Lower Extremity
Part 2


PRINCE CHIROPRACTIC
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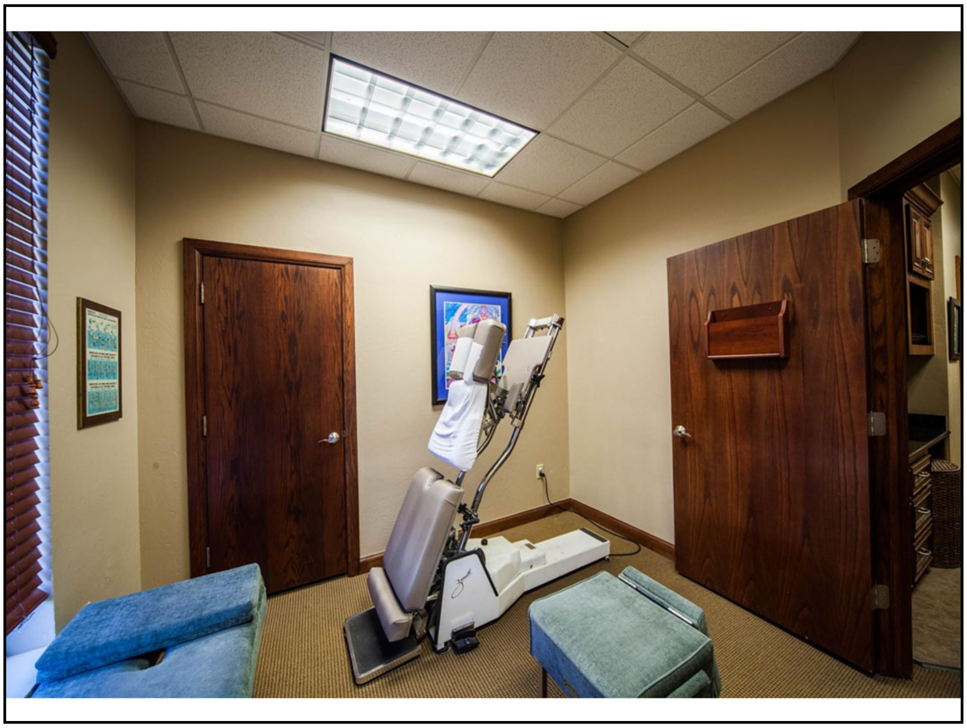
WE BELIEVE
that people are created to be healthy and whole - physically, mentally, emotionally, and spiritually.
WE COMMIT
people journey toward
through
chiropractic care.


NUTRITIONAL FOUNDATION
P C W


PCWG


STRETCH
STRENGTHEN
STABILIZE


THE SPINE



WHAT IS THE PRIMARY SHOCK ABSORBER OF THE BODY?

- Biomechanically the primary shock absorber of the human body is FOOT PRONATION.

WHAT IS FOOT PRONATION?

- Eversion of the foot?
- Dropping of the medial arch of the foot?
- Abduction of the foot?
- Dorsiflexion of the foot?
- When the heel strikes and the foot flattens out?
- Is it all of the above?

IS FOOT PRONATION NORMAL OR PATHOLOGICAL?

- Does it increase or decrease shock?
- Can it be excessive?
- Can it be not enough?
- Does it affect anything besides the feet?
- Is it congenital?
- Is it developmental?
- Can it be all of the above?

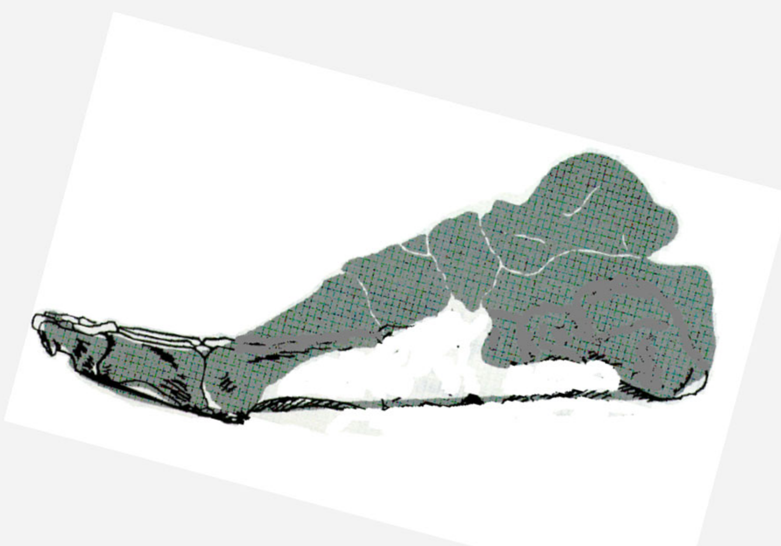
What are the forces into the feet each time I take a step?

- Walking- 0ne to Three times body weight.
- Running- Three to Five times body weight.
- Jumping- Five to Seven times body weight.

What are the laws of physics that control shock absorption?

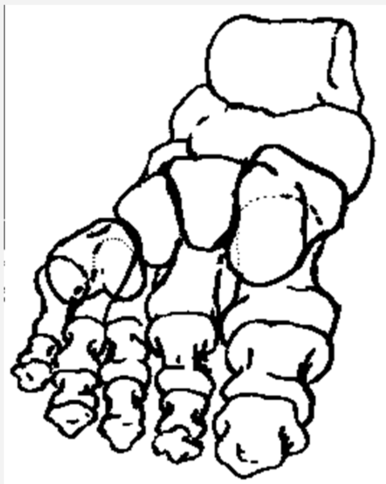
- You must increase the surface area of the mass that is striking. Foot length and width.
- You must increase the time it takes to bottom out. Joint glide up and down slowed by the posterior tibial muscle through eccentric contraction while lowering the medial longitudinal tarsal arch.

HOW COULD SURFACE AREA INCREASE ?

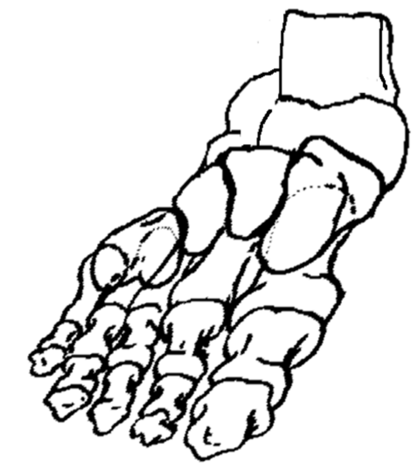


ANTERIOR VIEW OF WHOLE FOOT

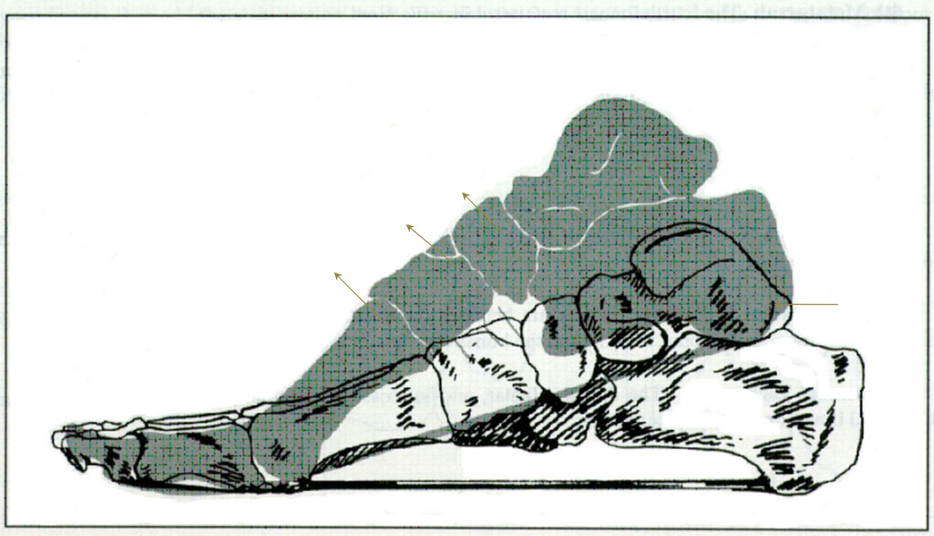
NEUTRAL



PRONATED



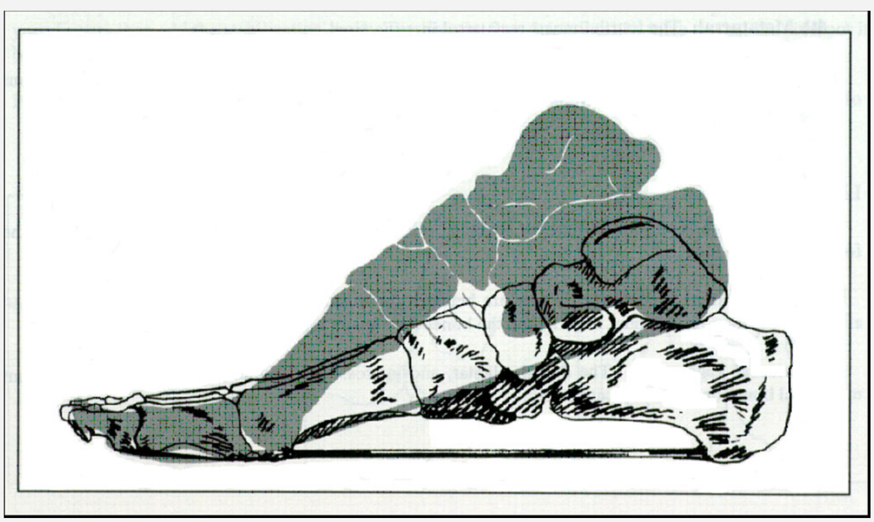
JOINTS MUST GLIDE TO RESTORE ARCH



WHAT IS THE ETIOLOGY OF THE FOLLOWING?

- PLANTAR FASCITIS
- CALCANEAL HEEL SPURS
- ABDUCTO HALLUX VALGUS
- BUNIONS
- HAMMER TOES
- CLAW TOES

IS THE ETIOLOGY UNKNOWN AS THE TEXTS SAY?



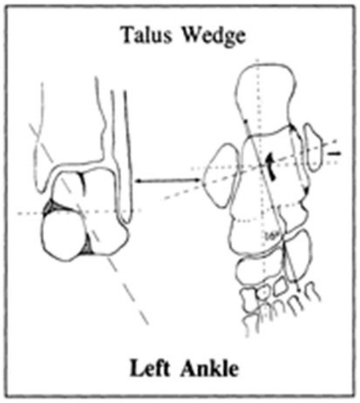
PLANTAR FASCIA MUST TIGHTEN TO DRAW HEEL FORWARD AND RAISE THE ARCH – THE ARCH JOINTS MUST BE ABLE TO GLIDE FOR THE ARCH TO RAISE.

THE ANKLE

ANKLE MORTISE (1,p.1-3; 2,p.28-41; 6,p.459-471)

STRUCTURE

The medial and lateral malleoli viewed from above reveal a postero-laterally angled transverse plane. The medial malleolus extends 1/3 of the way down the medial talus. The lateral malleolus extends down the length of the entire lateral talus.



The body of the talus is a wedge shaped bone with the wider portion anterior. Upon dorsiflexion the wider portion spreads the malleoli and wedges between them. This wedge widens obliquely to its lateral side.

As the foot plantar flexes, the more narrow posterior portion of the talus allows greater lateral motion within the mortise.

The more plantar flexion increases, the more unstable the ankle mortise, which increases the stress on the supporting ligaments.

The superior portion of the talus body supports the tibia and acts as a hinge joint within the ankle mortise.

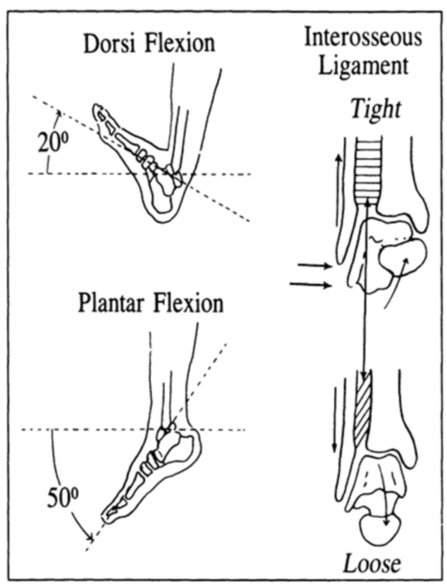
The interosseous ligament extends from the inner aspect of the tibia inferiorly and laterally to the inner aspect of the fibula.

During dorsiflexion, the wedge of the talus widens the mortise laterally, forcing the fibula to rise slightly allowing these fibers to become more nearly horizontal.

Plantar flexion, on the other hand, slackens this ligament and allows the fibula to lower itself.

The anterior tibiofibular ligament runs parallel to the interosseous ligament and reinforces it.

The posterior tibiofibular ligament runs parallel to the interosseous ligament and reinforces it.



LIGAMENTS - (1,p.3-8; 2,p.90-92; 6,p.459-471)

The lateral collateral ligaments have three bands that give the ankle joint support. They are;

A. Anterior Talofibular - from the neck of the talus to the tip of the fibula.
B. Calcaneofibular - from the calcaneus to the tip of the fibula.
C. Posterior Talofibular - from the body of the talus to the tip of the fibula.

Note: The most frequently injured ligaments during an ankle sprain are the anterior talofibular and the calcaneofibular. This is usually an inversion injury while the ankle is in plantar flexion, which is the most unstable position for the ankle.

