The Feet- an Osteopathic Perspective

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Acknowledgements

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Presentation Objectives

- At the conclusion of the presentation, learners will be able to:
- recognize and locate common areas of Somatic Dysfunction that cause headaches, as well as shoulder and foot issues
- utilize multiple Osteopathic Manipulative Treatments (OMT) for common disorders such as rotator cuff strain, shoulder pain, foot and heel pain, as well as musculoskeletal related headaches
- utilize their Osteopathic skills for headaches, shoulder and foot pain; knowing better when it is time to use OMT and when it is time to obtain X-rays and/or surgical consultation

Foot and Ankle Anatomy

- The foot and ankle form a complex system which consists of 28 bones, 33 joints, 112 ligaments, controlled by 13 extrinsic and 21 intrinsic muscles.
- The foot is subdivided into the rearfoot, midfoot, and forefoot.

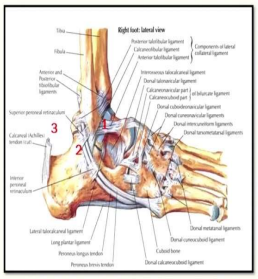
Tensegrity of the Foot- Compression Elements

- Know the MOTIONS
- 14 phalanges (forefoot)
  - Motion testing: A/P glide, IR/ER, medial/lateral glide
- 5 metarsals (forefoot)
  - Motion testing: A/P glide, IR/ER, Medial/lateral glide
- 3 cuneiforms (midfoot)
  - Motion testing: plantar/dorsal glide, inversion/eversion
- Cuboid
  - Motion testing: plantar/dorsal glide, inversion/eversion
- Navicular
  - Motion testing: inversion/eversion
- Talus
  - Motion testing: anterior/posterior glide
- Calcaneous
  - Motion testing: inversion/eversion

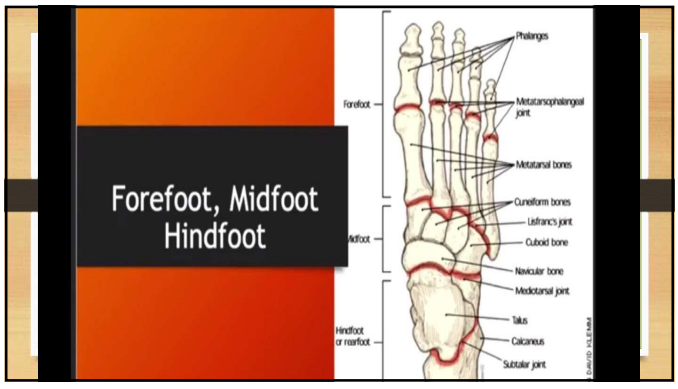
Three Parts Reviewed

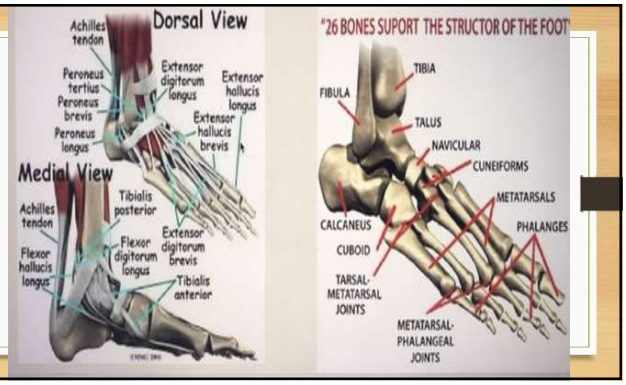
- **Hindfoot:** the most posterior aspect of the foot, is composed of the talus and calcaneus, two of the seven tarsal bones. The talus and calcaneus articulation is referred to as the subtalar joint
- **Midfoot:** is made up of five of the seven tarsal bones: navicular, cuboid, and medial, middle, and lateral cuneiforms. The junction between the hind and midfoot is termed the Chopart's joint, which includes the talonavicular and calcaneocuboid joints.
- **Forefoot:** is the most anterior aspect of the foot. It includes metatarsals, phalanges (toes), and sesamoid bones. There are a metatarsal and three phalanges for each digit apart from the great toe, which only has two phalanges. The articulation of the midfoot and forefoot forms the Lisfranc joint.

