

# Introduction to the Foot and Ankle Joints & Physical Examination, Assessment and Management of the Foot and Ankle

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## Objectives:

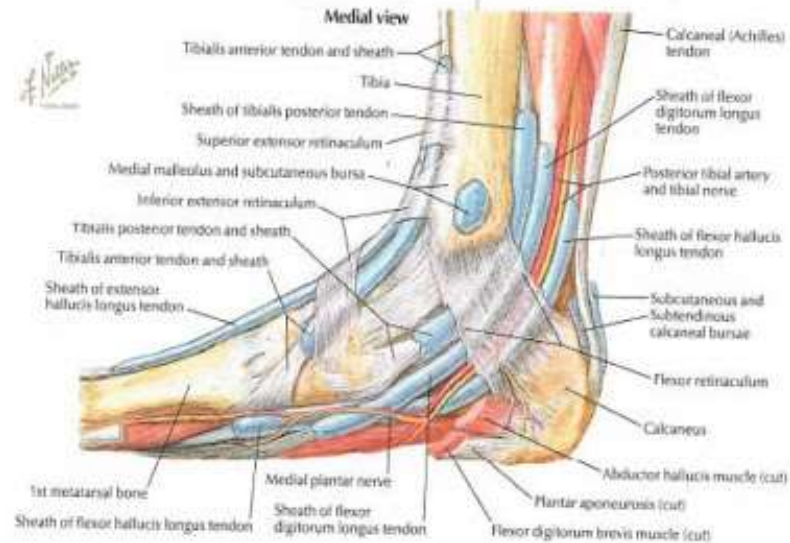
1. Complete a comprehensive physical examination of the foot and ankle.
2. Interpret physical examination findings for common foot and ankle conditions
3. Understand the various conservative management strategies for foot and ankle conditions.

# Anatomy Review

Lateral view

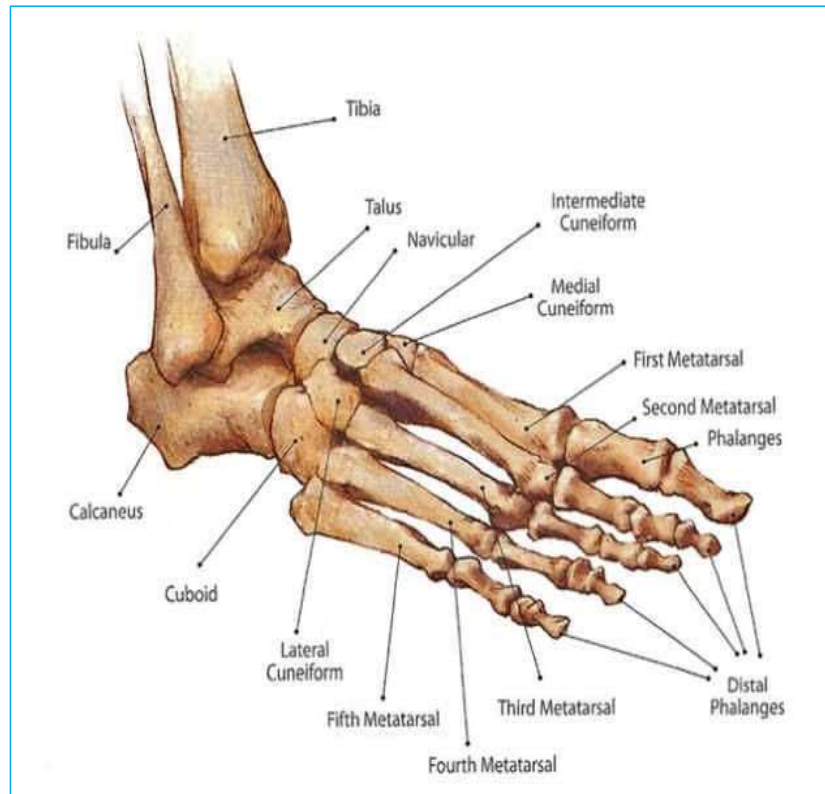


Medial view



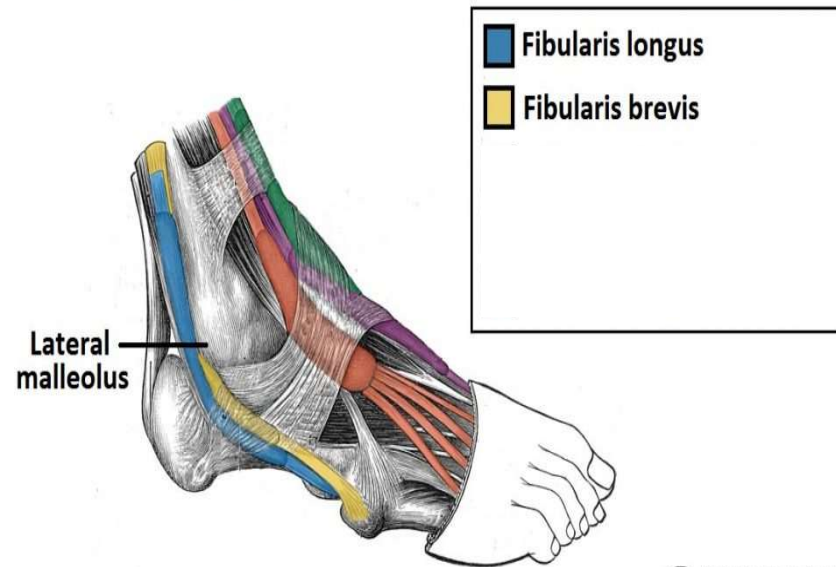
# Anatomy Review: Bones

- Ankle (talocrural joint): tibia, fibula and talus
- Foot: made up of 26 bones. Divided into three areas:
  1. Hindfoot (subtalar joint): talus and calcaneus
  2. Midfoot: navicular, cuboid, cuneiforms
  3. Forefoot: metatarsals and phalanges