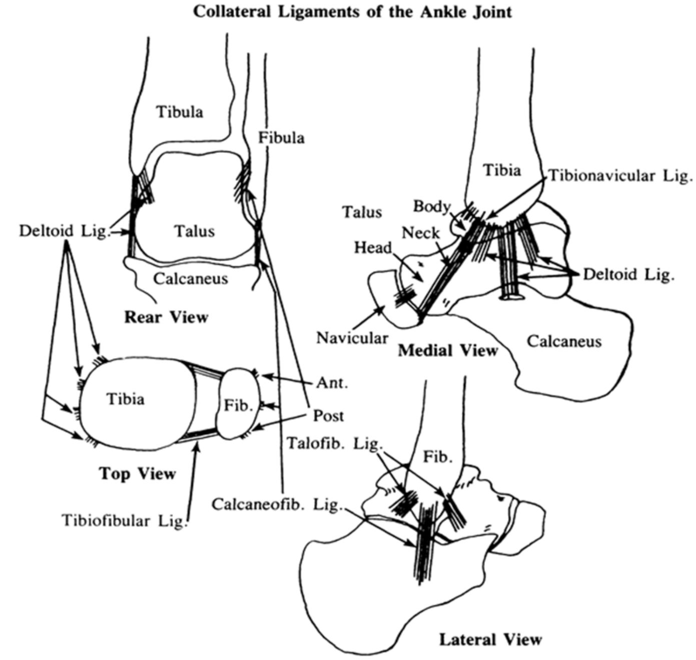
The deltoid ligaments are four bands that support the medial portion of the ankle joint from the medial malleolus to the navicular, the sustentaculum talus, and the posterior aspect of the talus.

A. Tibionavicular
B. Anterior Talotibial
C. Calcaneotibial
D. Posterior Talotibial

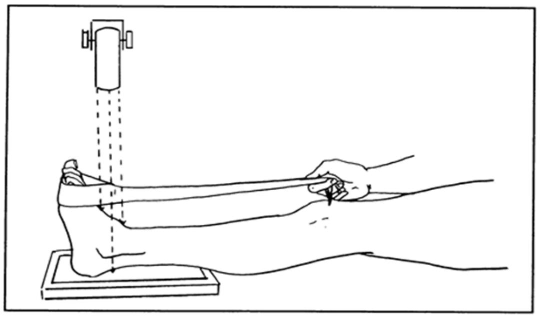
Note: An avulsion of the malleolus is more likely than a tear of the deltoid ligament during severe eversion sprain because of its strength.

Note: The talus is the only bone in the foot without any tendons attaching to it.

Collateral Ligaments of the Ankle Joint



X-RAYS OF THE ANKLE (16,p. 54-56)

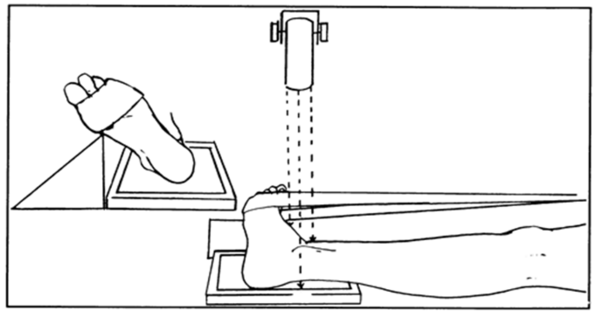


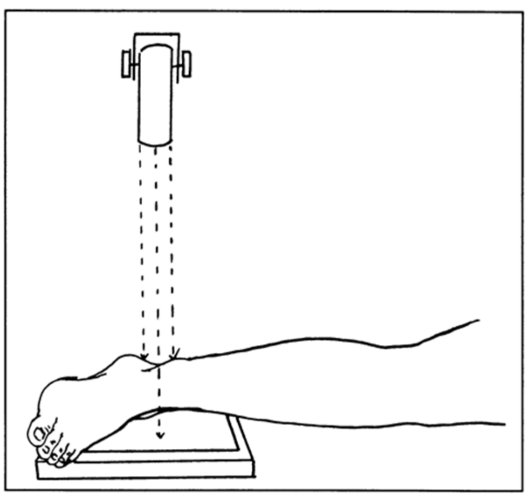
Anteroposterior Ankle Projection

Film Size	10 x 12 inches (24 x 30 cm)
Central Ray	Center between the malleoli.

Medial Oblique Ankle Projection

Film Size	1/2 of a 10 x 12 inches (24 x 30 cm) *Use the other half for the A-P Projection.*
Central Ray	Center between the malleoli with the foot internally rotated 35-45 degrees.





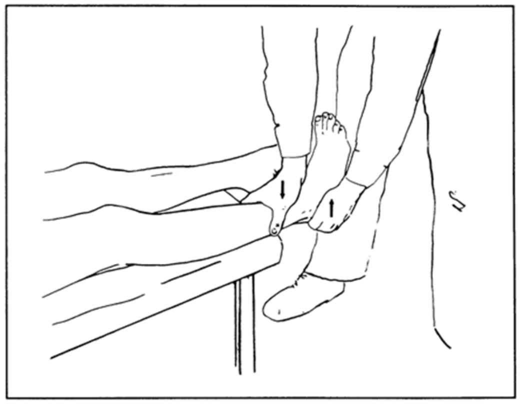
Lateral Ankle Projection

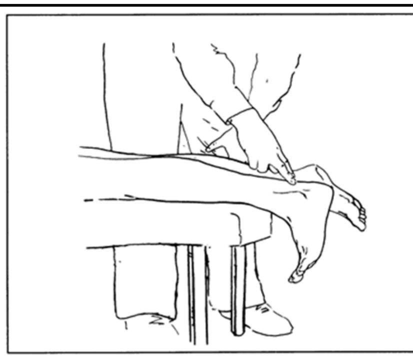
Film Size	8 x 10 inches (18 x 24 cm)
Central Ray	Center of medial malleolus.

ORTHOPEDIC TESTS OF THE ANKLE AND FOOT

ANTERIOR FOOT DRAW (19, p.215)

Stabilize the anterior distal tibia with one hand. Then grasp the posterior calcaneus with the other hand and pull it anterior. Normally there is no movement of the foot anteriorly in the ankle mortise. If movement occurs, it is indicative of an anterior talofibular ligament instability that is secondary to its rupture.



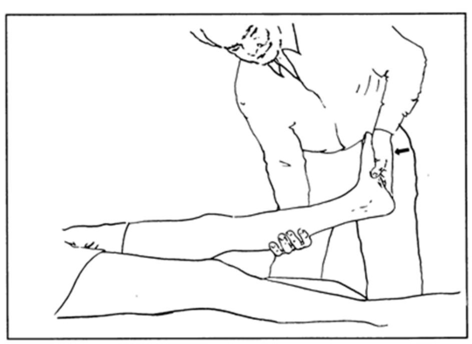


HOFFA'S SIGN (19, p.287)

The patient is prone, with their feet hanging well over the end of the table. Observe for increased dorsiflexion of one foot and palpate the achilles tendon on that side to feel if it is less taut than the other side. If present, it is indicative of an avulsion fracture of the calcaneus. A fragment may be seen or felt behind either malleolus.

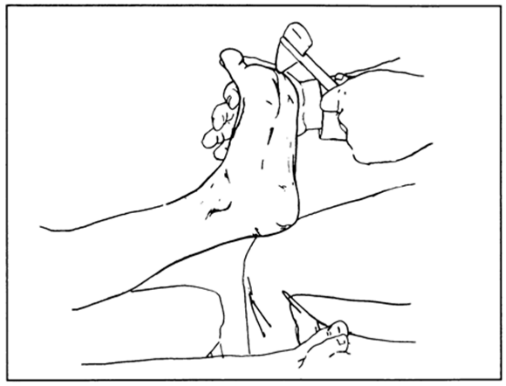
HOMAN'S SIGN (19, p.287)

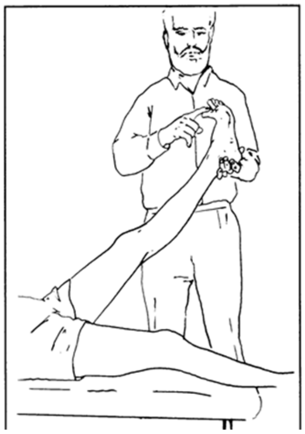
With the patient supine and the legs fully extended, you firmly dorsiflex the foot on the ankle. If the patient experiences well localized deep pain in the back of the calf or behind the knee, it is indicative of thrombophlebitis (thrombosis of the deep veins of the leg).



METATARSAL (19, p.326)

Press the outer four toes into dorsiflexion and percuss the metatarsal heads with a reflex hammer. If neuritic type pain occurs, it is indicative of anterior metatarsalgia due to inflammation of the metatarsophalangeal joints.



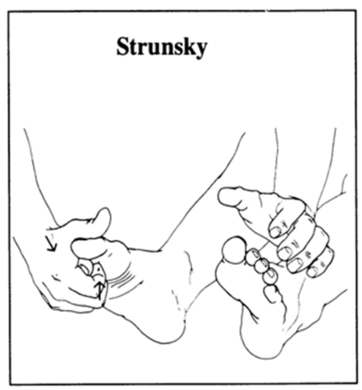


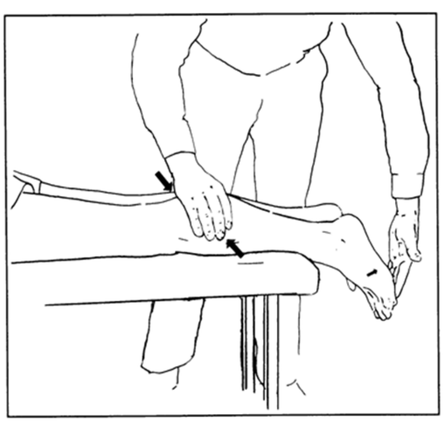
SICARD'S SIGN (19, p.356)

Similar to the Lasegue (straight leg raise) test, the patients leg is raised just short of producing pain. If sciatic pain is produced when you dorsiflex the big toe it is indicative of a sciatic radiculopathy.

STRUNSKY'S SIGN (19, p.362)

The examiner grasps the patients lateral four toes and suddenly flexes them. This is painless in a normal foot. If lancinating pain occurs, the sign is present. This is indicative of a drop of the metatarsal arch with resultant metatarsophalangeal inflammation.





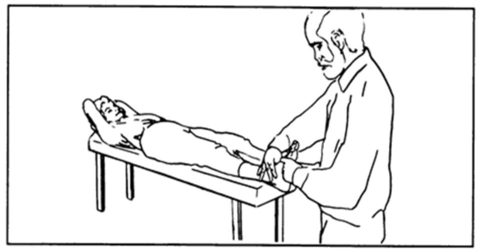
THOMPSONS (19, p.366)

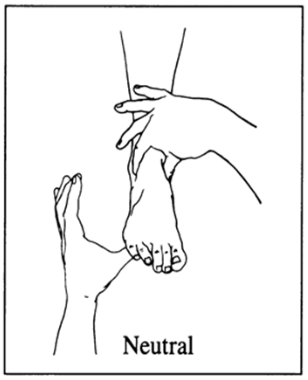
With the patient prone and their feet hanging over the end of the table, squeeze the calf below its widest portion and observe for plantar flexion of the foot. If this does not occur, it is indicative of a complete rupture of the achilles tendon.

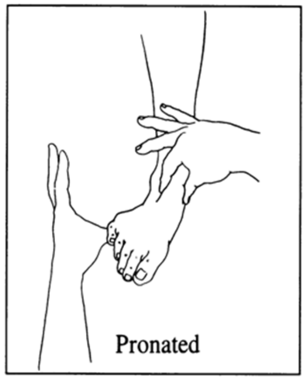
NEUTRAL POSITION OF THE FOOT/SUBTALAR JOINT (S.T.J.) NEUTRAL POSITION

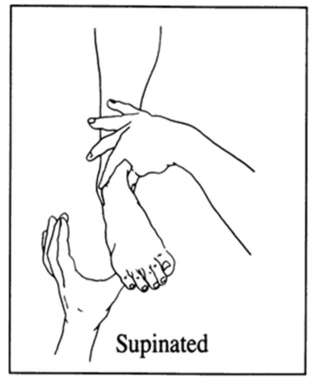
(2,p. 154-157);

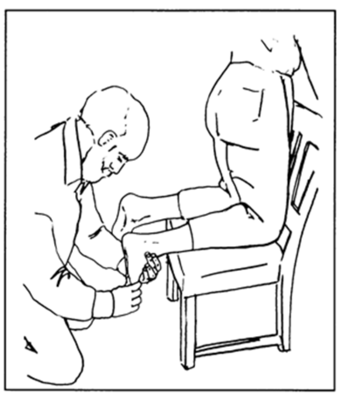
The position where the S.T.J. is neither pronated nor supinated. When the S.T.J. is in neutral position, there is a congruency of the talonavicular joint. This can be palpated at the joint articulation between the head of the talus and the navicular.

