

HUMAN FUNCTIONAL ANATOMY 213 THE ANKLE AND FOOT IN LOCOMOTION

JOINTS OF THE FOOT

THIS WEEKS LAB:

Forearm and hand

READINGS

The leg and sole of foot

1. Stern – Core concepts – sections 99, 100 and 101 (plus appendices)
2. Faiz and Moffat – Anatomy at a Glance – Sections 50 and 51
3. Grants Method:- The bones and sole of foot & Joints of the lower limb

or any other regional textbook - similar sections

IN THIS LECTURE I WILL COVER:

Joints related to the talus

- Ankle
- Subtalar
- Talocalcaneonavicular
- Transverse tarsal

Other tarsal joints

Toe joints

Ligaments of the foot

Arches of the foot

Movements of the foot & Compartments of the leg

The ankle in Locomotion

Ankle limps

1. Flexor limp
2. Extensor limp

THE HINDFOOT -(JOINTS OF THE TALUS)

TROCHLEAR

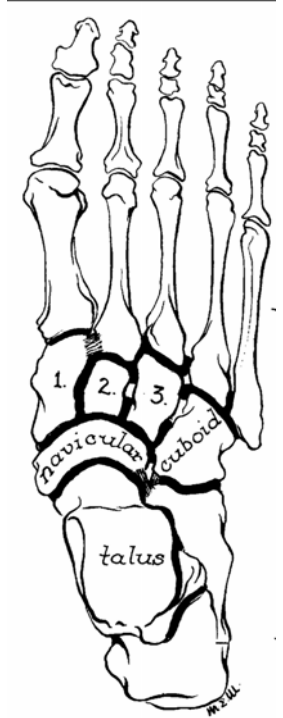
The ankle, and distal tibiofibular joints

BODY

Subtalar joint (Posterior talocalcaneal)

HEAD

Talocalcaneonavicular
& Transverse tarsal joints



THE MID FOOT

THE FOREFOOT

METATARSAL AND PHALANGEAL JOINTS (same as in the hand)

Except 1st metatarsal and Hallux

No saddle joint at base is 1st metatarsal

Metatarsal head is bound by deep

transverse metatarsal ligament

Toes are like fingers

Same joints, Lumbricals, Interossei, Extensor expansion

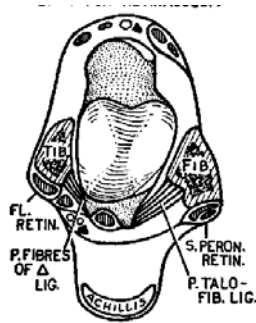
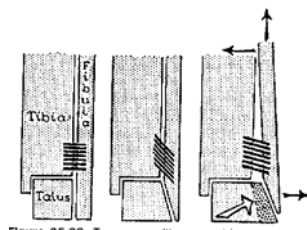
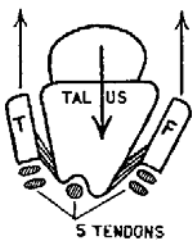
Axis of foot (for abduction-adduction) is the 2nd toe.

JOINTS OF THE FOOT

DISTAL TIBIOFIBULAR

Syndesmosis (fibrous joint like interosseous membrane)

Fibres arranged to allow a little movement



THE ANKLE (talocrural) JOINT

Allows flexion and extension only

Synovial "mortice" joint

Trochlear of the talus fits between the malleoli

Lateral malleolus lower than medial

Trochlear is slightly wedged so that the joint is tighter in extension

Skiing injury (foot dorsiflexed) spiral fracture of the fibula

JOINTS OF THE FOOT (2 joints that allow inversion and eversion)

SUBTALAR (Posterior talocalcaneal) JOINT

Two (or three) talocalcaneal joints

Posterior is subtalar

Anterior (and middle) is part of the talocalcaneonavicular.

