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SHSS5062 Ankle Foot Arthrokinematics



By the end of this session...

- Students should be able to
 - Understand the arthrokinematics of normal movement in the
 - Talocrural
 - Inferior Tibiofibular
 - Subtalar
 - Midtarsal
 - Hallux Metatarsophalangeal



The foot and ankle complex

- The Complex doesn't need to be complex
- 28 irregularly shaped bones
- 30 + joints
- 32 muscles
- 100+ ligaments
- High requirements



The foot and ankle complex

- Ankle (talocrural joint)
- Foot
 - Rearfoot (subtalar joint: talus and calcaneus)
 - Midfoot (midtarsal joint: all tarsal bones)
 - Forefoot (metatarsals and phalanges)
- Movement of the foot and ankle is inter-related
- Action at one single joint will effect other joints
- Coupled movements



Talocrural (Tibia)

- Distal end expands to accommodate loads
- More prominent on medial side (medial malleolus)
- Lateral side – fibular notch
- Tibia rotates externally by 20-30° relative to proximal end
- Lateral tibial torsion



Talocrural (Fibula)

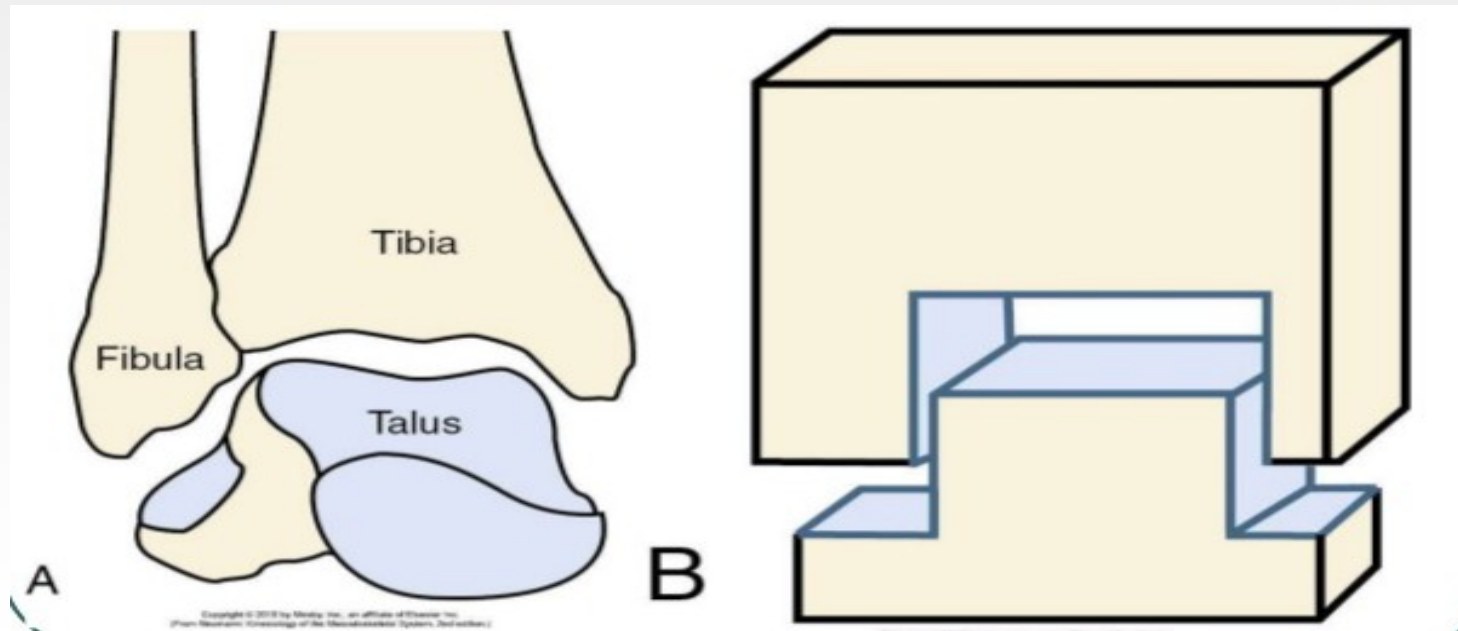
Slender and shall only transfer about
10% BW