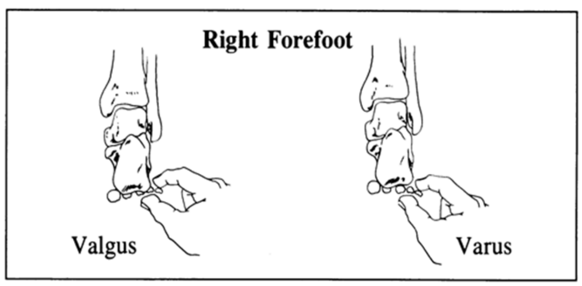


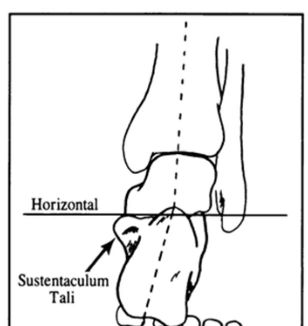












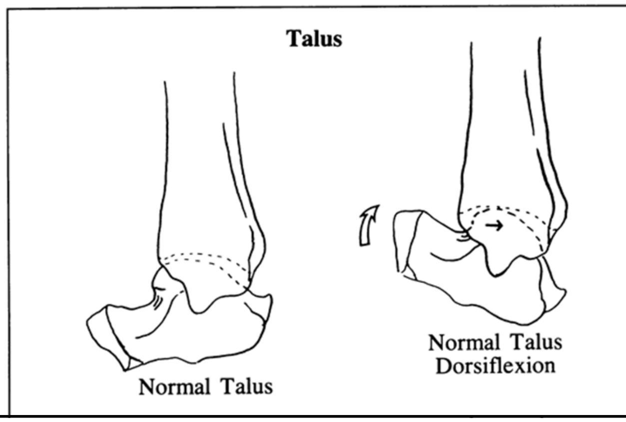
A Rearfoot Varus due to non vertical calcaneus while horizontal plane of Sustentaculum Tali is present.

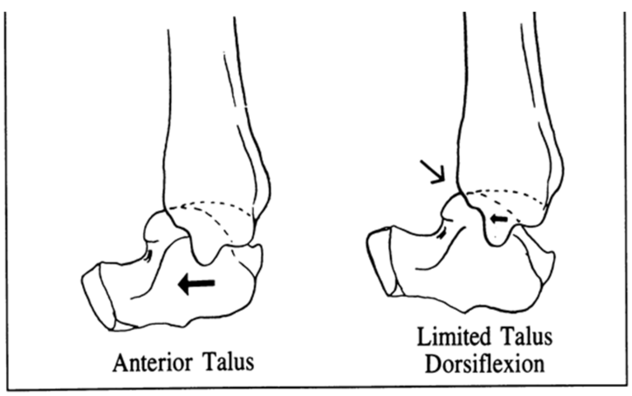
Note: To successfully attain neutral position, it is important to lock the midfoot against the rearfoot by pressing the 4th and 5th metatarsal heads into dorsiflexion. This will fully pronate the midtarsal joint and allow correct viewing of varus and valgus deformities when the foot is held in neutral position.

SUBLUXATION OF THE TALUS: (14,p.60-61)

The talus typically moves anterior during an ankle sprain, which results in limited dorsiflexion of the ankle due to jamming of the condyle against the anterior tibial ridge. Document the distance of difference in dorsiflexion (e.g. 1/4", 1/2", 1", 5mm, 10mm, 15mm, etc.).

Eighty percent of all ankle sprains are inversion sprains, in which the talus gets rotated medially, creating a false or exaggerated forefoot varus deformity. In the event of a eversion sprain, the talus rotates laterally at its head and creates a false or exaggerated forefoot valgus. Document the angles of varus or valgus before the adjustment (e.g. 7 degrees, 12 degrees, 15 degrees, etc.).





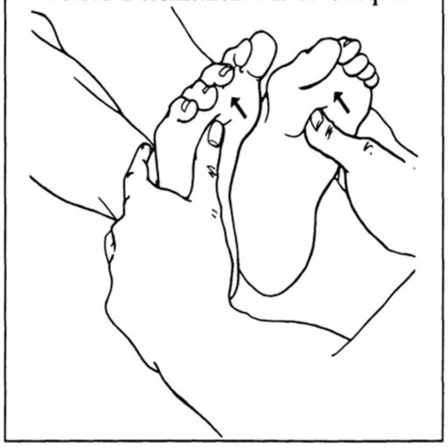
This is exactly why it is so important to check for this subluxation before casting a foot in the neutral position. The neutral position may be pathomechanical and so will be the foot orthotic if one is made without correcting the talus subluxation.

It is important to note at this time that not all forefoot varus or valgus conditions are a result of subluxations of the foot. You cannot adjust out what God made that way and expect it to perform well. If all of the talus signs are negative, then neutral position is probably correct.

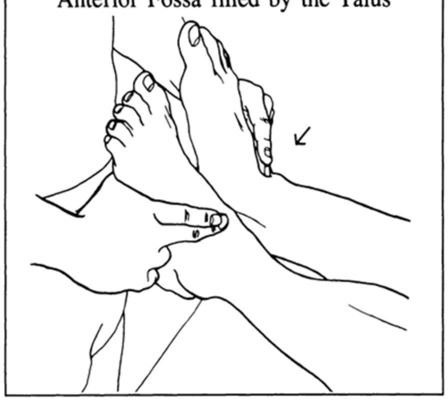
SIGNS

- Limited firm dorsiflexion of involved foot.
- Anterior fossa is shallow, being filled by the talus.
- While holding the foot in the neutral position, it will be evident that the head of the talus is either medial or lateral, because the foot is definitely not centered.
- Limited movement of fibular head at the knee upon ankle dorsiflexion.
- Pain on side of injury when palpated if acute.

Forced Dorsiflexion will be Unequal



Anterior Fossa filled by the Talus

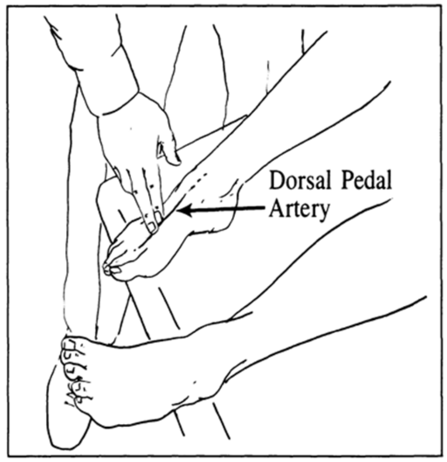


MUSCLE AFFECTED

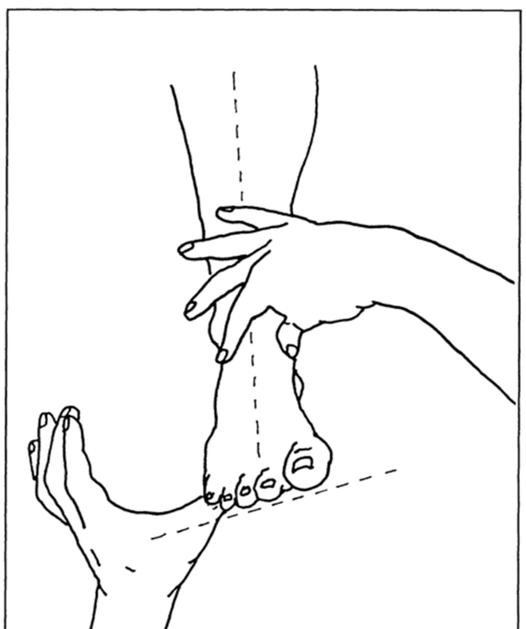
The talus is the only bone in the foot with no muscles and tendons attaching to it.

DIFFERENTIAL DIAGNOSIS

- Short achilles tendon.
- Tight gastrocnemius and or soleus.
- Congenital anomalies, eg. equinus foot.
- Can you attain neutral position?
- Patency of dorsal pedal artery.
- Anterior tibial bone spur.



ADJUSTMENTS OF THE TALUS:


Forefoot Varus

ANTERO-MEDIAL TALUS:

SIGNS

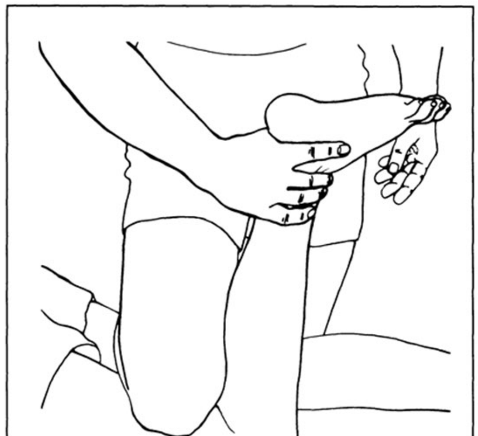
- Limited firm dorsiflexion of the foot.
- Shallow anterior talar fossa to palpation.
- Varus forefoot that becomes more normal following the talus adjustment.

IMPACT OF INJURY

Inversion ankle sprains; plantar flexion and inversion of the foot while coming down on the involved limb.

CONTACT

Stand facing the knees of a prone patient on the opposite side of the involved leg. Flex the involved leg to 90 degrees and place your knee closest to the head across the lower hamstrings of both legs with equal pressure. Using the hand closest to the head, grasp the lateral ankle like a pistol grip with your middle finger on the mid talar fossa as the contact finger, and your thumb around the Achilles tendon.



Contact

STABILIZATION

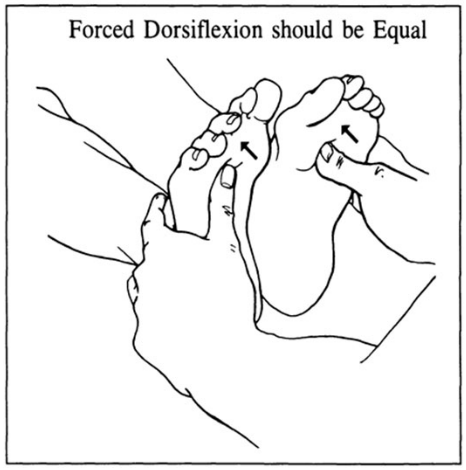
The hand toward the feet is for stabilization, and is used to support the contact finger and thumb while lifting the inside of the foot before the thrust until you feel distraction of the joint.

Stabilization with Distraction

Thrust

THRUST

After applying the stabilization hand, lift the ankle toward the ceiling until you feel distraction. Thrust the talus straight back toward the heel. Rotation is taken care of automatically by your position.



POST CHECKS

Is foot dorsiflexion now even or much closer to even ?

Are both anterior talar fossas equal in depth ?

Is the forefoot varus decreased or absent? By how much? Please document these findings.

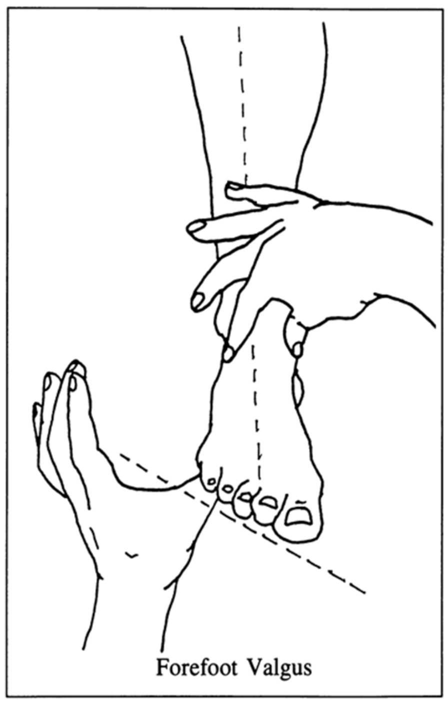
ANTERO-LATERAL TALUS:

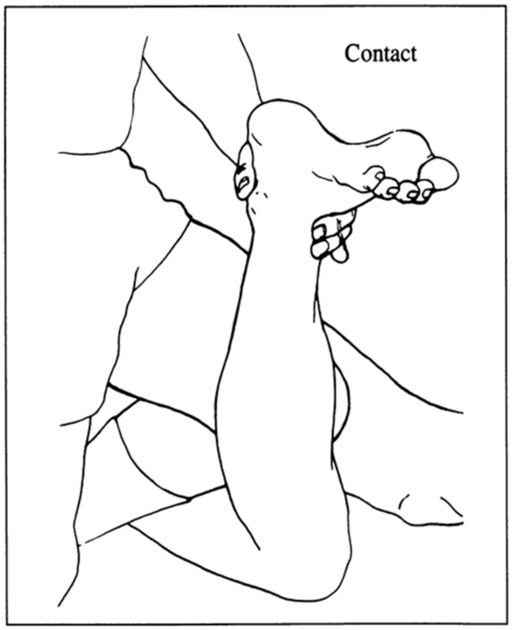
SIGNS

Limited firm dorsiflexion of the foot. Shallow anterior talar fossa. Forefoot valgus that becomes normal or significantly improved following the talus adjustment.

IMPACT OF INJURY

Eversion ankle sprains; plantar flexion and eversion of the foot while landing on the involved limb.



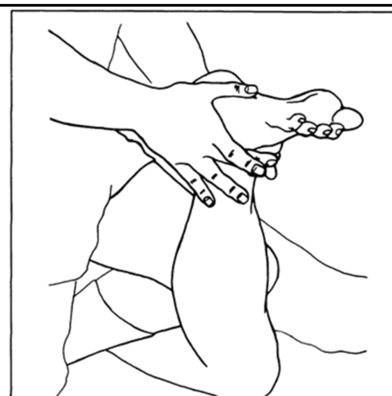


CONTACT

Stand facing the knees of a prone patient on the same side of involvement. Flex the involved leg to 90 degrees and place your knee closest to the head across the hamstrings of only the involved leg. Using the hand closest to the head, grasp the medial ankle like a pistol grip with your middle finger on the mid talar fossa and your thumb around the Achilles tendon.

