



# Arches of foot

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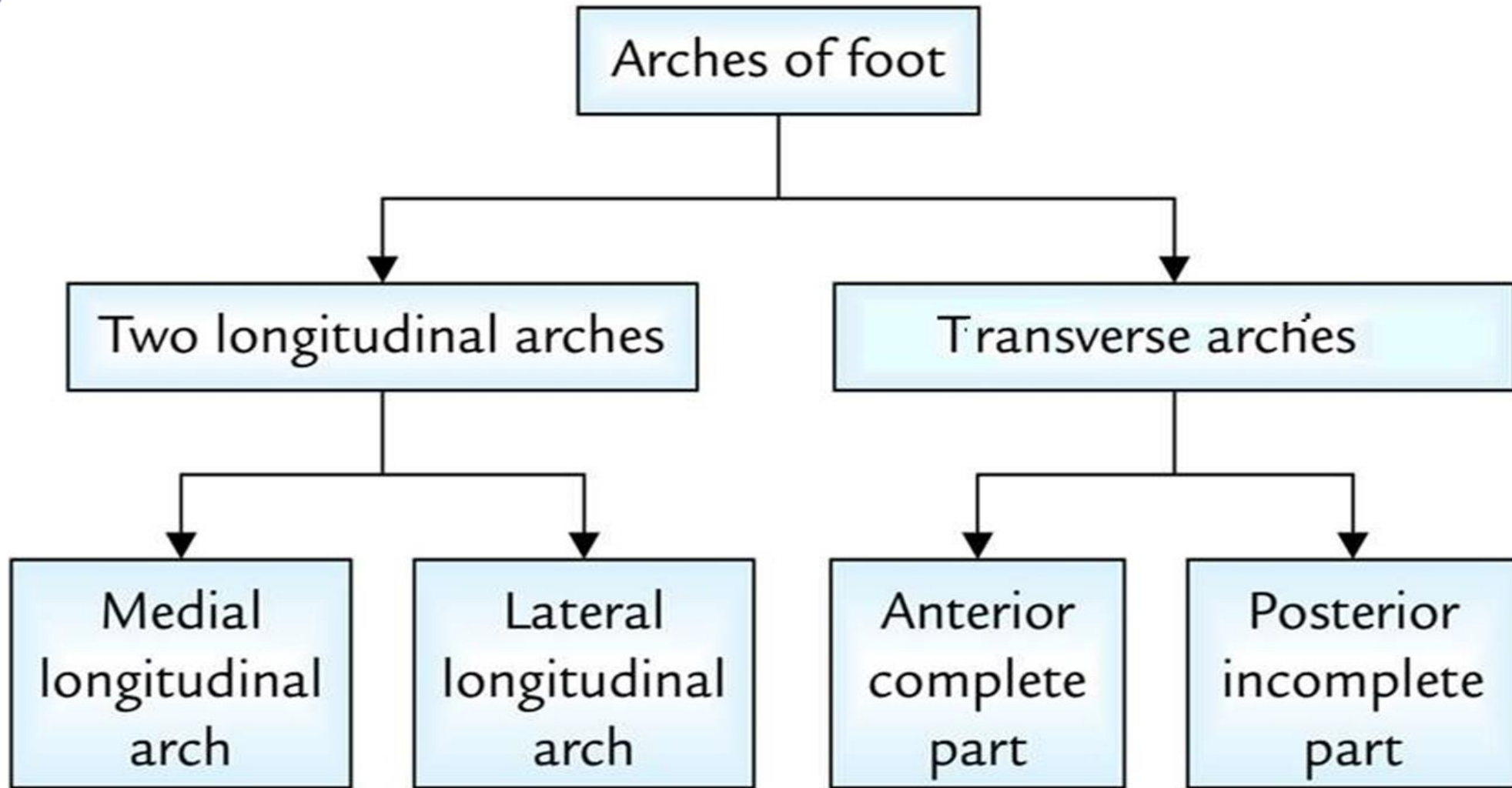
# INTRODUCTION

- Arches are the supporting mechanism designed to **facilitate absorption and distribution of superimposed body weight through the foot.**
- Arches not presented during the birth, but it involve with the progression of weight bearing



# Types of arches

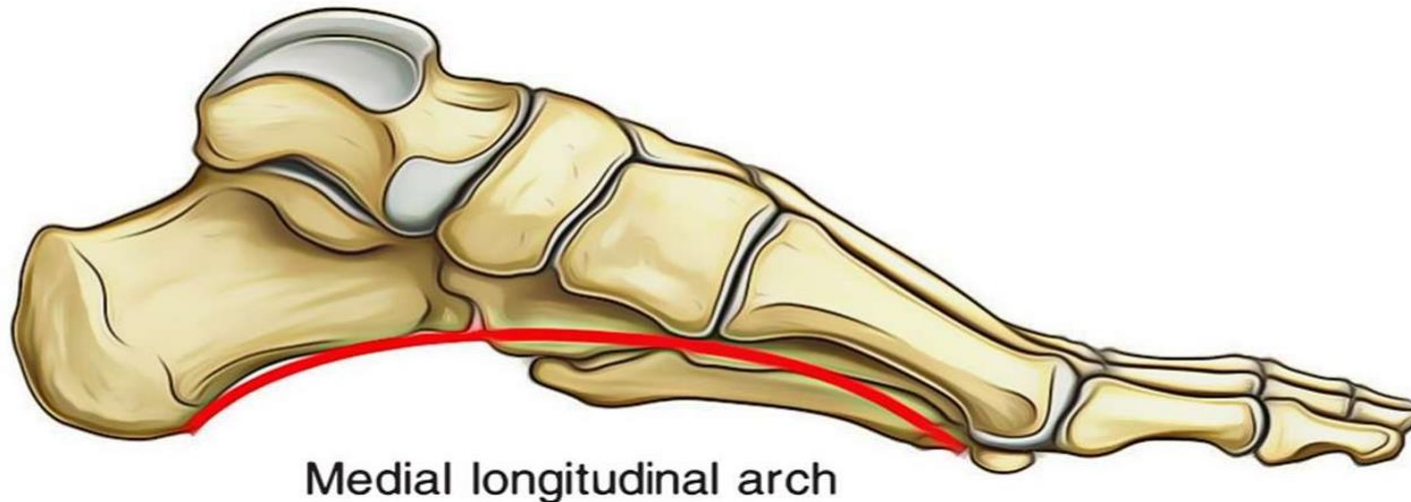
- The foot has three arches:
  - Two longitudinal (medial and lateral) arches
  - One transverse arch.
  - Their shape allows them to act in the same way as a spring, bearing the weight of the body and absorbing the shock produced during locomotion.