# Anatomy Review: Muscles (Lateral Compartment)

- **Peroneals (longus and brevis)**
  - Action: eversion and plantarflexion
  - Origin:
    - Longus: head of fibula and prox. 2/3 of lateral fibula
    - Brevis: distal 2/3 of lateral fibula
  - Insertion:
    - Longus: medial cuneiform and 1<sup>st</sup> MT
    - Brevis: base of 5<sup>th</sup> MT



## Anatomy Review: Medial Compartment

- **Tibialis Posterior:**

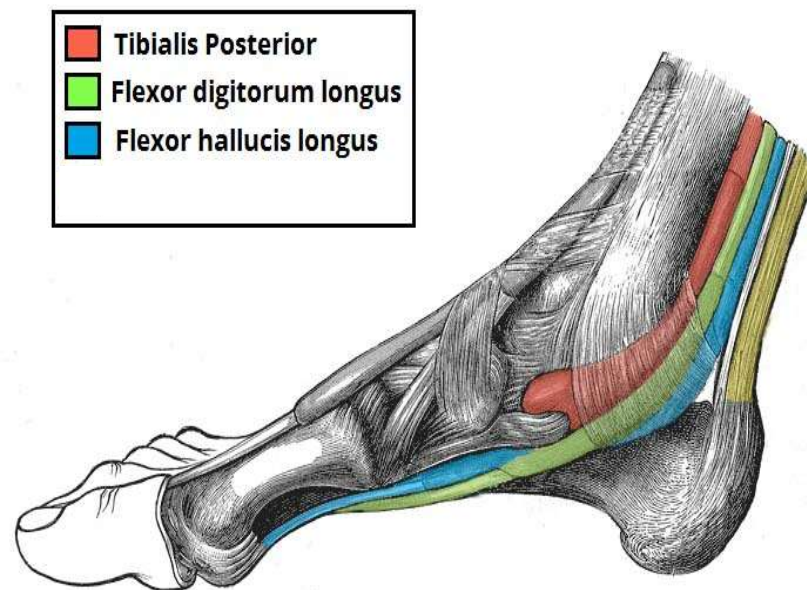
- Action: plantarflexion and inversion; supports the medial arch of foot
- Origin: Tibia and fibula
- Insertion: navicular, medial cuneiform, 2-4 MT

- **Flexor digitorum longus:**

- Action: flexes toes 2-5
- Origin: post. Tibia
- Insertion: base of 2-5<sup>th</sup> distal phalanges

- **Flexor hallucis longus:**

- Action: flexes 1<sup>st</sup> toe
- Origin: post. Fibula
- Insertion: base of distal phalanx of 1<sup>st</sup> toe



# Anatomy Review: Anterior Compartment

- **Tibialis Anterior:**

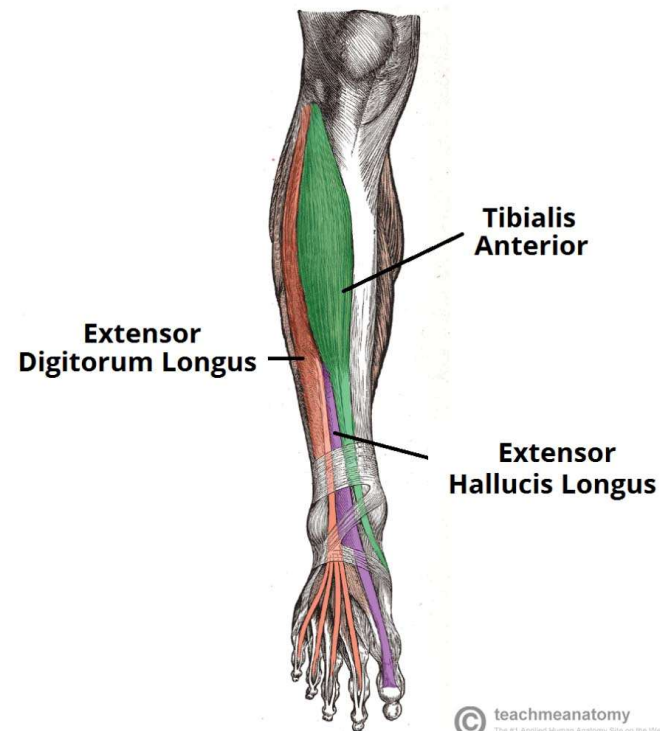
- Action: dorsiflexion and inversion
- Origin: upper lateral surface of tibia
- Insertion: Medial cuneiform and 1<sup>st</sup> MT

- **Extensor digitorum longus:**

- Action: extends toes 2-5
- Origin: lateral surface of tibia, anterior surface of fibula
- Insertion: base of middle and distal phalanx of toes 2-5

- **Extensor hallucis longus:**

- Action: extends the 1<sup>st</sup> toe
- Origin: middle fibula
- Insertion: distal phalanx 1<sup>st</sup> toe



## Anatomy Review: Posterior Compartment

- **Gastrocnemius:**

- Action: plantarflexion (knee flexion\*)
- Origin: medial and lateral condyles of femur
- Insertion: calcaneus (via Achilles tendon)

- **Soleus:**

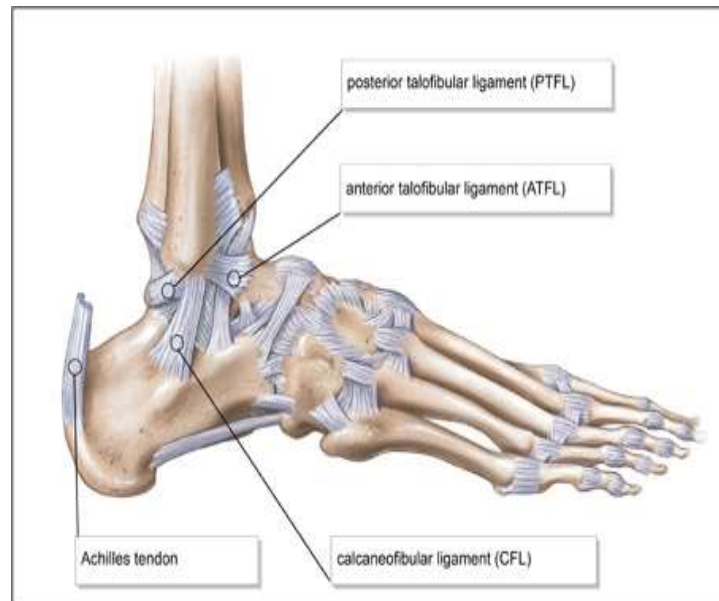
- Action: plantarflexion
- Origin: head of fibula (post. surface)
- Insertion: calcaneus (via Achilles tendon)