With a strong interosseus ligament running between them (tarsal sinus)

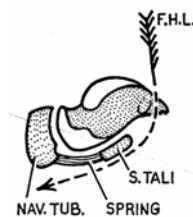
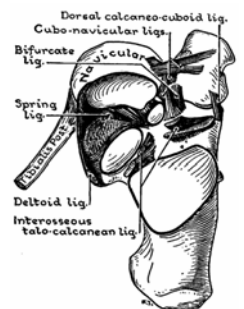
THE TALOCALCANEONAVICULAR JOINT

The head of the talus fits into a socket formed from the:

The anterior talocalcaneal facets.

The spring ligament.

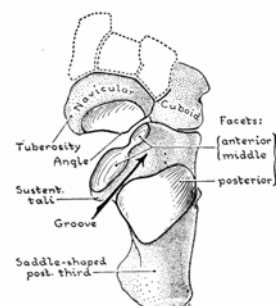
The socket of the navicular.



Inversion and eversion below the talus (subtalar and talocalcaneonavicular)

Axis of motion runs below the subtalar, and above the talocalcaneonavicular joints (upwards, forwards, medially)

Inversion (abduction & "supination") – Eversion (adduction and "pronation")

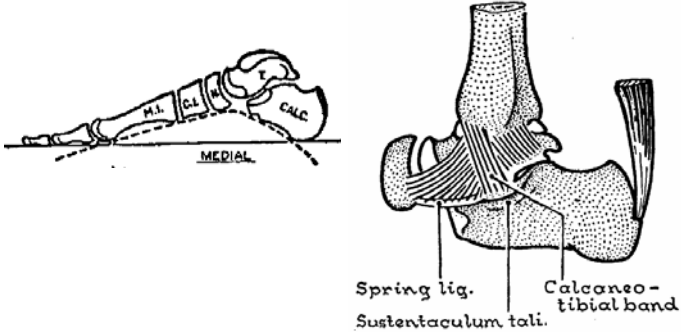


LIGAMENTS OF THE FOOT

Many ligaments are associated with more than one joint

SPRING LIGAMENT (Plantar calcaneonavicular ligament)

Stretches between the sustentaculum tali of the calcaneus to the navicula
It completes the socket of the talocalcaneonavicular ligament
It supports the head of the talus. (arches of the foot)



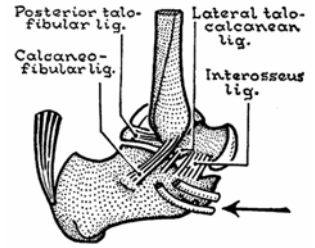
DELTOID LIGAMENT (from medial malleolus)

1. Tibiotalar (to posterior part of the talus)
2. Tibiocalcaneal (to sustentaculum tali of calcaneus)
3. "Tibio-spring ligament"
4. Tibionavicular

LIGAMENTS OF THE FOOT (continued)

THREE LATERAL LIGAMENTS (from lateral malleolus)

1. Posterior talofibular
2. Calcaneofibular
3. Anterior talofibular

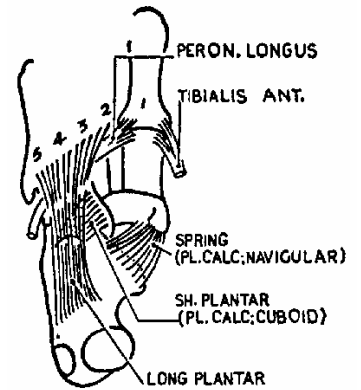


SHORT PLANTAR LIGAMENT (plantar calcaneocuboid)

From the calcaneus to the cuboid
Does not cross the groove for the peroneus longus tendon

LONG PLANTAR LIGAMENT (plantar calcaneometatarsal)

From the calcaneus
To the cuboid and the bases of the metatarsals (distal to the groove for peroneus longus)
Converts the groove for the peroneus longus tendon into a tunnel



