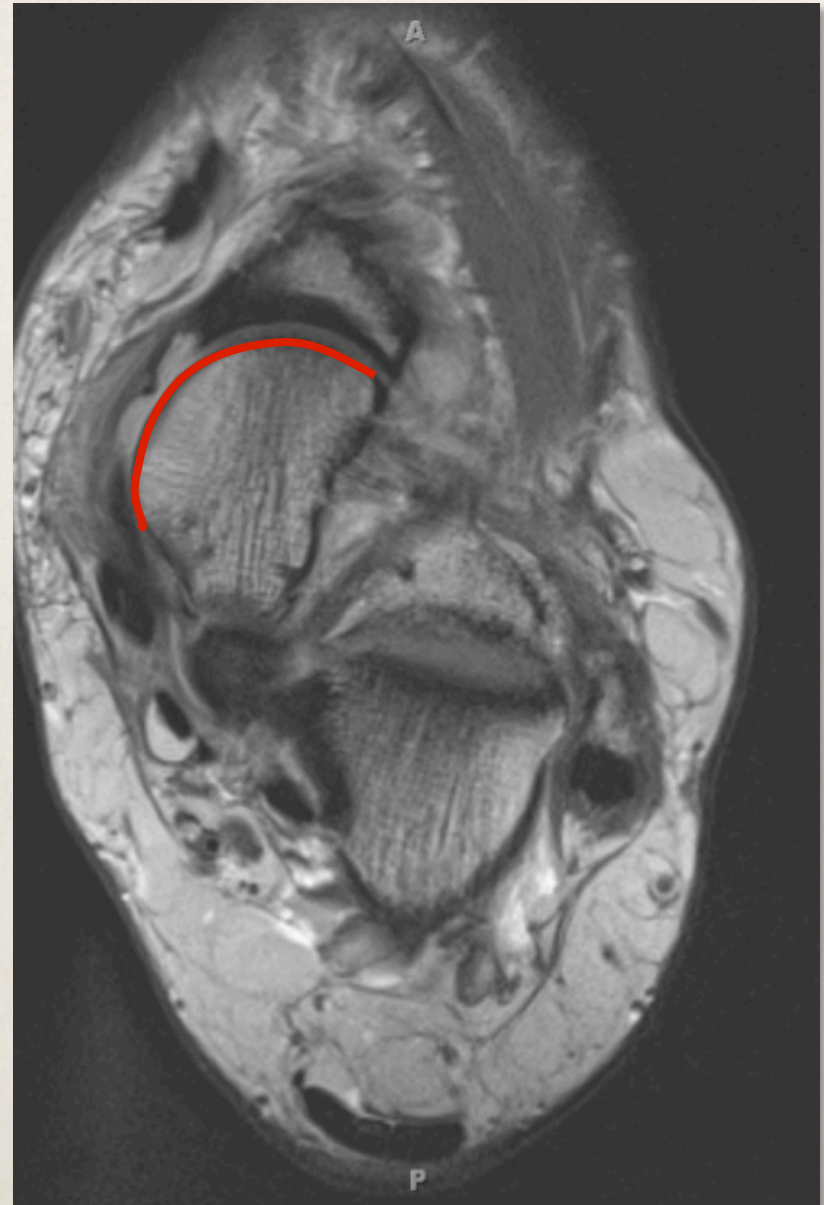
- Radiographic Signs
 - Lateral talocalcaneal angle > 50 degrees.
 - Angle formed by lines bisecting the talus and parallel to the inferior border of the calcaneus.
 - Measured on weight bearing views.



