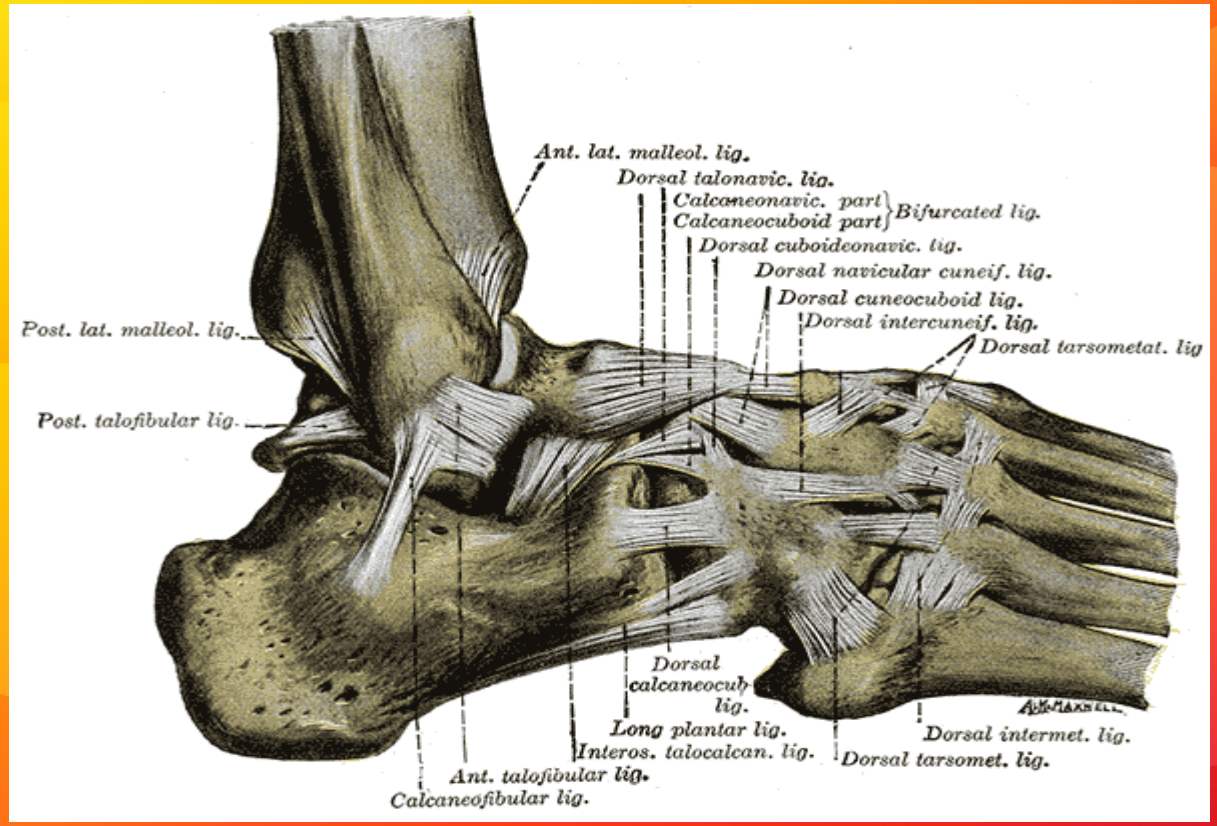


The Foot and Ankle: Extended Protocol

Kyle Foster – Musculoskeletal Sonographer and Owner of Inner-Vision Musculoskeletal Ultrasound Scans

Standard Protocol

ANTERIOR
- Extensor tendons
- Neurovascular bundle (Deep/sup peroneal)
- Anterior joint recess (Impingement? Effusions?)
- AITFL and ATFL

LATERAL
- Peroneal complex
- Calcaneofibular ligament
- Superior peroneal retinaculum

MEDIAL
- Flexor tendons
- Neurovascular bundle (tibial nerve)
- Deltoid ligament complex

POSTERIOR
- Achilles complex
- Kagers fat pad and retrocalcaneal bursa

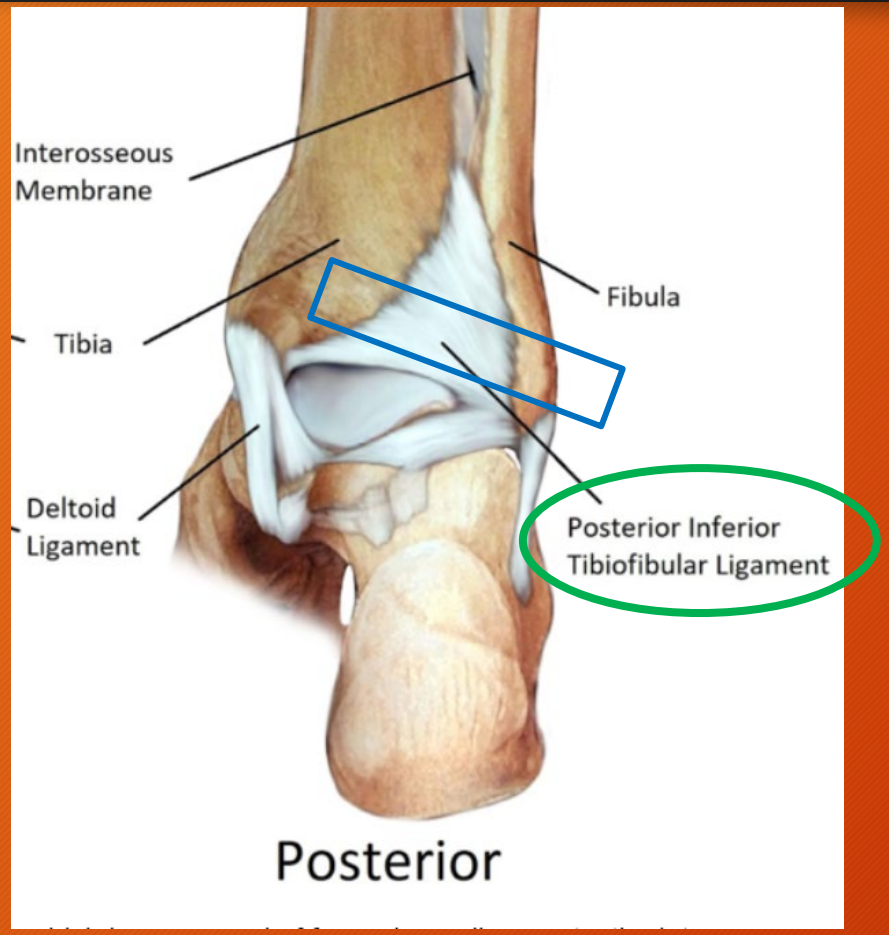
PLANTAR FOOT
- Plantar fascia
- Plantar plate
- Flexor tendon complex
- Metatarsal pad (metatarsal bursa)

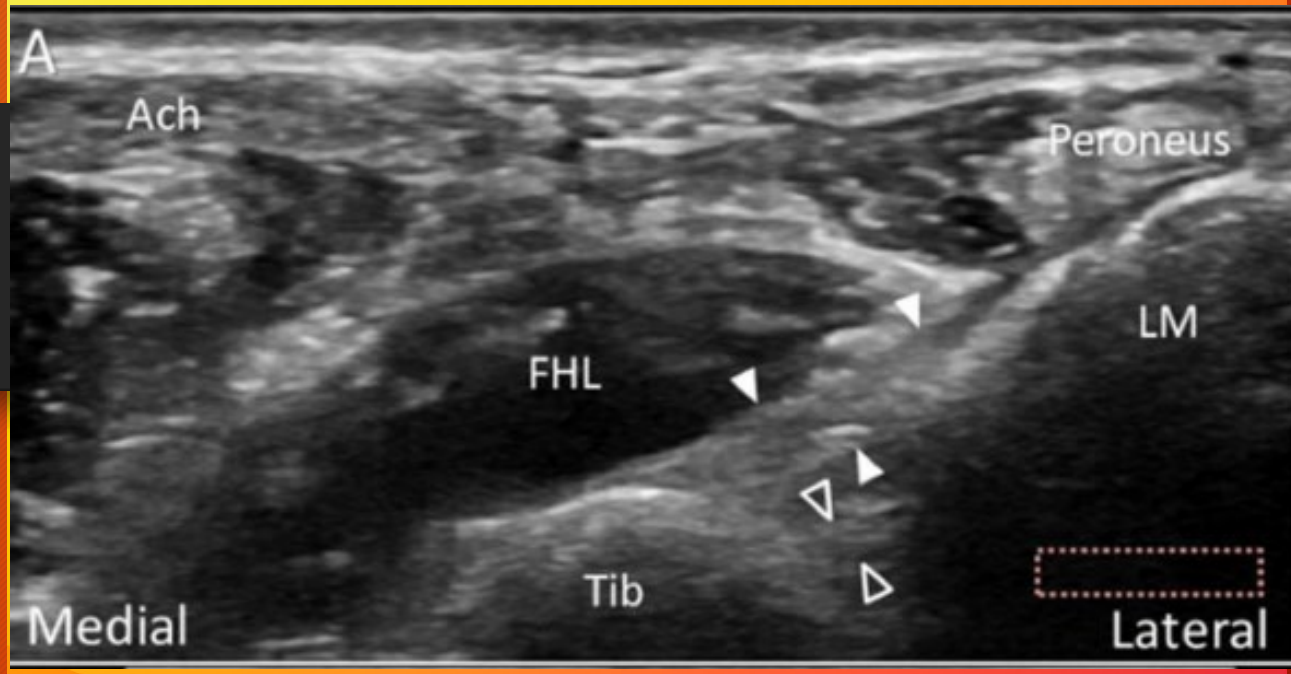
DORSAL FOOT
- Tarsal and metatarsal-phalangeal joints

Extended criteria

- Dorsal calcaneocuboid ligament
- Bifurcate ligament
- Talonavicular ligament
- Sinus tarsi complex
- Calcaneonavicular ligament (spring)
- Baxters nerve (medial plantar nerve)
- Plantar digital nerve
- Intrinsic foot muscles
- Posterior Inferior tibiofibular ligament
- Posterior talofibular ligament
- Knot of henry

Posterior Inferior Tibio-Fibular Ligament





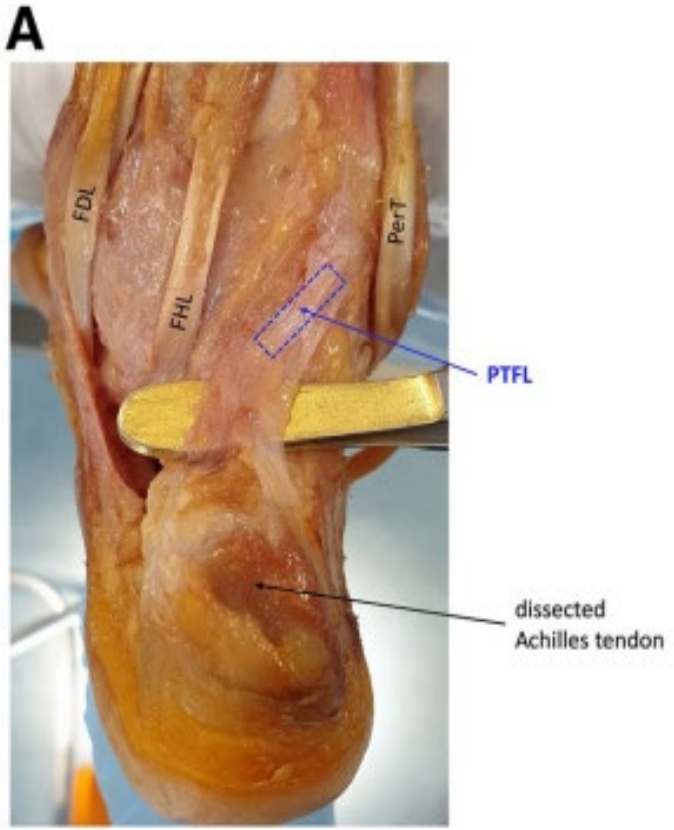
Patient Prone

ACH - Achilles tendon
FHL - Flexor hallucis longus
LM - Lateral malleolus
Tib - Tibia