STABILIZATION

The hand toward the feet is the stabilization hand, and is used to support the contact finger with its middle finger. The thumb can either go over the cuboid or around the Achilles tendon.


Stabilization


Distraction

Apply the stabilization hand and lift the ankle until you feel distraction.

THRUST

Thrust the talus straight back toward the heel. Rotation is taken care of by your position automatically.

POST CHECKS

Do the dorsiflexion press test to see if both feet dorsiflex evenly and check the depth of the anterior talar fossa. Note the change of the forefoot valgus, then document your findings.

TARSAL TUNNEL SYNDROME/POSTERIOR TIBIAL NERVE SYNDROME (25,p. 100; 26,p. 15)

SIGNS

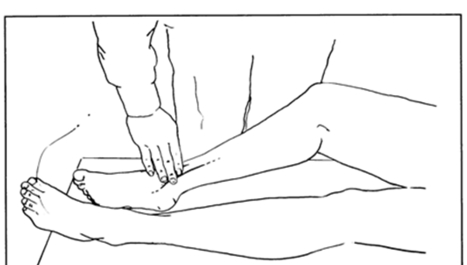
Numbness about the medial malleolus (the inside of the ankle) and medial plantar aspect of the foot. This may wake the patient up in the middle of the night and require motion of the joint or massage to relieve the symptoms.

IMPACT OF INJURY

Cramping and compression of the calf. Repetitive motions that force the heel and forefoot into the valgus position, which tightens the flexor retinaculum and the abductor hallucis, thereby compressing the nerve. This compression neuropathy is similar to carpal tunnel syndrome in the hand. It is for this reason that I am moved to call this the *Tarsal Flat Syndrome*, because the valgus position of the foot usually flattens the tarsal arch.

LOCATION OF NERVE

Behind the medial malleolus, palpate the posterior tibial pulse. The posterior tibial nerve is one finger breadth behind this.



Posterior Tibial Artery

ORTHOPEDIC TEST - ***TINEL TAP***

When tapping on the posterior tibial nerve, a positive test will elicit pain along the nerve into the medial foot.

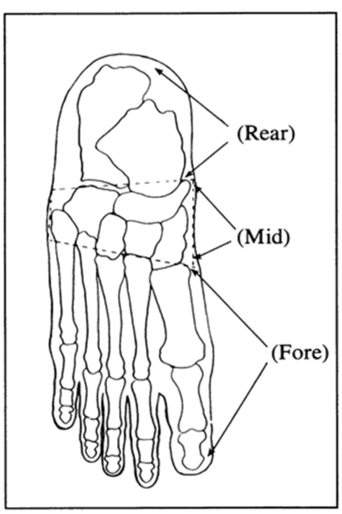
TREATMENT

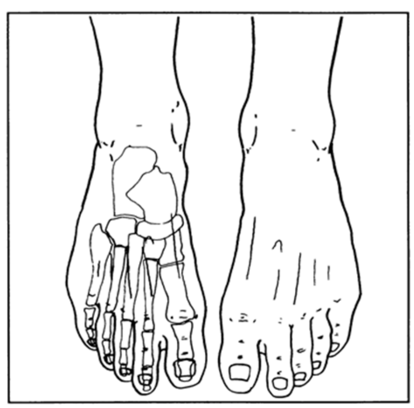
Correction of valgus stresses into the rearfoot and forefoot should be the first approach at reducing compression of the retinaculum on the posterior tibial nerve. Correction may be as simple as wearing a shoe with a strong heel counter or a good tarsal arch support. The probability of the need for correction of foot subluxations and a foot orthotic is high for a person with this problem. Lodye taping of the foot with Zonas Porous tape or a foot slipper with a heel lock made with elastic tape can give temporary relief, until a permanent resolution is produced.

The Foot

(1,p.1-3; 2,p.28-41; 6,p.459-471)

ANATOMY OF THE FOOT: There are twenty six bones of the foot that may be divided into seven tarsals, five metatarsals and fourteen phalanges.



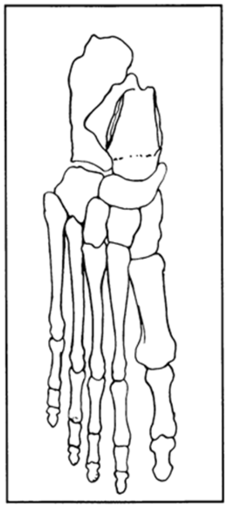


Functionally speaking the foot has five major segments.

1. The rear foot
2. The middle medial
3. The middle lateral
4. The medial forefoot
5. The lateral forefoot

THE REAR FOOT

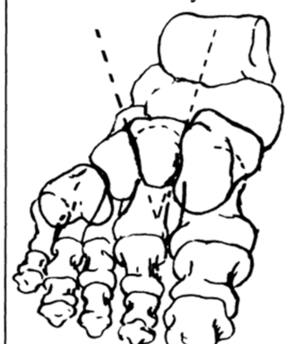
A posterior segment that is under the tibia and supports it which includes the talus and calcaneus. The talus is a domed wedge shaped bone in the ankle joint with the wide portion of the dome at the anterior aspect. Its medial side is in the sagittal plane. Its lateral side is oblique to the sagittal plane. It is responsible for medial foot motion during pronation and supination. It is the keystone of the medial longitudinal tarsal arch..



The calcaneus is under and behind the talus, supporting it and controlling it during the pronation and supination process. It is responsible for lateral foot motion during pronation and supination.

Talus Keystone

Cuneiform Keystone



THE MID FOOT (6,p.469)

The middle medial segment is a continuation of the medial foot from the talus. It proceeds distally to the navicular, which then articulates with the three cuneiforms, the first, second and third. Together, these three cuneiforms, with the medial three metatarsals, make up the medial three rays with phalanges. It is important to note at this time that the middle or second cuneiform is the keystone of the transverse arch of the medial mid foot.

Cuboid Keystone

Keystone

(6,p.469)

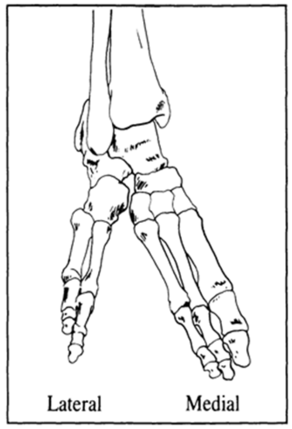
The middle lateral segment is a continuation of the lateral foot from the calcaneus. It is the cuboid bone, which is a wedge shaped bone with the wide part facing medially articulating with the navicular and lateral cuneiform. It also articulates with the base for the 4th and 5th rays of metatarsal phalangeal segments. It should be noted that the cuboid is the keystone of the lateral longitudinal arch of the foot.

THE FOREFOOT

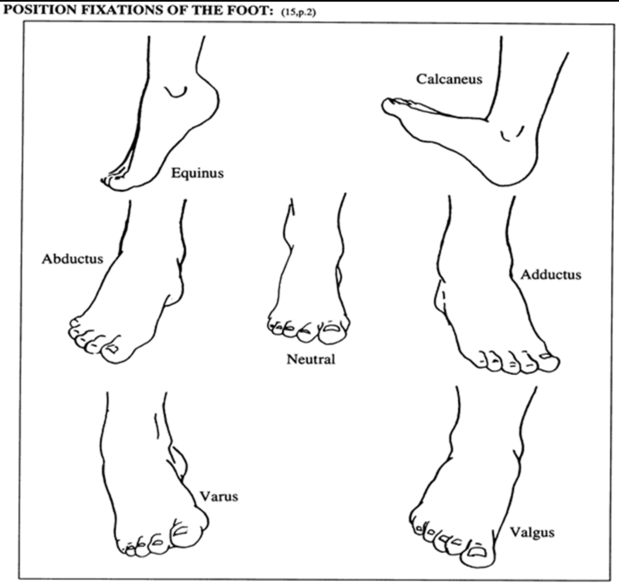
The medial forefoot consists of the medial three metatarsals and phalanges. Each series of bones are called rays. Each one articulates proximally with the corresponding three cuneiforms.

The lateral forefoot consists of the lateral two metatarsals, and the 4th and 5th phalanges. These two lateral rays articulate proximally with the cuboid.

Of course the medial and lateral foot articulate to tie the units together to form what is commonly thought to be a single unit biomechanically. However, it seems to function at times in a separate way. More like a medial and lateral foot than the classic rear, middle and forefoot. However these latter classifications do apply to the medial and lateral sides individually.



POSITION FIXATIONS OF THE FOOT: (15,p.2)



Calcaneus - a fixed position of dorsiflexion
Equinus - a fixed position of plantarflexion
Adductus - a fixed position of adduction
Abductus - a fixed position of abduction
Varus - a fixed position of inversion
Valgus - a fixed position of eversion

SUBTALAR JOINT/TALOCALCANEAL JOINT: (1,p.5-10; 2,p.28-41,6,p.459-471; 15,p.4)

This structure allows simultaneous movements in different directions through several joints in different planes. It consists of three articular surfaces. One articulation in the posterior portion and two articulations in the anterior portion side by side.

The talocalcaneal joint is divided into two synovial lined chambers with an oblique groove in the talus and calcaneus called the tarsal canal. This funnel shaped canal can be palpated laterally in front of the malleolus and is called the sinus tarsi.

The posterior joint allows inversion and eversion of the calcaneus while the talus is locked in the ankle mortise. The locked position is dorsiflexion of the foot. The body of the talus is concave and the calcaneus is convex.

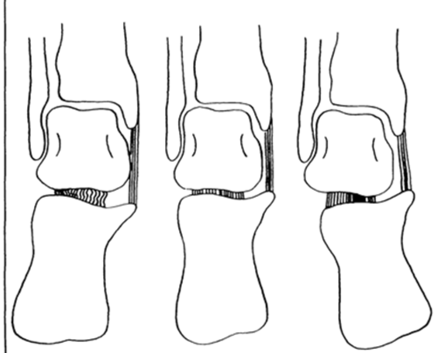
The anterior joint/facets are two separate facets on the head and neck of the talus that articulate with the calcaneus. The anterior facet of the talus is convex and the calcaneus is concave. The same is true of the middle facet on the neck of the talus.

Note: The concave - convex relationship reverses between the posterior joint and the anterior joints.

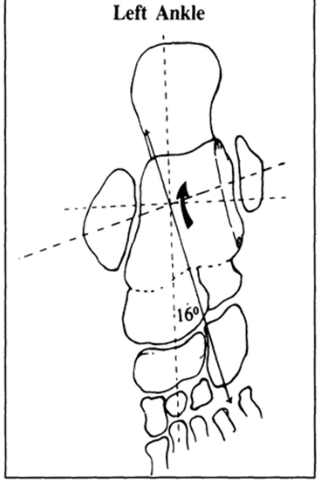
LIGAMENTUM CERVICIS

The ligamentum cervicis/interosseous talocalcaneal ligament runs the length of the tarsal canal and divides it into its anterior and posterior portions. At its lateral fibular end, it connects small tubercles on the talus and calcaneus. This is slack during eversion and tense during inversion.

Ligamentum Cervicis in the Tarsal Canal



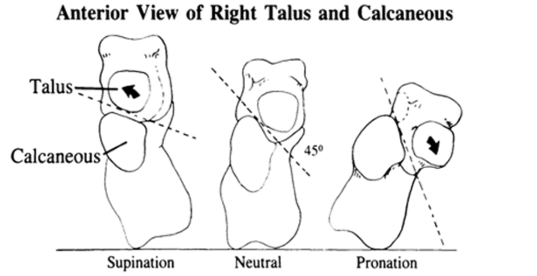
Left Ankle



FUNCTION OF THE SUBTALAR AXIS

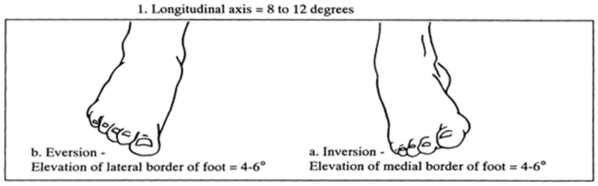
The subtalar axis is a 45 degree angle to the floor in the neutral position, about which the calcaneus rotates in relation to the talus and has a 16 degree angle medial to a line drawn through the second metatarsal.