Ankle Anatomy



"26 BONES SUPORT THE STRUCTOR OF THE FOOT"





Hindfoot

- *The Hindfoot* begins at the ankle joint and stops at the transverse tarsal joint (a combination of the talonavicular and calcaneal-cuboid joints). The bones of the hindfoot are the **talus and the calcaneus**.
-

Midfoot

- *The Midfoot* begins at the transverse tarsal joint and ends where the metatarsals begin --at the tarsometatarsal (TMT) joint. The five bones of the midfoot comprise the **navicular, cuboid**, and the **three cuneiforms (medial, middle, and lateral**).

Forefoot

- *The Forefoot* is composed of the **metatarsals (5), phalanges (14), and sesamoids (2).** The great toe-->proximal and distal phalanx, and the four others each have proximal, middle, and distal phalanges. There are two sesamoid bones embedded in the flexor hallucis brevis tendons that sit under the first metatarsal at the level of the great toe joint (1st metatarsophalangeal joint).

Columns of the Foot

- The foot is sometimes described as having two columns.
- The **Medial column** is more mobile and consists of the **talus, navicular, medial cuneiform, 1st metatarsal, and great toe**.
- The **Lateral column** is stiffer and includes the **calcaneus, cuboid, and the 4th and 5th metatarsals.**

Mobile Joints of the Foot and Ankle or (Essential Joints)

- Ankle joint (tibiotalar joint)
- Subtalar joint
- Talonavicular joint (TN joint)
- Metatarsophalangeal (MTP) joints

Joints that Move a Moderate Amount

- Calcaneal-cuboid joint
- Cuboid-metatarsal joint for the fourth and fifth metatarsal.
- Proximal interphalangeal joint (PIP)
- Distal interphalageal joint (DIP)

Joints with Minimal Movement (Non-Essential Joints)

- Navicular-cuneiform joints
- Intercuneiform joints
- Tarsometatarsal (TMT) joint "Lisfranc" Joint (a.k.a. midfoot joint)

Bones of the lower leg and hindfoot

- Tibia
- Fibula
- Talus
- Calcaneus

The Tibiofibular articulation

Proximal Joint
- -- Oriented in space postero-medial → antero-lateral
- -- Vector of force in all manipulative procedures need to follow the joint line
- -- One needs to be aware of the fibular nerve
- -- Frequently dysfunctional with ankle sprains

Distal joint (a syndesmosis)
- -- Not a true synovial joint
- -- Maintained by anterior and posterior tibiofibular ligaments and the anterior and posterior talofibular ligaments
- -- Essential to integrity of the ankle mortise.
- -- Expands with dorsi flexion of the ankle

Joints of the hindfoot

- Ankle (Tibiotalar)
- Subtalar

Tibia and Fibula (long bones)

- The foot is connected to the body where the talus articulates with the tibia and fibula.
- Tibia supports 85% and Fibula does 15% of body weight.
- Fibula main role- serves as the lateral wall of the ankle mortise .
- The tibia and fibula are held together by the tibiofibular syndesmosis, a collection of 5 ligaments.
- Distal tibia--> medial malleolus, Fibula--> lateral malleolus.

Talus

- The talus- most proximal bone of the foot.
- 70% covered with hyaline cartilage (joint cartilage), because it articulates with so many other bones
- Connects to the *calcaneus* on the underside through the *subtalar joint (rotation around Talus)*
- Distally it connects to the navicular through the *talonavicular joint rotation around Talus)*
- Relatively poor blood supply, injuries to this bone take greater time to heal

Talus cont'd

- Three parts: the body, the head, and the neck
- The talar body connects the talus to the lower leg at the ankle joint
- The talar head is adjacent to the *navicular bone* to form the *talonavicular joint*.
- Talar neck is the point of entry for the blood vessels supplying the talus.

Calcaneus

Foot Arches

- ***Medial longitudinal arch-** calcaneus, talus, navicular, the three cuneiform bones and the first 3 metatarsals. The apex of the MLA is the superior articular surface of talus. In addition to the plantar aponeurosis the MLA is also supported by the spring ligament and the deltoid ligament. The Tibialis anterior and posterior muscles play an important role in raising the medial border of the arch, whereas Flexor hallucis longus acts as bowstring.

Foot Arches continued

- **Lateral longitudinal arch-** calcaneus, cuboid, fourth & fifth metatarsal.The anterior pillar is formed by the metatarsal heads of 4th and 5th metatarsals. The plantar aponeurosis, long & short plantar ligaments provides support to the LLA. The Peroneus longus tendon plays an important role in maintaining the lateral border of the arch.