Solid Arrowheads - Superficial Component
Void Arrowheads - Deep Component

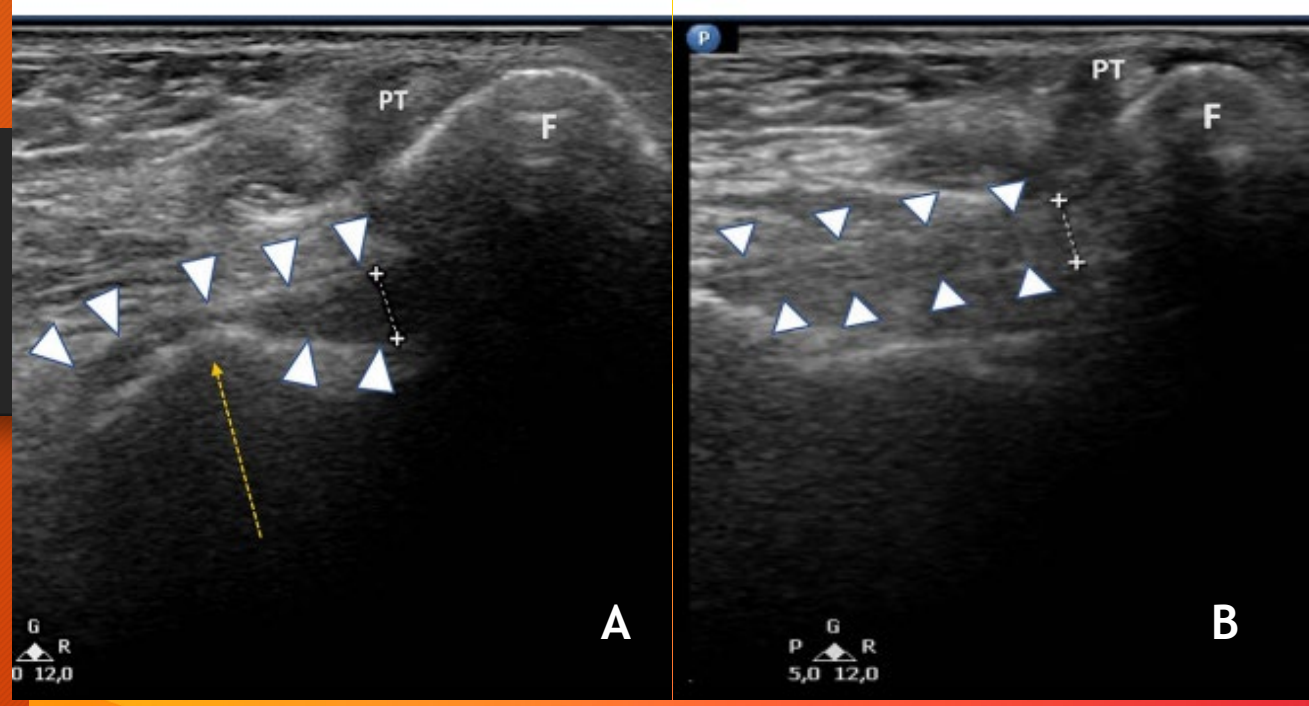
1. Place the probe (blue rectangle) in the horizontal orientation between the postero-inferior aspect of the lateral malleolus and Achilles
2. Rotate medial aspect of the probe 5-10 degrees clockwise
3. Slide the probe slighty superiorly

Posterior Talo-Fibular Ligament



Patient Prone in Dorsi Flexion

Large Stand-off

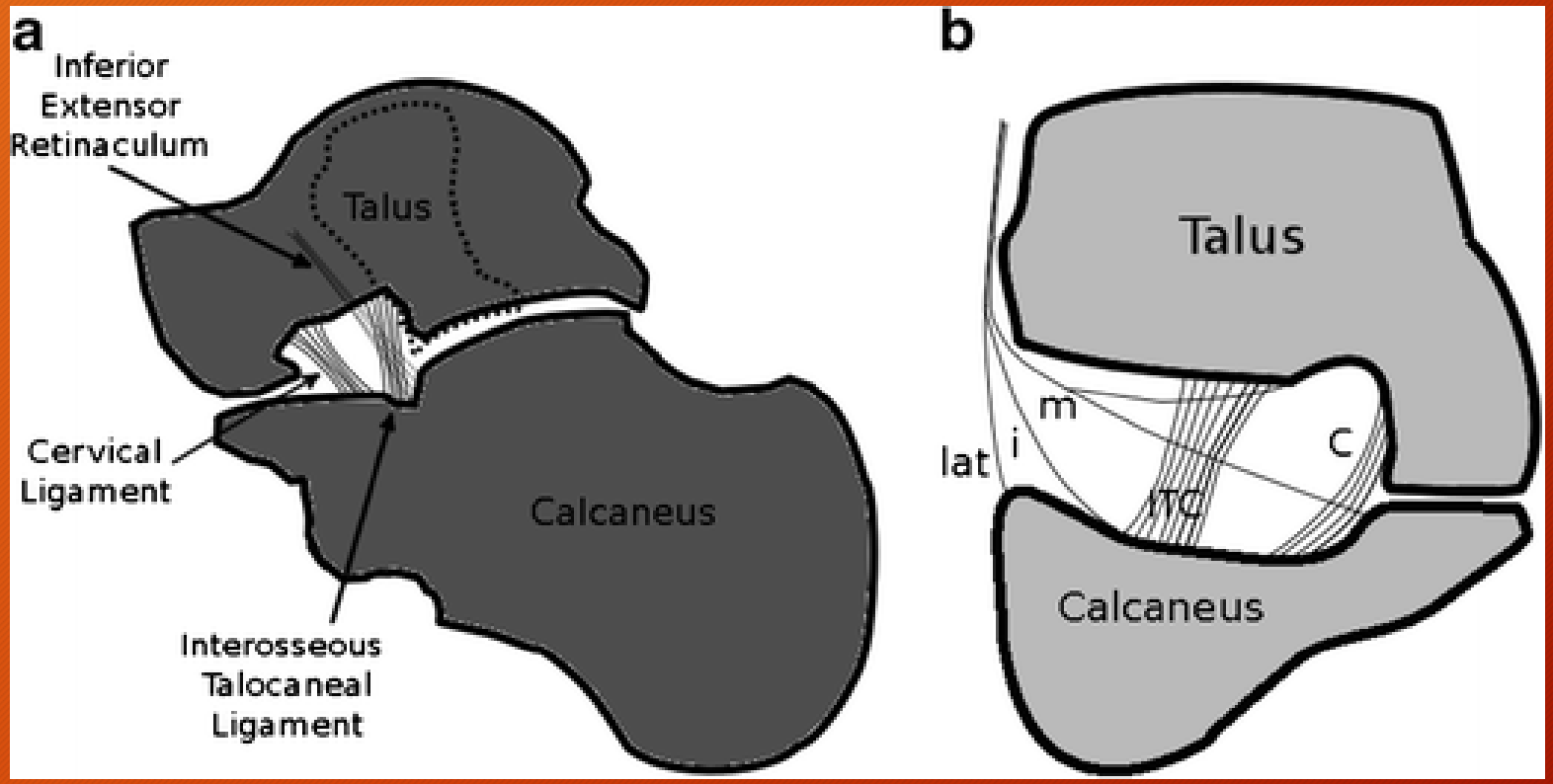


A: Neutral ankle
B: Dorsi-Flexion
PT – Peroneal tendons F – Lateral Malleolus (Fibular)

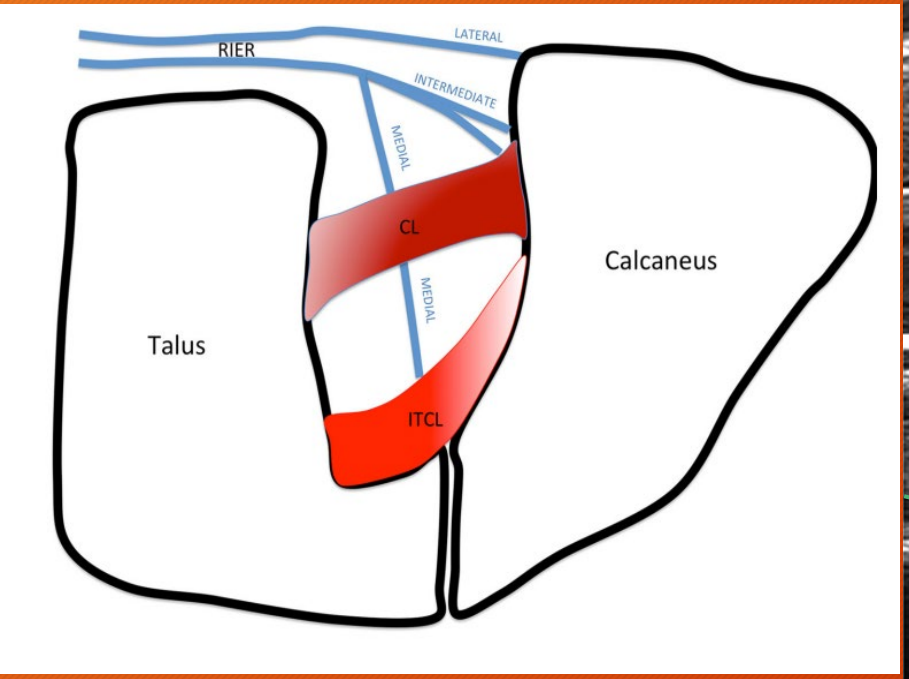
Solid Arrowheads – Posterior Talo-Fibular Ligament
Yellow Arrow – Posterior margin of the talus

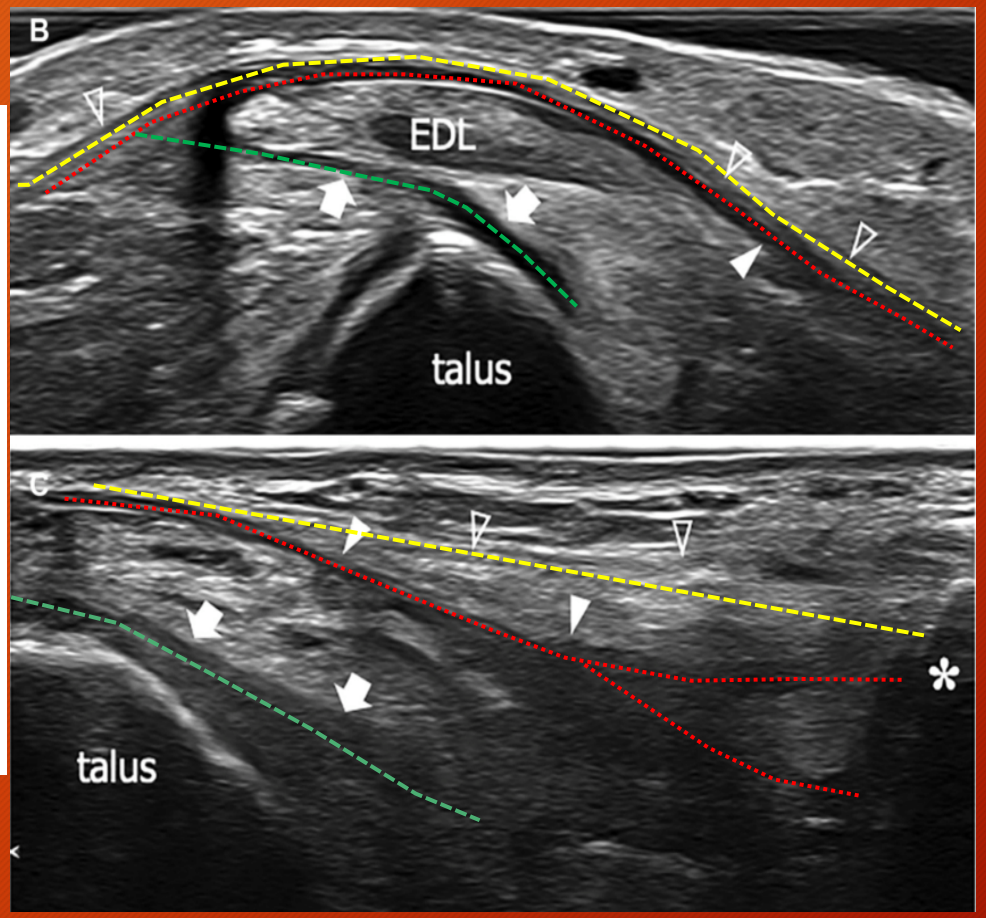
1. Place the probe (blue rectangle) in the horizontal orientation between the postero-inferior aspect of the lateral malleolus and Achilles
2. Slide the probe slighty inferiorly
3. Rotate anticlockwise to orientate with ligament

