

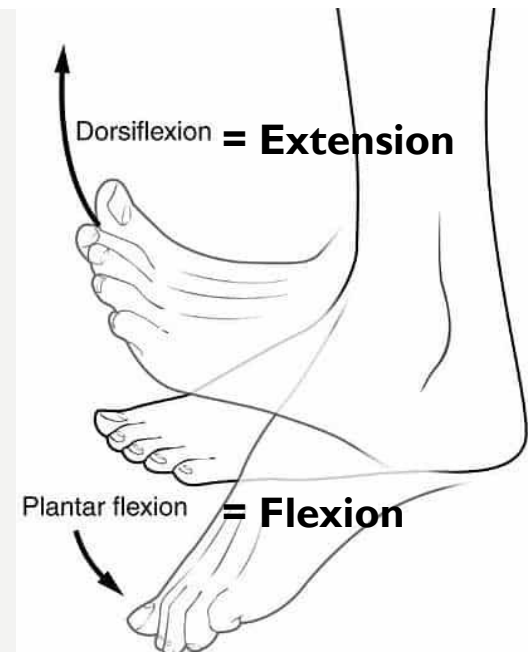
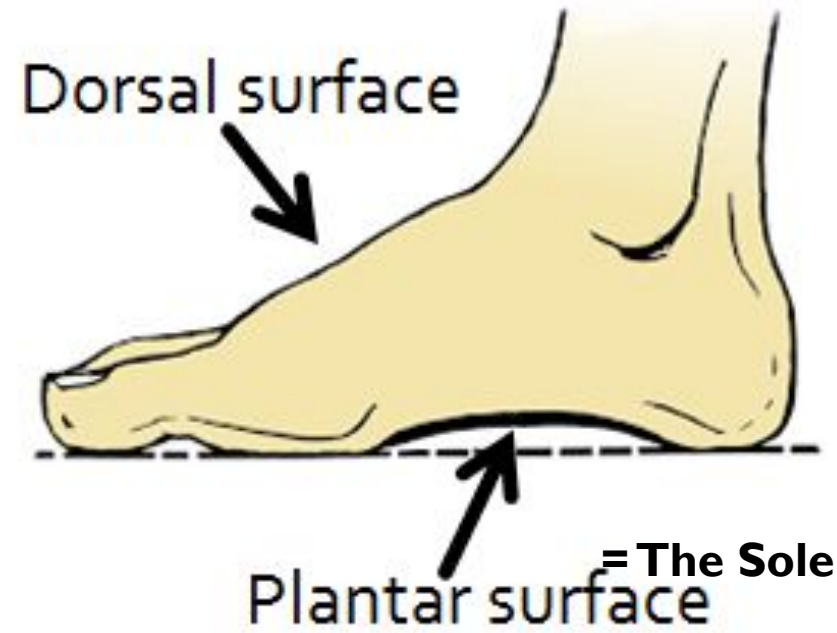
FOOT & ANKLE

PREPARED BY: DR.YASER HAMAM

FOOT

❑ The foot bones can be divided into (hind foot, midfoot, and forefoot)

1. **Hindfoot:** formed of calcaneus and talus
2. **Midfoot:** formed of navicular, cuboid, and the cuneiforms
3. **Forefoot:** formed of metatarsals, and phalanges



BONES OF THE FOOT

- There are three groups of bones in the foot :

1. **The seven tarsal bones**, which form the skeletal framework for the ankle.
2. **Metatarsals (I to V)**, which are the bones of the metatarsus.
3. **The phalanges**, which are the bones of the toes-each toe has three phalanges, except for the great toe, which has two.

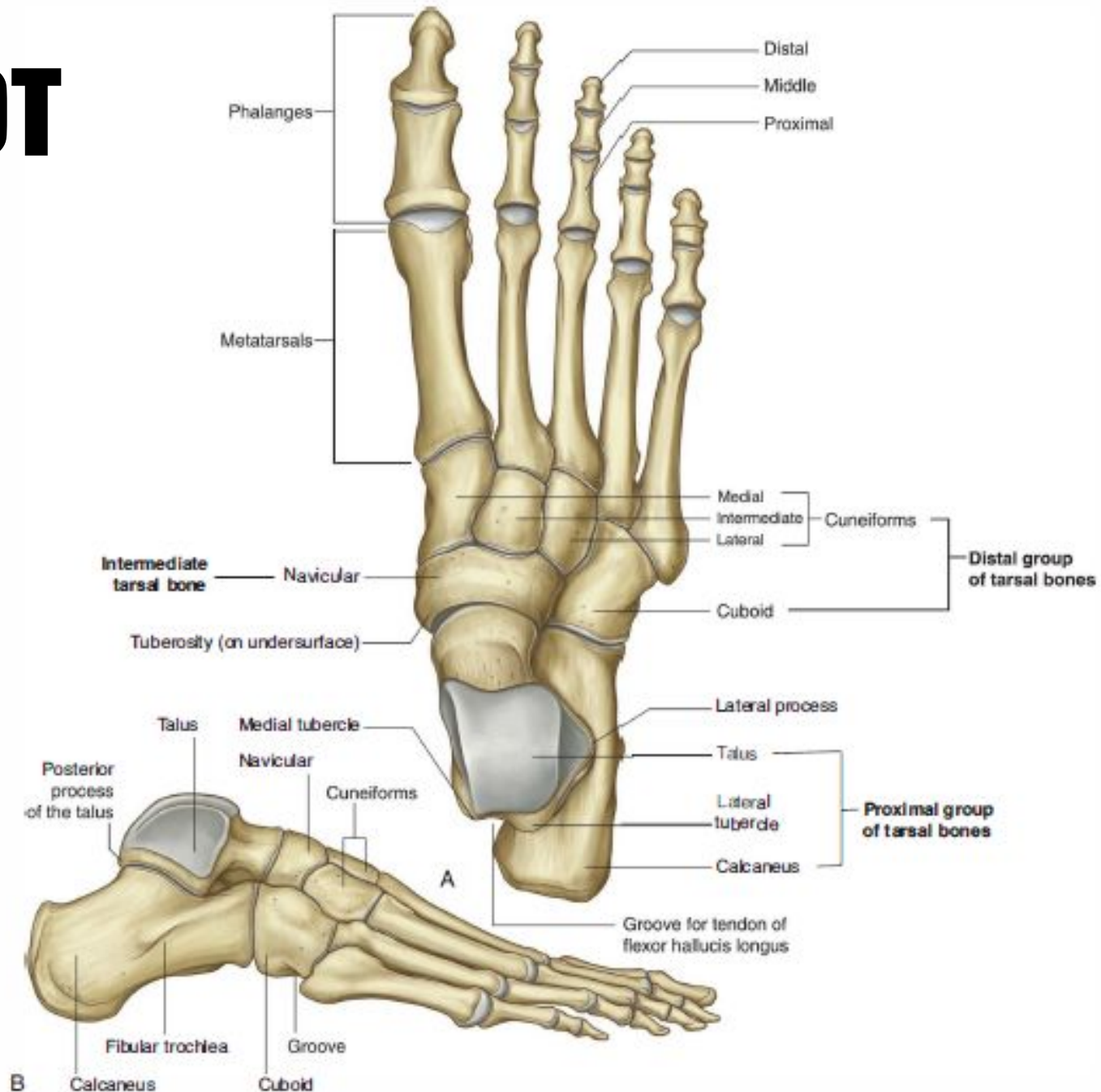


Fig. 6.92 Bones of the foot. A. Dorsal view, right foot. B. Lateral view, right foot.