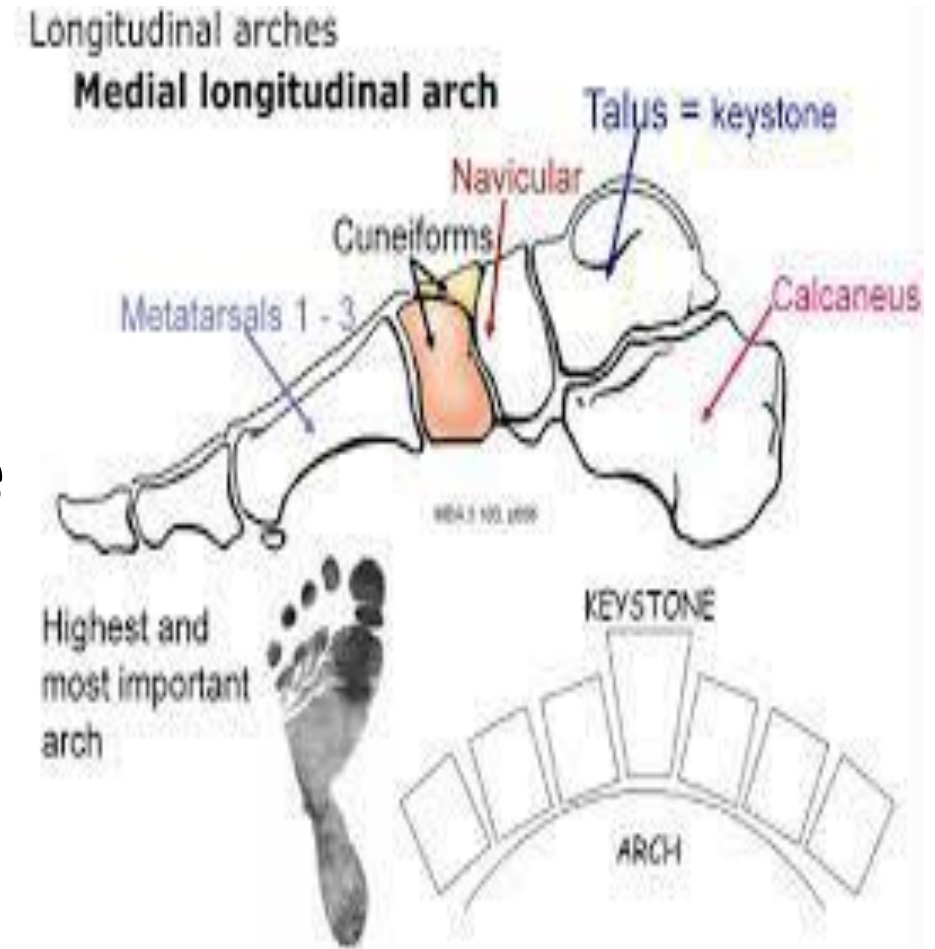
# STRUCTURES OF ARCHES

## MEDIAL LONGITUDINAL ARCH

- The medial longitudinal arch is composed by the **calcaneum, talus, navicular, 3 cuneiforms, and medial 3 metatarsals.**



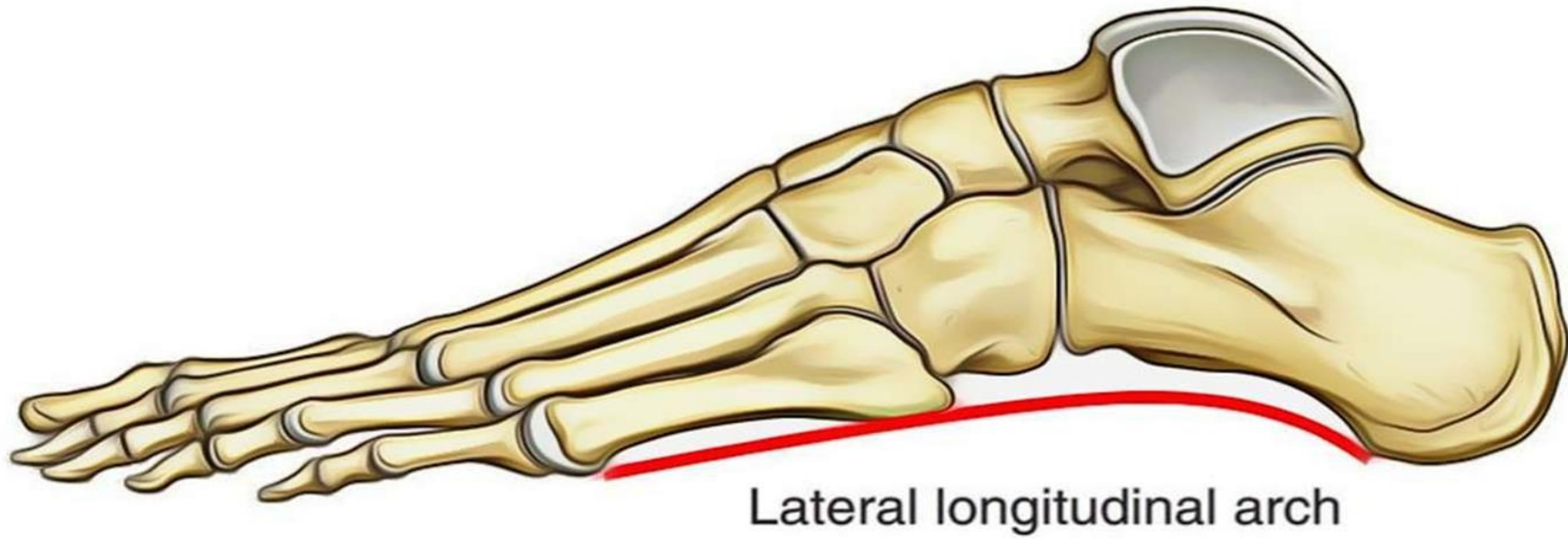
- Medial longitudinal arch is anchored :
- Anteriorly by –metatarsal head
- Posteriorly by- at calcaneum
- **Talus** rest on the top the vault- **keystone**