Sinus Tarsi Complex



Sinus Tarsi – Inferior extensor Retinaculum



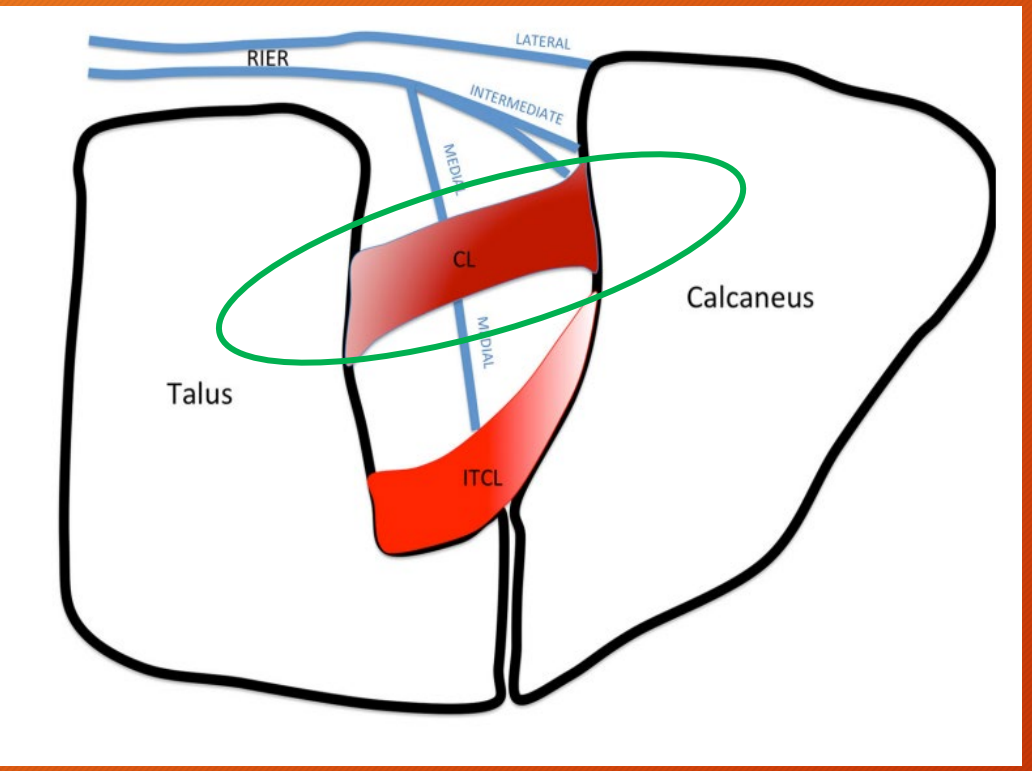


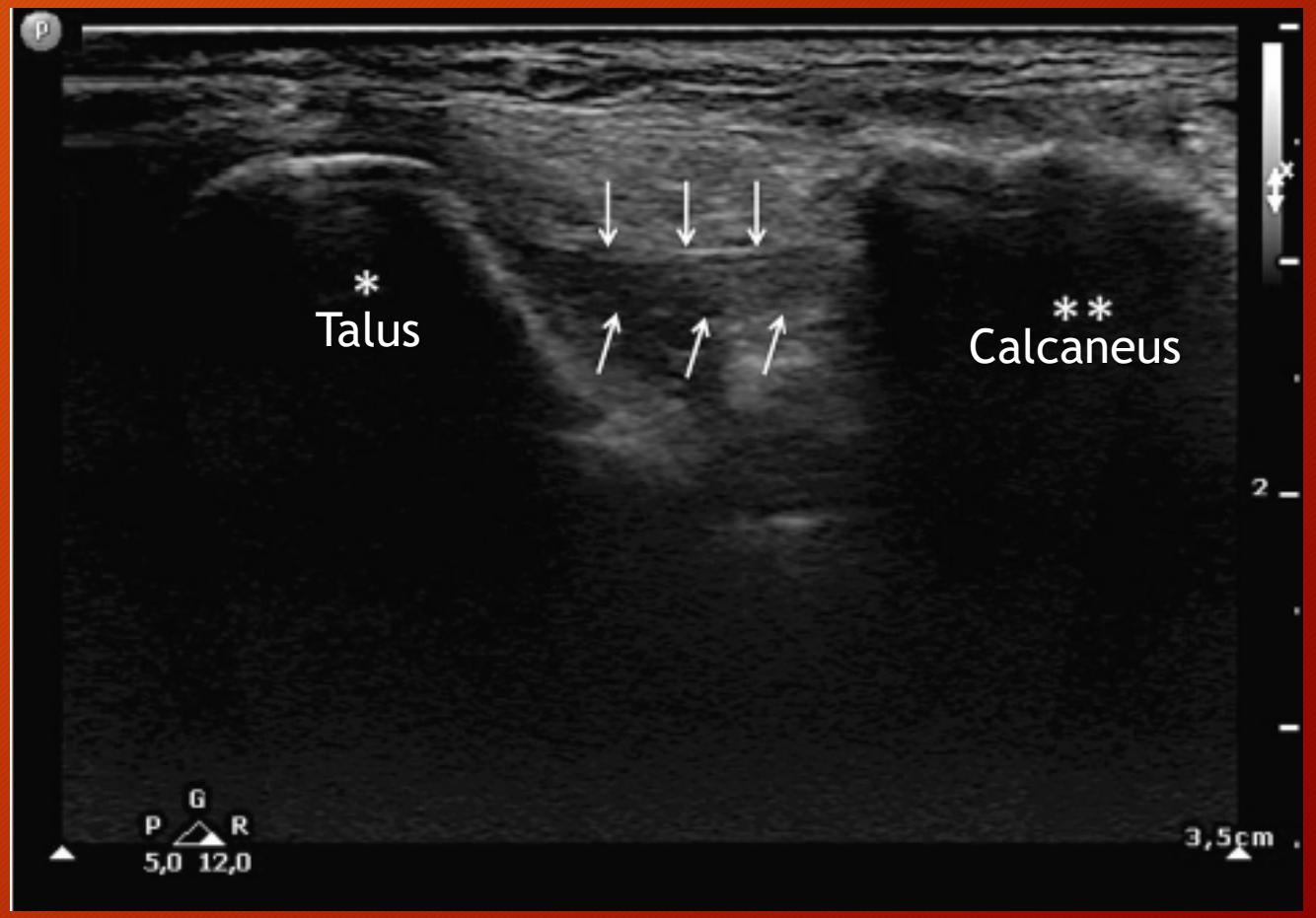
Void arrowheads and yellow dotted line – Inferior extensor retinaculum into lateral roots

White arrowhead and red dotted lines– Intermediate roots

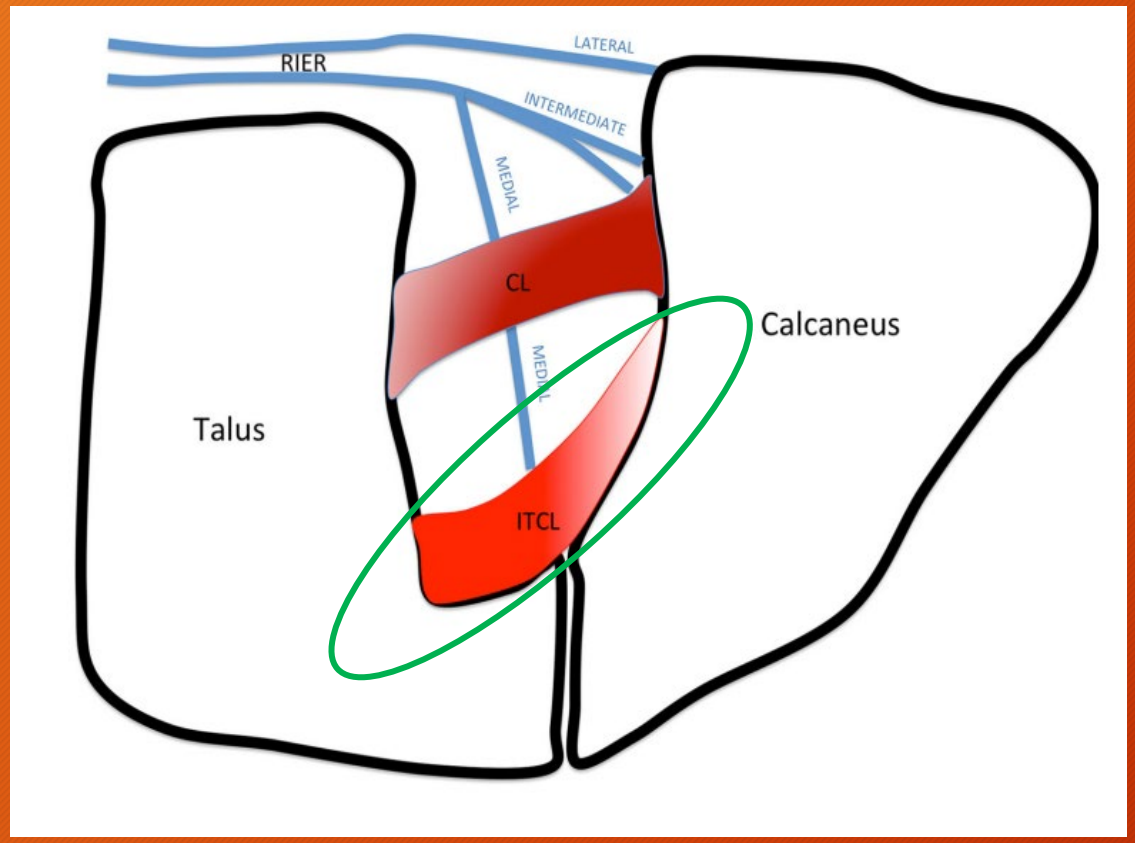
White arrows and green dotted line – Medial roots