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# Anatomy Review: Lateral ligaments

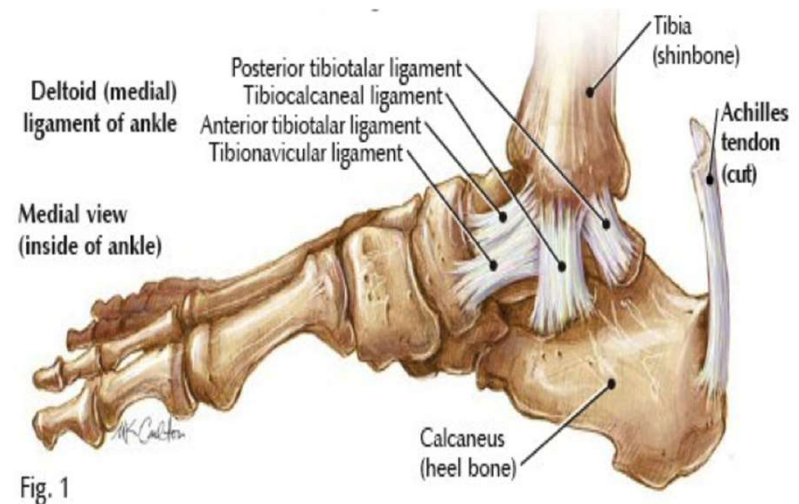
- Three major ligaments:
- **ATFL**: anterior talofibular ligament
- **CFL**: calcaneofibular ligament
- **PTFL**: posterior talofibular ligament
- Weak structure: most common ankle injury
- Injured with PF and INV of ankle
- Various degrees of damage:
  - Grade 1: partial tear ATFL
  - Grade 2: complete ATFL + partial CFL
  - Grade 3: complete rupture ATFL + CFL, +/-PTFL



<https://www.physio-pedia.com/File:Lateral-ankle-ligaments.jpg>

# Anatomy Review: Medial Ligaments

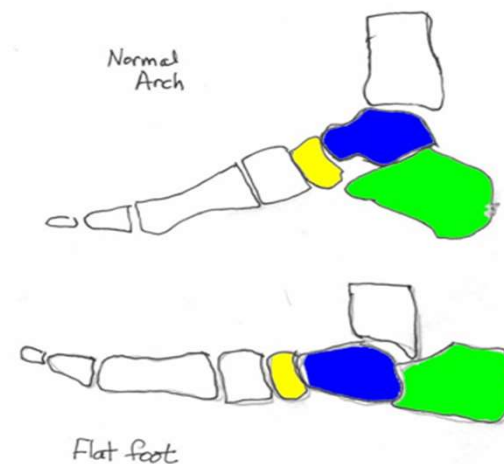
- **Deltoid ligament:**
  - Made up of 4 ligaments
  - Provides stability to the medial side of the ankle
  - Very strong structure and injury is rare
  - Injury caused by severe trauma- eversion of ankle



# Anatomy Review: Medial Ligaments

- **Spring Ligament:**

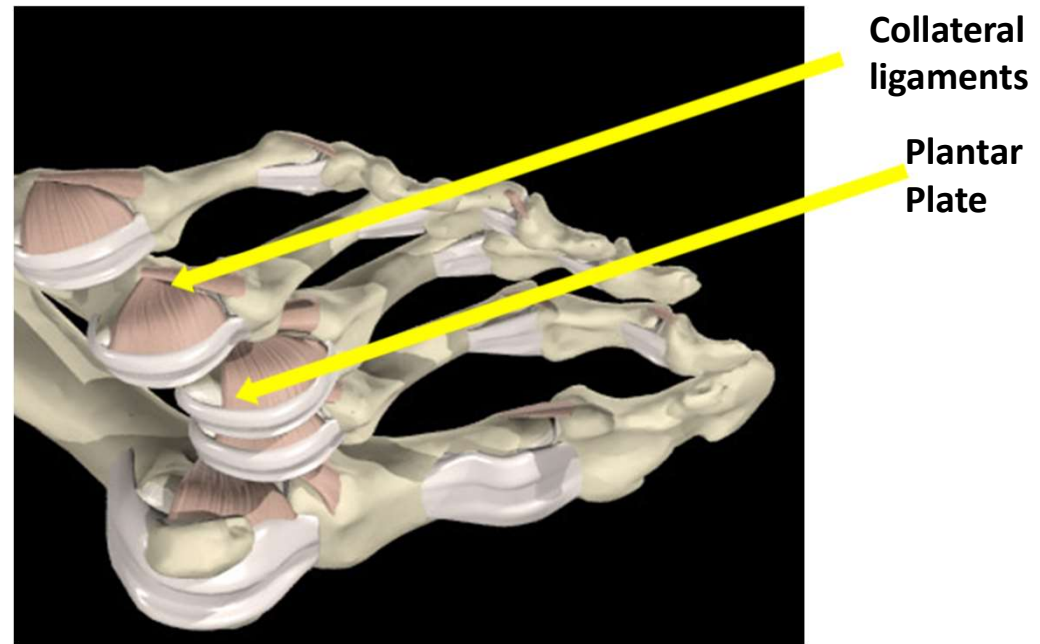
- Made up of 3 ligaments
- Attaches from calcaneus to navicular
- **Function:**
  - Static restraint for medial longitudinal arch
  - Supports the head of the talus: prevents plantar & Medial subluxation during WB
- Injury leads to flat foot deformity