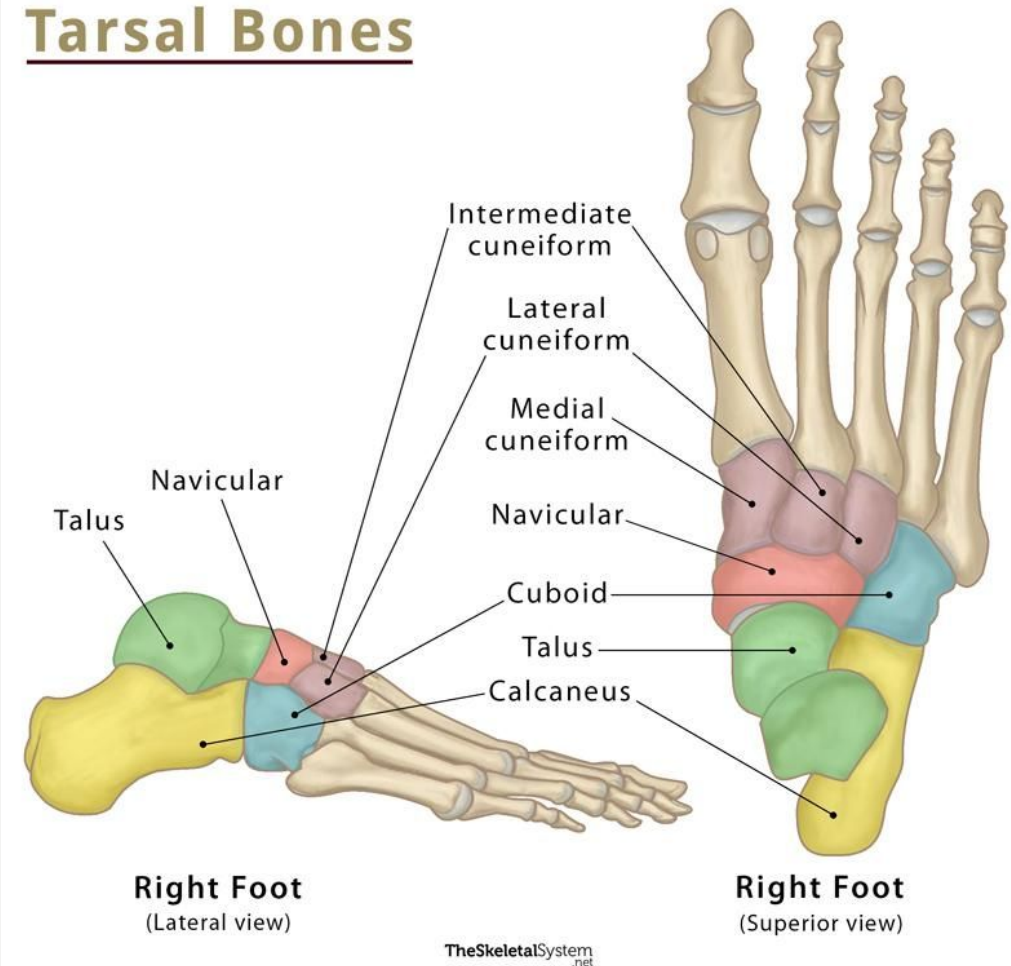
TARSAL BONES

- The tarsal bones are arranged in a proximal, intermediate, a distal groups:

1. **The proximal group (forefoot)** consists of two large bones, the **talus** (the most superior bone of the foot) and the **calcaneus** (the largest of the tarsal bones).
2. **The intermediate tarsal bone** on the medial side of the foot is the **navicular** (boat shaped).
3. **The distal group of tarsal bones** (from lateral to medial) consists of: **cuboid**, and **three cuneiforms** [lateral, intermediate, and medial cuneiform bones]

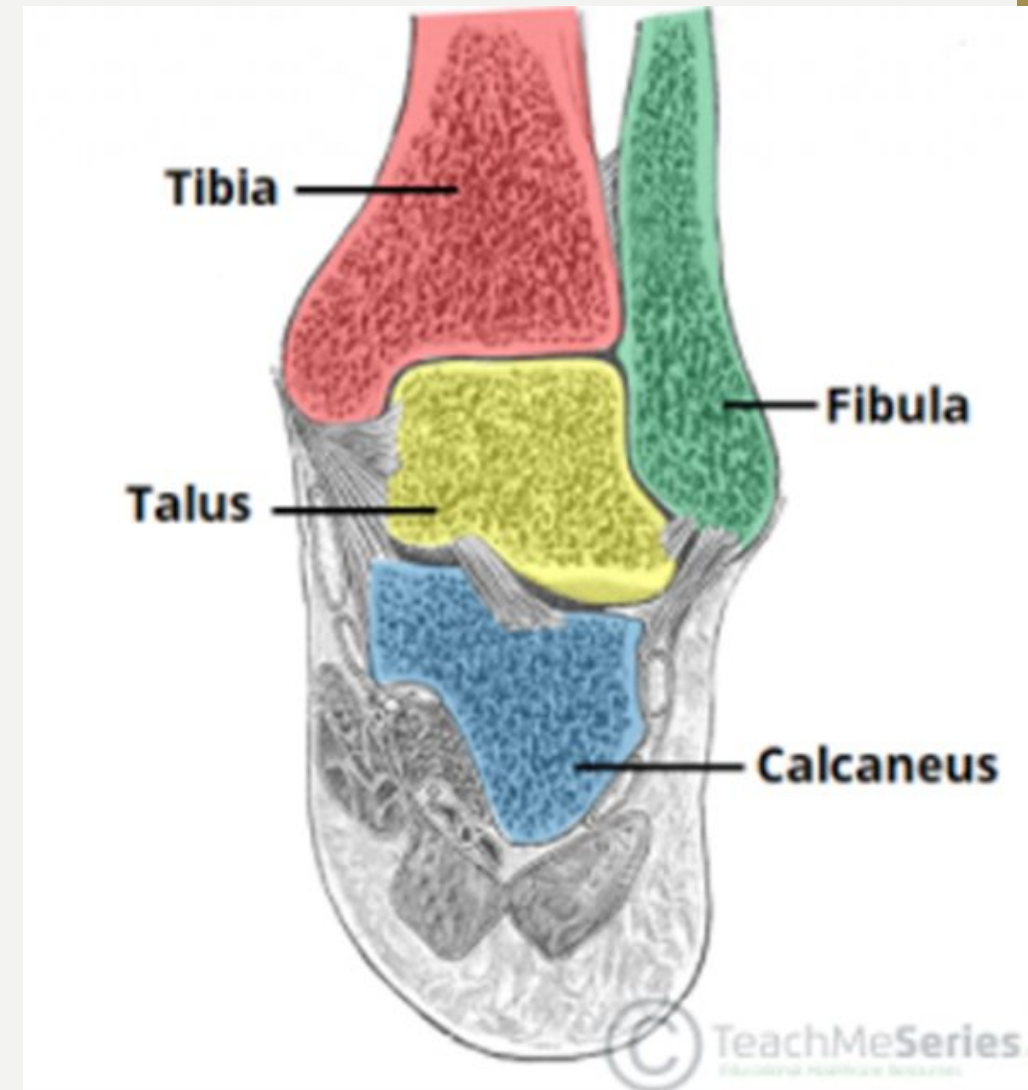
- The tarsal bones are
1. The calcaneum
 2. The talus
 3. The navicular
 4. The cuboid
 5. The three cuneiform bones.