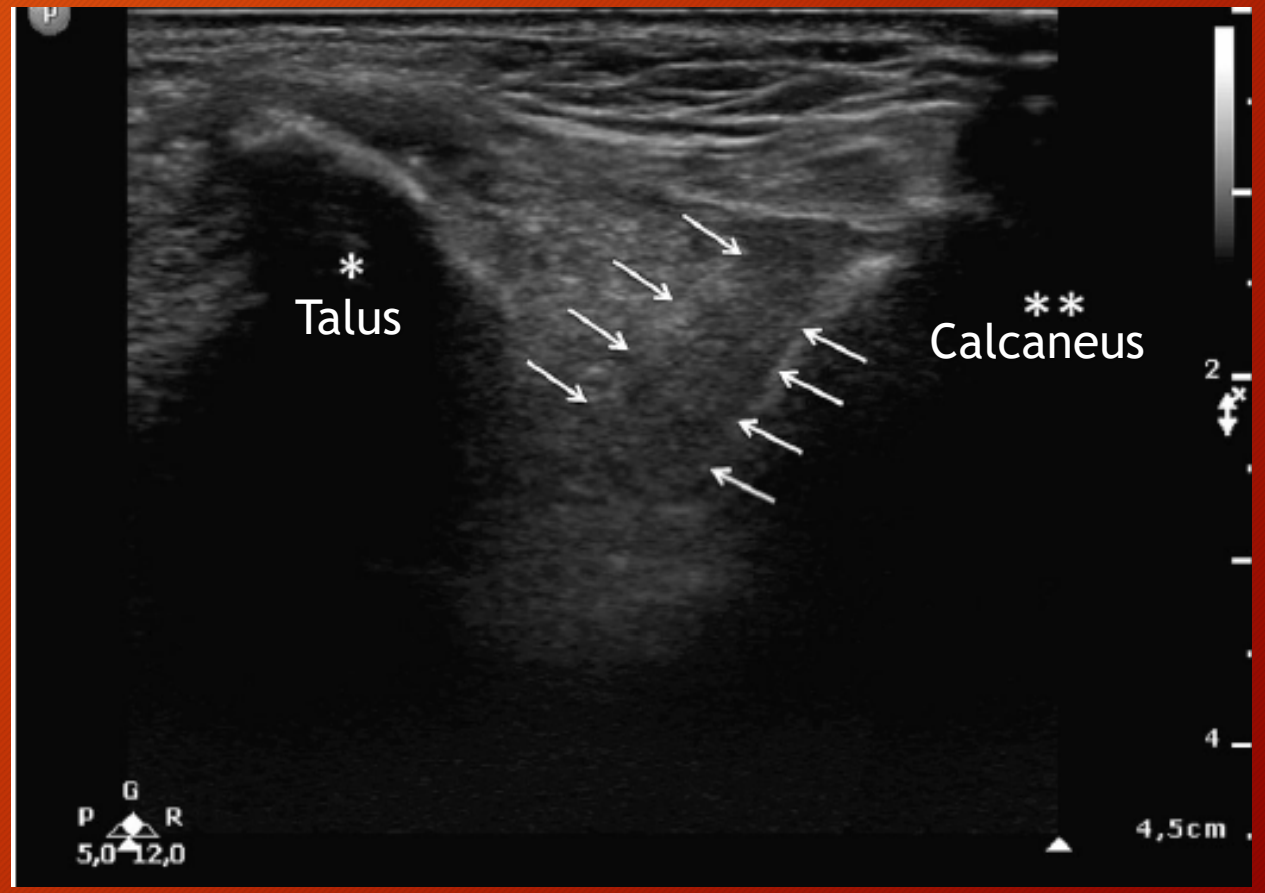
Sinus Tarsi – Cervical ligament



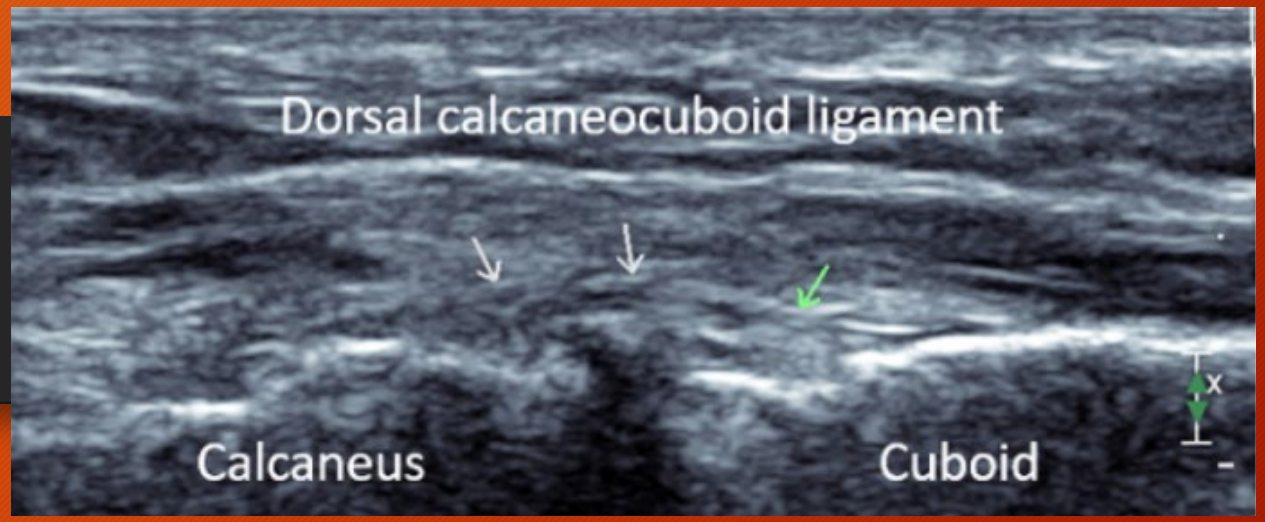


Sinus Tarsi – Interosseous ligaments





Dorsal Calcaneocuboid Ligament



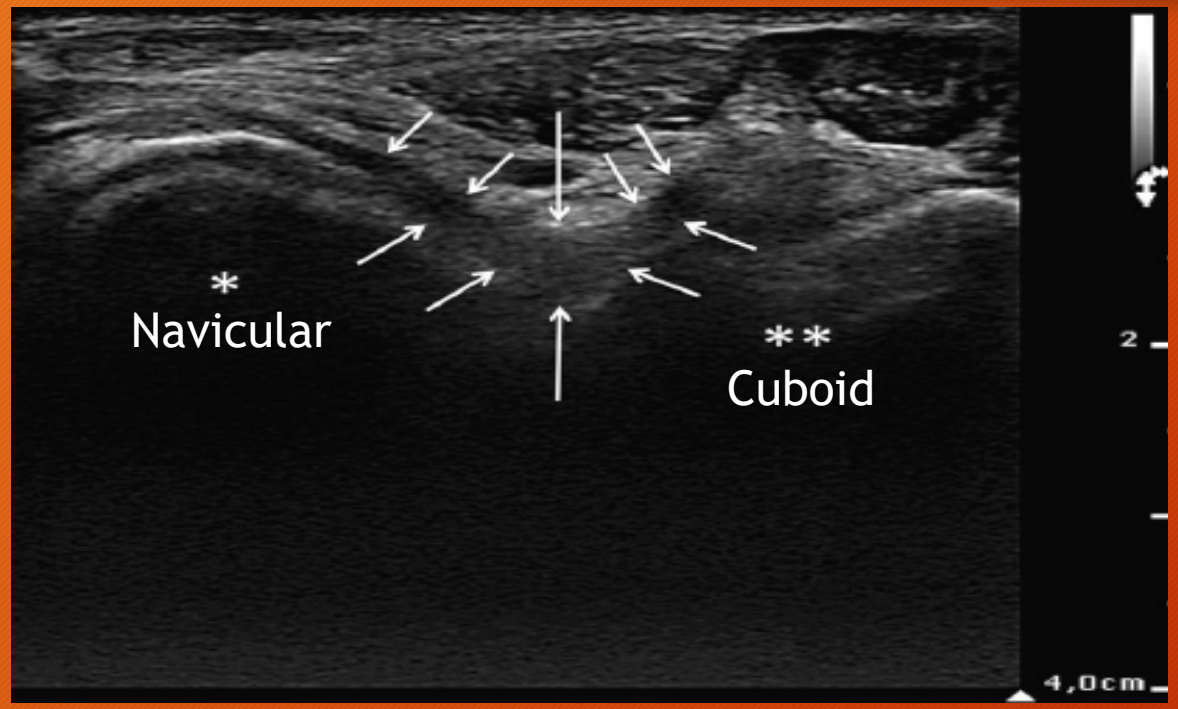
White Arrows – Dorsal Calcaneocuboid ligament

1. Orientate probe in transverse plane parallel with the plantar aspect of the foot
2. Find lateral aspect of calcaneum
3. Slide probe distally towards toes until 1st joint space comes into view (calcaneocuboid joint)
4. Slide probe in this orientation superiorly, slightly fishtailing the probe to maintain alignment with the cortical surface of the joint

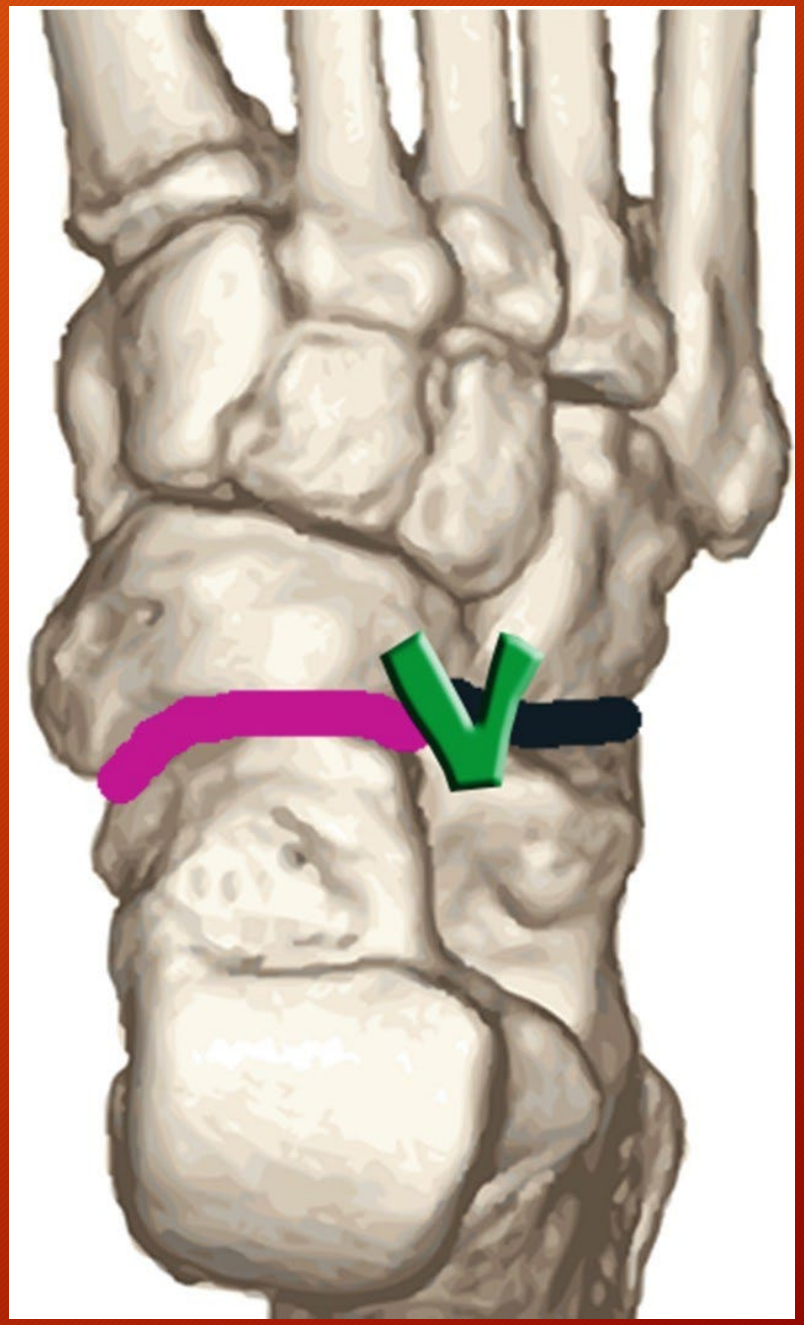
**

Patient Supine, Foot in slight plantar inversion

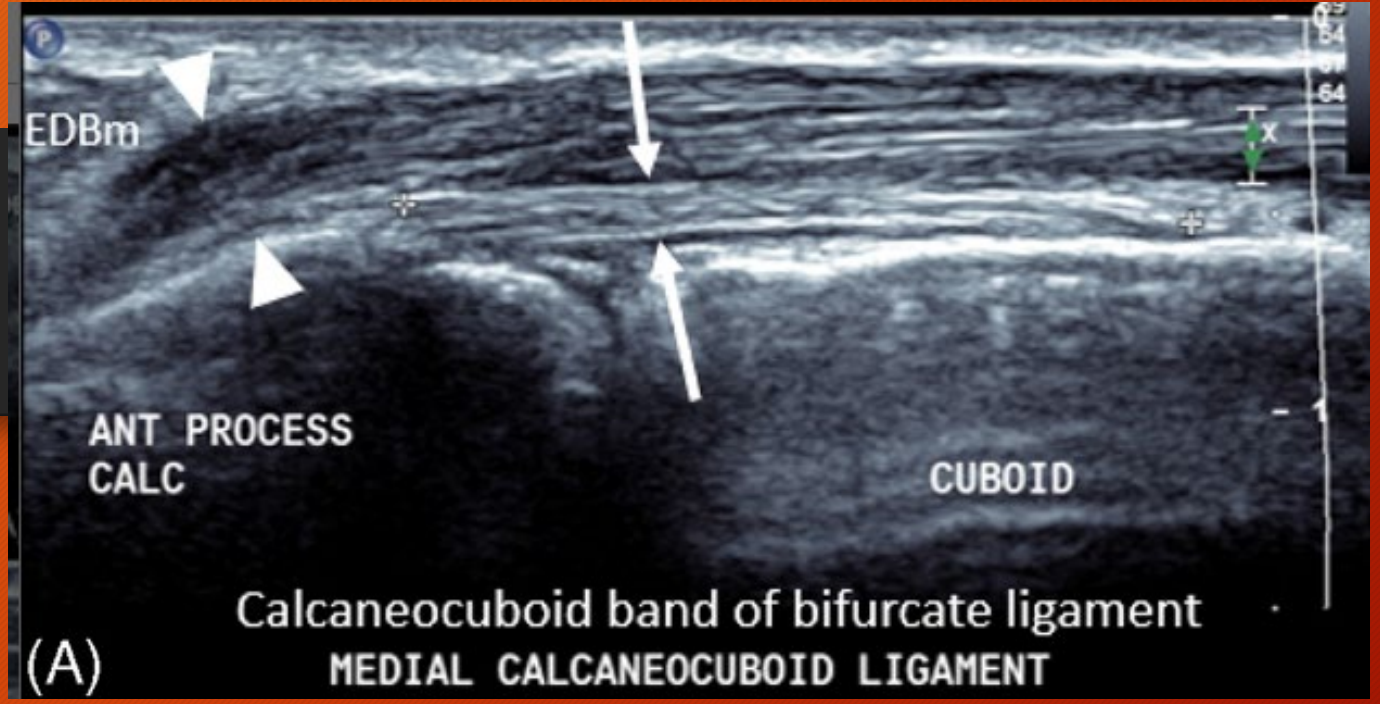
Bifurcate Ligament



Longer Arrows: Bifurcation of the Ligament



Bifurcate Ligament – Dorsal Calcaneocuboid band



White Arrows – Dorsal Calcaneocuboid band of Bifurcate Ligament
EHBm – Extensor hallucis brevis muscle

Patient Supine, Foot in slight plantar inversion

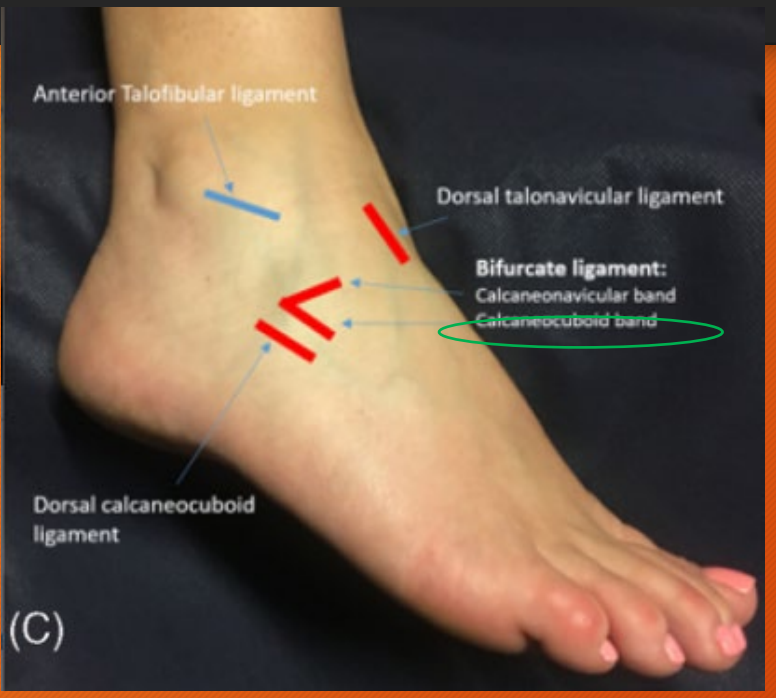
1. From the dorsal calcaneocuboid ligament orientation, slide the probe further supero-dorsally resting the posterior tip over the anterior process of the calcaneum