Anterior View of Right Talus and Calcaneous

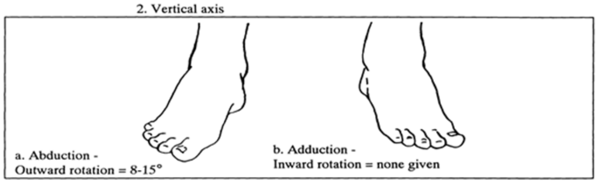


Three types of movement occur about this subtalar axis:

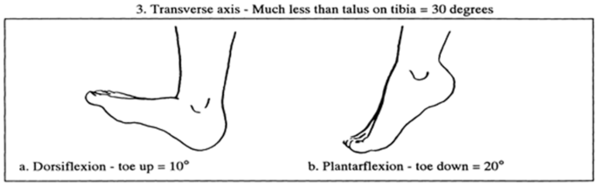
1. Longitudinal axis = 8 to 12 degrees



2. Vertical axis



3. Transverse axis - Much less than talus on tibia = 30 degrees

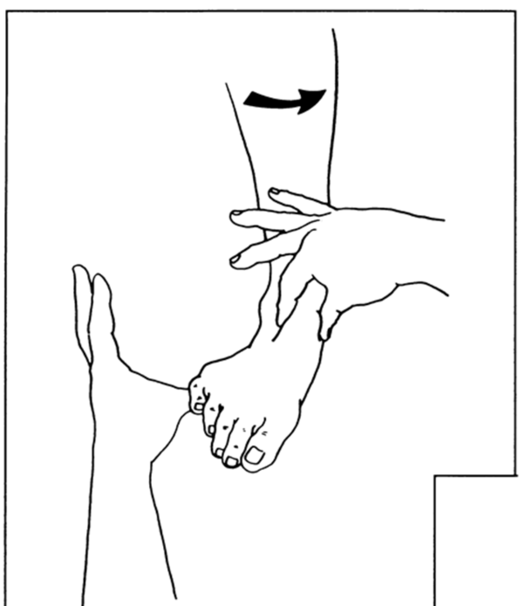


Combinations of these three types of movement are:

1. Supination = Inversion, adduction, plantarflexion.

2. Pronation = Eversion, abduction, dorsiflexion.

CLOSED CHAIN MOTION OF S.T.J. (SUBTALAR JOINT) (15,p.4)



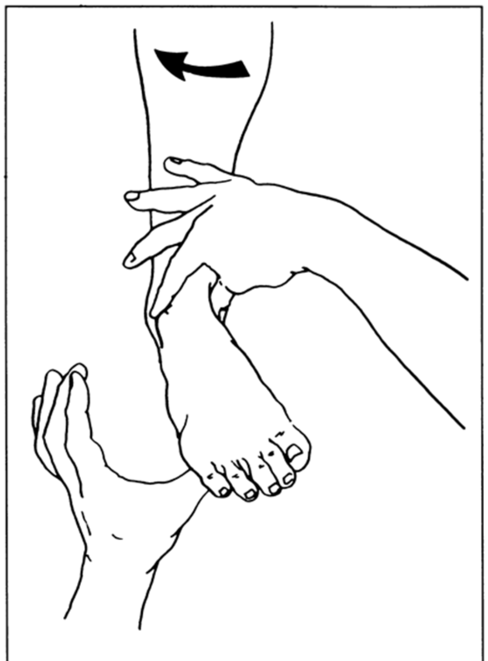
Pronation

PRONATION - *5 degrees*

Calcaneus -	Everts
Talus -	Adducts & plantar flexes
Leg -	Internally rotates & shortens
Knee -	Flexes & everts - valgus

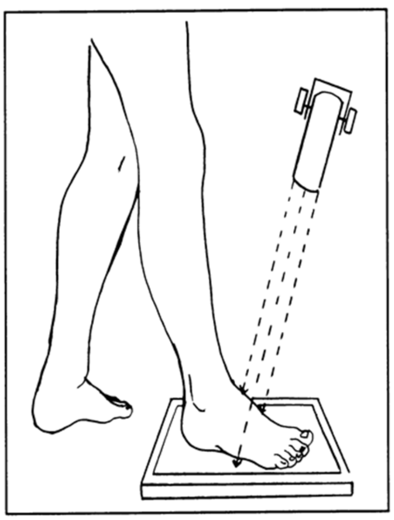
SUPINATION - *5 degrees*

Calcaneus	-	Inverts
Talus	-	Abducts & dorsi flexes
Leg	-	Externally rotates & elongates
Knee	-	Extends & inverts - varus



Supination

X-RAYS OF THE FOOT (16,p. 57-59)

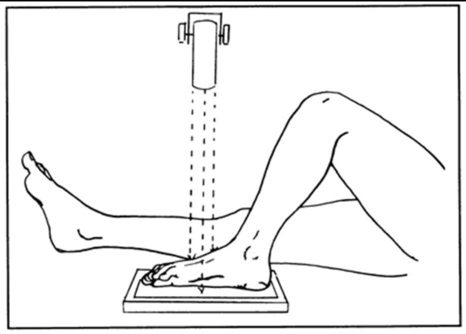


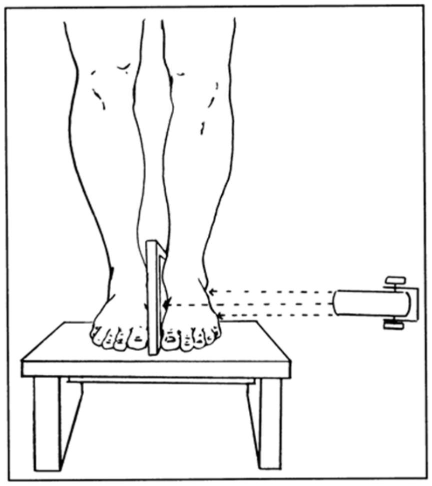
Dorsiplantar Foot Projection

Film Size	10 x 12 inches (24 x 30 cm)
Central Ray	Through the base of the third metatarsal with ten degrees cephalad tube tilt.

Medial Oblique Foot Projection

Film Size 10 x 12 inches (24 x 30 cm)
Central Ray Through the base of the third metatarsal with no tube tilt.





Lateral Foot Projection

Film Size 8 x 10 inches (18 x 24 cm) or larger if foot size requires it
Central Ray Through the medial navicular prominence.

ADJUSTMENTS OF TALOCALCANEAL JOINT:

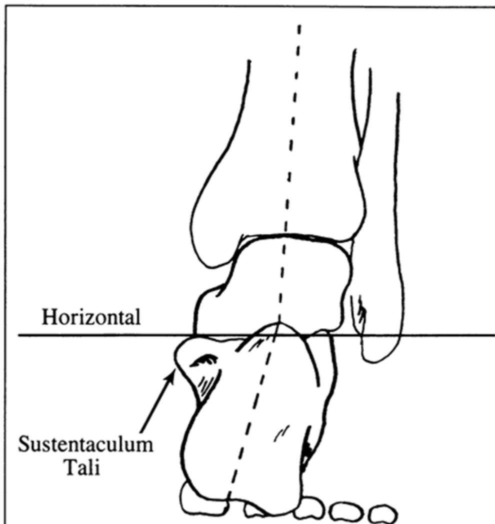
In neutral position, the calcaneus should be vertical and the sustentaculum tali should be horizontal.

SIGNS

1. Fixation upon motion palpation while side bending the calcaneus medially and laterally then internal and external rotation
2. Hypermobility
3. Pain at calcaneotibial or spring ligaments (medial)
4. Pain at calcaneofibular or calcaneocuboid ligaments (lateral)

DIFFERENTIAL DIAGNOSIS: ***RULE THESE OUT***

. Ankle sprain
. Avulsion fracture



Rearfoot Varus due to non vertical calcaneus while horizontal plane of Sustentaculum Tali is present.

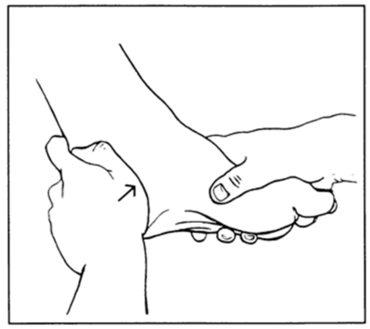
MEDIAL CALCANEUS:

SIGNS

Fixation or excess motion of calçaneus in relation to the talus, cuboid or spring ligament, with pain upon pressure at these joints or ligament.

IMPACT OF INJURY

Weak heel counters of shoes fail to support the calcaneus. Chronic repetitive trauma of distance running or take off leg when jumping. Severe ankle sprains.



STABILIZATION

Face the bottom of the feet, and grasp the top of the forefoot with the hand to its lateral side. Place it against the inside of your flexed knee on the same side of your stabilization hand.

CONTACT & THRUST

With your thumb's metacarpo phalangeal prominence, contact the sustentaculum tali while your fingers grasp around the head of the calcaneus. Traction the foot and thrust at 90 degrees to the articulation directly laterally.

POST CHECKS

Normal motion should be restored if it was fixated with a 50% pain reduction in the previously tender adjacent joints.

LATERAL CALCANEUS:

SIGNS

Fixated or hypermobile with pain at the talocalcaneal joint and the calcaneal cuboid joint.

IMPACT OF INJURY

Hyperpronation and eversion ankle sprains.

STABILIZATION

Face the bottom of the feet and grasp the top of the forefoot with the hand to its medial side. Now place it against the inside of the Dr.'s knee on that same side.

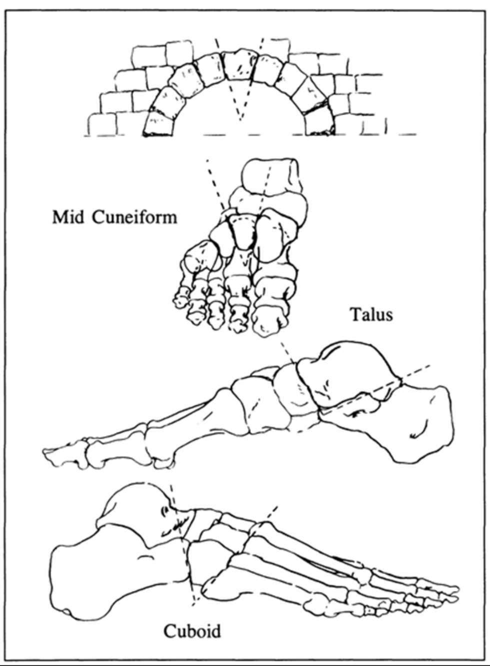
CONTACT & THRUST

With your thenar pad, contact the massive lateral surface of the calcaneus. With your fingers around the head of the calcaneus, traction and thrust medially.

POST CHECKS

Normal motion should be restored if there was a subluxation or fixation, pain should be 50% reduced in the previously tender adjacent joints.

TRANSVERSE TARSAL JOINT/MIDTARSAL/CHOPART'S/"SURGEON'S TARSAL JOINT"
(1,p.10,11; 2,p.41-46; 6,p.459-471)



STRUCTURE OF THE MIDFOOT:

This is often the site of amputation of the foot. It consists of two main joints, each with two axes of motion. Each axis is a supination - pronation axis, which means there are three body planes to each axis angle.

TALONAVICULAR JOINT- The convex head of the talus fits into the concave body of the navicular.

CALCANEOCUBOID JOINT - The calcaneus articulates with wedge shaped and arched bone called the cuboid. The cuboid is the keystone of the lateral foot and supports the lateral two metatarsals.

THREE CUNEIFORMS - These are structural extensions of the navicular longitudinally, while supporting the medial three metatarsals. The middle cuneiform is the keystone of the transverse arch.

LIGAMENTS OF THE MIDFOOT - ***NOT INCLUDING CAPSULAR LIGAMENTS***

1. Interosseous - Holds together the transverse arch of the middle five tarsals.
2. Talonavicular - Connects neck of talus to the dorsal surface of the navicular bone.
3. Calcaneocuboid - A group that connects the dorsal and plantar surfaces of the calcaneus, cuboid, and metatarsals.
4. Calcaneonavicular - (Spring Ligament) A bifurcated band that ties the calcaneus to the navicular bone.

FUNCTION OF THE MIDFOOT:

It allows accommodation to the uneven surfaces upon which man walks, and gives support while standing.

ADJUSTMENTS OF MID-TARSAL JOINTS:

The navicular and cuboid shapes determine the direction of traction when setting them up for the adjustment.

* *These adjustments are also what is used for the cuneiforms and the proximal metatarsal bases.*

SIGNS

- The bone involved is surrounded by painful joints
- Weakness of muscles inserting into subluxated mid tarsal bones
- Muscles will test strong if plastic deformation occurred
- A lump (if anterior)
- Indented (if posterior)
- Fixated upon shear stress
- Hypermobile upon shear stress

DIFFERENTIAL DIAGNOSIS

1. Tendon ruptures
2. Avulsion fractures
3. Congenital anomalies

MIDTARSAL ADJUSTMENTS

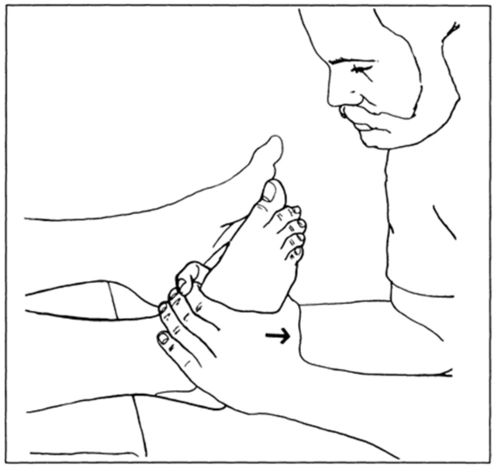
NAVICULAR ANTERIOR:

SIGNS

X-rays demonstrate a raise of 2mm or greater from the anterior talus head. Fixated or hypermobile with the talus and pain between the two bones to palpation. Weakness of the posterior tibial muscle.

IMPACT OF INJURY

Getting stepped on by human or animal. Kicking a hard object. Poor supporting shoes.



STABILIZATION

Grasping over fingers of contact hand on opposite side of foot.

CONTACT & THRUST

Place middle finger over the navicular, and your thumb on the ball of the foot. Press the foot down, so that the leg presses into the table before thrusting, then pull quickly inferior.

The purpose of pressing the leg into the table is to isolate the joint from yanking on the knee and hip as much as possible.

POST CHECKS

Restored motion if it was fixated, with reduction of palpatory pain at the talonavicular joint. A strong posterior tibial muscle.