Tarsal Bones



ANKLE JOINT

- The ankle joint (also known as the tibiotalar joint) forms the articulation between distal tibia, fibula with the dome of talus
- It is a hinge synovial joint lined with hyaline cartilage.
- The joint strong and stable, due to:
 1. The shape of the bones
 2. The strength of the ligaments and the surrounding tendons□ There are two groups of ligaments medial and lateral.



- ❑ **The medial (deltoid) ligament** is large, strong and triangular in shape.
- ❑ The medial ligament is subdivided into four parts based on the inferior points of attachment:
 1. Tibionavicular part
 2. Tibiocalcaneal part
 3. The posterior tibiotalar part
 4. The anterior tibiotalar part

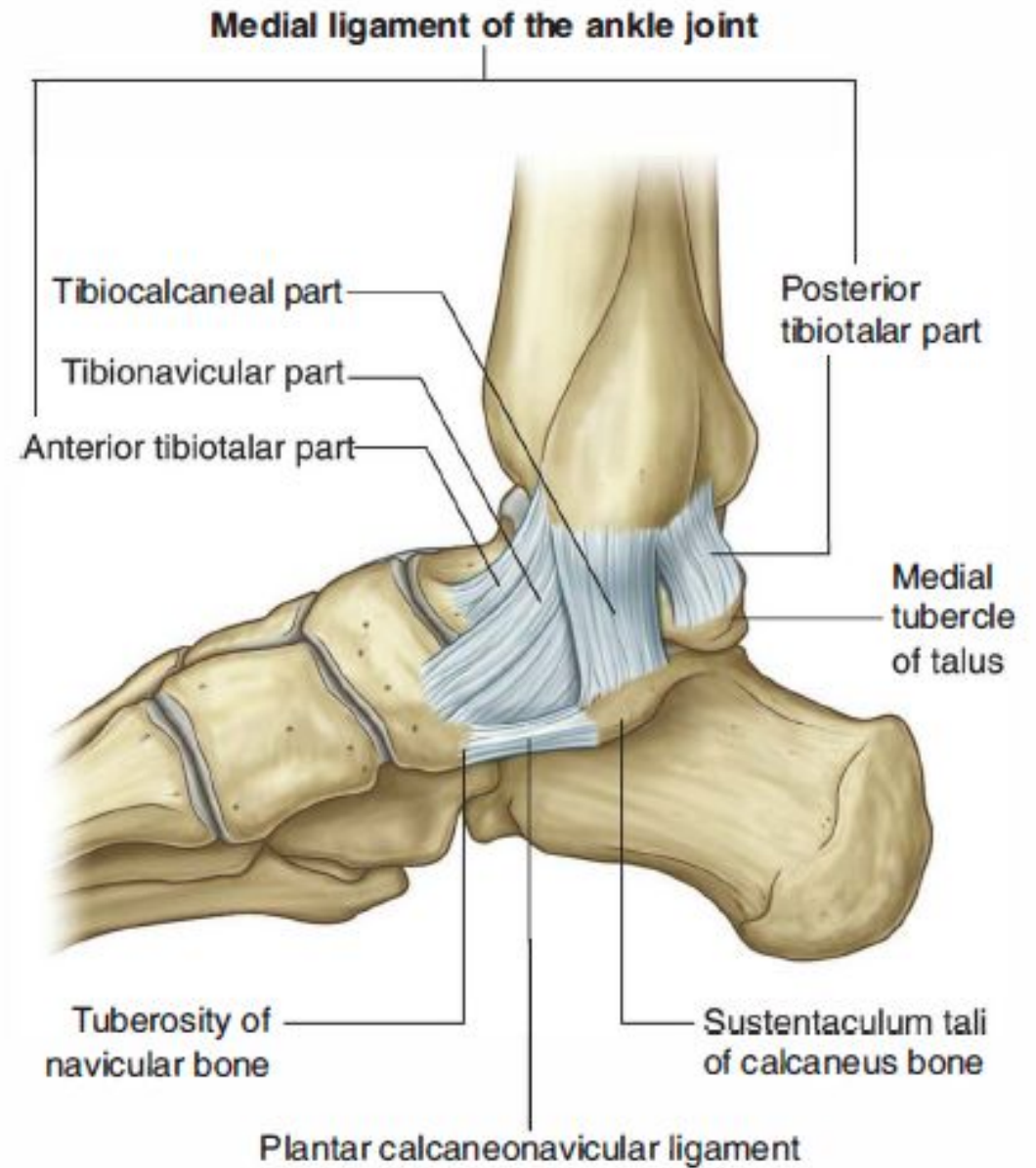
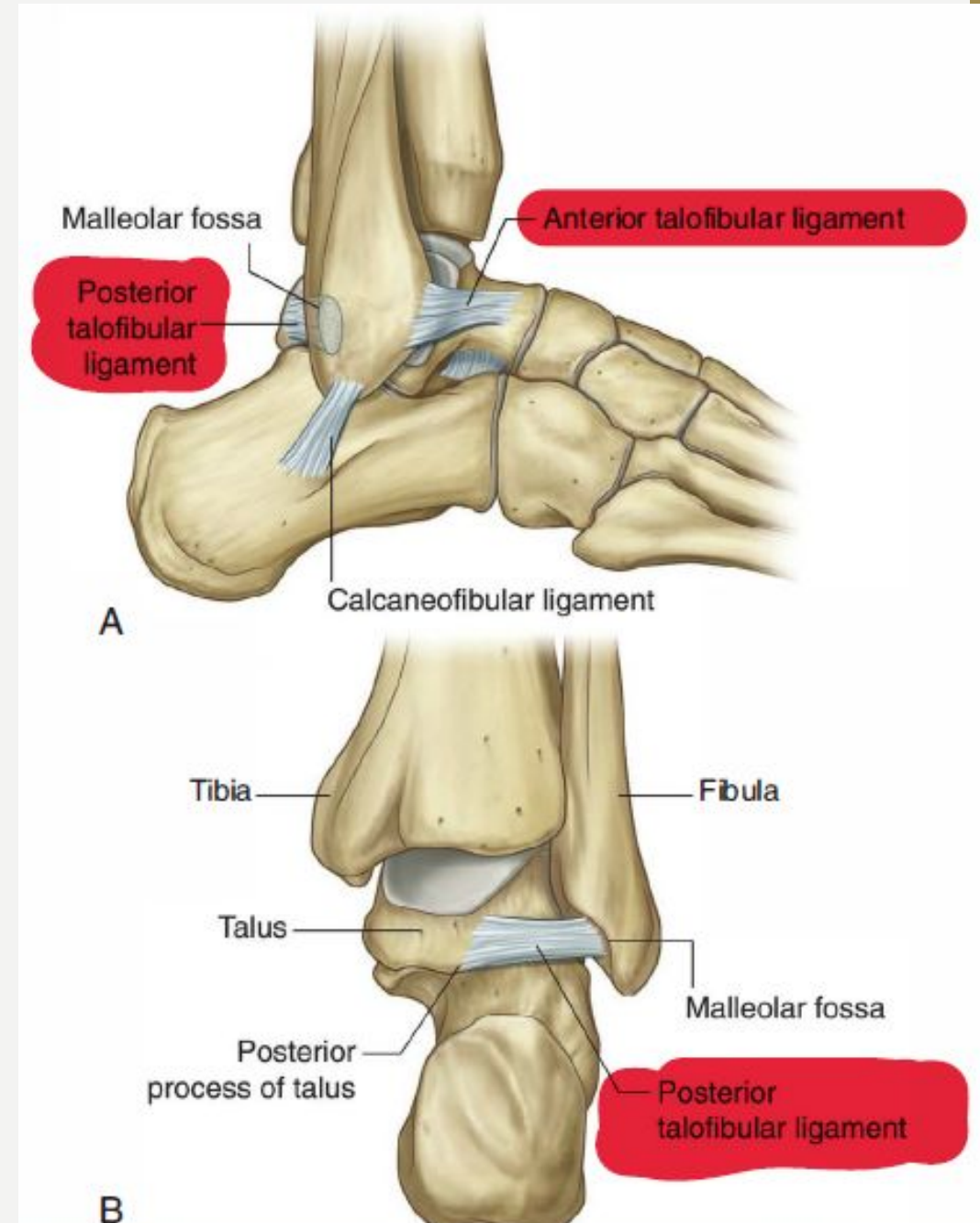