- Lateral malleolus is longer than medial
- Functions as a pulley for the peroneus longus and brevis tendons



Talocrural (Talus)

- Wedge shaped (wide at front)
- Dorsal surface is domed (convex A-P slightly concave M-L)
- Head of talus
- Neck of talus
- Lined with 3mm of articular cartilage which compresses by 30-40% under peak physiological loading
- Protects subchondral bone





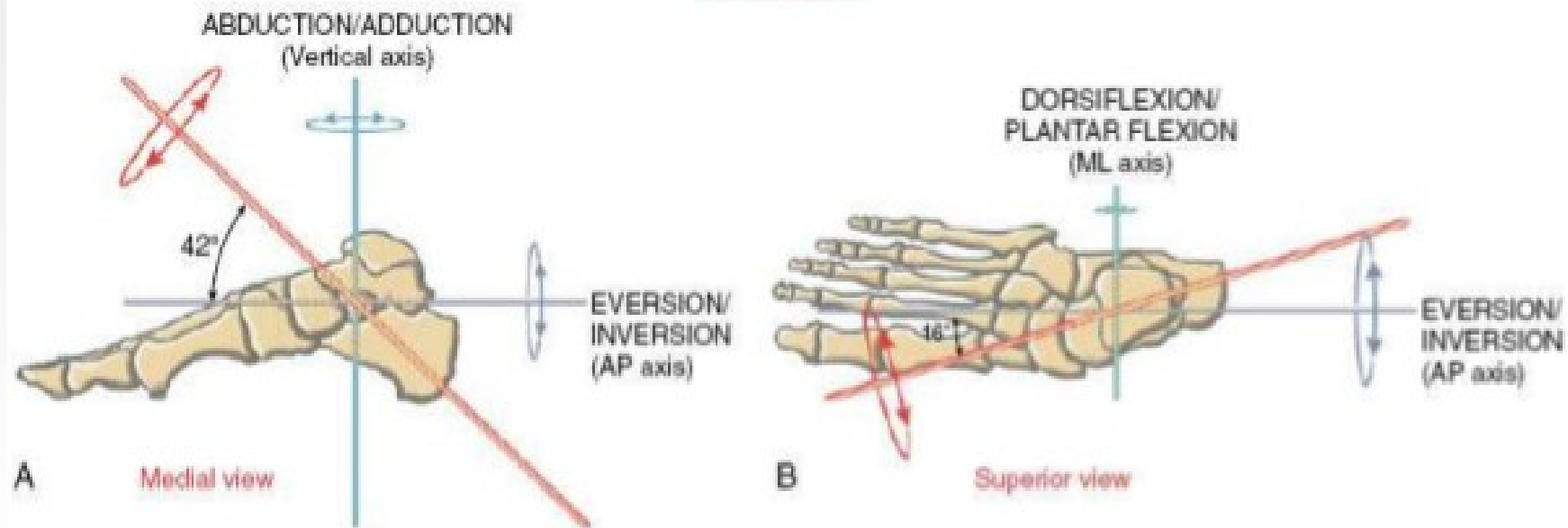
Inferior Tibiofibular

Syndesmosis joint

- Fibrous synarthrodial joint closely bound by interosseous membrane
- Supported by Anterior and Posterior (Distal) Tibiofibular ligaments
- Very little movement (2mm in FWB DF)



Subtalar joint





Subtalar (Calcaneus)

- Largest tarsal bone
- Impact at heel strike
- Roughened tuberosity for the attachment of Achilles Tendon
- Articulation with talus
 - Calcaneus is convex
 - Talus is concave
- Sinus tarsi (canal)
- Sustentaculum Tali (shelf for the talus)