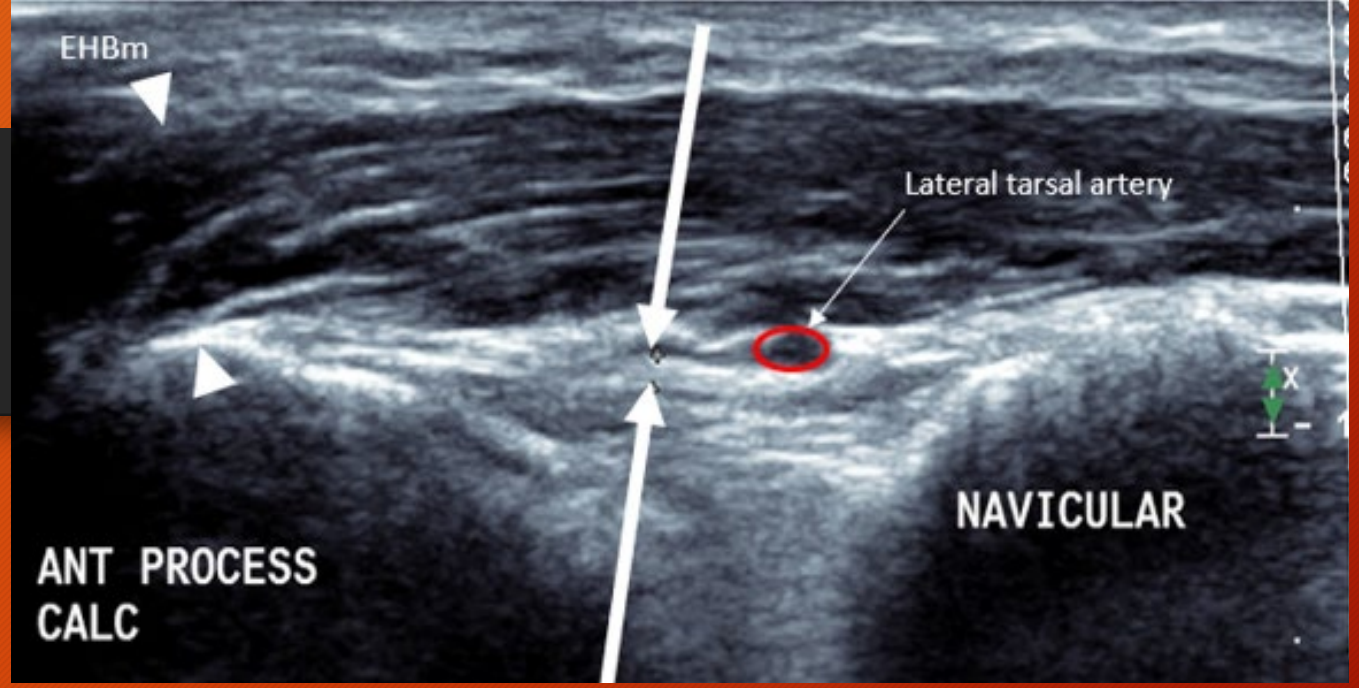
*The anterior process of the calcaneum should change shape, observing a more rounded tip with flattened surface

2. It may be useful to ‘heel-toe’ the probe to overcome the anisotropy often associated with this ligament.

*Tip – a bit of compression can help you appreciate the ligament better under the overlying extensor hallucis brevis muscle.

Bifurcate Ligament – Calcaneo-navicular band





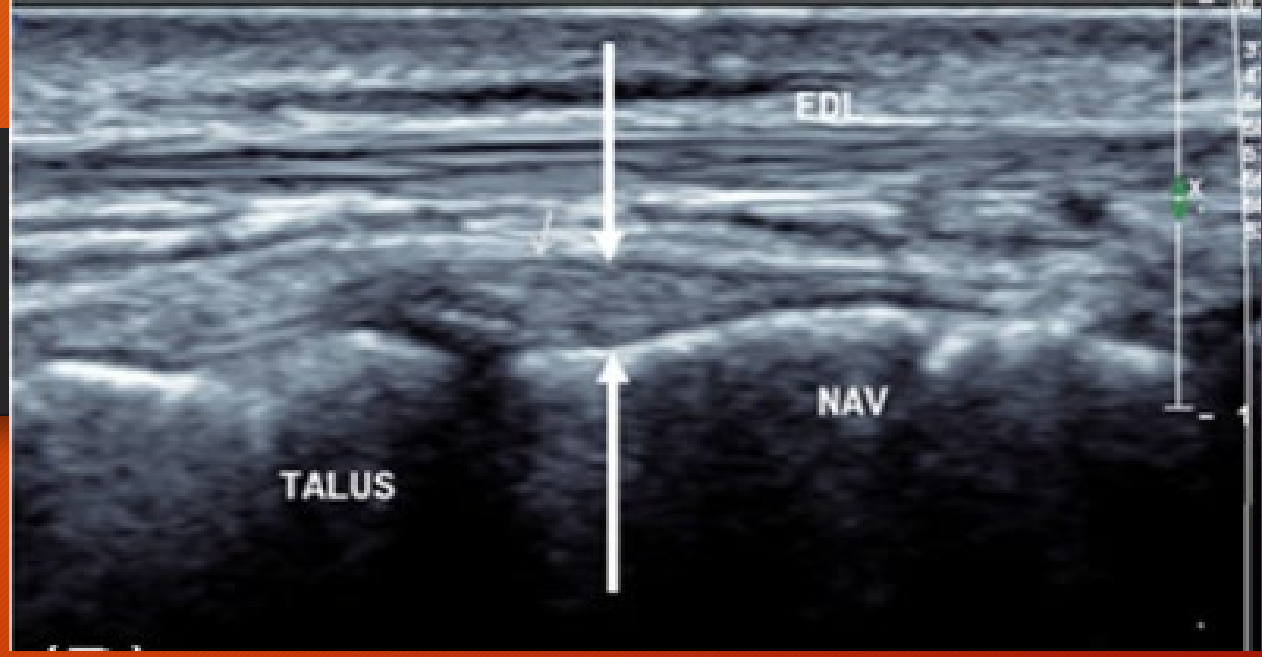
White Arrows – Dorsal Calcaneonavicular band of Bifurcate Ligament
EHBm – Extensor hallucis brevis muscle

Patient Supine, Foot in slight plantar inversion

1. From the lateral band, maintaining contact with the anterior process of the calcaneum, rotate the anterior/distal tip of the probe anticlockwise, over the dorsum of the foot, to align with the navicular
2. Use the landmark of the lateral tarsal artery which sits between the calcaneo-navicular band and the extensor hallucis brevis muscle.

*Tip – the ligament may blend with the underlying sinus fat of the sinus tarsi so it may be useful to 'heel-toe' the probe to actually cause anisotrophy to differentiate the structures

Dorso Talonavicular Ligament

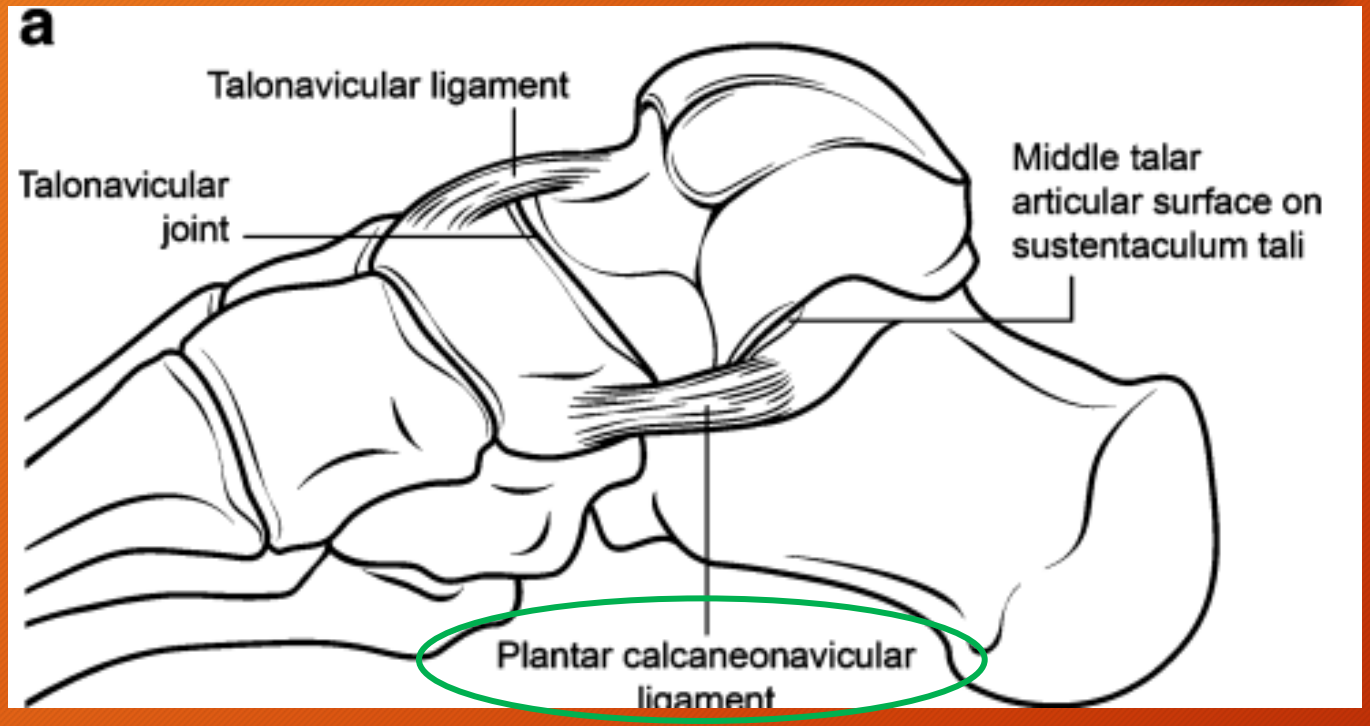


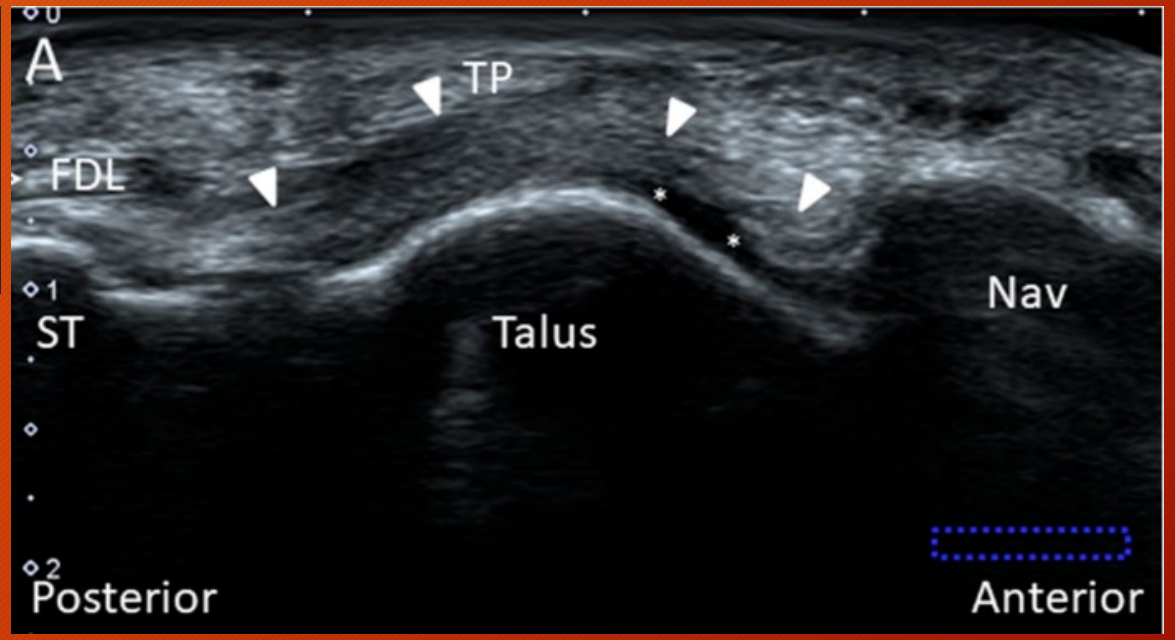
White Arrows – Dorsal Talonavicular ligament
EDL – Extensor digitorum longus tendon

Patient Supine, Foot in plantar flexion

1. Start with the probe in transverse over the anterior ankle extensor tendons
2. Identify the extensor hallucis longus tendon
3. Rotate the probe to align parallel with the longitudinal axis of the extensor hallucis longus tendon
4. Starting over the anterior recess, identify the articular cartilage over the talar dome
5. Slide the probe distally to the 1st joint, the talonavicular joint.
6. Slide the probe from medial to lateral to identify the ligament in its entirety.