# Anatomy Review: Static Restraints

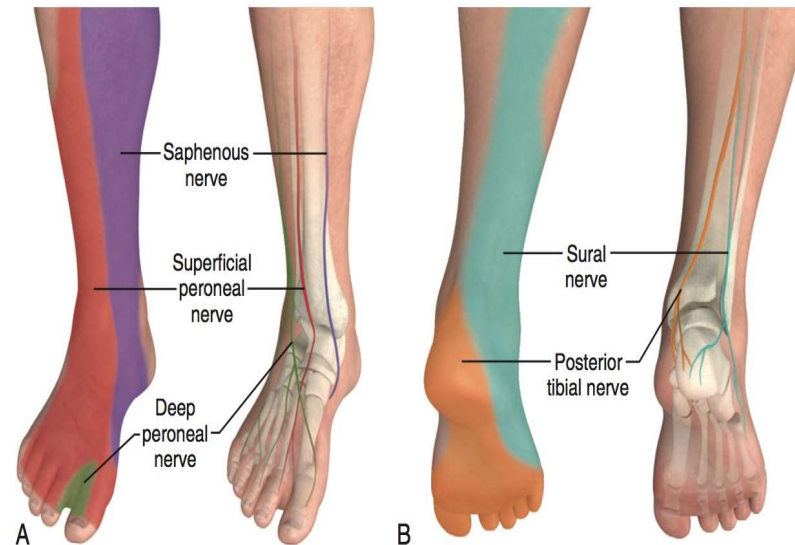
- **Plantar Plate complex:**

- Thick fibrocartilaginous structure
- Runs along plantar aspect of MTP's
- **Function:**
  - Protects MT heads from excessive pressure
  - Injury causes hyperextension of lesser toes and splaying



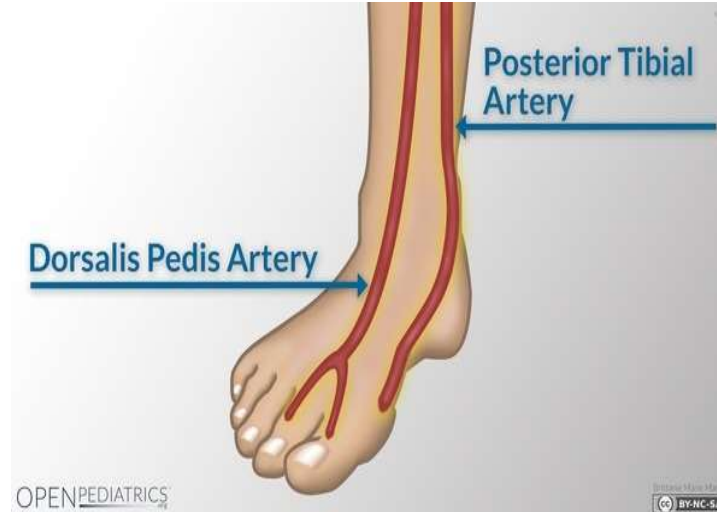
# Anatomy Review: Nerves

- **Superficial Peroneal N.**
  - Peroneus longus & brevis
  - Sensation to dorsum of foot (except 1<sup>st</sup> web space)
- **Deep Peroneal N.**
  - Tibialis anterior
  - EHL, EDL, EDB, EHB
  - Sensation to 1<sup>st</sup> web space
- **Sural N.**
  - Sensation to lateral ankle and foot
- **Saphenous N.**
  - Sensation to anteromedial aspect of lower leg
- **Post. Tibial N.**
  - Tibialis posterior, FDL, FHL
  - Sensation to plantar aspect of heel



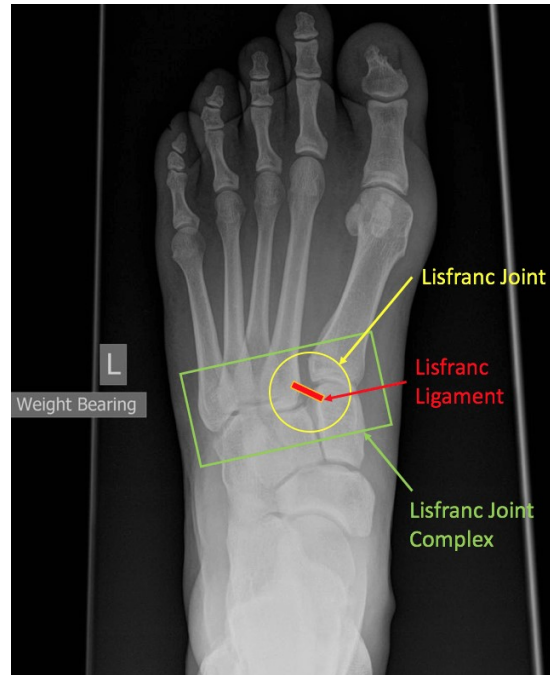
# Anatomy Review: Arteries

- **Dorsalis pedis artery:**
  - Supplies dorsal surface of foot
- **Posterior tibial artery:**
  - Supplies posterior compartment of the leg and plantar surface of foot



# Anatomy Review: Lisfranc Joint Complex

- Consists of the articulation between MT 1-5 and the bones of the midfoot
- **Lisfranc ligament:** connects the second MT to the medial cuneiform
- Direct Injury= crush injury
- Indirect Injury= rotational force on a plantar flexed foot
- Range from sprain to fracture/dislocation
- Indirect injuries are difficult to assess and often misdiagnosed



an anteroposterior weight-bearing radiograph demonstrating

# Anatomy Review

## Tarsal Tunnel



## Sinus Tarsi



A large, light blue, semi-transparent graphic of a DNA double helix is positioned on the left side of the slide, extending from the top to the bottom.