# Lateral longitudinal arch

- The lateral longitudinal arch is composed by the calcaneum cuboid and lateral 2 metatarsals.
- It is characteristically **low** and just about touches the earth.
- It is involved in **receiving and supporting the body weight during walking and running.**







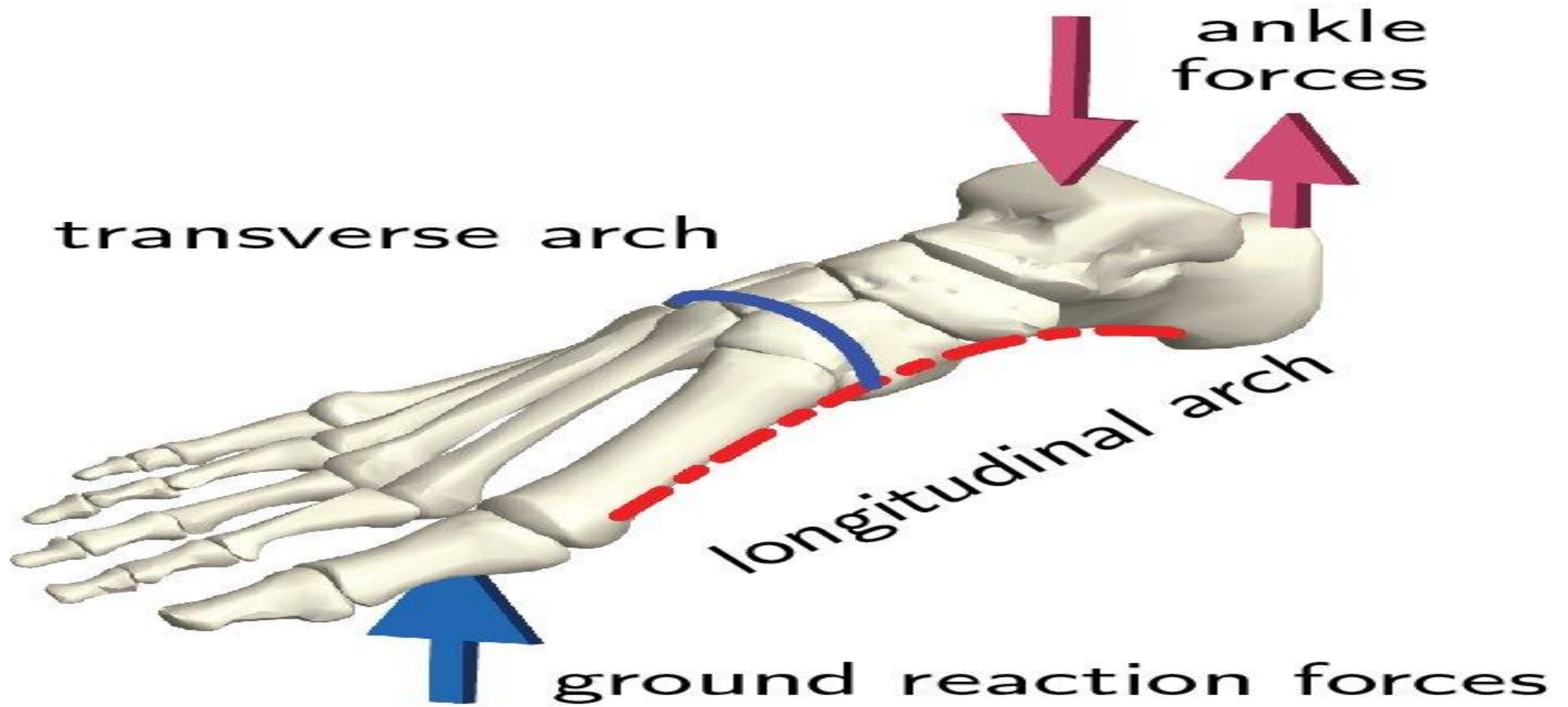
# TRANSVERSE ARCHES

- ANTERIOR TRANSVERSE ARCH
- The **heads of the metatarsals** create the anterior transverse arch.
- It's a whole arch because during standing position the **heads of first and fifth metatarsals come into contact to the earth and create the 2 ends of the arch.**



## • POSTERIOR TRANSVERSE ARCH

- The posterior transverse arch is composed by greater parts of the **tarsus and metatarsus**.
- It's an incomplete arch because only its lateral end enters into contact with all the earth during standing position. It creates only half of the dome in a single foot. The entire dome is composed when both feet are brought together.





- **FUNCTION OF ARCHES**

- **1. STABILITY**

- ❖ Distribution of the weight through the foot for proper weight bearing.
- ❖ Conversion of flexible foot to rigid foot.



# MOBILITY

- To reduce the impact of weight bearing.
- To adopt to the change in the supporting surfaces.
- Foot **is flexible arch** than fixed arch, so distribution of body weight depends on
  - » Shape of arch
  - » Location of line gravity