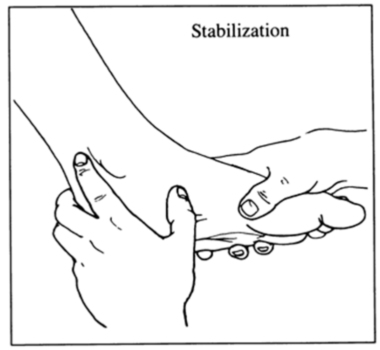
NAVICULAR MEDIAL:

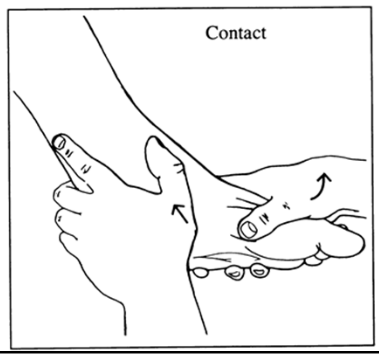
SIGNS

A more prominent medial and sore navicular bone. Weak posterior tibial muscle.

IMPACT OF INJURY

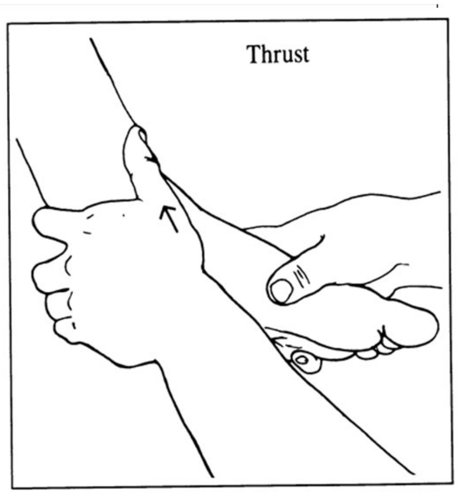
Excess foot pronation or forefoot abductus from medial to lateral foot trauma.





STABILIZATION

Grasping forefoot with lateral hand and tractioning inferiorly and laterally.



CONTACT & THRUST

With thenar eminence, contact the medial navicular with your fingers around the head of the calcaneus. Thrust superiorly so that your thumb slides up the anterior tibia while flexing the forefoot laterally.

POST CHECKS

A less prominent and better feeling medial navicular. Strong posterior tibial muscle.

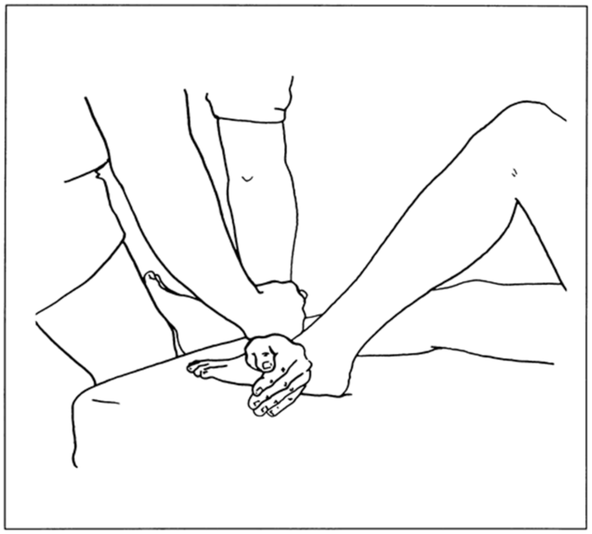
CUBOID ANTERIOR:

SIGNS

Fixated or hypermobile cuboid with pain at its articular surfaces, creating a lump on top of the foot. Weak peroneus muscle.

IMPACT OF INJURY

Stepping on the sharp edge of a board or a rock.



STABILIZATION

Grasping wrist of contact hand.

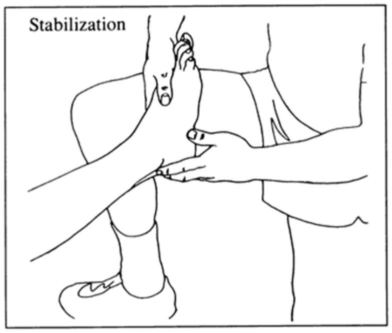
CONTACT & THRUST

A pisiform contact on top of the cuboid with a toggle recoil thrust.

POST CHECKS

Normal motion with a reduced lump and pain. Strong peroneus muscle.

CUBOID LATERAL:



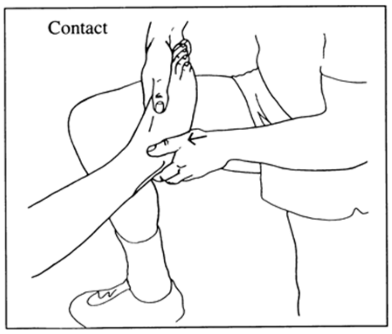
This adjustment is easier to perform if you utilize the wedge shape of the cuboid and flex the rearfoot and forefoot laterally toward the cuboid.

SIGNS

Painful adjacent joints with no obvious lump or indentation. Weak peroneus muscle.

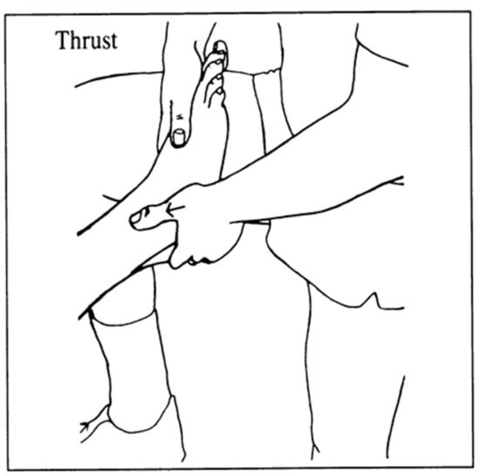
IMPACT OF INJURY

Forefoot stepped on from lateral side. Side kick in karate.



STABILIZATION

Grasping forefoot with medial hand and tractioning.



CONTACT & THRUST

With your thenar eminence contact the lateral cuboid with your fingers around the calcaneus. Thrust superiorly so that your thumb glides along the anterior fibula while flexing the forefoot laterally.

POST CHECKS

Reduced pain of adjacent joint spaces with normal motion. Strong peroneus muscle.

POSTERIOR TARSAL

This is by far the most frequent midfoot subluxation. During walking the forces into your foot are 1 to 3 times your body weight. During running, the forces are from 3 to 5 times your body weight. During vertical leap sports such as volleyball or basketball the forces can reach levels of 5 to 7 times your body weight.

Now what are the chances of you getting your feet stepped on in athletic competition? What kind of force is going into your foot when it is stepped on? Do you think that maybe someone should know how to correct foot subluxations that are being created by these forces?

Learning the following adjustment will be a big step toward helping these people.

POSTERIOR MIDTARSALS AND METATARSAL BASES:

SIGNS

On X-ray, a 2mm or greater drop from the more proximal segment. A palpable stair stepping down from the proximal segment with pain at that joint to palpation. Fixation or hypermobility on shear stress motion. A weak posterior tibial muscle.

IMPACT OF INJURY

Getting stepped on by man or beast. Kicking hard objects. Poor tarsal arch support in shoe.

STABILIZATION

With the patient prone, you grasp the opposite side of the forefoot from the contact hand and place your thumb or pisiform directly over the contact thumb.

CONTACT & THRUST

Place your thumb on the sole of the foot under the bone that is posterior. Grasp the forefoot with your fingers then add the stabilization hand. Traction the foot down into the table so that the forefoot is being pulled away from the hind foot, then thrust anteriorly with your thumbs and or pisiform.

POST CHECKS

A more even joint alignment with better motion and less pain. A strong posterior tibial muscle.

FOREFOOT/ANTERIOR FOOT, MEDIAL AND LATERAL (1,p.12-15; 2,p.46-54; 6,p.461-471)

STRUCTURE

The phalanges and their function of flexion and extension are extensions of the mechanics of these articulations, but will not be described in this section.

MEDIAL FOREFOOT:

1st Metatarsal: The thickest and shortest metatarsal, but third in length in terms of forward projection.

The proximal base is kidney shaped, allowing dorsi and plantar flexion including rotation about an arc around the base of the second metatarsal.

Attaching to the plantar surface are the anterior tibial and peroneus longus tendons.

Two accessory bones act as a fulcrum on the plantar surface of the head for the tendons of the flexor hallucis brevis and they bear body weight. It is this fulcrum that allows the windlass effect to supinate the foot.

2nd Metatarsal: The longest metatarsal which protrudes the farthest. Because of its length it bears weight readily.

3rd Metatarsal: The second longest metatarsal in forward projection.

LATERAL FOREFOOT:

4th Metatarsal: The fourth longest metatarsal in projection.

5th Metatarsal: The shortest in projection, but has ample motion about a triplane axis in directions of supination and pronation and probably is third in weight bearing.

LIGAMENTS:

These hold the forefoot and midfoot together, allowing gliding of the articular surfaces when the forefoot is under load.

Tarsometatarsal Ligaments: These are between the tarsals and metatarsals, and they are named after their position (eg. plantar, dorsal) and the bones they attach to.

Metatarsal Ligaments: The dorsal, plantar, and interosseous ligaments go between the adjacent metatarsal bones and non-adjacent bones.

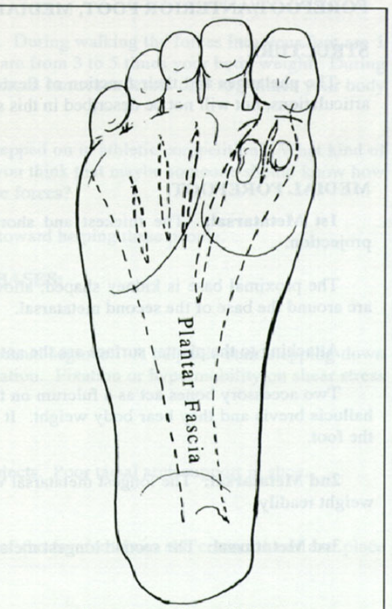
FUNCTION OF THE METATARSALS:

They allow gliding of articular surfaces through pronation and supination, locking the tarsals when they are in full pronation and assisting the supination process as a fulcrum for the plantar fascia.

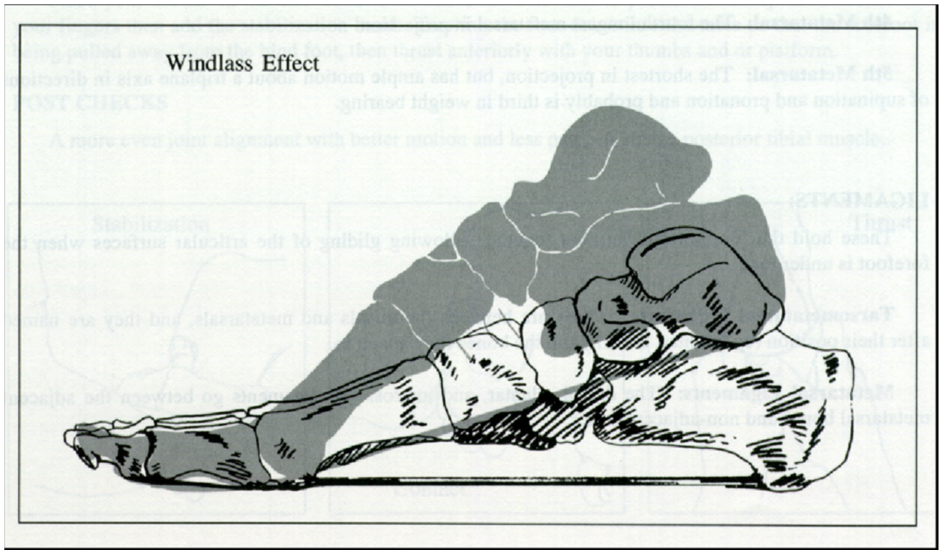
You just read a very profound statement that I am afraid you may pass by too quickly, without some contemplation about how it relates to the illustrations on this page.

Consider the fulcrum at the ball of the foot and how the toes would draw tight the plantar fascia as they dorsiflex in relation to the metatarsal heads. This would shorten the foot's length by drawing the heel toward the metatarsal heads.

Imagine how this motion would change due to fixation or hypermobility of the metatarsal shafts at either end.