# Physical Examination

- Gait
- Observation
- Neurological Examination
- Pulses
- Palpation
- ROM
- Strength
- Ligament stability testing
- Special tests/Functional tests

## Gait: Antalgic

- Due to pain in lower extremity
- Decreased stance time on affected limb
- Decreased stride length on affected limb
- Decreased swing phase of unaffected leg

## Gait: High Stepping

- Due to foot drop
- Unable to heel strike
- Excessive hip and knee flexion to clear foot
- Slaps foot on ground on advancing to the involved side



# Gait

## • **Over pronation**

- Flattening or rolling in of the foot
- Pronation occurs naturally in the gait cycle as you move from heel strike to mid stance
- As you move towards toe off your foot should start to supinate -this phase is either delayed or does not occur
- Causes abnormalities up the kinetic chain

## • **Over Supination**

- Arching of the foot
- The foot fails to flatten during mid stance and is unable to absorb shock and impact forces of the foot
- This leads to high arches, less flexible foot and increase risk of ankle sprains
- Causes abnormalities up the kinetic chain

## Over pronation video



# Over supination video



# Observation:

- **Ankle and Foot Alignment:**

- **Hindfoot valgus:**

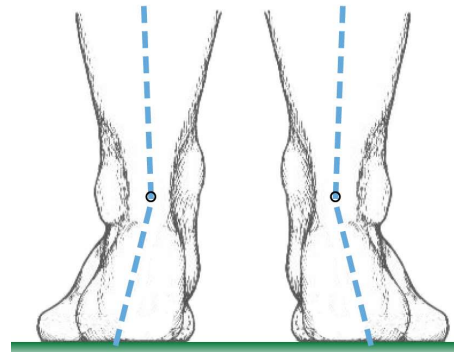
- “too many toes sign”
- Pes planus/pronation of foot

- **Hindfoot varus:**

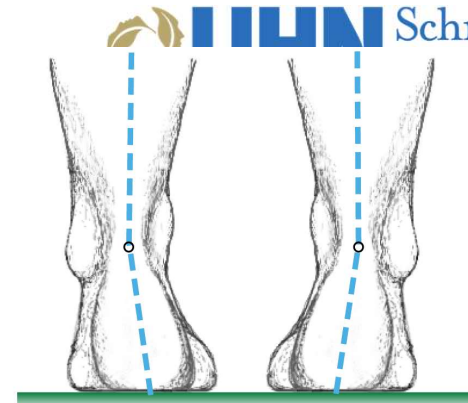
- “peak-a-poo heel”
- Cavo varus foot/supination of foot

- **Longitudinal arch:**

- Flattened vs. high arch



**Valgus Heel** (everted)



**Varus Heel** (inverted)



# Observation

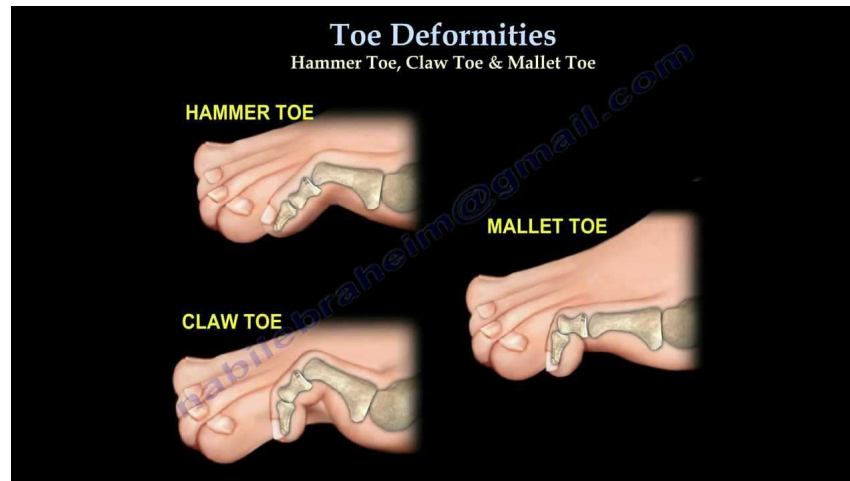
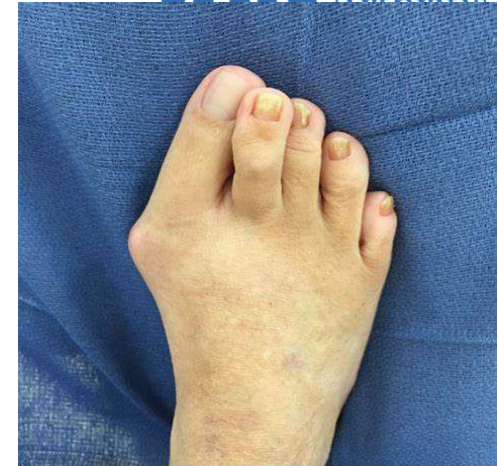
- **Toe Alignment:**

- Hallux valgus
- Hallux varus
- Hammer toe
- Claw toe
- Mallet toe
- Crossover toe

Hallux varus



Hallux valgus



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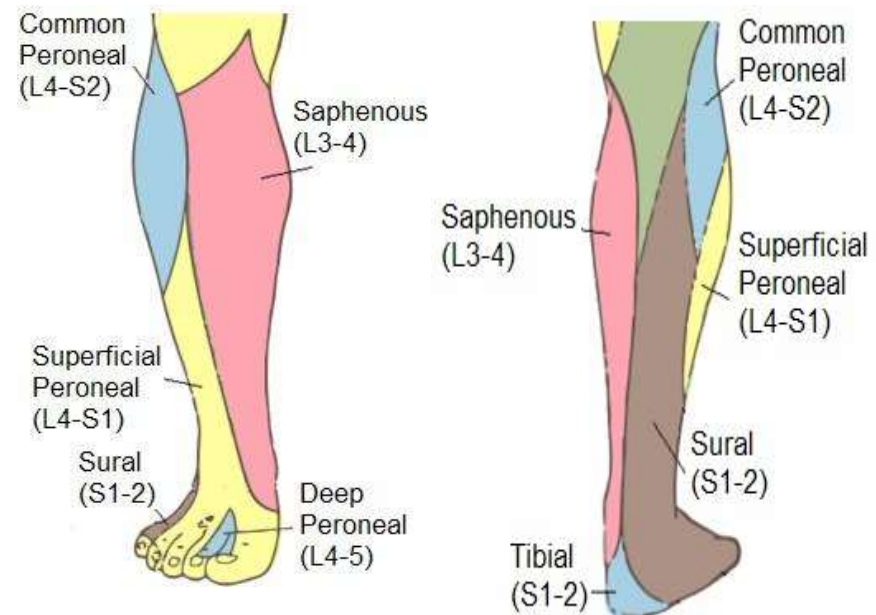
# Observation:

- **General Observation:**

- Swelling
- Muscle atrophy (calf)
- Skin integrity (rashes, erythema, discolouration, bruising\*)
- Surgical incisions/scars
- \*Look at bottom of feet (ulcers/callus formation)

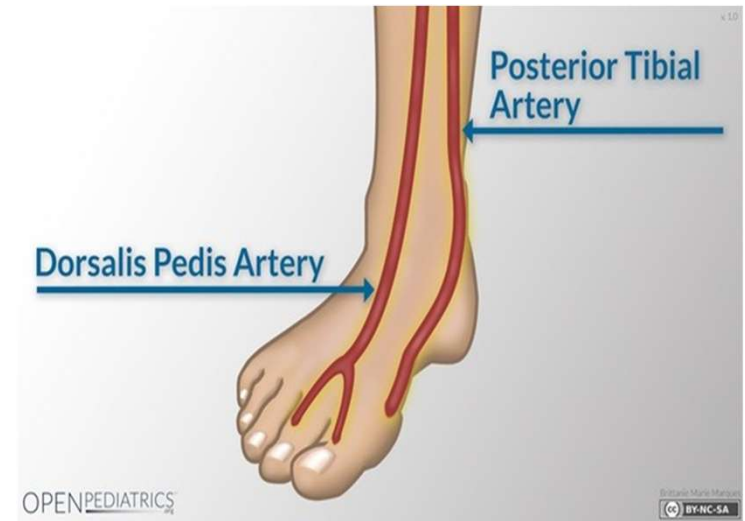
# Neurological Examination:

- Dermatomes
- Myotomes
- Reflexes (ankle)- as applicable
- Babinski/Clonus-as applicable
- **Tinel's Sign:**
  - Common peroneal nerve
  - Superficial peroneal nerve
  - Deep peroneal nerve
  - Posterior tibial nerve
  - Sural nerve



# Pulses

- **Dorsalis pedis pulse:**
  - Palpate medial to EHL tendon and between the 1<sup>st</sup> and 2<sup>nd</sup> metatarsals
- **Posterior Tibial pulse:**
  - Palpate between medial malleolus and Achilles tendon above calcaneus



## Palpation: Bony structures

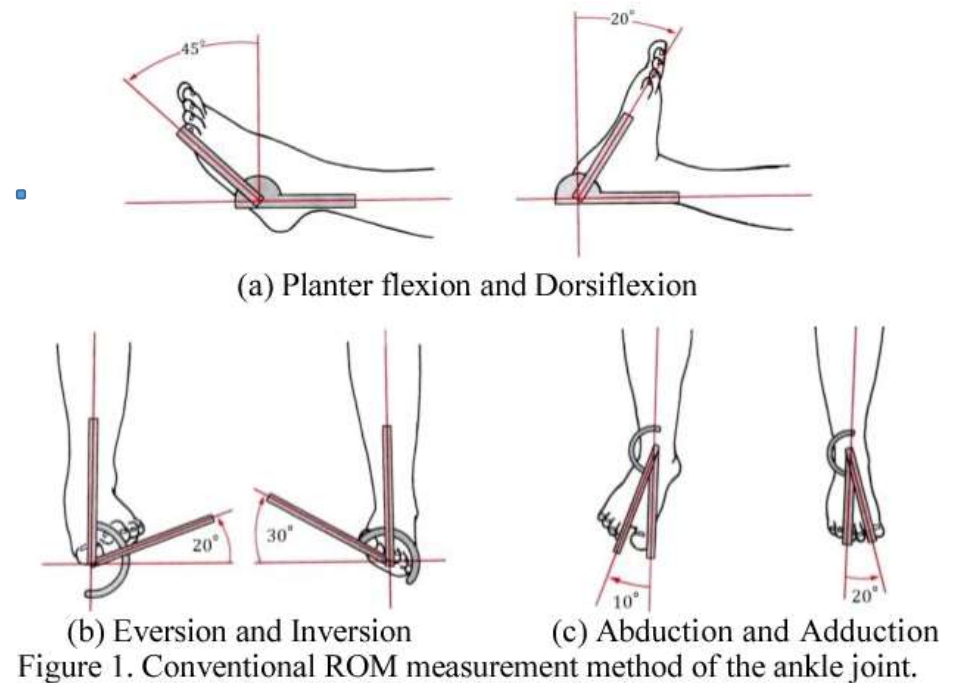
- Anterior Tibial Shaft
- Lateral malleolus\*
- Medial malleolus\*
- Talar Dome
- Calcaneus
- Navicular (tubercle)\*
- Cuboid
- Cuneiforms
- Styloid process 5<sup>th</sup> MT\*
- Metatarsals
- MTP joints
- Phalanges
- DIP/PIP joints
- Metatarsal heads (plantar aspect)

# Palpation: Soft tissues/ligaments

- Posterior:
  - Gastroc/soleus complex
  - Achilles tendon
  - Retrocalcaneal bursa
- Anterior:
  - Tibialis anterior
  - EHL
  - EDL
- Plantar:
  - Plantar fascia
- Lateral:
  - ATFL
  - CFL
  - PTFL
  - Peroneals
- Medial:
  - Deltoid ligament
  - Posterior tibial tendon