# Plantar arch stability



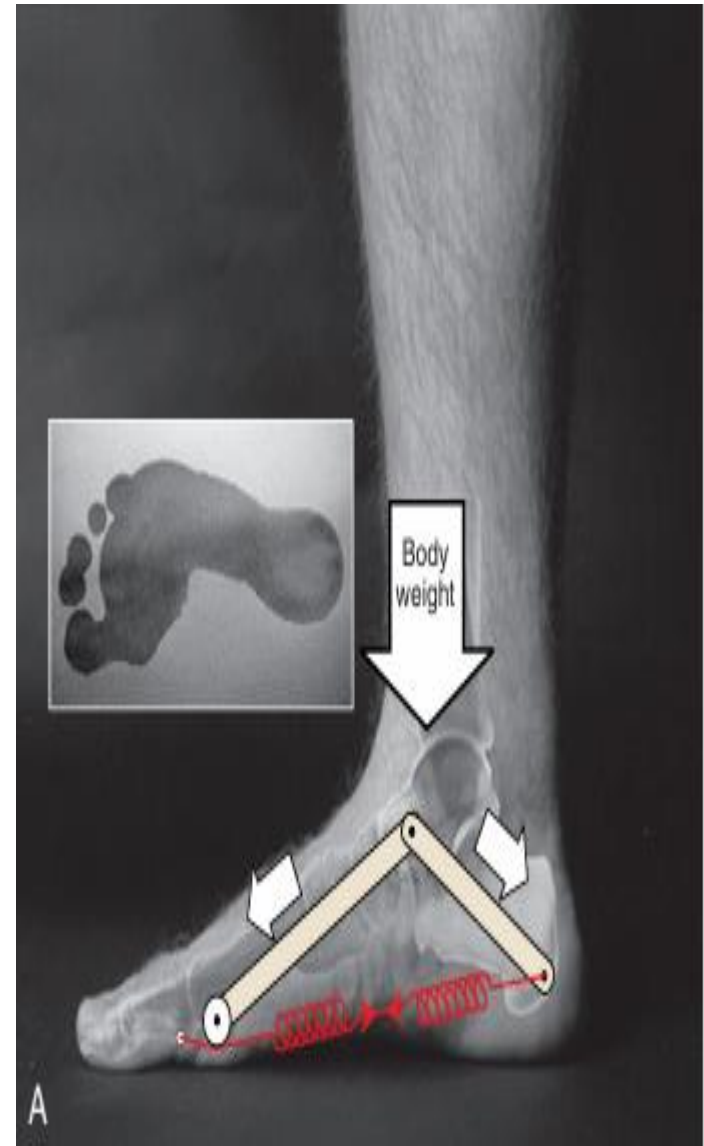
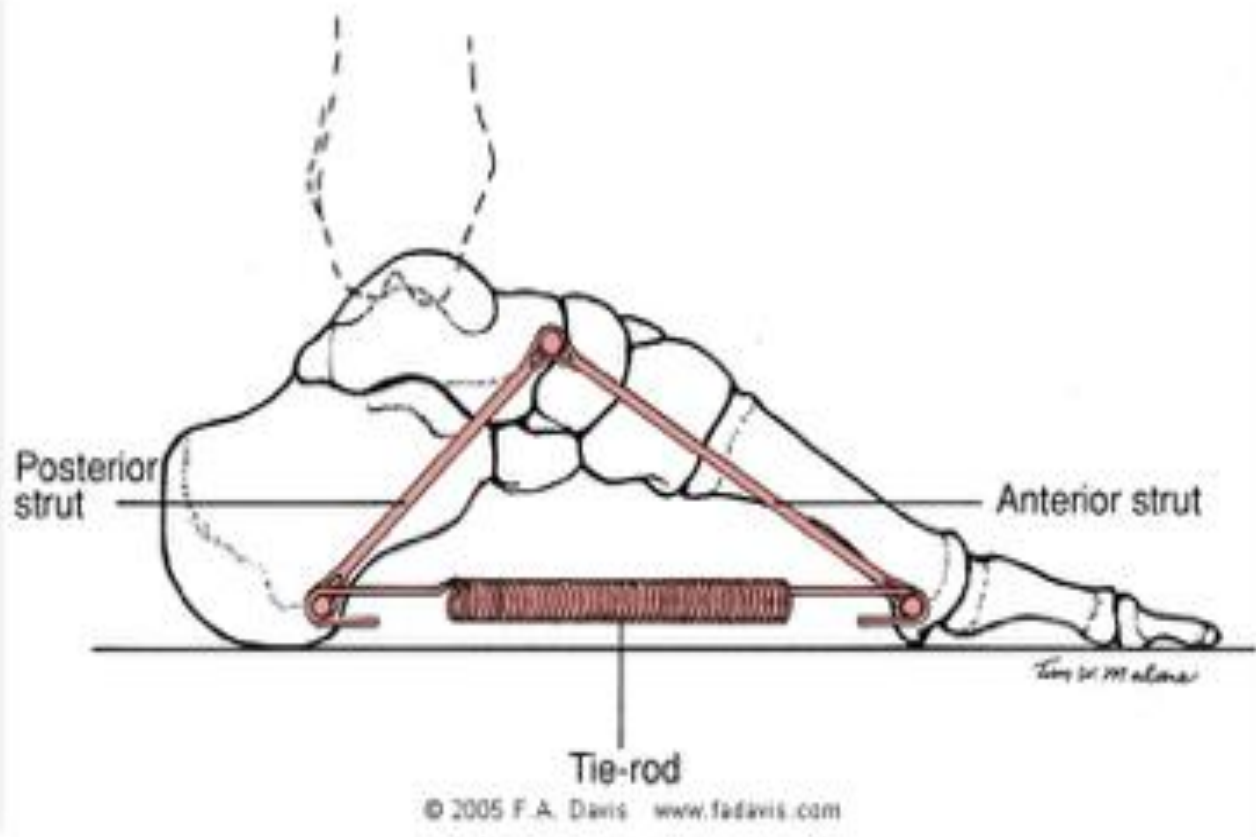
- Ligaments:
- Calcaneonavicular ligament( spring lig)
- Talonavicular ligament
- Cervical ligament
- Long and short plantar ligament



# Plantar fascia



- Is a Dense fascia
- Plantar aponeurosis attaches to the medial tubercle of calcaneum ,plantar plates to the proximal phalanges.
- Plantar arch consist of Posterior and anterior strut and tie rod.
- **Talus and calcaneum- form posterior strut.**
- **Tarsal and metatarsal form the anterior strut.**
- **Plantar aponeurosis- tie rod**
- When body weight passes through both strut it undergo compressive forces.
- Whereas tie rod (plantar aponeurosis) undergo pulled from both direction and undergo tensile forces.