Foot Arches continued

- **Transverse arch-** medial to lateral in the midtarsal and tarsometatarsal area and consists of the metatarsal heads, cuboids and 3 cuneiform bones. The medial and lateral pillars of the arch is formed by the medial and lateral longitudinal arch respectively. The arch is maintained by the Posterior tibialis tendon and the Peroneus longus tendon which cross the plantar surface from medial to lateral and lateral to medial respectively.

Arches and Their Muscles and Tendons

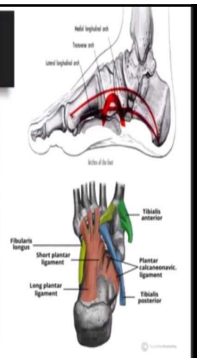
- **Medial longitudinal arch-** Tibialis anterior and posterior muscles and the Flexor hallucis longus tendon
- **Lateral longitudinal arch-** Peroneus longus tendon
- **Transverse arch-**Posterior tibialis tendon and the Peroneus longus tendon

Arches of the Foot- Anatomy Review

Medial Longitudinal arch
- Calcaneus, talus, navicular, 3 cuneiforms and first 3 metatarsal bones
- Supported by tibialis anterior/posterior, fibularis longus, flexor digitorum longus, flexor hallucis, intrinsic foot muscles, plantar aponeurosis, plantar ligaments

Transverse arch
- Metatarsal bases, cuboid, 3 cuneiforms
- Fibularis longus and tibialis posterior, plantar aponeurosis

Lateral Longitudinal arch
- Calcaneous, cuboid, 4th/5th metatarsals
- Supported by fibularis longus, flexor digitorum longus, flexor hallucis and intrinsic foot muscles, plantar ligaments, plantar aponeurosis



Forefoot Pain

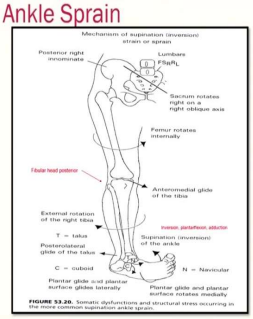
- First MTP- Bunion- Hallux Valgus
- First MTP- Hallux rigidus
- Turf Toe
  - Sprain of the first toe ligaments from forced extension
- Hammer Toe/Clawtoe/ Mallet toe
  - Abnormal flexor tension
  - Collapse of the transverse arch
- Gout
- Metatarsalgia
  - Trauma, length abnormalities, deformity (osseous, soft tissue)
  - Pain at MPJ
- Morton callus
  - A longer 2nd toe than great toe- hypermobility of the first metatarsal and calluses under the second and third metatarsals
- Morton Neuroma
  - Commonly b/w the 2nd/3rd or 3rd/4th metatarsals- neuroma of the plantar nerve- burning numbness
- Tailor's bunion
  - A bunion on the lateral edge

Feet- An Osteopathic Perspective- Clinical Pearls

- Anatomy- areas of importance
- Talus- anterior S.D. when treated, can resolve decades old pain syndromes in seconds
- Tibialis Anterior

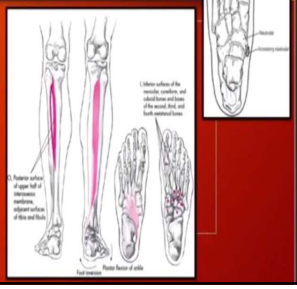
Common Osteopathic Findings in a Supination Ankle Sprain

- Restriction not only at the talus, but cuboid, navicular, fibular head, tibia, innominate and sacrum
- Look for tenderpoints
- Assess for areas that would impeded lymphatic drainage
- Treatment
  - *OMT- even in the acute phase- gentle BLT, MFR, lymphatics, CS*
  - *Rest*
  - *Ice*
  - *PRN Tylenol*
  - *Compression*
  - *Early ROM with alphabet*
  - *Proprioceptive retraining when can stand without pain*