Plantar Calcaneonavicular Ligament – 'Spring Ligament'



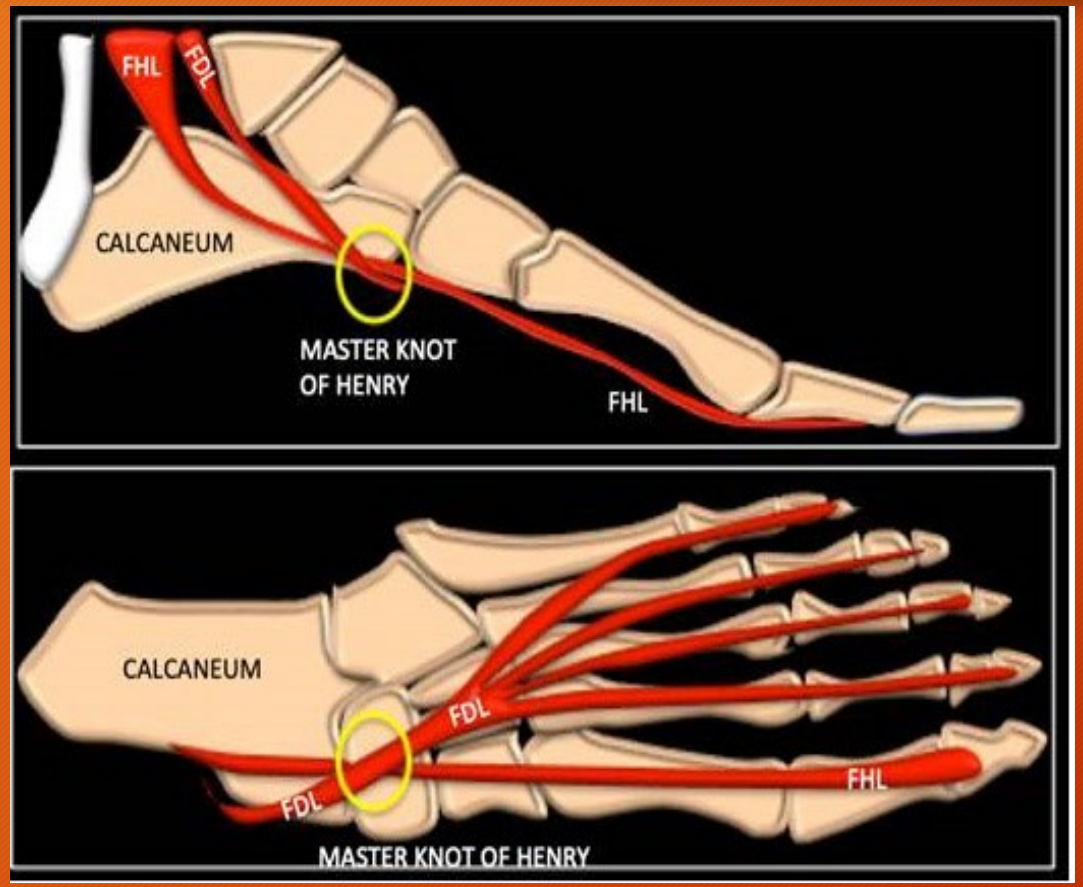


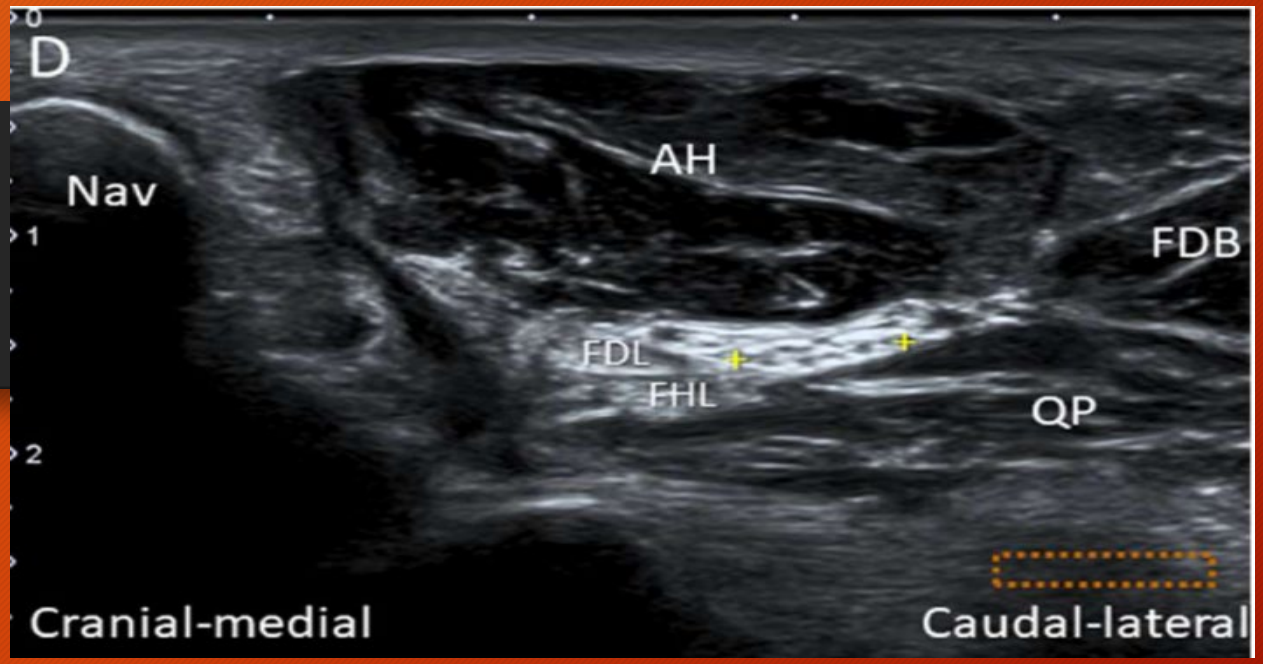
White arrowheads – Spring Ligament
Long arrows – Tibialis posterior tendon
Block Arrow - Articular cartilage of talar head

1. Palpate the navicular tuberosity, place tip of probe here in transverse orientation
2. Rotate the probe to align opposite tip of probe with the sustentaculum tali
3. Fishtail the probe until the ligament is seen draped over the talus v

Patient Supine, Foot in dorsi-flexion

Knot of Henry and Medial Plantar Nerve

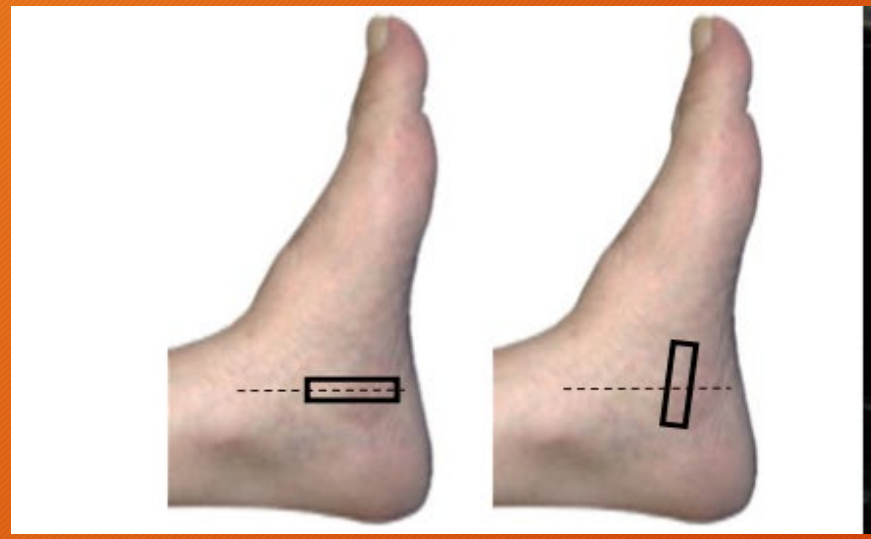


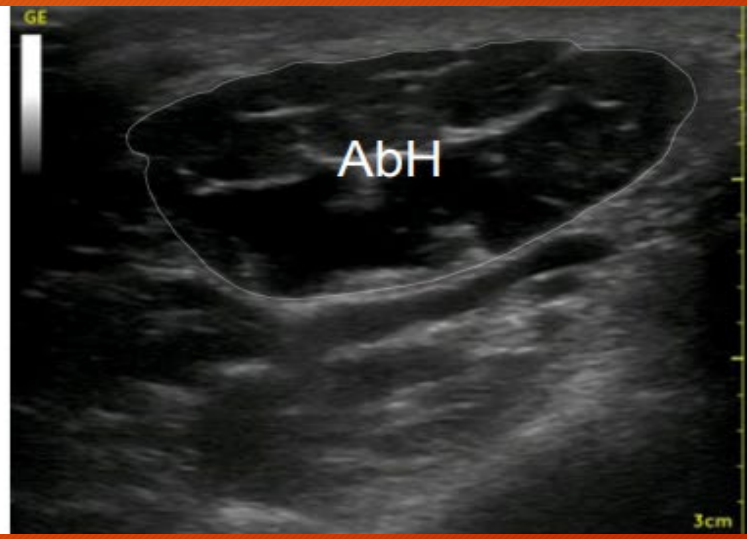


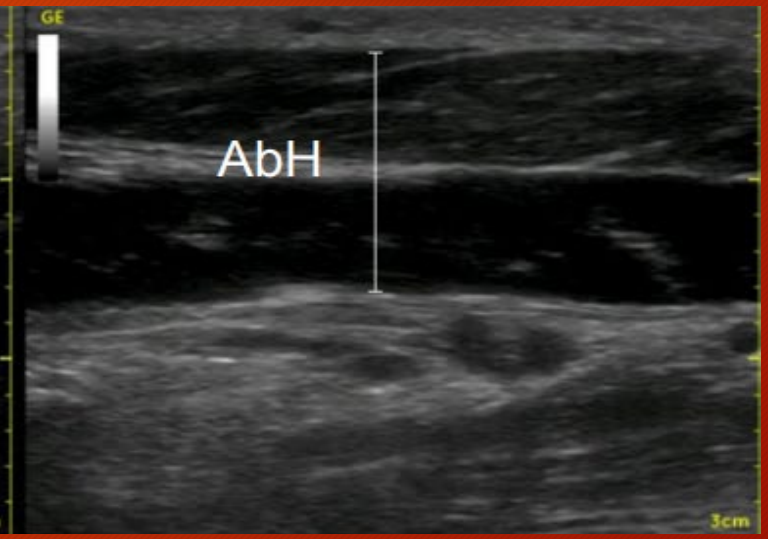
1. Start on either the flexor hallucis longus or flexor digitorum tendons at the level of the medial malleolus.
2. Follow the tendon in transverse, maintaining the ovoid tendon shape. The tendons should become almost contiguous deep to the abductor hallucis muscle.
3. The knot of henry can then be appreciated best when rotating into longitudinal and fishtailing the probe from plantar to dorsal. The tendons will be seen crossing over.

** The medial plantar nerve can be appreciated adjacent to the knot of henry and can in rare occasions become involved in the knot of henry intersection syndrome.

Abductor Hallucis



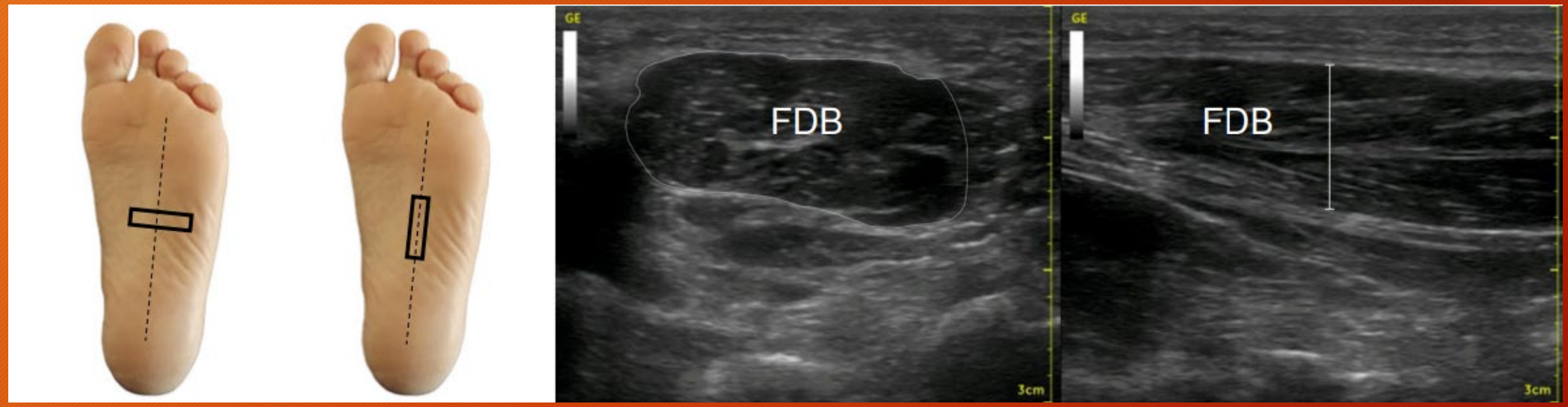




1. Place the transducer at the medial arch orientated in line with the longitudinal axis of the tibia
2. The abductor hallucis muscle is identifiable in a transverse orientation.
3. Slide the probe from proximal to distal to interrogate the whole muscle