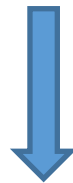




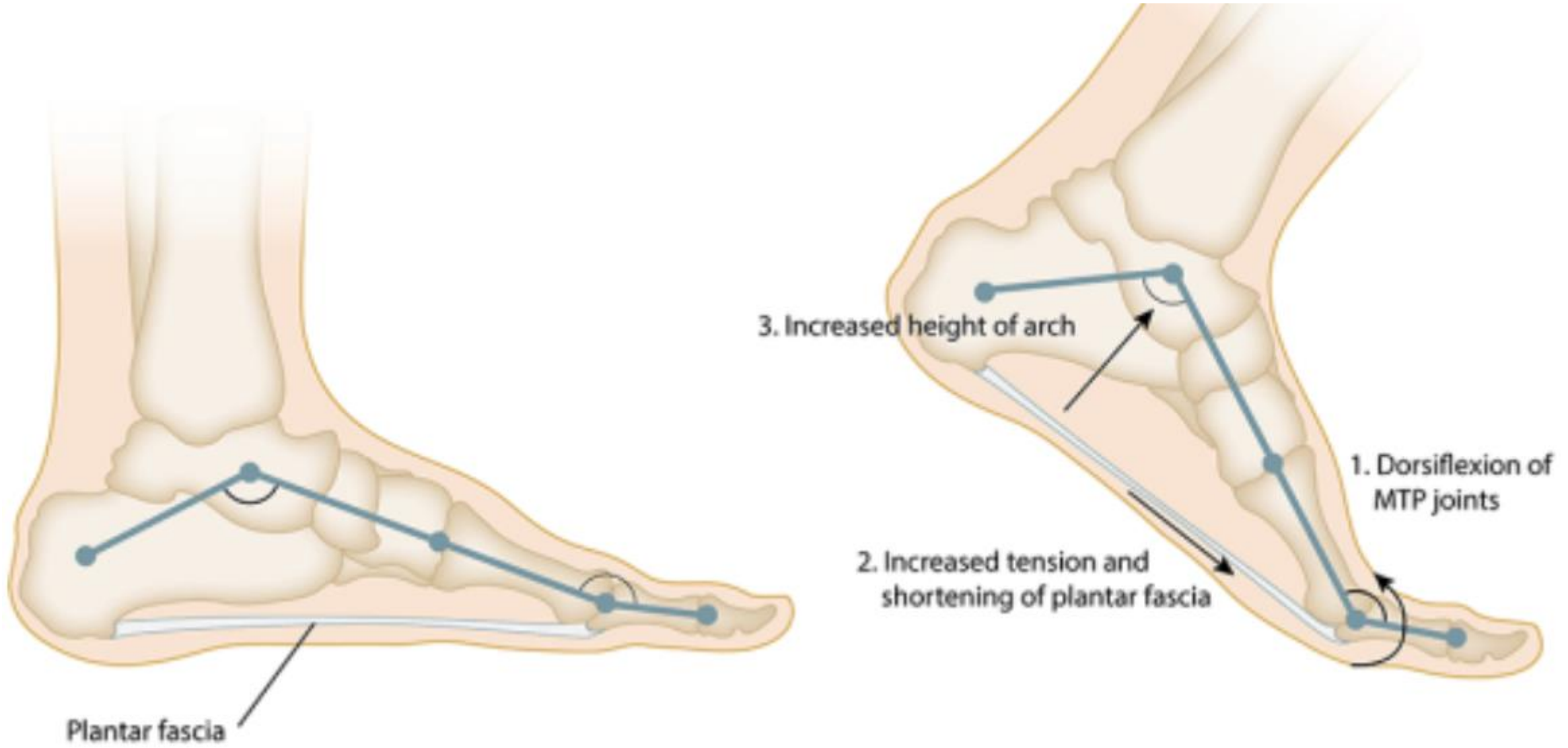
- Tension occurs in the plantar aponeurosis during metatarsophalangeal joint extension.



- MTP joint extension draws hindfoot and forefoot(struts) together.



- The longitudinal arch is raised- this phenomenon is called **windlass mechanism**





# WEIGHT DISTRIBUTION:



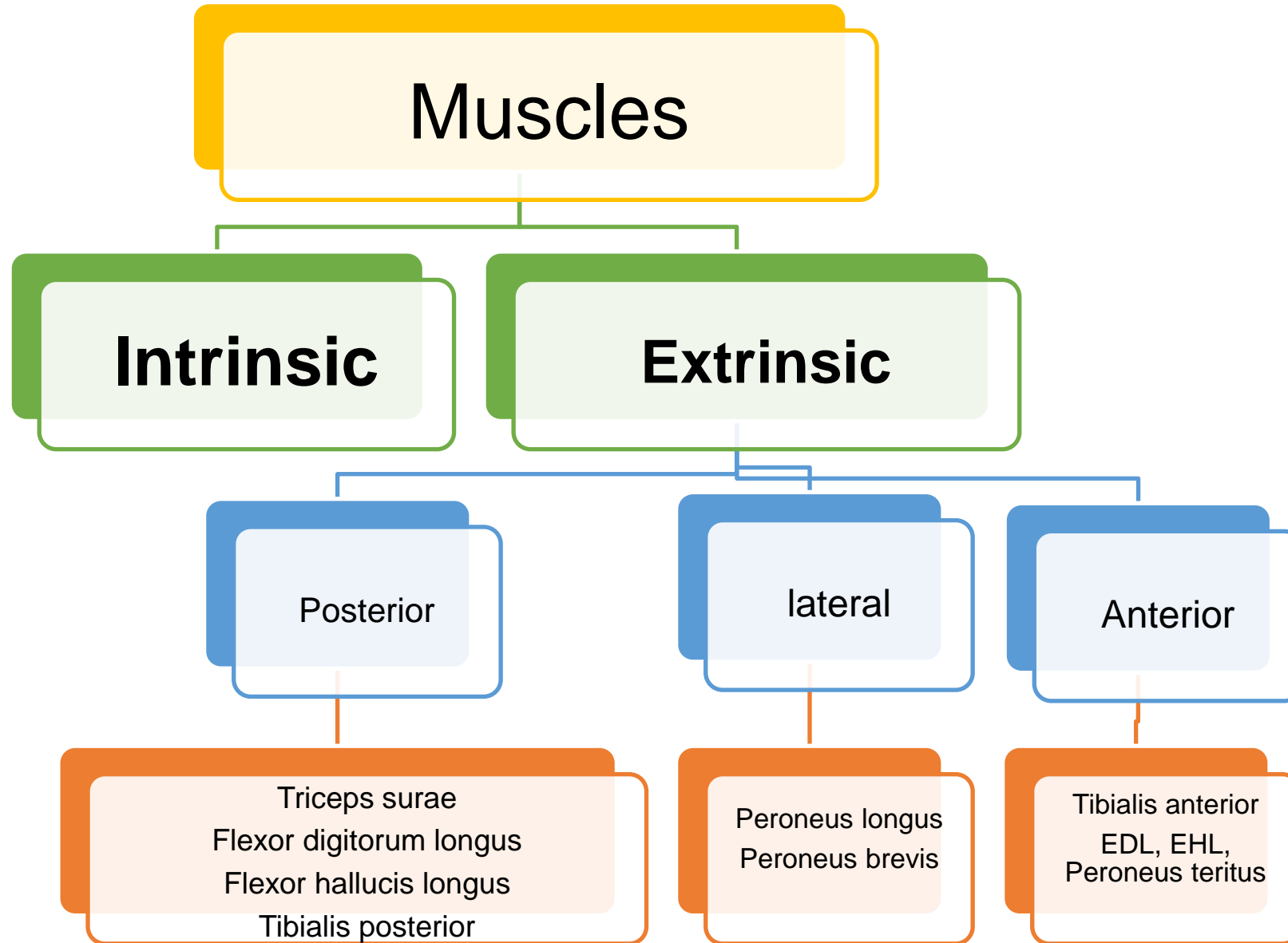
- The distribution of body weight through the foot begins with the talus.
- In unilateral stance the weight bearing talus receives 100% of the body weight
- **In bilateral stance:**
- Talus receives 50% of the body weight.
  - posterior subtalar articulation.
    - ❑ a large amount body weight passes
    - ❑ because of the more medial location of talar head.
    - ❑ **Twice** weight passes through talonavicular joint.
  - anterior- subtalar articulation.
    - ❑ **Less weight** is transferred
    - ❑ **Decrease compressive load-** calcaneocuboid joint