# ROM

- Ankle:
  - Dorsiflexion (knee flexed & extended)
  - Plantarflexion
  - Inversion
  - Eversion
- Great toe:
  - Extension
  - Flexion
- Lesser toes:
  - Combined toe flexion
  - Combined toe extension



## Strength Testing:

- Tibialis anterior
- Gastrocnemius
- Peroneals (DF + eversion)
- Tibialis posterior (PF +inversion)
- EHL
- EDL
- FHL
- FDL

# Ligament Stability Tests

## Anterior Drawer

- To assess the integrity of the anterior talofibular ligament (ATFL)
- Pt. lays supine with foot off the end of plinth, in slightly PF position with knee slightly flexed
- Stabilize the distal tibia at level of malleoli; distal hand cups talus and calcaneus
- Passively draw hindfoot forward
- +ve test: increased anterior translation of talus

## Talar Tilt

- To assess the integrity of the calcaneo-fibular ligament (CFL) and deltoid ligaments
- Similar position as with anterior drawer but foot is in neutral position
- Hand position same as with anterior drawer
- Passively invert and evert the ankle
- +ve test: increased motion/pain with inversion (CFL); increased motion/pain with eversion (deltoid)

\*Always compare to unaffected side

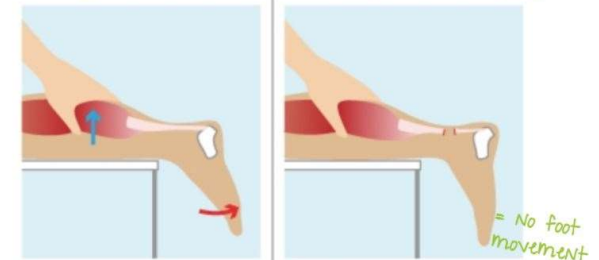


## Special Tests:

- Thompson Test (Achilles rupture)
- Heel Raises (PTT dysfunction)
- Circumduction of ankle (peroneal subluxation)
- Squeeze (Hopkin's) Test
- Grind Test (great toe OA)
- Web space compression Test/  
Foot squeeze test (neuroma)

### achilles tendon rupture

#### Thompson Test



Normal

Ruptured

EM'S



# Common Foot and Ankle Problems and Conservative Management

- Ankle osteoarthritis
- Osteochondral defect (lesion)
- Pes planus deformity
- Cavo varus deformity
- Hallux Valgus (bunion)
- Hallux rigidus (1<sup>st</sup> MTP OA)
- Toe deformities (hammertoe, clawtoe, mallet toe)

# Ankle Osteoarthritis

- Mostly commonly post traumatic
- Presents with typical OA symptoms
  - Worst with WB activities
  - Better at rest
  - Restricted ROM/stiffness
- Diagnosis confirmed with x-ray
- Physical Exam:
  - Antalgic gait
  - effusion around ankle
  - Restricted DF/PF ROM (+/- crepitus)
  - TOP along ankle joint



## Ankle Osteoarthritis- Conservative Management

- Physiotherapy
- Activity Modification
- NSAID's
- Cortisone injection
- Brace:
  - Stir up brace
  - Custom rigid AFO
  - Arizona Brace
- Custom/orthopaedic shoe:
  - Rocker bottom



## Osteochondral defect (lesion)

- Lesion of the talar bone and its subchondral cartilage
- Caused by a single or due to multiple traumatic events
- Partial or complete detachment of the fragment
- Symptoms:
  - Deep anterior ankle pain with WB
  - Decreased ROM/stiffness
  - \*\*catching/locking of ankle
- Diagnosed by MRI

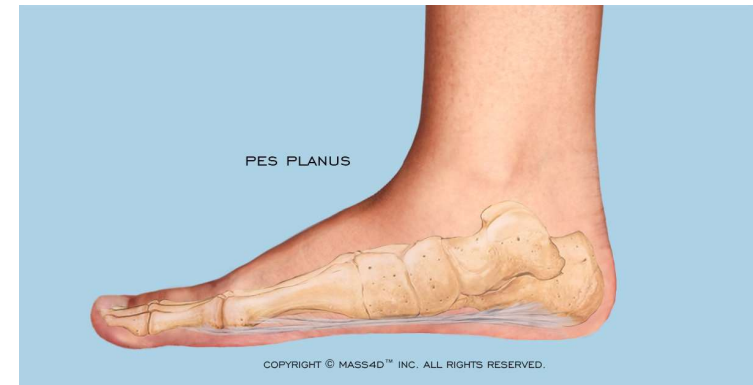


# OCD- Conservative Management

- Physiotherapy
- Brace
- Activity modification
- \*\*If the lesion is unstable (loose) then will require surgery as can lead to arthritis rapidly

# Pes Planus

- Flattening of the medial longitudinal arch of the foot
- Arches develop in childhood
- Congenital vs. acquired
- The use of the term *acquired* implies that some physiologic or structural change causes deformity in a foot that previously was structurally normal.
- Most common cause is posterior tibial tendon dysfunction
- 2 types: flexible and rigid
  - Flexible-have the ability to form an arch but the arc flattens with WB
  - Rigid-cannot form an arch at all



## PTTD Classification by Stages

Stage I	Stage II	Stage III	Stage IV
Tenosynovitis or degeneration of the tendon	Elongation and degeneration of the tendon	Elongation and degeneration of the tendon	Same presentation as stage 3 with inclusion of:
Pain	Pain	Pain	Valgus deformity of the talocrural joint
No deformity	Flexible pes planovalgus deformity	Fixed pes planovalgus deformity	Arthritis of the ankle
Mild weakness (able to complete single heel rise with inversion of hindfoot)	Forefoot abduction when weightbearing	Forefoot abduction when weightbearing	
	Significant weakness (no or limited inversion of hindfoot in single heel rise)	Inability to perform a single-leg heel rise	