**There is a well defined aponeurosis running through the centre of the muscle.

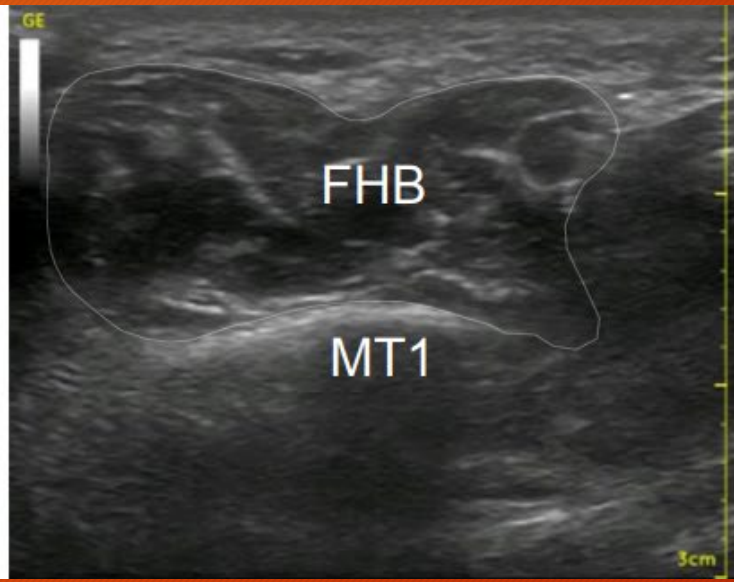
Flexor digitorum brevis

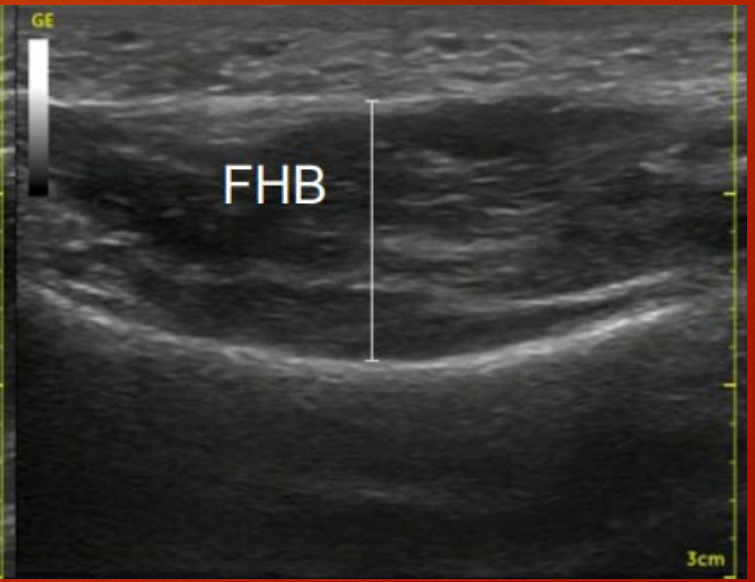


1. Place the probe in the transverse orientation across the plantar aspect of the mid foot
2. The most superficial muscle in this plane is the flexor digitorum brevis muscle
3. Scan from proximal to distal to identify the muscle in its entirety

** there is a well defined aponeurosis running throughout the muscle belly

Flexor hallucis brevis



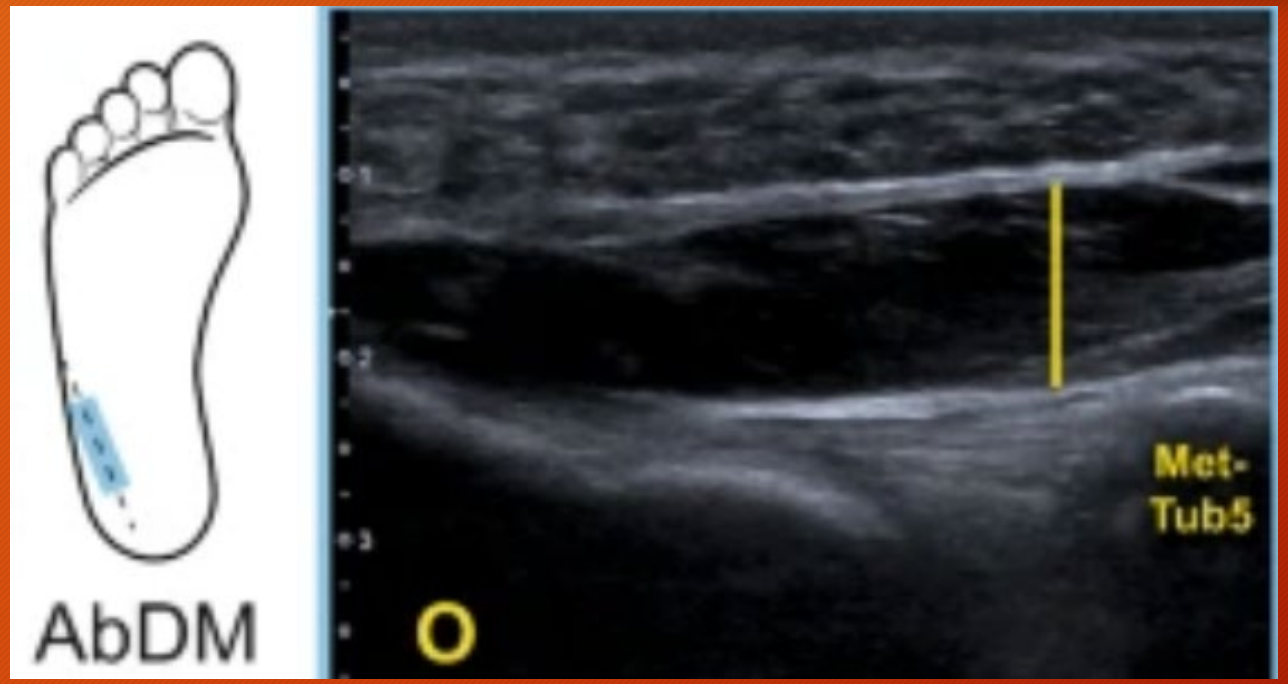


1. Place the probe in the transverse orientation across the plantar aspect of the forefoot, proximal to the metatarsal head. This will demonstrate the short axis of the muscle.
2. Slide the probe to the proximal origin of the muscle which runs obliquely across the mid to hind foot.

Quadratus plantae

1. Place the probe in the transverse orientation across the plantar aspect of the hind foot
2. Deep to the flexor digitorum brevis muscle, the quadratus plantae is visible.
3. Scan from proximal to distal to identify the muscle in its entirety

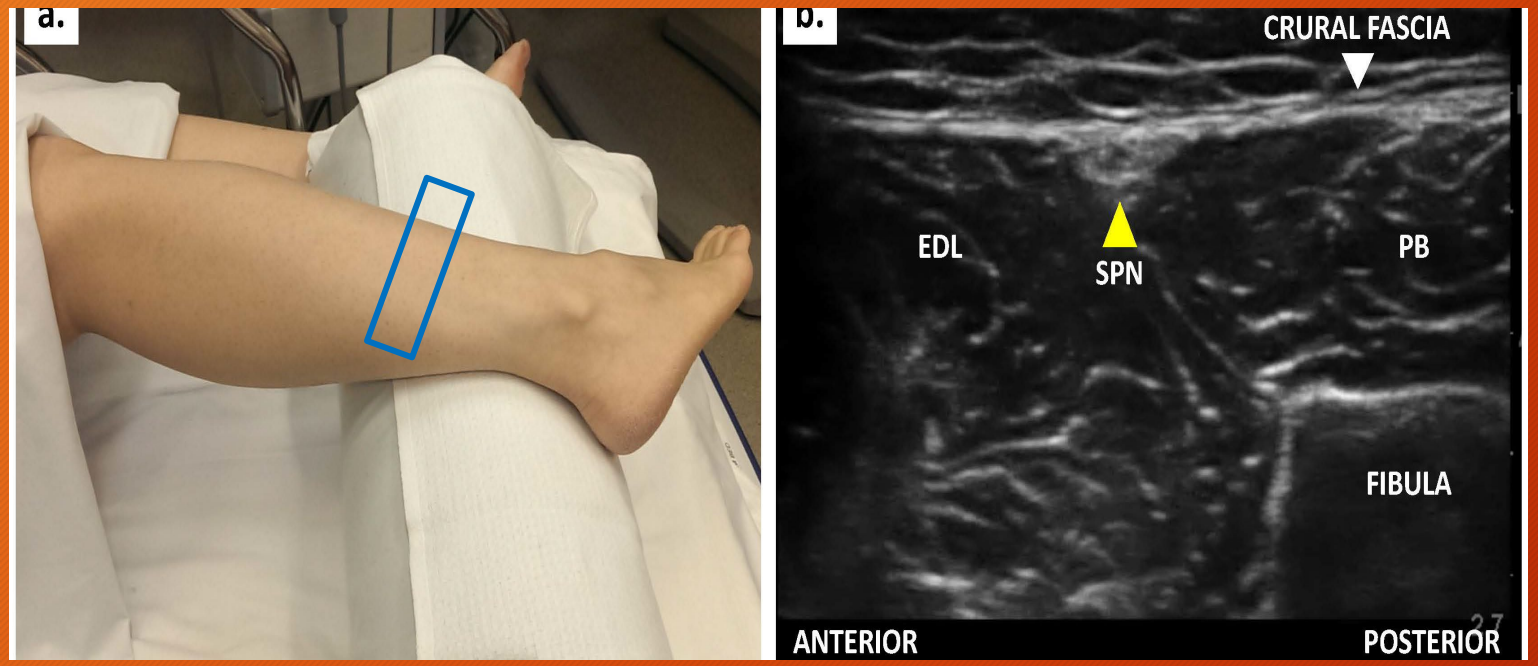
Abductor digiti minimi



1. Place the probe in the transverse orientation across the plantar lateral aspect of the hind foot
2. The abductor digiti minimi muscle is visualised deep, overlying the plantar calcaneum and extending over the proximal/base of the 5th metatarsal.

Major peripheral nerves

Superficial Peroneal nerve

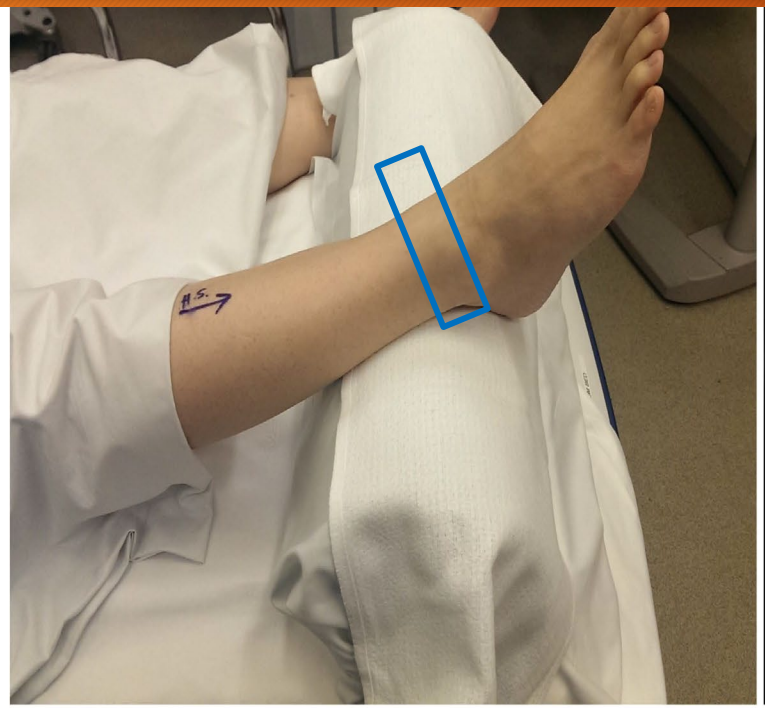


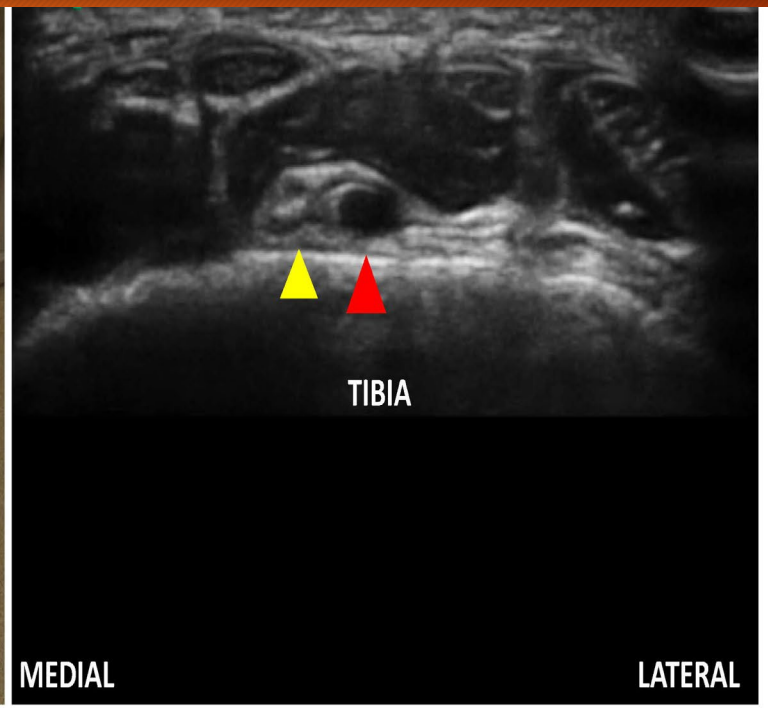
1. Place the transducer in a transverse orientation over the anterolateral lower leg/fibula
2. Identify the peroneal tendons
3. Slide the probe superiorly to identify the adjacent peroneal brevis and extensor digitorum longus muscle bellies
4. Sited within the crural fascia between the two muscles the superficial peroneal nerve (yellow arrow) is visible.