MidTarsal

- Transverse tarsal joint
 - Talonavicular
 - Calcaneocuboid
- Distal intertarsal joint
 - Cuneonavicular
 - Cuboideonavicular
 - Intercuneiform
 - Cuneocuboid complex

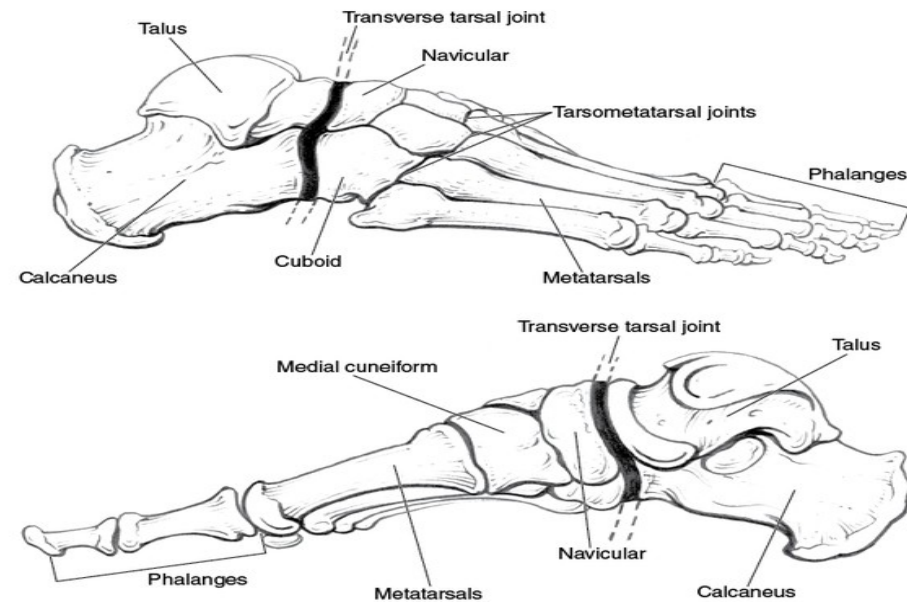


Figure 11.38 The transverse tarsal joint is composed of the talonavicular and calcaneocuboid joints.



MidTarsal

Midtarsal (Navicular)

- Concave articulation to talus creates talonavicular joint
- 3 flat facets that articulate with all 3 cuneiforms
- Tuberosity of navicular (Tibialis Posterior and spring ligament)

Midtarsal (Cuneiforms)

- Wedge
- Spacer between Navicular and base of 3 metatarsal bones
- Transverse arch of the foot



MidTarsal

Midtarsal (Cuboid)

- Cube – 6 sides
- 3 articulations
 - Calcaneus
 - 4 and 5 metatarsal bases
 - Groove occupied by peroneus longus



