

Virtual Anatomy Lab: Study notes

Week 3

OSTEOLOGY

The following are important anatomical landmarks.

- (1) **Tibia:** the tibial tuberosity, the anterior border of the shaft and the medial malleolus.
- (2) **Fibula:** The proximal end with the head and neck and the distal end's lateral malleolus.
- (3) **The bones of the foot.** The foot is made up of 7 **tarsal bones**, 5 **metatarsal bones** and the **phalanges**. The tarsal bones are talus, the **calcaneum**, the **navicular bone**, the **Cuboid bone**, and the 3 **Cuneiform Bones** (medial, intermediate and lateral). For the five metatarsal bones note the tuberosity of the fifth metatarsal.

ANKLE JOINT

The ankle joint is a uniaxial synovial hinge joint. The joint surfaces (the mortise and the trochlea of the talus) are covered by articular cartilage. **The mortise** is the lower surface of the tibia and the inner surfaces of the medial and lateral malleoli.

FIBROUS CAPSULE AND COLLATERAL LIGAMENTS

The fibrous capsule is attached to the edges of the joint surfaces except anteriorly, where it extends as far as the neck of the talus. It is thin anteriorly and posteriorly. The fibrous capsule is formed by 2 ligaments:

- (1) The **medial collateral ligament (deltoid ligament)**, which connects the medial malleolus to the medial tarsal bones.
- (2) The **lateral collateral ligament**, which is made up of 3 parts: the anterior portion known as the anterior talofibular ligament; the middle portion known as the calcaneofibular ligament and the posterior portion known as the posterior talofibular ligament.

The **synovial capsule** lines the non-articular surfaces.

Clinical note: An inversion injury of the ankle involves a sprain (rupture) of the lateral collateral ligament. A minor sprain affects the anterior portion (anterior talofibular ligaments) whereas a moderate sprain affects the anterior

and middle portions. A major sprain involves all 3 portions of the ligament.

MOVEMENTS

- (1) **Dorsiflexion:** Dorsiflexion is achieved by the muscles of the anterior compartment of the leg. (**L 4, 5**)
- (2) **Plantar flexion:** Plantar flexion is caused by the muscles of the posterior compartment of the leg, except for the popliteus muscle, and the muscles of the lateral compartment of the leg. Of the muscles of the anterior compartment, the triceps surae (gastrocnemius, soleus) are the most powerful. (**S 1, 2.**)

The ankle joint is very stable in the dorsiflexion position. The wider anterior portion of the trochlea of the talus is grasped between the 2 malleoli and the tibiofibular interosseous ligaments are stretched. The joint is less stable in the plantar flexion position, as the narrower posterior portion of the trochlea is in the relatively wide space between the 2 malleoli.

Note: Inversion and eversion are not ankle movements. These movements occur in the following intertarsal joints:

- (1) The **calcaneocuboid joint**. This is a joint between the adjacent surfaces of the 2 bones.
- (2) The **subtalar joints**. This is a joint between the inferior facets of the talus and the superior facets of the calcaneum.
- (3) The **talocalcaneonavicular joint**. This is a ball & socket joint between the head of the talus, the posterior surface of the navicular, the superior surface of the sustentaculum tali and the spring ligament (plantar calcaneonavicular ligament).

Inversion is caused by L 4, 5 (innervation to the tibialis anterior & the tibialis posterior).

Eversion is caused by L 5, S 1 (innervation to the peroneus longus, peroneus brevis and peroneus tertius). [N.B. The terms Peroneus and Fibularis are synonymous]

SOLE OF THE FOOT

- (1) **Plantar Aponeurosis.** The plantar aponeurosis is the deep fascia, triangular in shape,

which is in the central part of the foot.

- (2) **Muscle layers.** There are 4 muscle layers of the sole of the foot. The first layer is composed of three muscles: the **abductor hallucis**, the **flexor digitorum brevis**, and the **abductor digiti minimi**. The second layer is formed by 2 tendons and 2 muscle groups. They are the tendon of the **flexor hallucis longus**, the **tendon of the flexor digitorum longus** and the **quadratus plantae muscle** (4 Lumbricals). The third layer is composed of 3 muscles. They are the **flexor hallucis brevis**, the adductor hallucis and the flexor digiti minimi brevis. The fourth layer is made up of 2 tendons and 2 muscle names. They are the tendon of the **peroneus longus**, the **tendon of the tibialis posterior**, the 3 **plantar interosseous (P.A.D.)** and the 4 **dorsal interosseous (D.A.B.)**.

NB: The abduction and adduction of the toes are in relation to the axis of the second toe.

NEUROVASCULAR SYSTEM

The **medial** and **lateral plantar nerves** are the terminal branches of the tibial nerve. Together with the plantar arteries, they pass between the 1st and 2nd muscle layers. The deep branch of the lateral plantar nerve goes between the 3rd and 4th layers with the plantar arch. The lateral plantar nerve innervates the skin of the lateral plantar surface of the foot and the lateral 1.5 toes. The medial plantar nerve innervates the skin of the medial plantar surface of the foot and the medial 3.5 toes.

The **medial** and **lateral plantar arteries** are the terminal branches of the posterior tibial artery. The lateral plantar artery forms the plantar arch.

PLANTAR ARCHES

To support the weight of the body, distribute this weight and have a lever effect during walking, the foot has 3 arches.

These arches are not rigid, but elastic. They collapse under a weight and recover their shape when the weight is removed, which helps absorb and cushion shocks.

I. The medial longitudinal arch.

(Higher than the lateral arch).

- A. The keystone: Talus.
- B. The posterior pillar: Calcaneus.
- C. The anterior pillar: Navicular, 3 cuneiforms, 3 medial metatarsals.

II. The longitudinal lateral arch.

- A. The keystone: Cuboid.
- B. The posterior pillar: Calcaneus.
- C. The anterior pillar: the 2 lateral metatarsals.

III. The transverse arch.

- A. Anteriorly: the base of the metatarsals.
- B. Posteriorly: the cuneiform and cuboid bones.

N.B.: The transverse arches of both feet together form a half dome so that the weight of the body can be distributed evenly during standing or walking.

The factors maintaining the arches are:

1. The shape of the bones.

2. The presence of the plantar aponeurosis and the plantar ligaments:

- **The plantar aponeurosis links the pillars of the longitudinal arches.**
- **Spring ligament** (plantar calcaneonavicular ligament). “The medial arch”.
- **Short plantar ligament** (plantar calcaneocuboid ligament). “The lateral arch”.
- **Long plantar ligament (long calcaneocuboid ligament).** “The medial arch”.
- **Deep transverse metatarsal ligaments** (joins the heads of the metatarsals). “The transverse arch”.

3. The intrinsic tendons and muscles of the foot. “They are not important for standing, but they play a very important role in walking and running.

- a. The tendons of the peroneus longus and peroneus brevis and the flexor digitorum longus. “The lateral arch”.
- b. The tendon of the peroneus longus. “The transverse arch”.

- c. The tendons of the flexor hallucis longus, the tibialis posterior and the tibialis anterior “The medial arch”.

Clinical note. Flat feet (pes planus). This condition is valgus of the hindfoot and is characterized by collapsed longitudinal arches. When the spring ligament is stretched, the head of the talus descends towards the plantar surface. Note that the term pronation must not be used in the case of flat feet, as pronation and supination are terms reserved for the position of the forefoot in relation to the neutral position of the hindfoot.

MOVEMENTS OF THE TOES

- (1) **Extension:** The extensor digitorum and extensor are innervated by L 5, S 1.
- (2) **Flexion:** The flexor digitorum and flexor hallucis are innervated by S 2, 3.