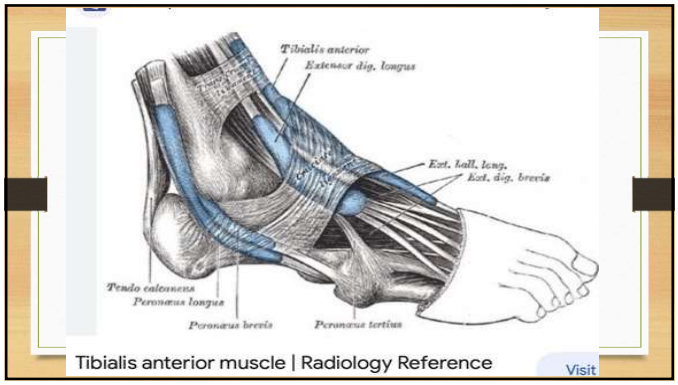


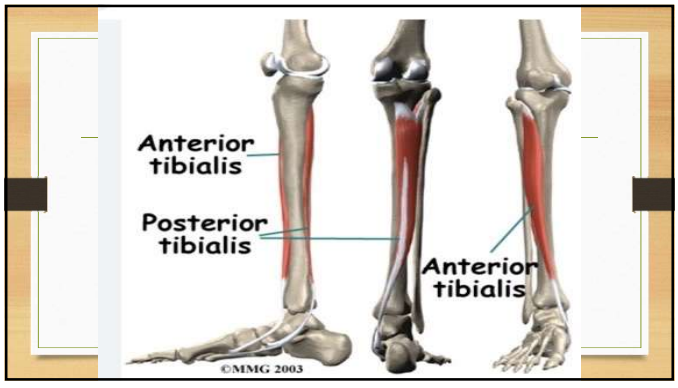
Midfoot Pain

- Navicular bone
  - Somatic dysfunction
  - Stress fracture
  - Tendinopathy of the posterior tibialis tendon
- Longitudinal Arch Collapse
- Cuboid pain
- Base of 5th metatarsal




Rear Foot Pain
• Haglund's deformity
• Bone spur on the calcaneous- caused by overuse and poorly fitting shoes
• Peroneal Tendinopathy
• Everters and external rotators
• Retrocalcaneal bursitis
• Pump bump- inflamed bursa- poorly fitted shoes
Achilles tendon
Metatarsal bones
Calcaneus (heel bone)
Plantar fascia ligament
Haglund's Deformity
Bursa
Bone Spur


Tibialis anterior
Extensor dig. longus
Ext. hall. long.
Ext. dig. brevis
Tendo calcaneus
Peronæus longus
Peronæus brevis
Peronæus tertius
Tibialis anterior muscle | Radiology Reference
Visit


Anterior tibialis
Posterior tibialis
Anterior tibialis
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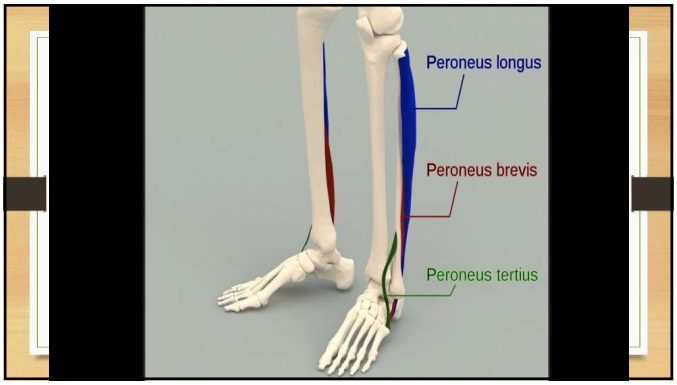
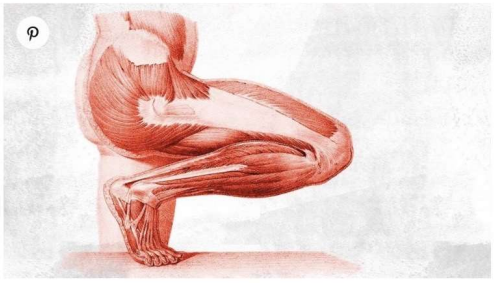


Lower leg definition



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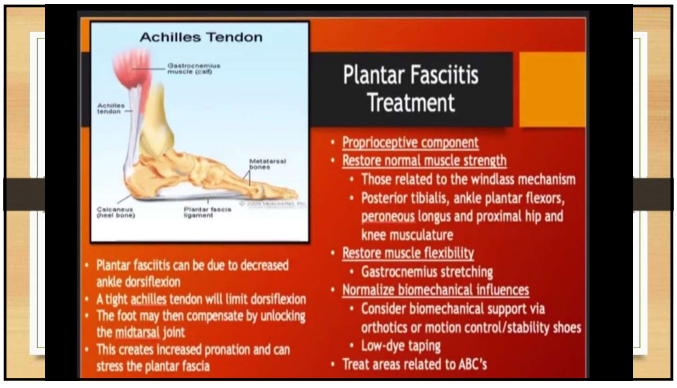


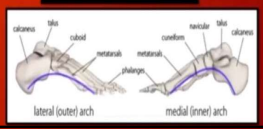
High Heels- and why not to wear them...