ARCHES OF THE FOOT

Arches are really springs - They absorb shock = Store energy
Kinetic energy of the foot is lost/stored in the support phase.
This springiness helps the foot conform with the substrate

MECHANISMS OF ARCH SUPPORT

BONES **LIGAMENTS** **MUSCLES**

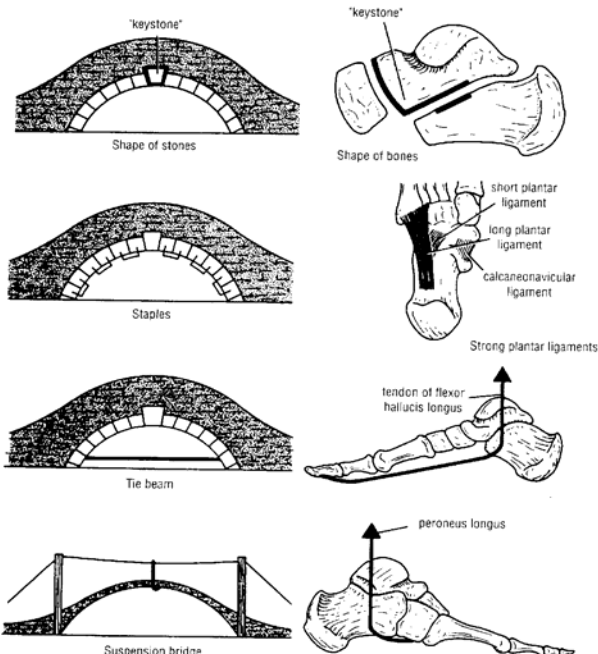
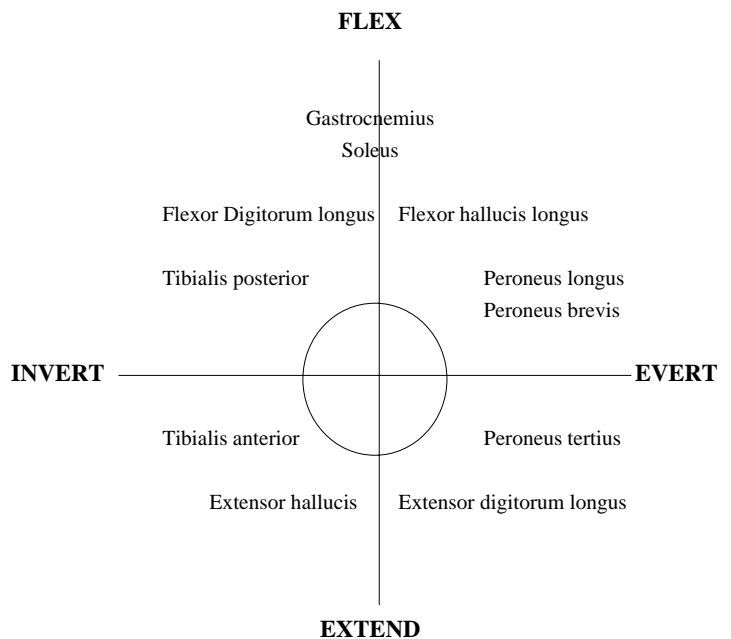
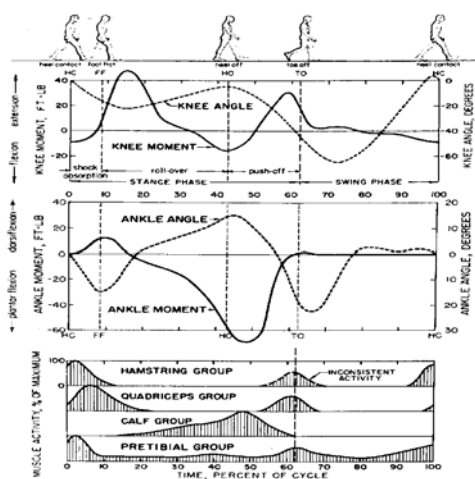


FIGURE 10-54 Different methods by which arches of foot may be supported.