* Remember to fishtail the probe as the orientation of the nerve is vulnerable to anisotropy

Patient Supine, Foot in internal Rotation

Deep peroneal nerve



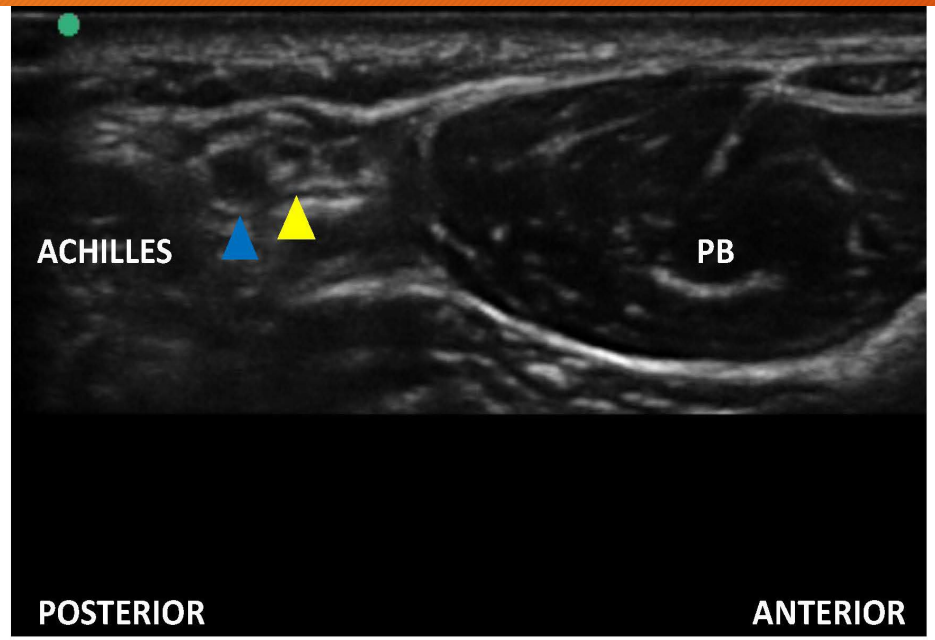


1. Place the transducer in a transverse orientation over the anterior ankle at the level of the extensor tendons
2. Identify the anterior tibial artery (red arrow) and veins
3. The deep peroneal nerve (yellow arrow) is sited medial to the anterior tibial artery.

** Gentle compression of the anterior tibial veins may help identify the deep peroneal nerve in the crowded neurovascular bundle.

Patient Supine, foot in neutral

Sural nerve

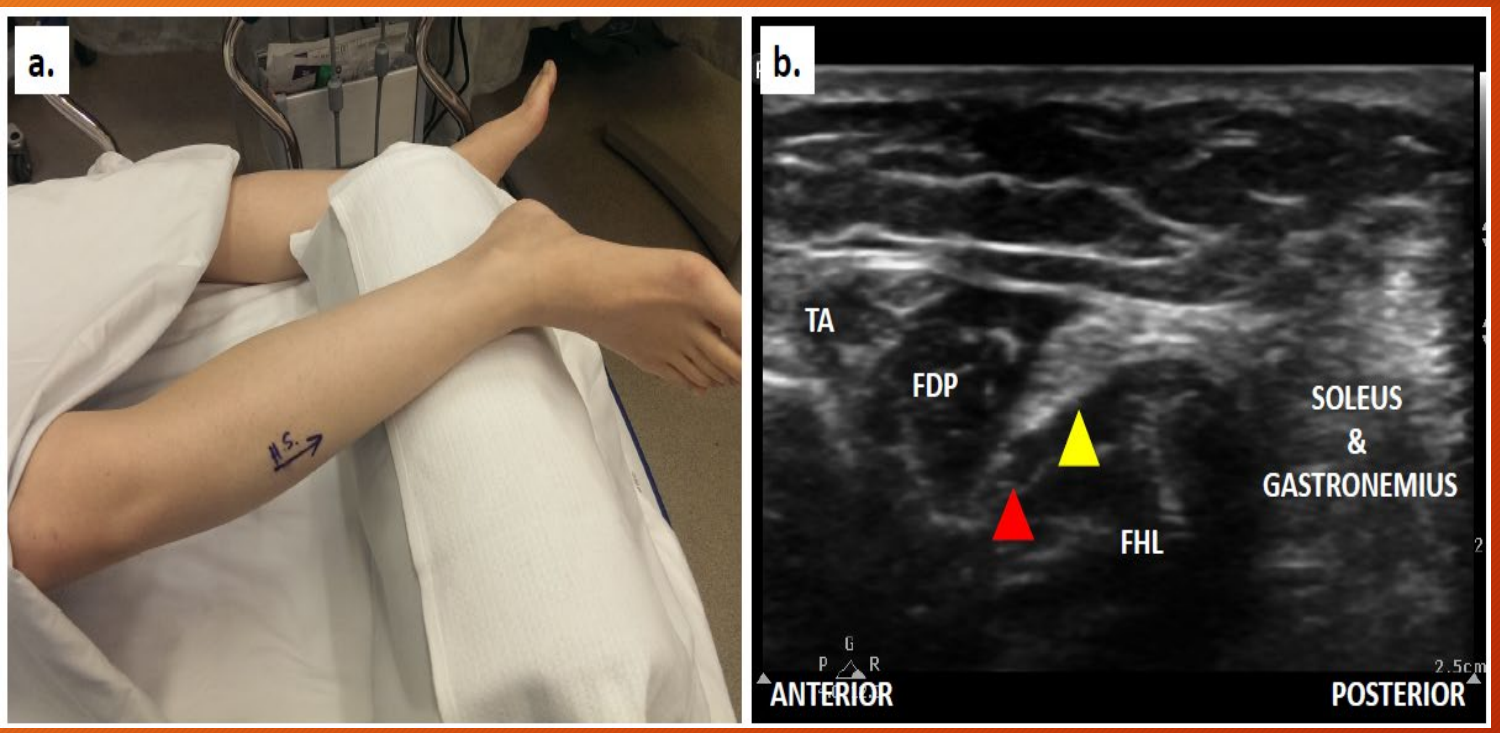


1. Place the transducer in a transverse orientation over the lower posterolateral ankle between the peroneal brevis muscle and Achilles tendon
2. The sural nerve (yellow arrow) is visualised at the level of the peroneal brevis aponeurosis.

** Gentle compression of the anterior tibial veins may help identify the sural nerve in the crowded neurovascular bundle.

Patient Supine, leg in internal Rotation

Tibial nerve

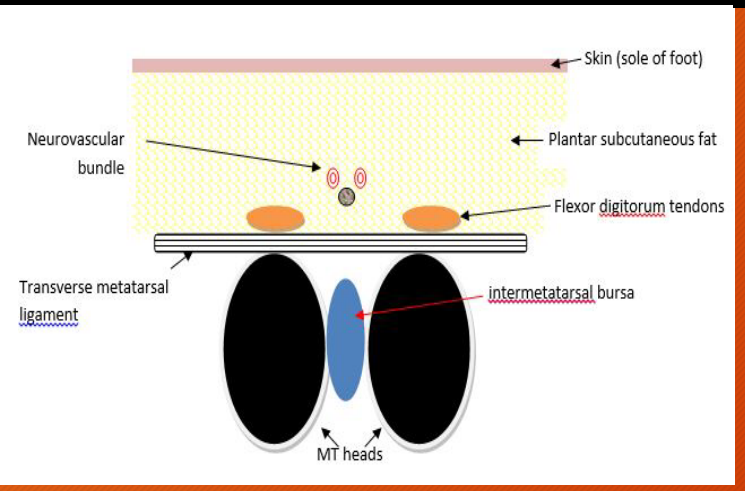


Patient Supine, leg in external Rotation

1. Place the transducer in a transverse orientation over the medial ankle
2. Identify the flexor tendons in transverse and the neurovascular bundle sited between the flexor digitorum profundus and the flexor hallucis longus tendons

** Gentle compression of the posterior tibial veins may help identify the tibial nerve in the crowded neurovascular bundle.

Interdigital plantar nerve



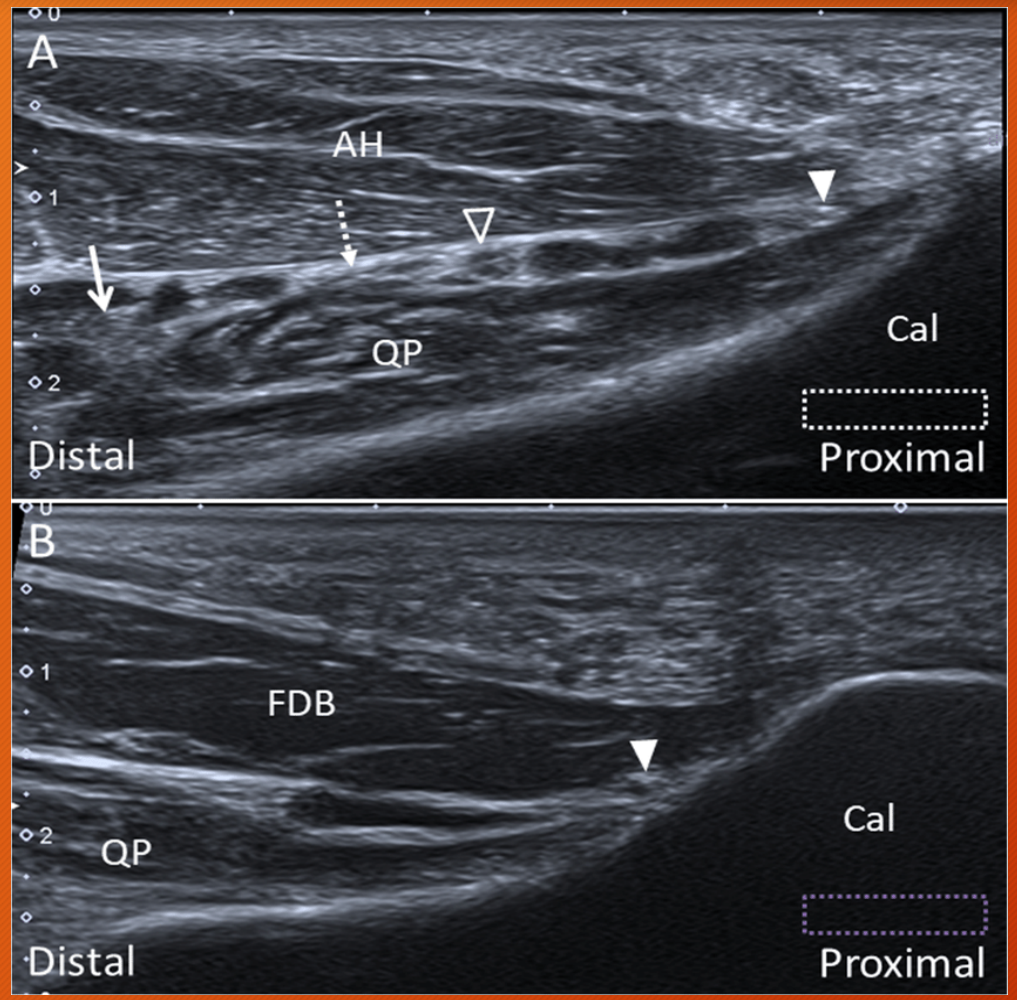
Green Arrow – Short axis Interdigital plantar nerve

Orange Arrows – Long axis View of interdigital plantar nerve

1. Place the transducer in a transverse orientation proximal to the metatarsal heads
2. The hyperechogenic focus between the metatarsal heads represents a short axis view of the interdigital nerve
3. Rotate the transducer through 90 degrees to align to the long axis of the interdigital plantar nerve

compression of the metatarsal fat pad may help identify the echogenic nerve

Baxters nerve (1st branch of lateral plantar nerve)



1. The transducer is placed in the transverse plane behind the medial malleolus to locate the tibial nerve.
2. Moving the transducer to the plantar surface, the tibial nerve bifurcates to the MPN and LPN.
3. The Baxter nerve can be seen emerging from the posterior margin of the LPN