- Plantar pressure increases during walking.
- Pressure increases at metatarsal head during **push off phase** of walking.
- when the patient is diabetic, having peripheral neuropathy they may develop **Hammer toe**- increase MTP extension, increases pressure, may leads to injury and skin breakdown



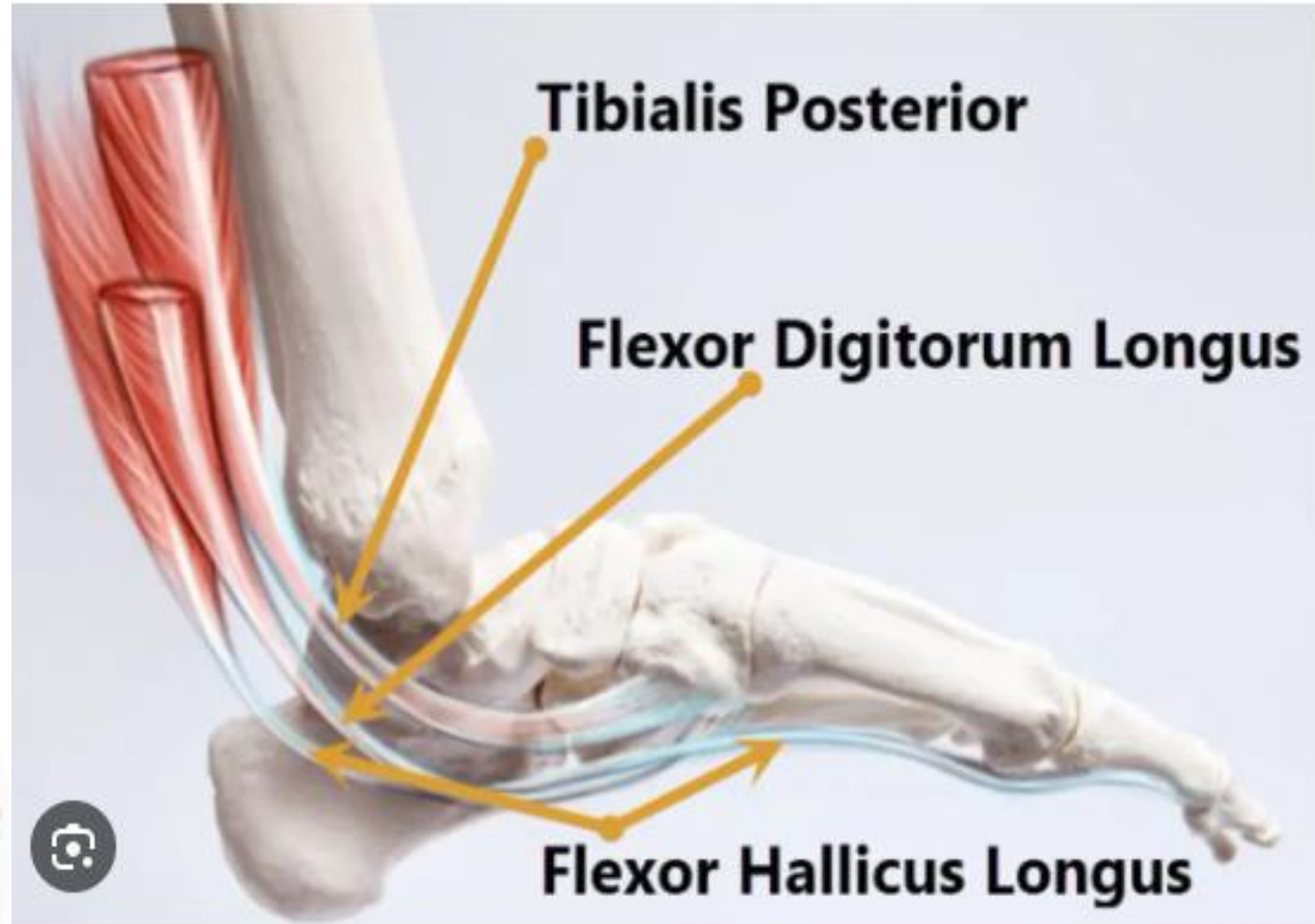
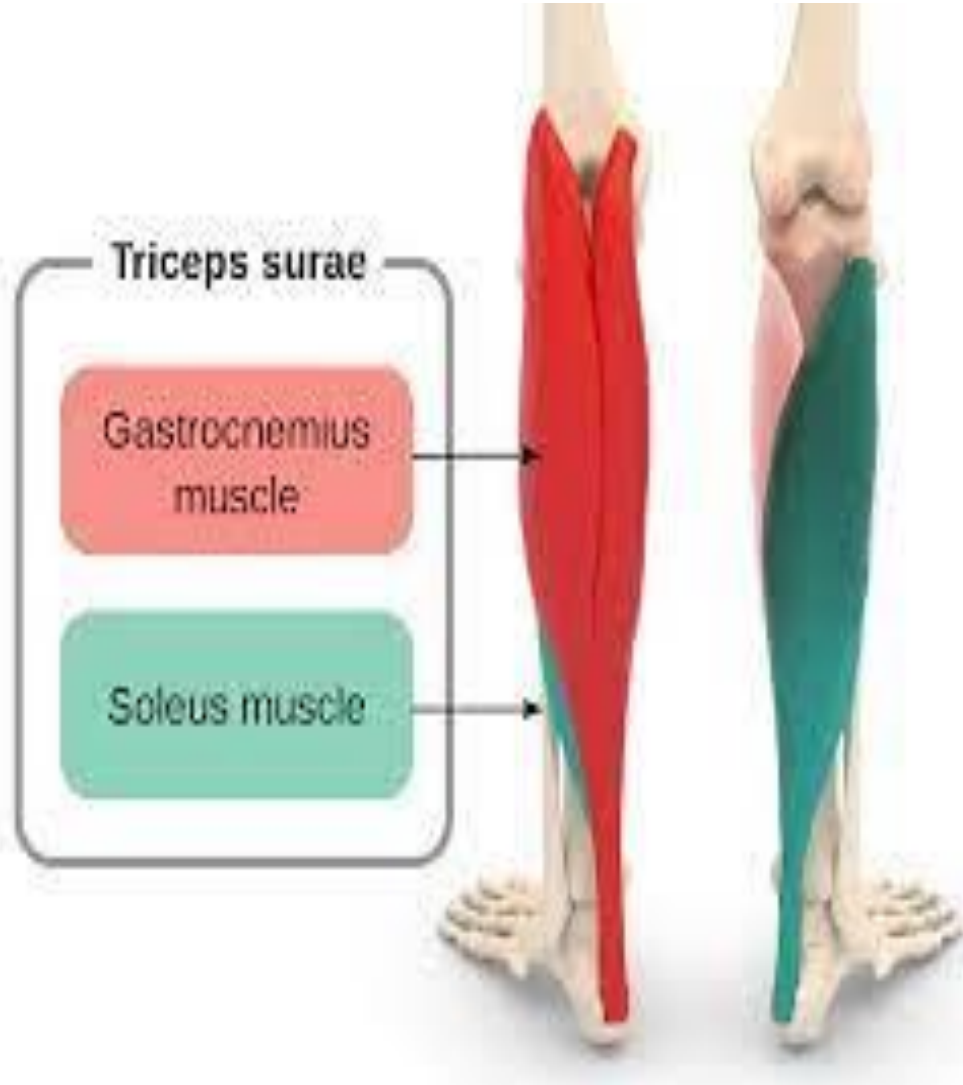
- The distribution of weight metatarsal head occur in 2:1:1:1 proportion from 1<sup>st</sup> to 5<sup>th</sup> toe.
- In normal weight bearing compression on the **talus produce eversion at subtalar joint.**
- This **cause pronation of calcaneum and adduction and plantar flexion of talar joint.**
- This talar motion cause **slight depression of navicular.**
- The Nett effect is to flattened slightly the longitudinal arch and to absorb the shock of he superimposed body weight.