COMPARTMENTS OF THE LEG AND MOVEMENTS OF THE FOOT



ANKLE IN LOCOMOTION - MOVEMENTS



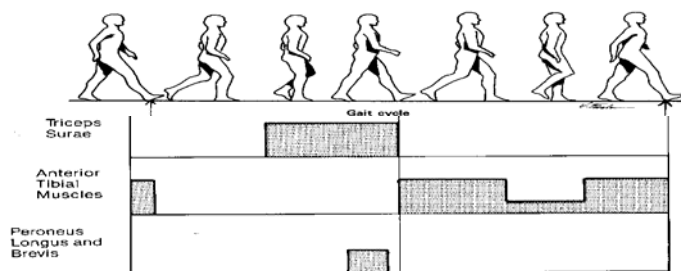
STANCE PHASE

- 1. At Heel strike** (ankle in neutral position)
Ankle flexes (so the toes touch the ground)
- 2. At Foot flat**
Ankle extends (Leg swings forwards over the ankle)
- 3. After heel off**
Ankle flexes (Moving into the power stroke)

SWING PHASE

- 4. After toe off (1st half of swing)**
Ankle extends
- 5. 2nd half of swing** - Ankle in neutral position

ANKLE IN LOCOMOTION - MUSCLES



STANCE PHASE

- 1. At Heel strike**
Ankle flexes (Lowering the forefoot to the ground)
Ground reaction - Anterior tibial muscles active (eccentric)
- 2. At Foot flat**
Ankle extends (trunk and leg move forwards over the foot)
Momentum of the trunk
Calf muscles are active slowing the leg down (eccentric)
(this is what causes the knee to extend)
- 3. After heel off**
Ankle flexes (power stroke)
Calf muscles acting concentrically

SWING PHASE

- 4. After toe off (1st half of swing)**
Ankle extends
Anterior tibial muscles are acting concentrically

ANKLE LIMPS

Ankle extensor Limp

Loss of anterior tibial muscles - Common peroneal nerve lesion

Anterior tibial muscles do two things

- 1. Control foot flexion after heel strike**
This action is against considerable resistance
- 2. Extend the foot so it will clear the ground in swing phase**
This action is not resisted

Ankle extensor limp

- 1. Foot slap - Forefoot hits the ground hard**

With weakness of the anterior tibial muscles

- 2. High stepping gait - to avoid toe drag**

With complete paralysis of anterior tibial muscles

Ankle flexor Limp

Loss of calf muscles - triceps surae - eg. damaged Achilles tendon

Calf muscles do two things

- 1. Control foot extension after foot flat**
- 2. Provide the thrust at toe off**

Ankle flexor limp

Can't control extension/dorsiflexion of foot

CoG must not get in front of the ankle joint

No push off with toes

So the phase between foot flat and toe off is shortened and the foot is lifted off.

or the toes are pointed laterally so the everters do the work of the flexors

SUBTALAR JOINT IN LOCOMOTION

Inversion - eversion

STANCE PHASE

After Heel off - Ankle Everts

- Adding extra thrust
- Ensuring that the hallux is the last toe to leave the ground

Cause Concentric action of the Peroneus longus and brevis

SWING PHASE

Ankle Inverts

Cause Concentric action of the Tibialis anterior (Tibialis anterior is already active extending the foot)

ARCHES OF THE FOOT IN LOCOMOTION

STANCE PHASE

The arches flatten out

Cause: Ground reaction

Resisted by:

- 1. The plantar ligaments**

The stretching of these ligaments stores energy which is released as the foot leaves the ground. (adds spring to your step)

- 2. The intrinsic muscles of the foot (eccentric)**

SWING PHASE

Arches deepen

Cause: elastic recoil of the ligaments