Forefoot

- Tarsometatarsal
- Intermetatarsal
- Metatarsophalangeal
- Interphalangeal



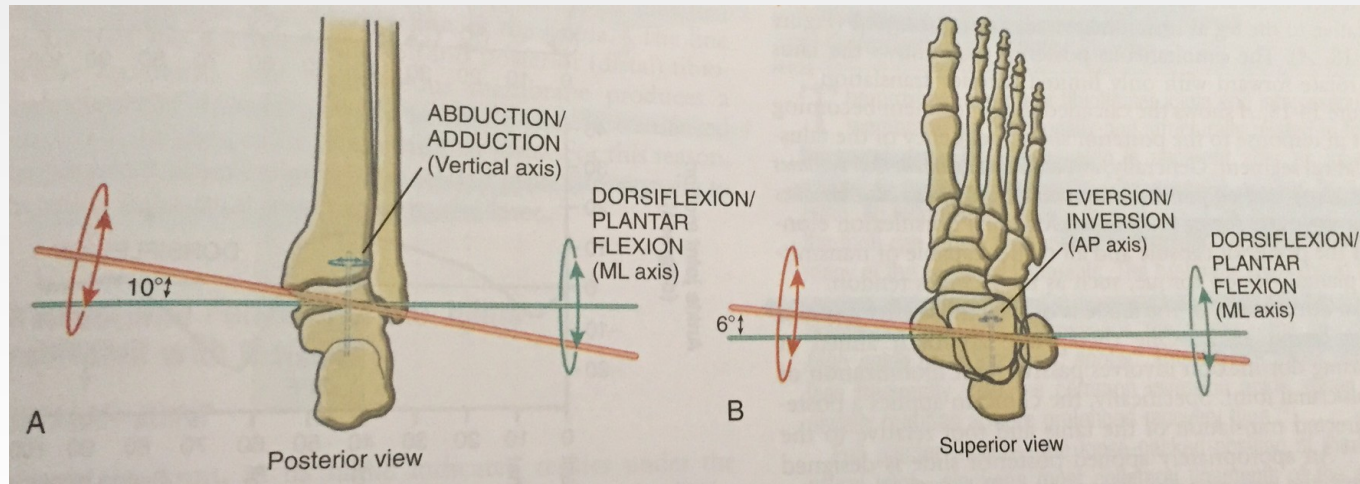
Forefoot

Hallux Metatarsophalangeal Joint

- Sesamoid bones under the head of 1st MT
- Embedded in flexor hallucis brevis tendon
- Hallus Extension (dorsiflexion) important for propulsion



Osteokinematics



Dorsiflexion
associated with
eversion
(abduction)
Plantarflexion
associated with
inversion
(adduction)