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°



Coronal PDFS Weighted Image

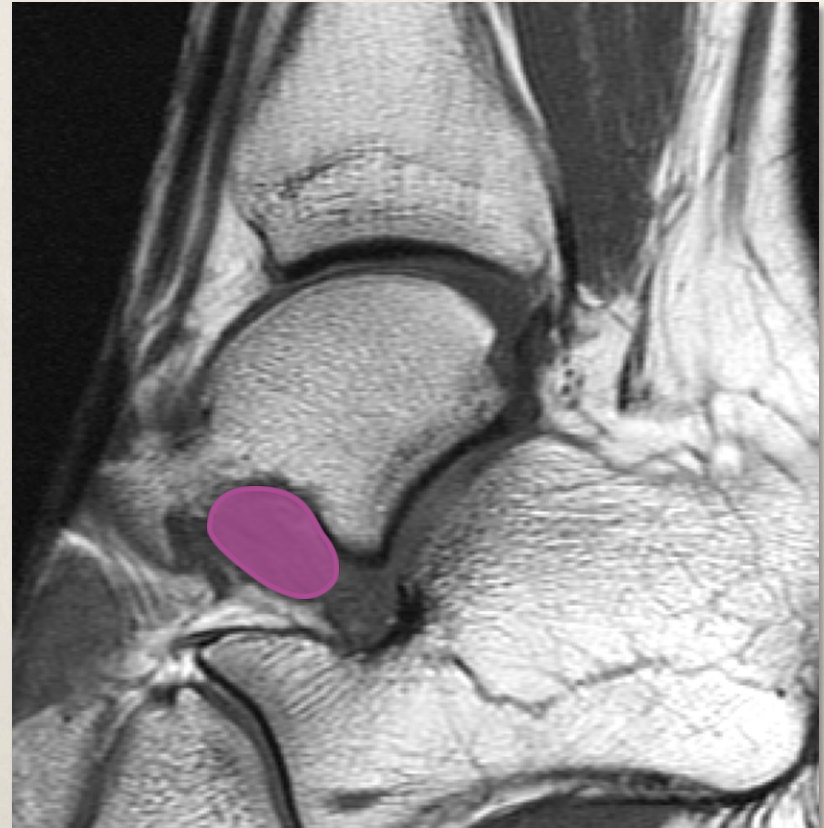
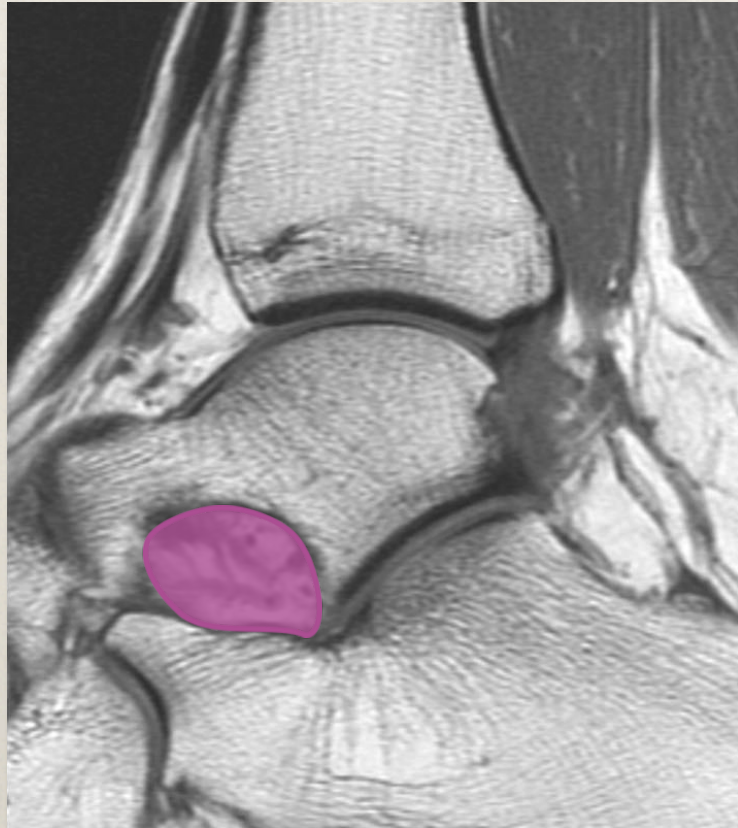
Associations: Sinus Tarsi Syndrome

- 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

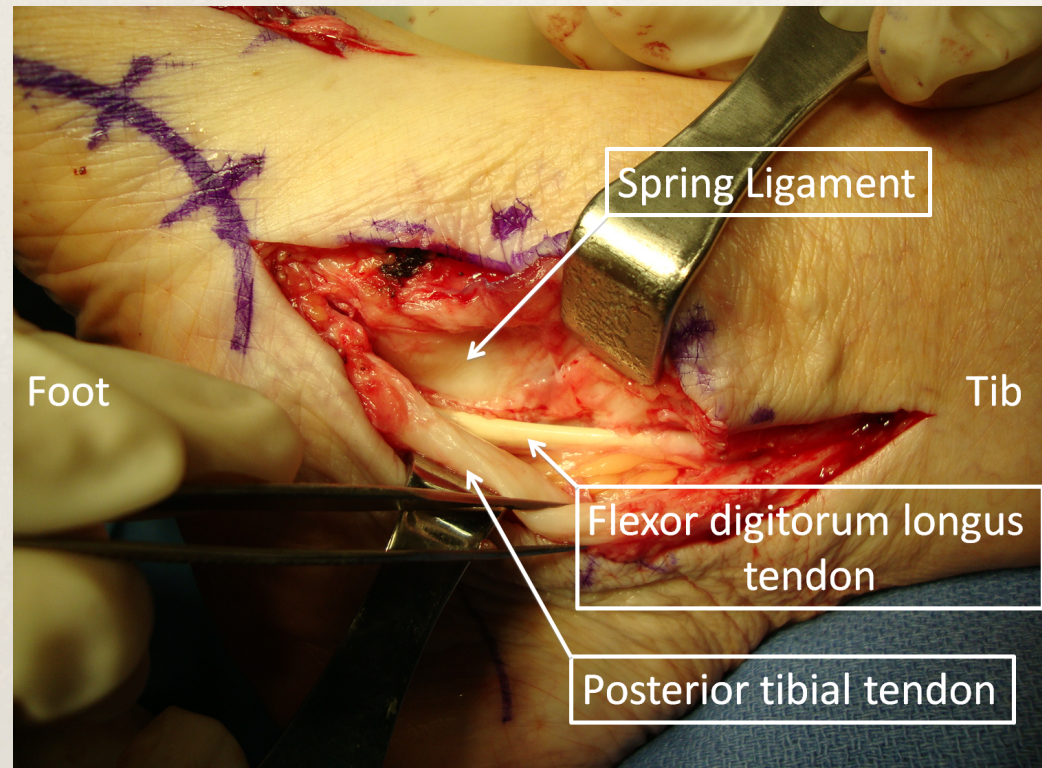
- Reserved for cases with low likelihood of worsening pes planovalgus.
- Medial longitudinal arch support is emphasized.
 - Orthotics/boots play a central role.

Treatment Algorithm: Operative Management

- Primarily for cases with high likelihood of progression of pes planovalgus.
- Restore medial 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.

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