Fig. 6.98 Medial ligament of the ankle joint.

LATERAL LIGAMENT

- **The lateral ligament** of the ankle is composed of three separate ligaments:
 1. Anterior talofibular ligament.
 2. Posterior talofibular ligament.
 3. Calcaneofibular ligament.



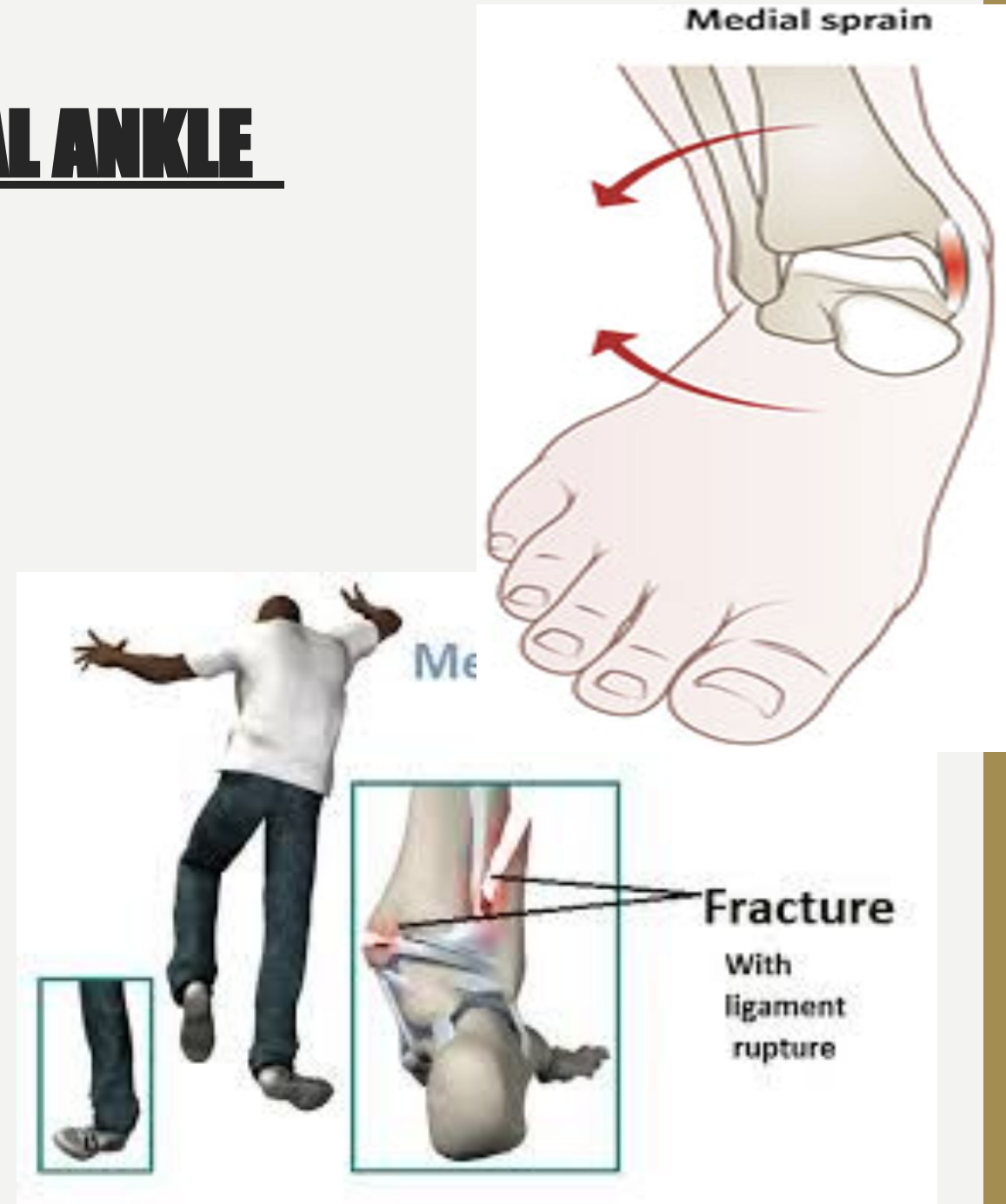
"ACUTE SPRAINS OF THE "LATERAL ANKLE

- Acute sprains of the lateral ankle are usually caused **by excessive inversion** of the foot **with plantar flexion** of the ankle.
- The **anterior talofibular ligament** and the **calcaneofibular ligament** are partially torn, giving rise to great pain and local swelling.
- **Anterior talofibular ligament** most commonly involved ligament in ankle sprains.



"ACUTE SPRAINS OF THE "MEDIAL ANKLE"