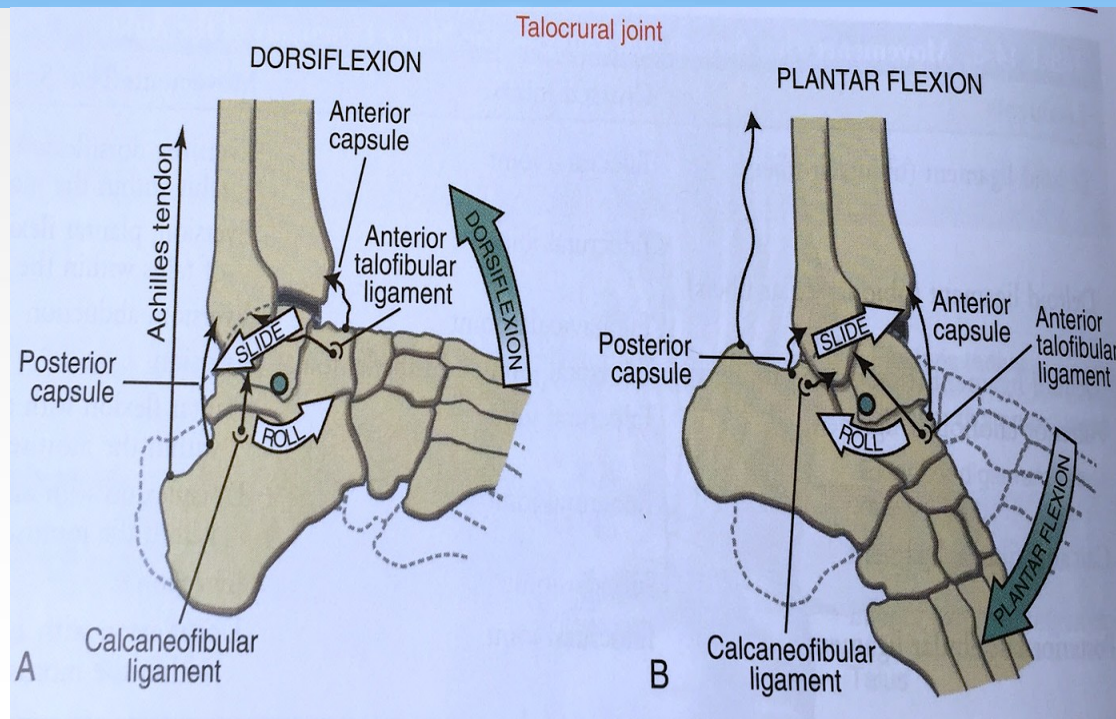
Osteokinematics

Osteokinematics

- Talocrural joint permits
 - 15-25° Dorsiflexion
 - 40-55° Plantarflexion
- Subtalar joint accessory movements may contribute 20% of talocrural ROM

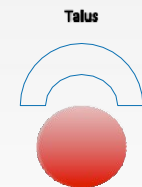
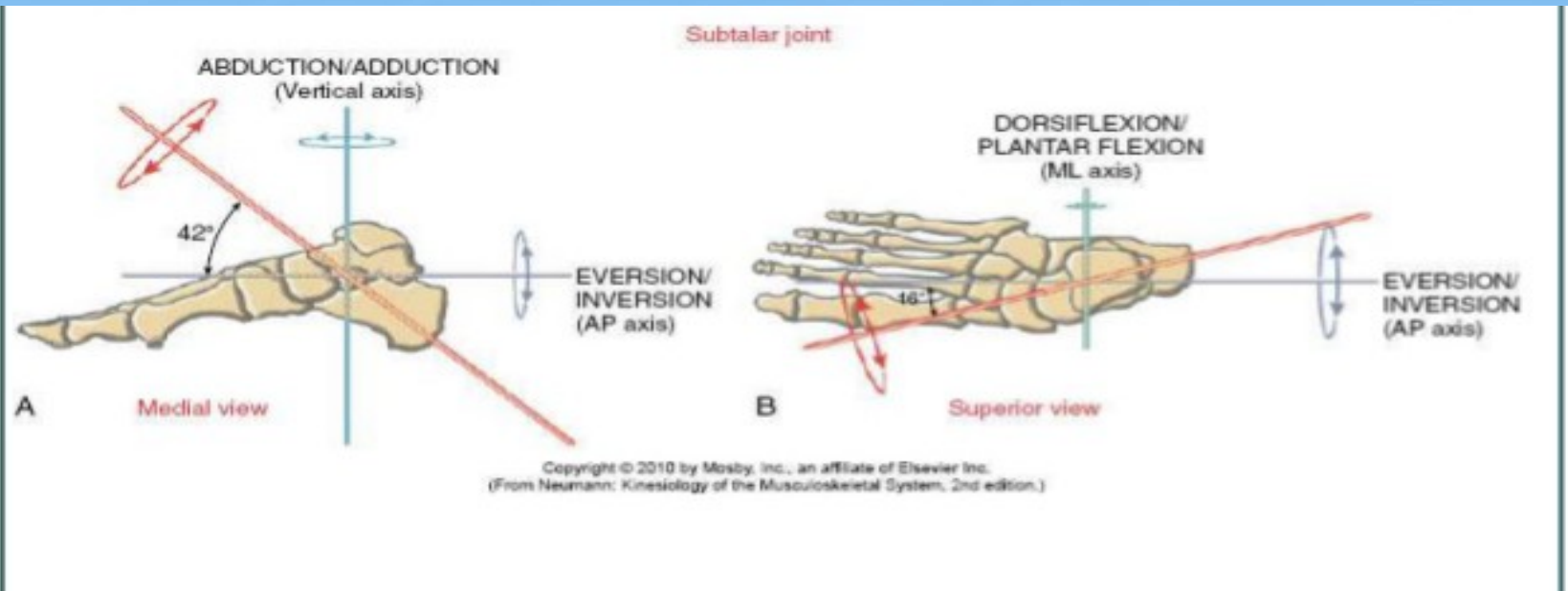