- Sprained ankles
- Low back pain
- Increased spinal curves
- Leg pain
- Shortened achilles tendon
- Increased oxygen consumption
- Predisposition to knee OA
- Clic

- Research studies
  - Lumbar flexion angle decreases
  - Erector spinae activity increase
  - Increased knee flexion

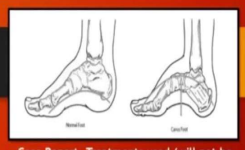
Barefoot Shoes

- "Born to Run"
- Barefoot runners land on forefoot or midfoot
  - This generates smaller collision forces
  - More plantar flexed at landing and more ankle compliance
  - Reduced stride length
- Shod runners tend to heel strike
  - Modern running shoes are designed to absorb and spread this force out
- Cushioned shoes are comfortable BUT
  - Limit proprioception
  - More likely to hit on heals
  - More runners with more injuries despite advances in technology
  - ? Weaker foot muscles
  - ? Weaker arch strength
- No good research on barefoot running yet



Pes Cavus

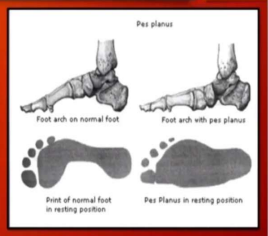
- Associated with
  - Greater forces/impact during gait
  - Higher risk in running related activities
  - Ankle sprains, arthritis, instability
  - Metatarsalgia
  - Knee, hip, back pain
- Lead to gait abnormalities
- Fixed vs Flexible
  - Flexible allows rearfoot mobility
- Often Treated with Orthotics, stretching, shoe modification
- "Hypomobility of the many joints of the foot and ankle may be mistaken as an idiopathic cavus foot deformity"



- Case Report- Treatments used (will not be tested)
  - HVLA to the Talocrual joint
    - (increase ankle dorsiflexion)
  - Counterstrain lateral calcaneus
    - (increase rearfoot eversion)
  - HVLA navicular
    - (increase pronation)
  - Mobilization of the cuboid
    - (increase pronation)
  - Mobilization of the first MTP
    - (increase dorsiflexion after heel-off)
- Home exercise was given after treatment

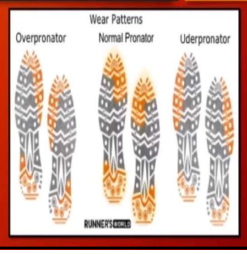
Pes Planus

- Aquired flatfoot deformity (AAFD)
  - Often caused by posterior tibial tendon dysfunction if it collapses and cannot support the arch which will collapse
  - Arthritis
  - Injury
  - Diabetic collapse (Charcot foot)
  - Family history
  - Pregnancy
  - Nervous system disease
  - Tarsal Coalition (fused bones)
  - Age- wear and tear
- Can contribute to other overuse syndromes
  - Achilles tendonitis, arthritis, bunions, hammertoes, plantar fasciitis, shin splints



Observe the Shoes for Wear Pattern

- http://www.runnersworld.com/running-shoes/whats-your-wear-pattern
- Look for symmetry
- Patterns of wear



Lower Extremity Muscular Attachments in the Foot- Look for Tenderness

KNOW

- Fibularis Longus
  - Base of the 1st metatarsal
- Fibularis Brevis
  - Base of the 5th metatarsal
- Tibialis Anterior
  - Medial & inferior surface medial cuneiform, base of first metatarsal
- Extensor Digitorum Longus
  - Medial & Distal Phalanges 2-5 dorsal surface
- Extensor Hallucis Longus
  - Dorsal 1st phalanx
- Gastrocnemius
  - Calcaneal tendon
- Soleus
  - Calcaneal tendon
- Flexor Hallucis Longus
  - Base of the distal first toe
- Flexor Digitorum Longus
  - Bases of phalanx 2-5
- Tibialis Posterior
  - Navicular, cuneiforms (all), cuboid, calcaneous, base of 2,3,4 metatarsal

Student doctor position: Standing on the ipsilateral side to foot being evaluated/treated
Patient position: Supine
Somatic Dysfunction(s): talocalcaneal inversion or eversion
Diagnosis:
1. Bring knee and hip to 90° of flexion, snug elbow of cephalad arm beneath patient's distal thigh (may use a pillow, towel, or practitioner's knee to lengthen the arm)
2. Capture proximal calcaneus bone between thumb and index finger of cephalad hand
3. Lean back slightly toward contact at thigh to produce slight distraction at the subtalar joint
4. Contact talus anteriorly by draping caudad hand across superior aspect of the foot
5. Assess motion at the subtalar joint by inverting and everting the foot with the caudad hand while maintaining joint gapping with cephalad upper extremity
Treatment (Bootjack articulatory treatment):
1. Maintain positioning as for diagnosis
2. Gently spring at the restrictive barriers identified until greater freedom of motion is appreciated