- Similar to but less common than those of the lateral ankle.
- They may occur to the medial or deltoid ligament as a **result of excessive eversion**.
- The great strength of the medial ligament usually results in the ligament **pulling off the tip of the medial malleolus**.



ACUTE SPRAINS OF THE ANKLE

Management:

- **Nonoperative:**

- ☐ RICE “**R**est, **I**ce, **C**ompression, and **E**levation”, elastic wrap to minimize swelling, rehabilitation with motion exercises.

- **Operative:**

- **Indications:**

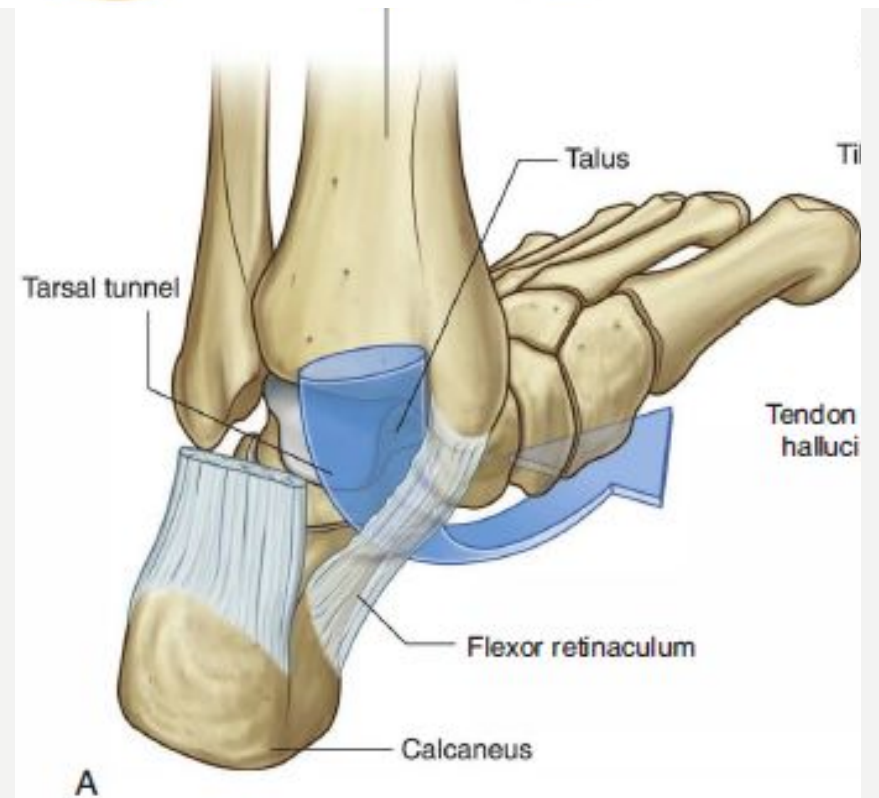
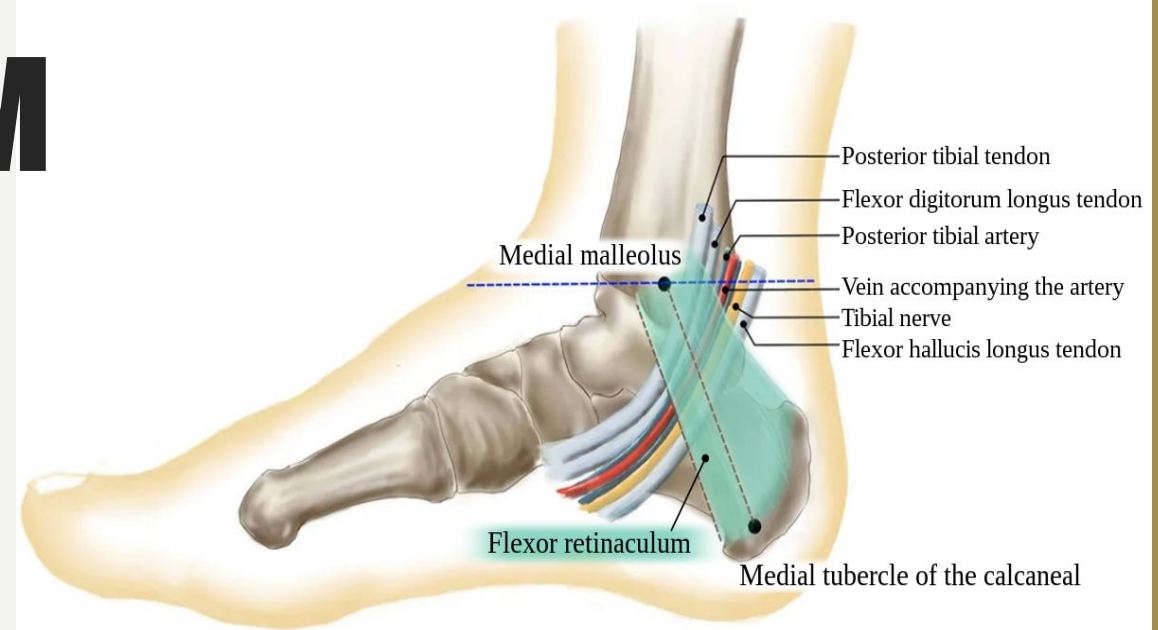
1. The patient continues to have pain and instability despite extensive nonoperative management
2. Associated with a bony avulsion