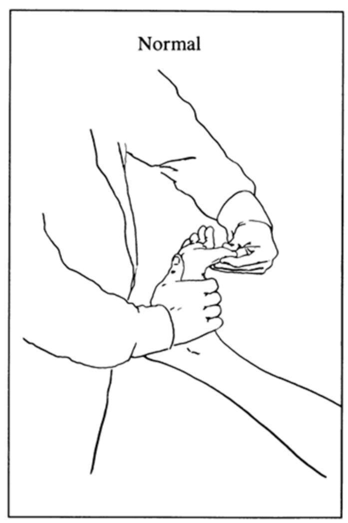


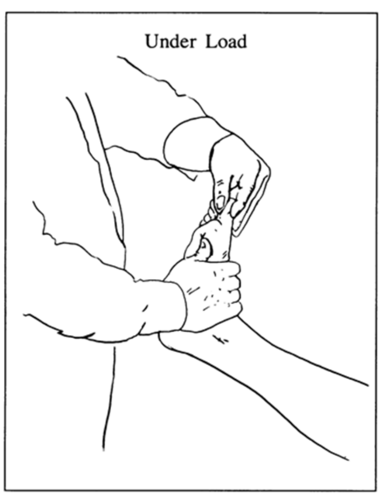
Accessory Bone Fulcrum



FUNCTIONAL HALLUX LIMITUS (F.H.L.): (20,p 12-14; 21,p 650; 22,p 54)

The normal big toe can dorsiflex, when not under load, from 70 to 90 degrees. When it is loaded with weight in the pronated position, this can drastically change with many individuals. The big toe may lock at 20 degrees of dorsiflexion effectively blocking normal supination and the windlass effect. If the first ray is allowed to plantar flex at

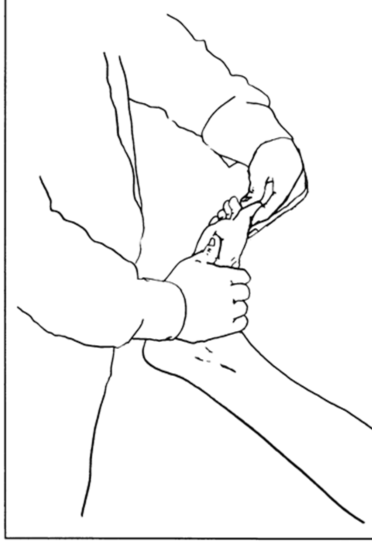




this point, it usually allows further dorsiflexion of the big toe and enhances supination and the windlass effect. But due to the design of most shoes and foot orthotics, this does not happen. Therefore, functional hallux limitus can be defined as the functional inability of the proximal phalanx of the hallux to extend on the first metatarsal head when under load.

To test this place your thumb under the first ray just proximal to the sesamoid bones. Press the first ray into dorsiflexion. Now dorsiflex the big toe and observe at what angle it begins to force your thumb down, that is under the first ray. This is the moment that F.H.L. begins.

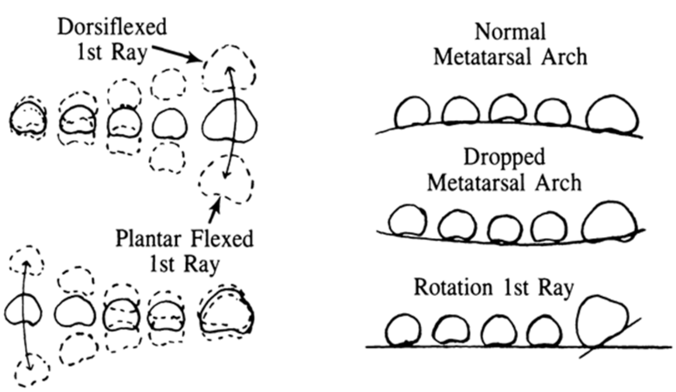
F.H.L. Begins

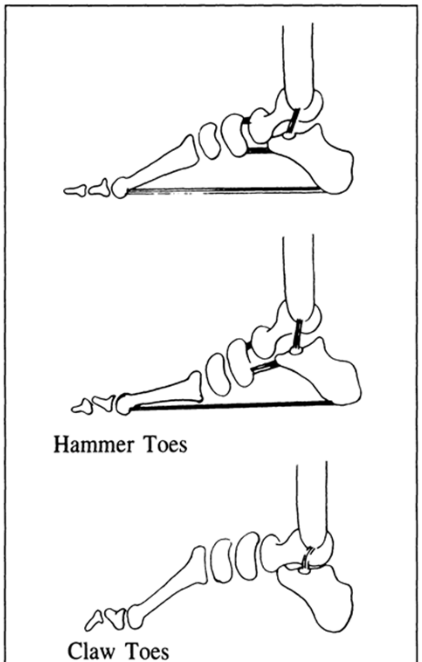


ADJUSTMENTS OF FOREFOOT:

The metatarsals and phalanges get a lot of forces that can rotate them as well as subluxate them anterior or posterior, such as getting stepped on, or kicking something, or simply stepping on a rock. Because the adjustments for anterior and posterior are the same as the previous tarsals, I will only describe the rotational maneuvers for the proximal metatarsals. The distal metatarsals and phalanges will be given their normal description.

Forefoot Range of Motion





SIGNS OF METATARSAL SUBLUXATION:

1. Pain at metatarsal base
2. Toe nail turned medial or lateral
3. Hallux valgus
4. Thick yellow toe nail from lack of trophic supply
5. Pinch callus
6. Flat metatarsal arch
7. Mallet toes, Hammer toes or Claw toes
8. Less than 10 mm dorsiflexion of the 1st ray M.T.P. relative to the 2nd ray M.T.P. joint
9. Inability of the 1st ray M.T.P. to plantar flex so it is even with the 2nd ray M.T.P. joint

DIFFERENTIAL DIAGNOSIS: ***RULE THESE OUT***

1. Hallux limitus
2. Bunion
3. Forefoot valgus or varus
4. Wart
5. Morton's neuroma
6. Functional hallux limitus
7. Plantar flexed 1st ray
8. Dorsiflexed 1st ray

METATARSAL ROTATION:

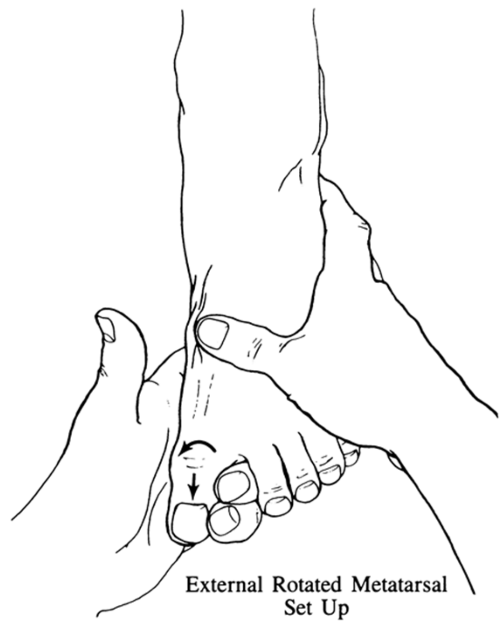
SIGNS

Rotated toe nail. Sore metatarsal base and interossei muscles on each side. Thick yellow toe nail.

IMPACT OF INJURY

Forefoot getting stepped on with momentum in transverse plane.

Toe nail turned Medial or Lateral
Hallux Valgus



External Rotated Metatarsal
Set Up

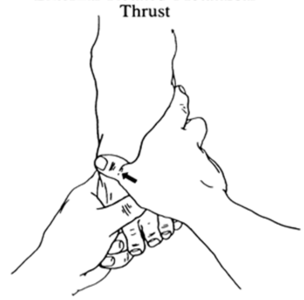
STABILIZATION

Grasping the distal metatarsal and phalanges while tractioning and rotating it in the direction of normal position.

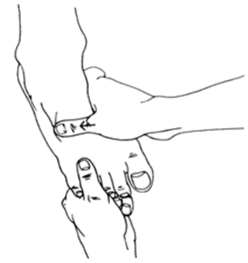
CONTACT & THRUST

Place your thumb on the proximal metatarsal base so that it pushes into the same side that the toe nail has turned toward. This will cause it to de-rotate. The fingers of this hand may squeeze the bottom of the foot to increase thumb pressure.

External Rotated Metatarsal
Thrust



Internal Rotated Metatarsal



POST CHECKS

Toe nail is level with the other toe nails now and interossei muscles feel much less painful along with the joint.

This adjustment has accomplished some wonderful things in the feet of my patients. Following this adjustment, some of my patients have noticed that their toe nail, that was thick and yellow with a fungus, has grown out to be a normal toe nail over the next six to nine months. I attribute this to the increased trophic supply to the nail bed by releasing the compression of the interosseous muscles. These patients had unsuccessfully tried the standard remedies, short of surgery, for this condition previously.

The other wonderful things this adjustment helps with when combined with correction of the cuneiforms and navicular, is that first rays that were stuck in plantar flexion or dorsiflexion, usually get their normal motions back. This is extremely useful when determining functional problems from congenital problems. I like to do this before I determine the degree of big toe dorsiflexion when checking for *functional hallux limitus*.

DROPPED METATARSAL ARCH:

This adjustment is identical to the orthopedic test called Strunsky's Sign. If lancinating pain occurs while performing this at the metatarsal phalangeal joints, it is indicative of metatarsalgia. This is a result of a dropped metatarsal arch.

SIGNS

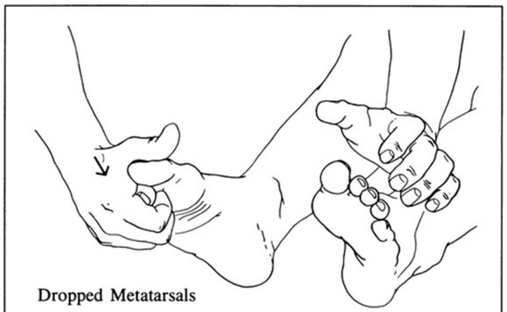
Calluses only under the middle metatarsal heads. A positive Strunsky's Sign. Hammer or claw toes.

IMPACT OF INJURY

This follows a dropped tarsal arch from getting stepped on and results in uneven loading, due to multiple subluxations of the foot.

STABILIZATION

The distal finger tips press against the plantar 2-5 metatarsal heads.



Dropped Metatarsals

CONTACT & THRUST

The base of the palm contacts the proximal dorsal 2-5 toes, while the fingers surround the distal toes and stabilizes against the ball of the foot. The thrust is given with a sudden palmar flexion of the wrist. Singularly this can be done by isolating one toe with the thumb and finger.

POST CHECK

Following a series of at least five adjustments over a two week period or more, Strunsky's Sign should be negative or much reduced. Toe flexibility should increase.

If it is painful the first time you perform this adjustment, I have found that by the fifth adjustment the majority of patients do not mind having it done. In fact, most people say that walking is much easier afterward and they like how their feet are now feeling.

PHALANGES:

SIGNS

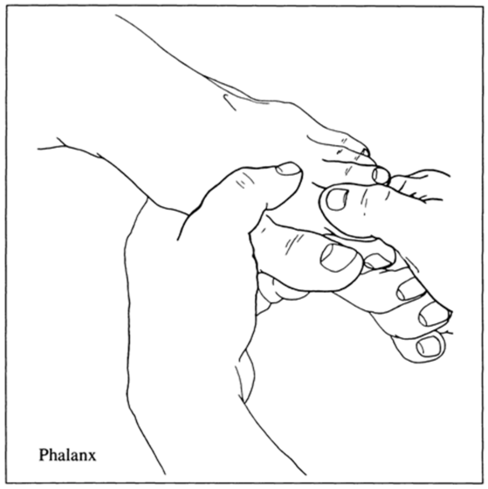
Fixation or hypermobility of the toes. Claw or hammer toes. Pain in the toe.

IMPACT OF INJURY

Getting stepped on, or short shoes that may be pointed.

STABILIZATION

Grasp the proximal bone of the joint being adjusted.



CONTACT & THRUST

While moving the distal phalanx through a circular motion, a fixation will be felt. At this time a gentle thrust is made into the fixation.

POST CHECK

Normal motion and reduced pain.

Remember that *energy goes where energy flows*, and callouses and bunions are an example of energy flowing and rubbing at these sites. Also remember that *energy stops where energy flops*, and baby soft skin where you would expect pressure to be applied is a sign of non-weight bearing.

You have just learned how to correct foot subluxations, which tremendously helps foot mechanics. However, if the foots structure, when totally corrected, is still not within normal ranges of motion to the ground and leg, it will probably benefit from a foot orthotic. The amount of benefit will depend upon your quality of examination findings and the ability of you or the lab to interpret those findings and make an optimal foot orthotic.

That orthotic should go into a quality shoe that has a firm heel counter that will support the calcaneus. The mid sole of the shoe should be supportive with most of the flexion occuring at the location of the metatarsal heads. The mid foot should feel support on each side, while the metatarsal heads and toes should have a roomy toe box.

HOW TO CHOOSE AN ATHLETIC SHOE

As Andy Rooney might say, "Did you ever wonder why ads for shoes all sound like they will support better than any other shoe," or "Did you ever notice how certain the shoe salesman is that this pair is for you." With feet so very different between individuals, there is no one shoe that is correct for everyone.

A simple procedure that has worked well for years with my patients is this: when you try on athletic shoes, put a different brand or style on each foot, then run, cut, jump, accelerate and stop through the store, on both carpet and a hard floor. When you return, there will usually be no question as to which shoe feels the best. Keep the shoe on that feels the best, and return the shoe with poor performance. Put another brand of shoe on the empty foot. Go through the store again, testing their performance. Once again it will be quite obvious which shoe does the job, and return the poor performer. Keep doing this through at least five to six pairs of shoes, always keeping on the best performing shoe. If you have narrowed it down to two styles of shoes, put one style on both feet now and go through the performance course. Your decision at this point will be much better for you and your feet in the long run!