- **TRICEPS SURAE:**

- 2 heads of gastrocnemius and soleus.
- **Strongest PLANTARFLEXOR.**
- It concentrically contract to produce PF.
- Soleus and gastrocnemius together eccentrically **control dorsiflexion of ankle and supination of subtalar joint.**
- So these muscle get tight there will be limited dorsiflexion and supination.
- This contribute excessive pronation at subtalar joint and pain at midfoot and fore foot.





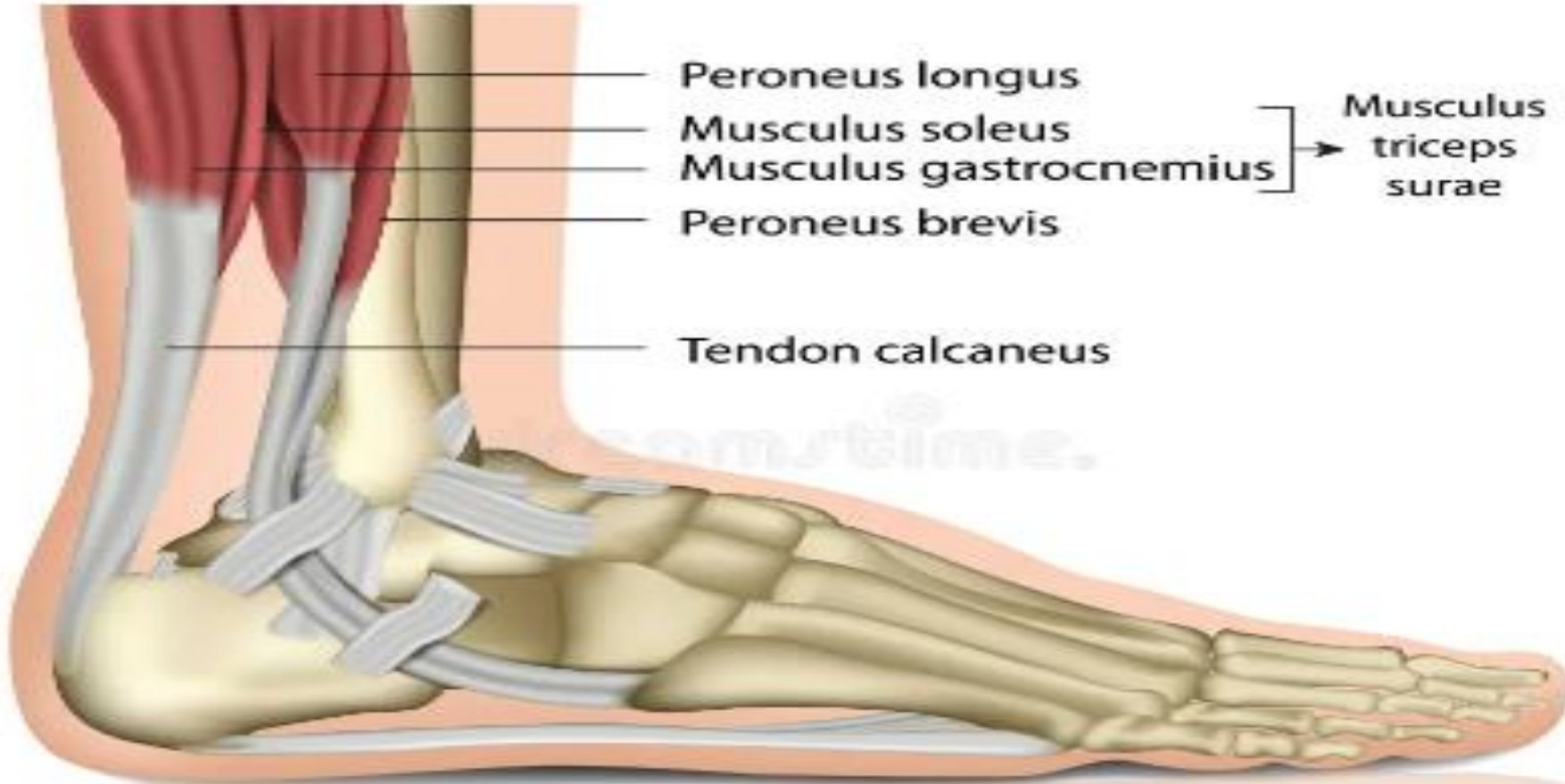
- **Plantaris, tibialis posterior, flexor hallucis longus, flexor digitorum longus , peroneus brevis and peroneus longus.**
- These muscle **moment arm for PF is small.**
- It only provide total **5 % plantarflexor force.**
- Tendon of tibialis posterior muscle passes just behind the **medial malleolus** and insert to navicular bone . So it has a large moment arm for **supination of subtalar joint.**