- **Surgical options:**

- ☐ Anatomic reconstruction
- ☐ Tendon transfer with tenodesis

FLEXOR RETINACULUM

- **The flexor retinaculum** is a strap-like layer of connective tissue that attaches above to the medial malleolus and below to the inferomedial margin of the calcaneus.
- **The tarsal tunnel** is formed on the posteromedial side of the ankle by:
 - A depression formed by the medial malleolus of the tibia, the medial and posterior surfaces of the talus, and the medial surface of the calcaneus
- And
 - An overlying flexor retinaculum



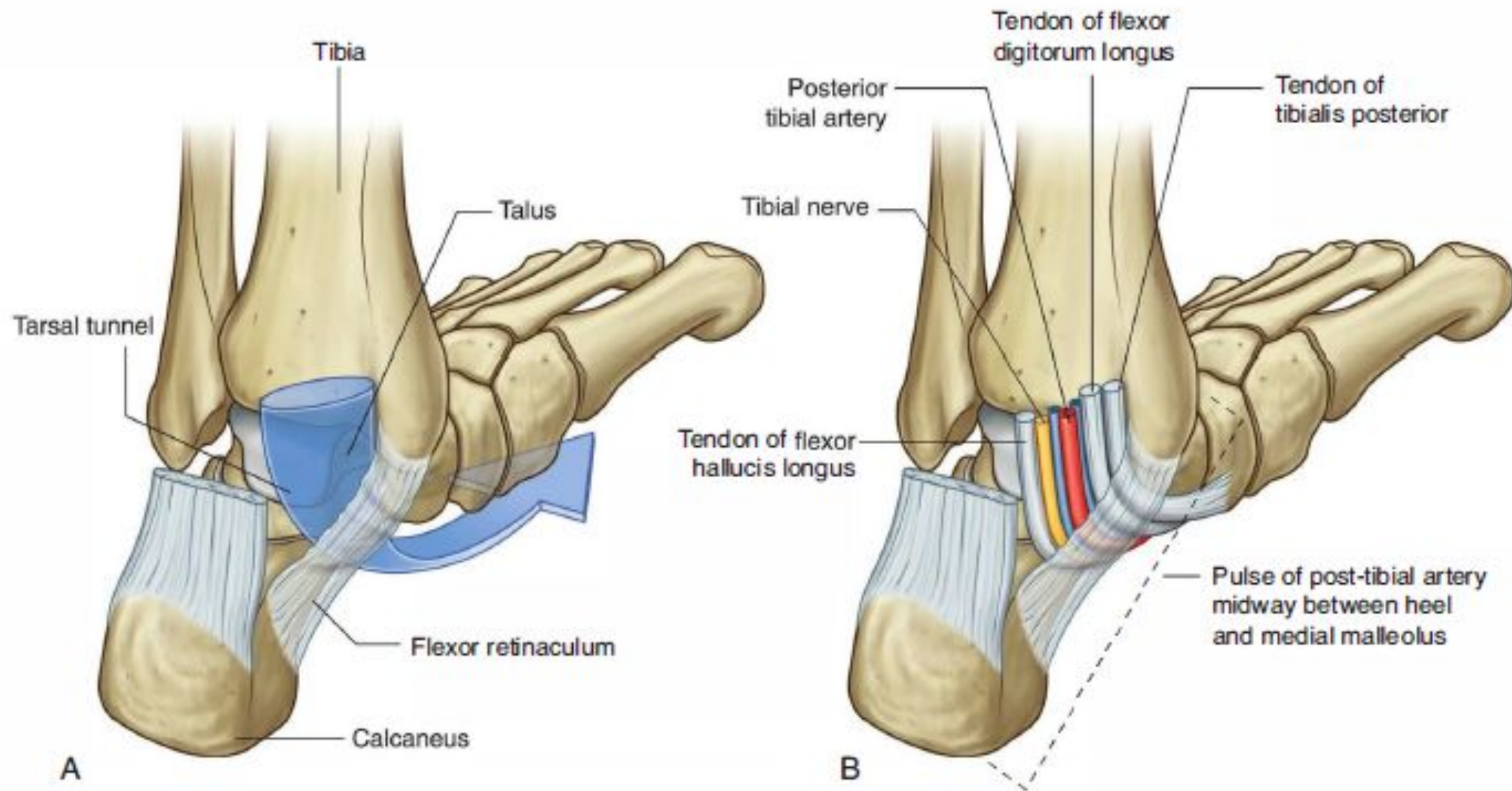
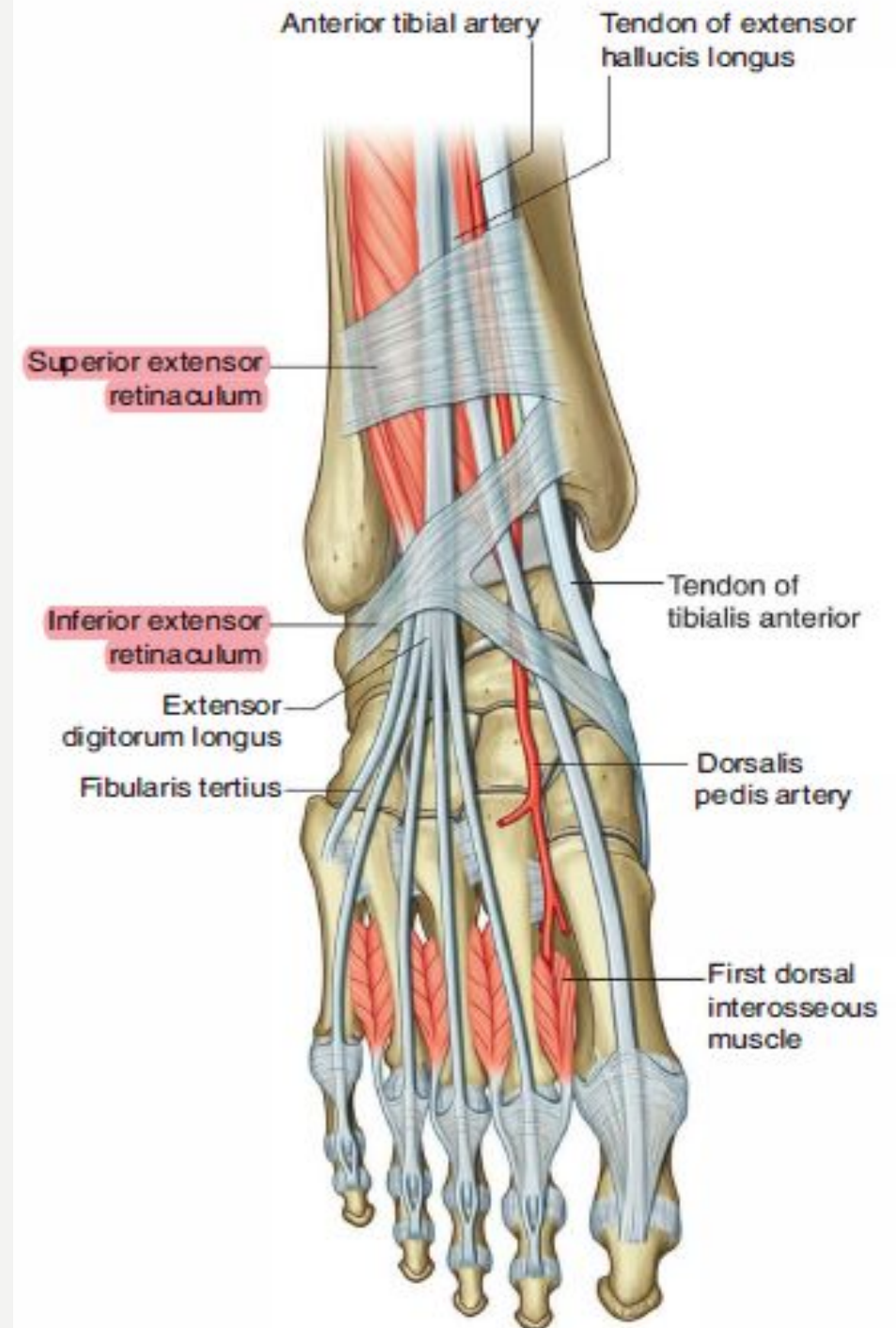