Osteokinematics



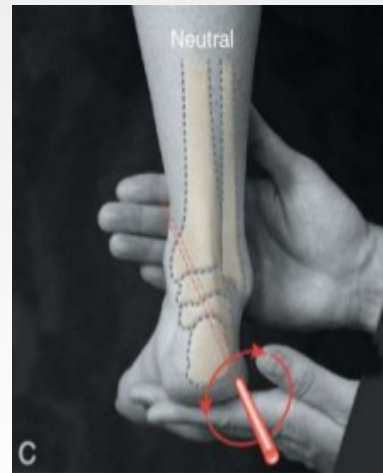


Osteokinematics





Osteokinematics



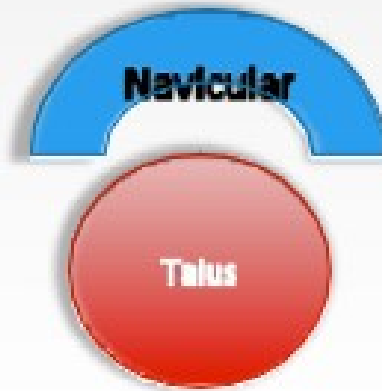
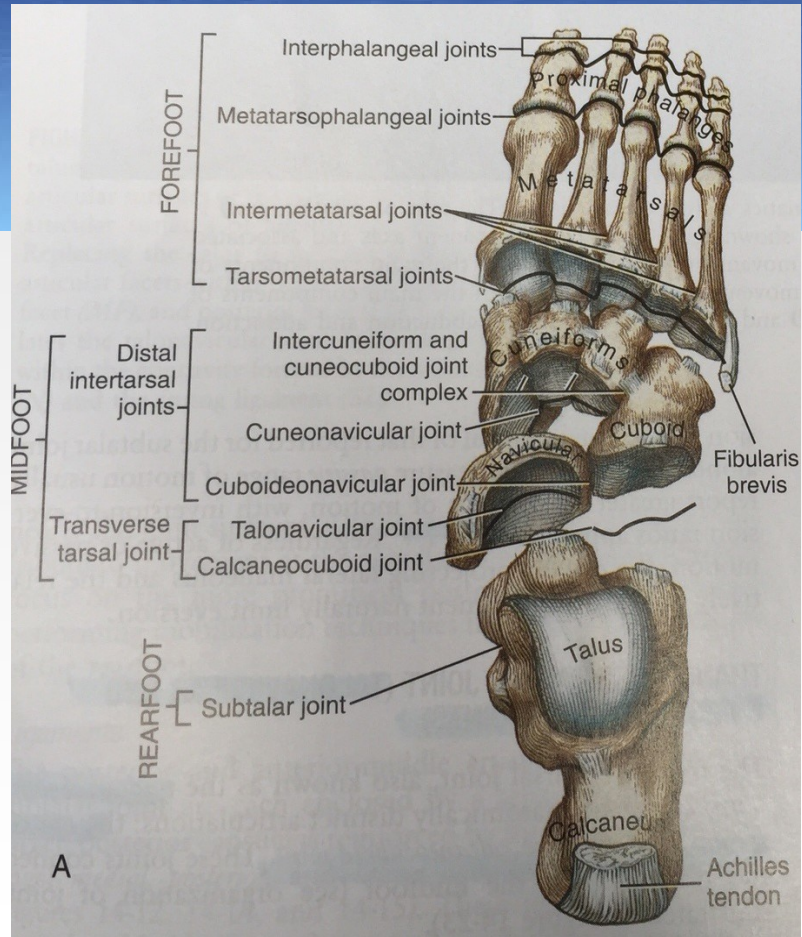