- Controls pronation of foot during gait.
- Flexor digitorum longus –
- helps to support medial longitudinal arch during gait.
- causes toes to flex.
- flexor hallucis longus- flexes the great toe and produce press of toe to the ground.

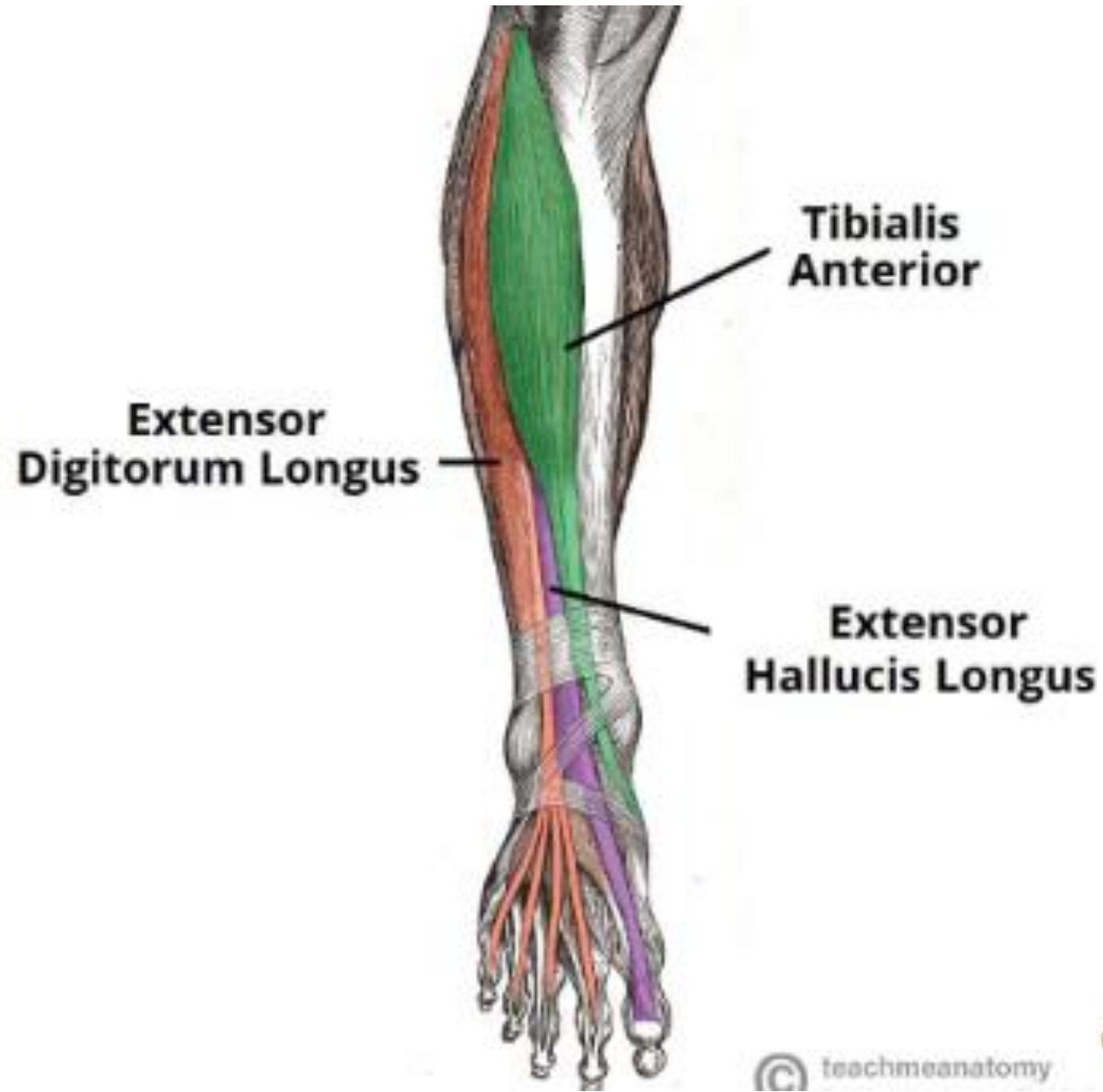


- **Lateral compartment muscles:**
- Peroneus longus and brevis –pass **lateral to subtalar joint,**
- **Primary pronators.**
- **Weak plantarflexors.**
- Peroneus longus facilitate **pronation twist** of tarsometatarsal joint.





- **Anterior compartment muscles**
- Tibialis anterior, extensor hallucis longus, extensor digitorum longus, peroneus tertius.
- **Strong dorsiflexors.**
- Tibialis anterior **passes medial to subtalar axis - supinator** of subtalar and transverse tarsal joint.



- **Extensor hallucis longus** :
- **weak supinator** of foot
- Active during gait when the heel first contacts the ground to control strong plantarflexion moment at ankle.
- Extensor hallucis longus prevents toes from dragging by extending MTP joints of the hallux.



- Extensor digitorum longus and peroneus tertius muscle pass lateral to subtalar axis- **dorsiflexor of ankle, pronators of hind foot.**
- Extensor digitorum longus – extends MTP joints of lesser toes.





# Intrinsic muscles

## Lumbricals and dorsal, palmar Interrossei muscles-

- Flex metatarsophalangeal joint, extends IP Joint
- stabilise metatarsal head and reduce loading during walking.
- Prevent MTP joint hyperextension.
- Weakness of interrossei leads to **instability, hammer toe, increase stress on metatarsal head can create metatarsalgia.**
- Function:
- Stabilizers of the toe
- Dynamic supporters of transverse tarsal joint.

## Lumbricals (Foot)