Fig. 6.105 Tarsal tunnel and flexor retinaculum. Posteromedial view. **A.** Bones. **B.** Tarsal tunnel and flexor retinaculum.

EXTENSOR RETINACULA

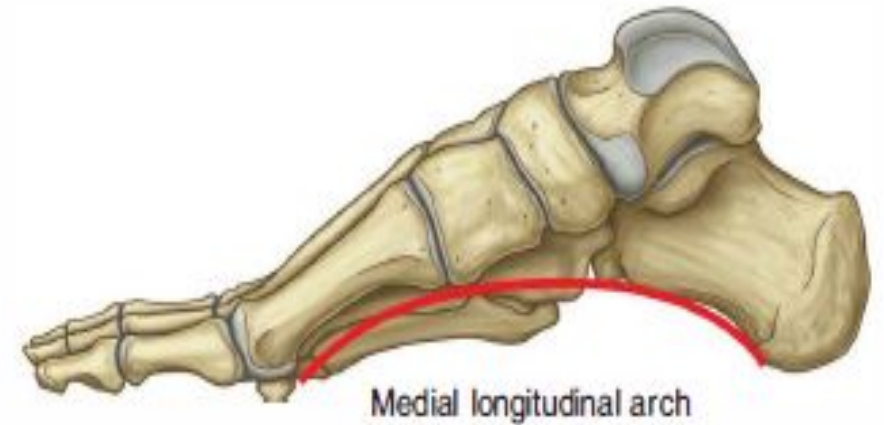
- Two extensor retinacula strap the tendons of the extensor muscles to the ankle region and prevent tendon bowing during extension of the foot and toes.

1. **A superior extensor retinaculum** is a thickening of deep fascia in the distal leg just superior to the ankle joint and attached to the anterior borders of the fibula and tibia.
2. **An inferior retinaculum** is Y-shaped, attached by its base to the lateral side of the upper surface of the calcaneus, and crosses medially over the foot to attach by one of its arms to the medial malleolus, whereas the other arm wraps medially around the foot and attaches to the medial side of the plantar aponeurosis.



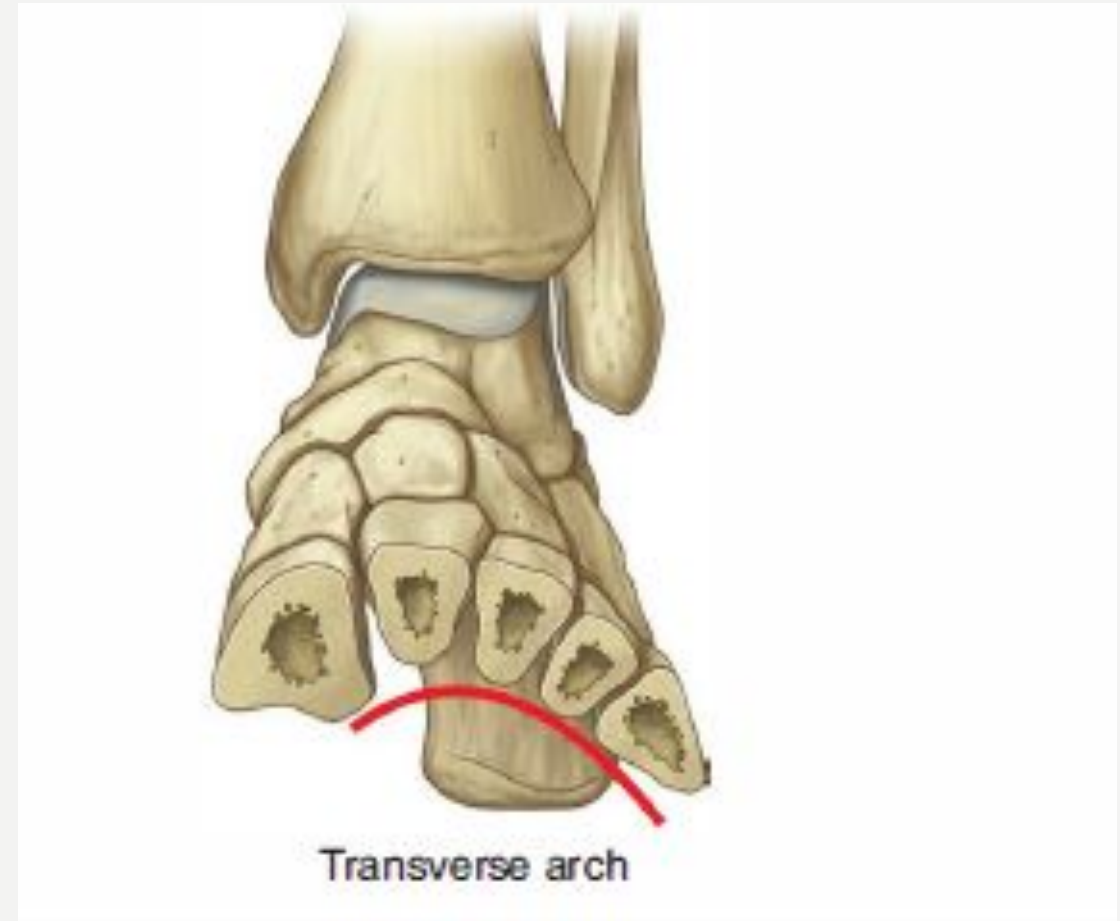
ARCHES OF THE FOOT

- There are **3 arches** in the foot: Medial longitudinal, lateral longitudinal, and anterior transverse arches
- **Role:** absorb and distribute downward forces from the body during standing and moving on different surfaces.
- **Longitudinal arch**
 - The longitudinal arch of the foot is **formed between the posterior end of the calcaneus and the heads of the metatarsals**.
 - Medial longitudinal arch is **higher than** lateral longitudinal arch



ARCHES OF THE FOOT

- **Trasverse arch:**
 - Made by Bases of Metatarsal bone, Cuboid, and 3 cuneiform bones.