Osteokinematics

- Midtarsal joint
- Rarely moves without associated movement of subtalar joint



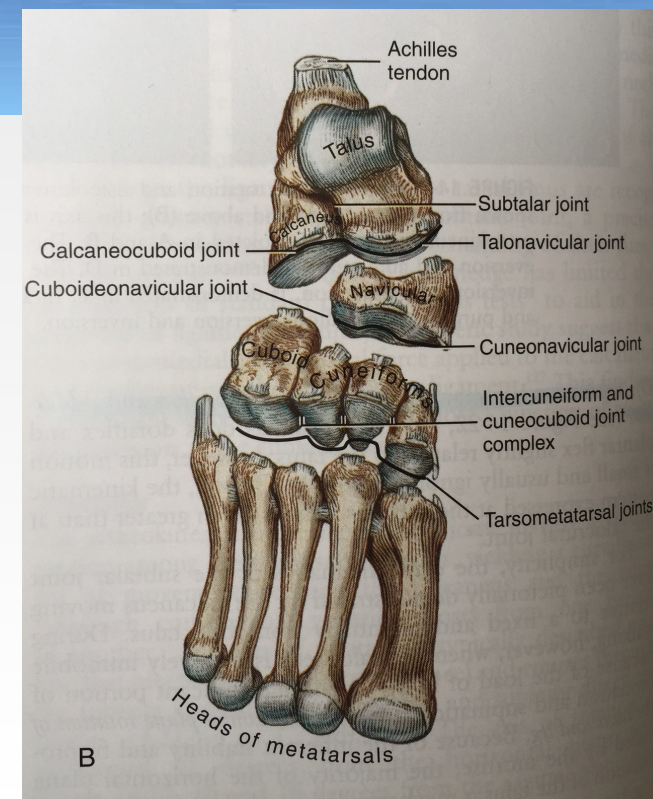
Osteokinematics





Osteokinematics

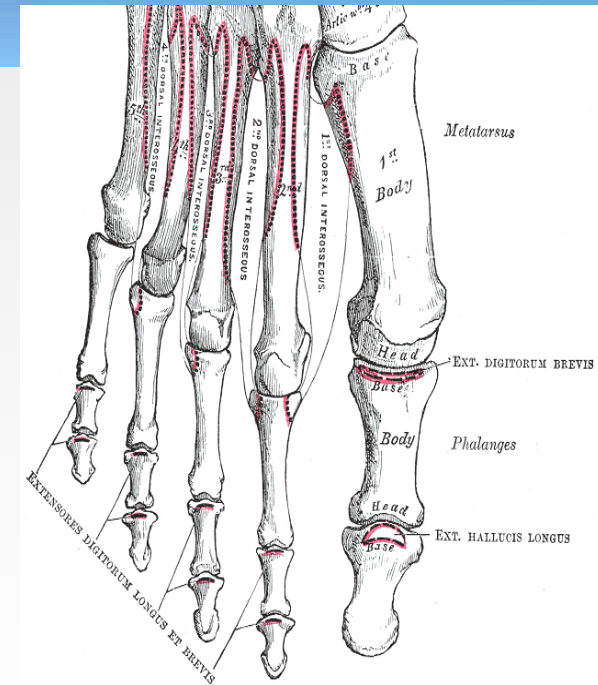
- Calcaneocuboid joint
- Inflexible
- Each surface is convex and concave
- Interlocking wedge that resists sliding
- Stability to lateral column of the foot





Hallux

- 1st Metatarsophlangeal joint (MTP)





Summary

Name of Joint	Convex surface	Concave surface
Inferior/ distal <u>Tibiofibular</u> joint		
Talocrural joint	Talus	Tibia (fibula)
Subtalar joint	Calcaneus	Talus
Talonavicular joint	Talus	Navicular
Calcaneocuboid joint	Calcaneus and cuboid	Calcaneus and cuboid
1 st MTP	1 st MT	Phalange



Ankle Task

Now go away and list as many structures in the foot and ankle you can. Include the major joints, bones, muscles, ligaments and tendons.