# Pes Planus

- Symptoms:
  - Pain along medial aspect of foot and into arch
  - Sometimes pain along lateral ankle depending on severity of the deformity
  - Fatigue of feet with prolonged standing/walking
- Physical Exam:
  - Too many toes sign
  - Hindfoot valgus
  - Difficulty/inability to perform single leg heel raise
  - TOP along PTT
  - Decreased strength of PTT during MMT



# Pes Planus-Conservative Management

- Successful for Stage 1 and 2 (Flexible deformity)
- Stage 3 and 4 require surgery
- Physiotherapy
  - Tib. Post strengthening
  - Intrinsic muscle strengthening
- Custom orthotics (UCBL)
- Custom brace (Arizona)



## Cavo varus

- Abnormally high longitudinal arches and a varus heel
- +/- clawtoes
- Very rare condition
- Usually caused by a neurological disorder: Most common is Charcot Marie-Tooth Disease
- Leads to ankle instability and strain on the peroneal tendons



# Cavo varus

- Symptoms:
  - Heel and lateral foot pain
  - Ankle instability/Hx of ankle sprains
  - Pain along peroneals
- Physical Exam:
  - Hindfoot varus
  - Peek-a-boo heel
  - +/- claw toes
  - Weak peroneals +/- tenderness



# Cavo Varus-Conservative Management

- Physiotherapy:
  - Calf stretches
  - Plantar fascia stretches
  - Proprioceptive exercises to improve ankle stability
  - Peroneal strengthening
- Orthotics-lateral posting

# Hallux Valgus (Bunions)

- Medial migration of the first metatarsal and lateral deviation of the MTP joint due to an imbalance of the muscles and tendons around the great toe
- “bunion” is the bony protrusion of the MT head
- Female > Male
- Causes:
  - Improper footwear- tight pointed shoes, high heels
  - Genetics
  - Pes planus
  - Hypermobility of 1<sup>st</sup> TMT joint
  - Rheumatoid arthritis



# Hallux valgus

- Symptoms:
  - Focal pain at bunion usually with footwear- but as deformity progress pain can become constant
- Physical Exam:
  - Visible deformity of first toe
  - Swelling/redness at deformity
  - Tenderness along bunion
  - Decreased great toe ROM

# Hallux Valgus-Conservative Management

- Modified foot wear
  - Flat shoes, wide toe box
- Orthotics:
  - Morton's extension
  - Metatarsal pad
- Bunion splint/toe spacers
- Taping
- Intrinsic muscle strengthening



# Hallux Rigidus

- Osteoarthritis of the first MTP joint
- Causes:
  - Female > Male
  - Family history
  - Previous injury
  - Overuse



# Hallux Rigidus

- Symptoms:
  - Focal pain in great toe
  - Pain/stiffness with weightbearing
  - Increased pain in cold/damp weather
  - Swelling and inflammation around great toe
- Physical Exam:
  - Visible or palpable bony prominence at MTP joint
  - Decreased Flex/Ext of big toe
  - Pain with end range of motion
  - +ve Grind Test



## Hallux Rigidus-Conservative Management

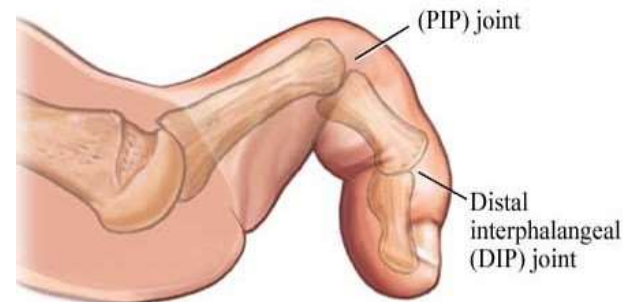
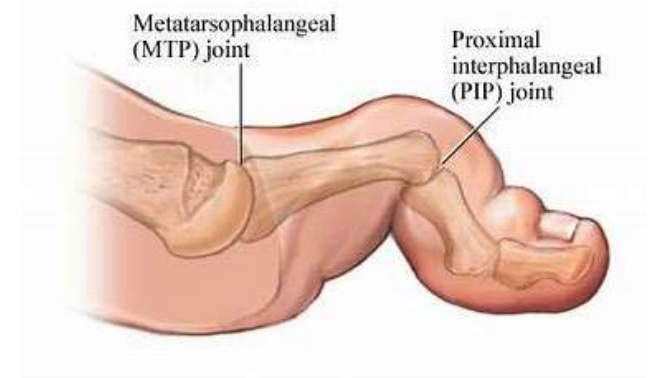
- NSAID
- Activity Modification
- Footwear modification-stiff sole shoes
- Orthotics:
  - Morton's extension



## Toe Deformities: Hammer Toe & Claw toe

- Hammer toe: Hyperextension at MTP jt and flexion of PIP jt
- Claw Toe: Hyperextension at MTP jt and flexion at IP joints
- Result of an imbalance between the muscles, tendons and ligaments
- Causes:
  - Female>Male
  - Genetics
  - Improper footwear
  - Anatomy-long 2<sup>nd</sup> toe
  - Neurological disorders (CMT)
  - Diabetes
  - RA

HAMMER TOE



CLAW TOE

## Toe Deformities: Hammer toe & Claw toe

- Symptoms:
  - Focal pain at affected toe along metatarsal head (plantar aspect) or at joint line with weight bearing
  - Development of callus/corn at affected joint due to friction from shoe-with claw toe can get callus at tip of toe
  - Worse when wearing closed-toe shoes\*
  - Redness and/or swelling at affected toe
- Physical Exam:
  - Visible deformity of toe
  - Deformity can be fixed or correctable
  - TOP along metatarsal head with prominent head
  - +/-Presence of callus (plantar aspect) and/or corn (at affected joint)

# Toe Deformities: Hammer toe & Claw Toe Conservative Management

- Orthotic with metatarsal pad
- Modified footwear
- Toe pads/sleeve/Budin Splint
- Taping- Not helpful for subluxed toe





The End!