In good health,

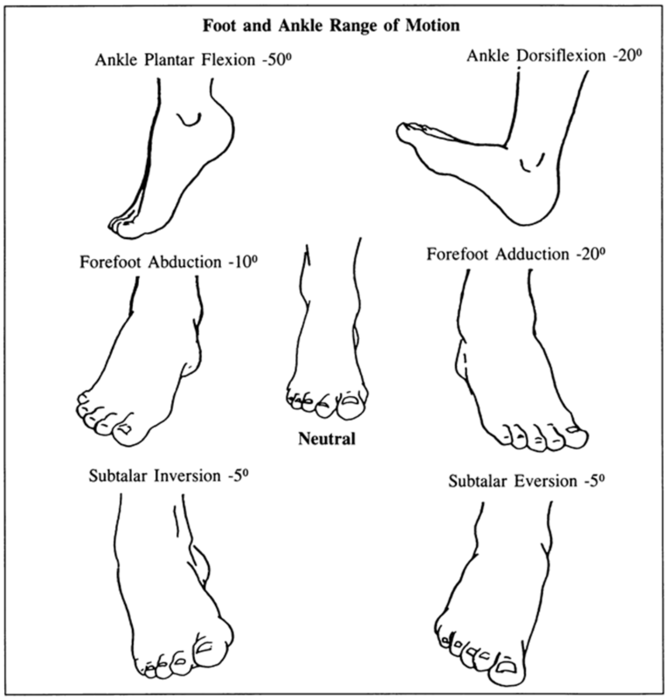
Dr. Kevin Hearon

FOOT AND ANKLE RANGE OF MOTION (8,p.223-225)

A. Ankle plantar flexion - 50 degrees
B. Ankle dorsi flexion - 20 degrees
C. Forefoot adduction / internal rotation - 20 degrees
D. Forefoot abduction / external rotation - 10 degrees
E. Subtalar inversion - 5 degrees
F. Subtalar eversion - 5 degrees

FIRST METATARSOPHALANGEAL JOINT (8,p.226)

A. Flexion - 45 degrees
B. Extension - 70 to 90 degrees



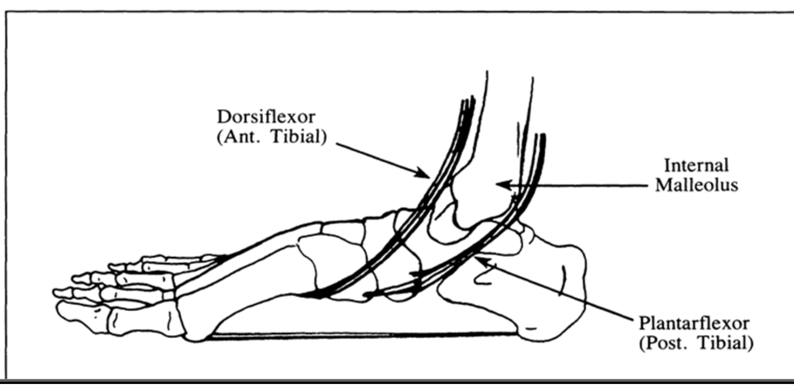
THE MAJOR MUSCLES OF MOTION OF THE FOOT
(3,p.52-65; 4,p.88-111; 6,p.571-575; 8,p.227-229;11,p.74-93)

Rehabilitative exercises are based upon a knowledge of these and other muscles and their function. Refer to this section when you want a motion strengthened in the foot and ankle.

THESE FALL INTO FOUR MAIN CATEGORIES:

1. Dorsiflexors - tendons go in front of the malleoli
2. Plantar flexors - tendons go behind the malleoli
3. Toe abduction
4. Toe adduction

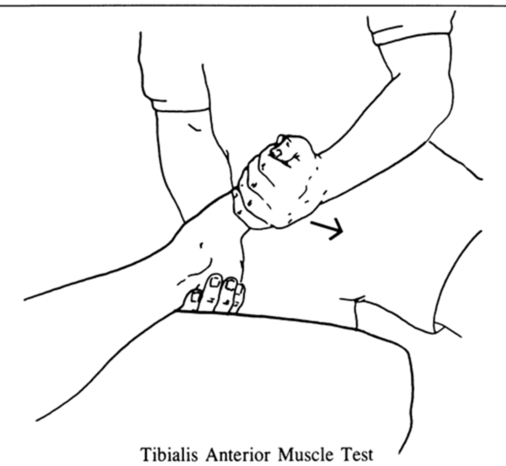
Many of these muscles have the additional function of performing inversion or eversion.



Dorsiflexors (20 degrees)

1. Tibialis anterior - deep peroneal nerve, L4, (L5).

Origin - tibial lateral condyle and proximal 2/3 of anterolateral shaft, and also the interosseous membrane.
Insertion - tendon travels in front of the talus to the medial and inferior surfaces of 1st cuneiform, and base of the 1st metatarsal.
Muscle test - dorsiflex and invert the foot.



Tibialis Anterior Muscle Test

2. Extensor hallucis longus - deep peroneal nerve, L5.

Origin - mid shaft of the fibula.
Insertion - dorsal surface of the distal phalanx of the big toe.
Muscle test - dorsi flexion of the big toe. Resistance should be applied distal to the interphalangeal joint.

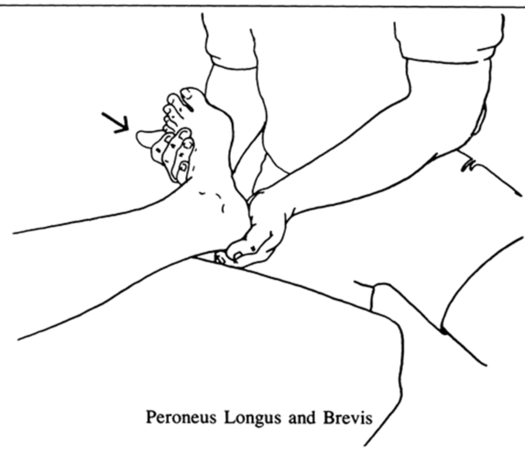
3. Extensor digitorum longus - deep peroneal nerve, L5.

Origin - lateral condyle of the tibia, and the proximal 3/4 of the anterior fibula.
Insertion - tendon passes anterior to the talus to extensor expansions into second and third phalanges of lateral 4 toes.
Muscle test - dorsiflex toes and press your thumb across distal phalanges. This also tests the brevis portion.

Plantar Flexors

1. Peroneus longus and brevis - superficial peroneal nerve, S1.

   Origin - longus - head and proximal 2/3 of lateral surface of fibula.
   brevis - distal 2/3 of lateral fibula.
   Insertion - longus - passes behind lateral malleolus to inferior cuboid and to lateral base of 1st metatarsal and 1st cuneiform.
   brevis - passes behind lateral malleolus to lateral base of 5th metatarsal.
   Muscle test - plantar flex and evert the foot.



Peroneus Longus and Brevis

2. Gastrocnemius and soleus - tibial nerve, S1, S2.

   Origin - gastroc - just above the posterior condyles of the femur.
   soleus - posterior head of the fibula and proximal 1/3 of fibula. Popliteal line and mid 1/3 of medial tibia.
   Insertion - gastroc - Achilles tendon and calcaneal head.
   soleus - same.
   Muscle test - walk on toes, or hop on one leg while staying on the ball of the foot.

3. Flexor hallucis longus - tibial nerve, L5.

Origin - distal 2/3 of posterior fibula and lower part of interosseous membrane.
Insertion - tendon travels under medial malleolus to plantar base of distal phalanx of big toe.
Muscle test - have patient bend or curl the big toe down.

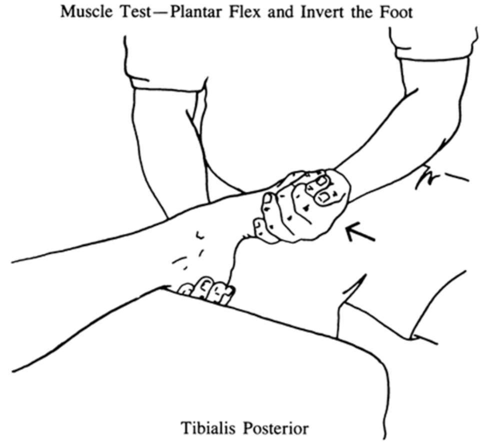
4. Flexor digitorum longus - tibial nerve, L5.

Origin - posterior body of tibia from below the popliteal line to within 7 or 8 cm. of lower end of shaft of tibia.
Insertion - tendon travels under medial malleolus to bases of distal phalanges of lateral 4 toes.
Muscle test - have the patient bend or curl their toes down.

5. Tibialis posterior - tibial nerve, L5.

Origin - proximal 2/3 of medial fibula and postero-lateral tibia and interosseous membrane.
Insertion - tendon passes under the medial malleolus to the navicular bone and sends fibrous expansions to the sustentaculum tali, the 3 cuneiforms, cuboid, and bases of 2., 3. and 4. metatarsal bones.
Muscle test - plantar flex and invert the foot.

Muscle Test—Plantar Flex and Invert the Foot



Tibialis Posterior

Toe Abduction - 0 To 15-20 Degrees

1. Abductor hallucis - medial plantar nerve, S2, S3. This is often atrophied in people, which allows the valgus big toe to develop.

   Origin - medial tuberosity of calcaneus.
   Insertion - medial side of base of 1st phalanx of the hallux (big toe).
   Muscle test - patient abducts toes and resistance is given from the side of the toe.

Abductor Hallux Valgus

2. Abductor digiti quinti - lateral plantar nerve, S2, S3.

   Origin - lateral tuberosity of calcaneus and the inferior surface of the calcaneus.
   Insertion - lateral side at base of proximal phalanx of fifth toe.
   Muscle test - patient abducts toes and resistance is given from the lateral side of the fifth toe (little toe).

Toe Adduction - 15-20 To 0 Degrees

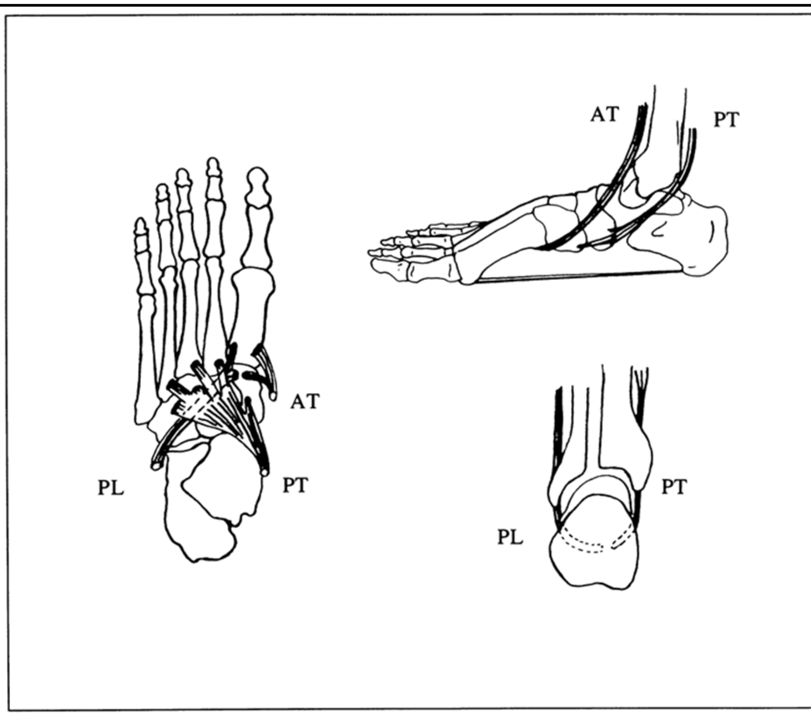
1. Adductor hallucis - lateral plantar nerve, S2, S3.

   Oblique head
   Origin - base of 2, 3, 4th metatarsals, and sheath of peroneus longus muscle.
   Insertion - lateral side of the base of the proximal phalanx of the big toe.

   Transverse head
   Origin - plantar metatarsophalangeal ligament of 3, 4, th toes.
   Insertion - same as above.
   Muscle test - pull 3, 4, 5th toes apart from hallux.

2. Plantar interossei - lateral plantar nerve, S2, S3.

   Origin - base and medial side of shaft of 3, 4, 5th metatarsal bones.
   Insertion - medial base of proximal phalanx of corresponding toes, and aponeurosis of tendons of extensor digitorum longus.
   Muscle test - pull 3, 4, 5th toes apart from hallux.



Utilization of these muscle tests can enhance your diagnostic ability of the feet and spine. The nerves supplying each muscle is listed for easy reference back to the spinal nerve root. Given that the spine is not involved, nerve entrapments along the course of the nerve should be ruled out. Should the nerve show normal function through the foot, I would then suspect a local condition of the foot.

This is where we as chiropractors diverge from all other health care practitioners. Structure can be restored to its normal position most of the time. Our job, should we decide to accept it, is to find the subluxations of the feet and adjust them if they are fixated, and stabilize them if they are hypermobile.

The muscle tests will be inhibited if there is stretch in the capsule, ligaments or tendons of the joint adjacent to where they attach. This leads to loss of strength, function and abnormal joint mechanics.

An interesting thing about the feet is that most people abuse them tremendously and go long periods before seeking professional care. When this goes on for months or years, plastic deformation can occur in the joint capsule, ligaments and tendons which elongates them. They now no longer activate the inhibition response of adjacent muscular activity due to a loss of stretch. But because of the structural subluxation, lever advantage is usually lost and therefore normal function does not return until the joint subluxation is corrected.

Due to long standing (excuse the pun) problems of the feet, I usually recommend foot orthotics for my patients after I have corrected their foot subluxations. The feet frequently need to be supported in their normal position so the muscles and proprioception can adapt to more efficient joint mechanics.

There are two main reasons for casting and ordering foot orthotics after you have adjusted the feet.

1. The angles of varus, valgus, equinus, etc. will often change following the adjustment.
2. The more correct the orthotic is made to the patients true neutral position, the better chance of acceptance and excellent results for the patient.

THE END of this SECTION