Tibiotalar HVLA: (For anterior SD only)

Patient Position: Supine

Physician Position: Standing at end of table

1. After gaining consent clasp foot with both hands, thumbs parallel on soles, and 3rd and 4th fingers overlapping over the talus anteriorly.
2. Induce slight flexion at the hip, apply traction to gap the tibiotalar joint.
3. Localize barrier further by inducing dorsiflexion and posterior glide.
4. Final thrust is a quick sharp tug to induce a composite motion of traction, dorsiflexion, and posterior glide through the articulatory barrier ("scooping" motion toward the physician's abdomen).
5. Reassess

Tibiotalar Joint (Talus) Evaluation for Somatic Dysfunction with Ankle Plantar/Dorsiflexion:

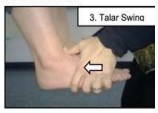
a. Major motions: Plantarflexion / Dorsiflexion
b. Minor Motions: Used for Segmental Diagnosis
-Anterior glide (during Plantarflexion)
-Posterior glide (during Dorsiflexion)

1. Talar A-P Glide Test for tibiotalar somatic dysfunction –Local motion
Patient seated or supine
1. Use the same grip on calcaneus as for Anterior Drawer Test
2 .Grip the anterior& lateral portions of the talus
3. Induce anterior and posterior glides of talus
4. Monitor for the initial restriction to motion of restriction, NOT the anatomic barrier

Talar AP Glide

2. Talar Swing Test for tibiotalar somatic dysfunction-Regional motion
Patient seated
1. Identify neck of talus with thumbs by plantarflexing feet
2. Assess for asymmetry of plantarflexion
3. Place ankles back to 90 degrees for starting position, fingers on soles
4. While monitoring neck of talus, slowly and smoothly push the foot away from you, creating knee flexion and subtle ankle dorsiflexion
5. The side with an anterior talus SD will have initial restriction to dorsiflexion and/or increased pressure on that thumb will be perceived, at the same point in the arc of the swing compared to the other ankle

3. Talar Swing

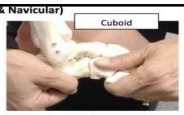


Dorsiflex

Treatment of Cuboid SD- BLT/MFR/LAR (also works for Cuneiforms & Navicular)

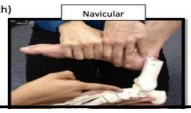
Patient seated or supine

1. One hand grips calcaneus
2. Other hand grips 4th & 5th metatarsals
3. Thumb of either hand monitors cuboid-can spring it to monitor for ease
4. Move front & back of foot with both hands to place the joints & ligaments into balanced tension


Cuboid

a. Compression or distraction (may be done first, last, or both)
b. Inversion/eversion (like wringing a washcloth)
c. AB/Adduction
d. Decreasing or increasing arch height

5. Hold at the point of balanced tension until the release is achieved
6. May repeat Tx at the cuboid/5th metatarsal joint
7. Reassess


Navicular

VI. Diagnose somatic dysfunction of Cuboid and Tx BLT/MFR (can be applied to Navicular/Cuneiform)

Minor Motions: Used for Segmental Diagnosis-

a. Plantar/Dorsal glide
b. Inversion/Eversion (rotation about an A/P axis)

1. Testing Plantar & dorsal glide
   a. Patient seated or supine or prone
   b. One hand stabilizes Calcaneus
   c. One hand glides the cuboid in a plantar/dorsal motion
2. Testing Inversion/ eversion
   a. Patient supine or prone
   b. Thumbs on medial and lateral plantar surface of the cuboid
      a. Springing on the medial aspect inverts the cuboid
      b. Springing on the lateral aspect everts the cuboid
   c. Spring each side dorsally for restriction
3. Cuneiforms/Navicular
   a. Tested in the same manner
   b. Medial cuneiform/navicular have dorsal/plantar, Inversion/eversion glide
   c. Intermediate and lateral cuneiform have plantar/dorsal glide only


VI Dx of Cuboid plantar /dorsal glide


VI. Cuboid Dx test Inversion/Eversion