PLANTER APONEUROSIS

- The plantar aponeurosis is a thickening of deep fascia in the sole of the foot.
- **Triangular in shape:**
 - **Posteriorly:** It is firmly anchored to the medial process of the calcaneus and extends forward as a thick band of longitudinally arranged connective tissue fibers.
 - **Anteriorly:** attaches to the heads of metatarsal bone it split to 5 processes.
- Functions
 - Firm attachment of skin of sole
 - Protection
 - Support arches

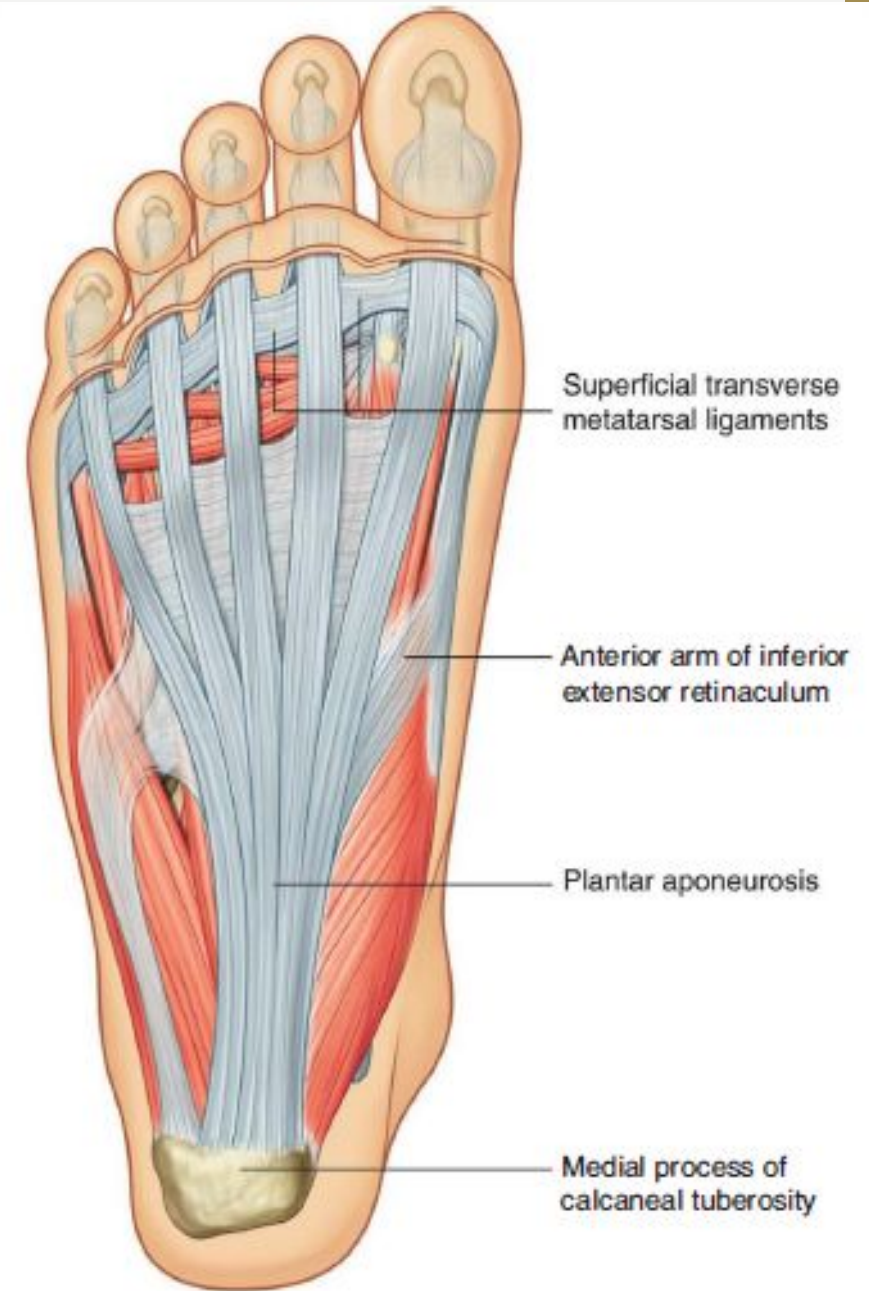


Fig. 6.110 Plantar aponeurosis.

MUSCLES OF SOLE OF FOOT

- There are 4 layers of muscles and tendons, separated by layers of fascia, where vessels and nerves lie.

- **First layer:** ~~3 Muscles~~

~~abductor hallucis, flexor digitorum brevis (FDB), abductor digiti minimi~~

- **2nd layer:** ~~= 4 lumbricals + 2 Muscles + 2 Tendons:~~

~~2 Muscles:~~

~~quadratus plantae~~

~~lumbrical muscles~~

~~2 Tendons:~~

~~flexor digitorum longus (FDL)~~

~~flexor hallucis longus (FHL)~~

- **3rd layer:** ~~3 Muscles~~

~~1. flexor hallucis brevis~~

~~2. oblique and transverse heads of the adductor hallucis~~

~~3. flexor digiti minimi brevis~~

- **4th layer:** ~~= 2 Muscles + 2 Tendons + 7 Interossei muscles~~

~~2 Muscles:~~

~~dorsal interosseous~~

~~plantar interosseus~~

~~2 Tendons:~~

~~peroneus longus~~

~~tibialis posterior~~

ARTERIAL SUPPLY

- Blood supply to the foot is by branches of the posterior tibial and dorsalis pedis arteries.

I. Posterior tibial artery:

- The posterior tibial artery bifurcates into **a medial plantar artery and a lateral plantar artery** (the larger branch).
- **Lateral plantar artery** run along the lateral side of the planter surface of the foot and reaches the **base of the 5th metatarsal** then curves medially to form **the deep plantar arch**.

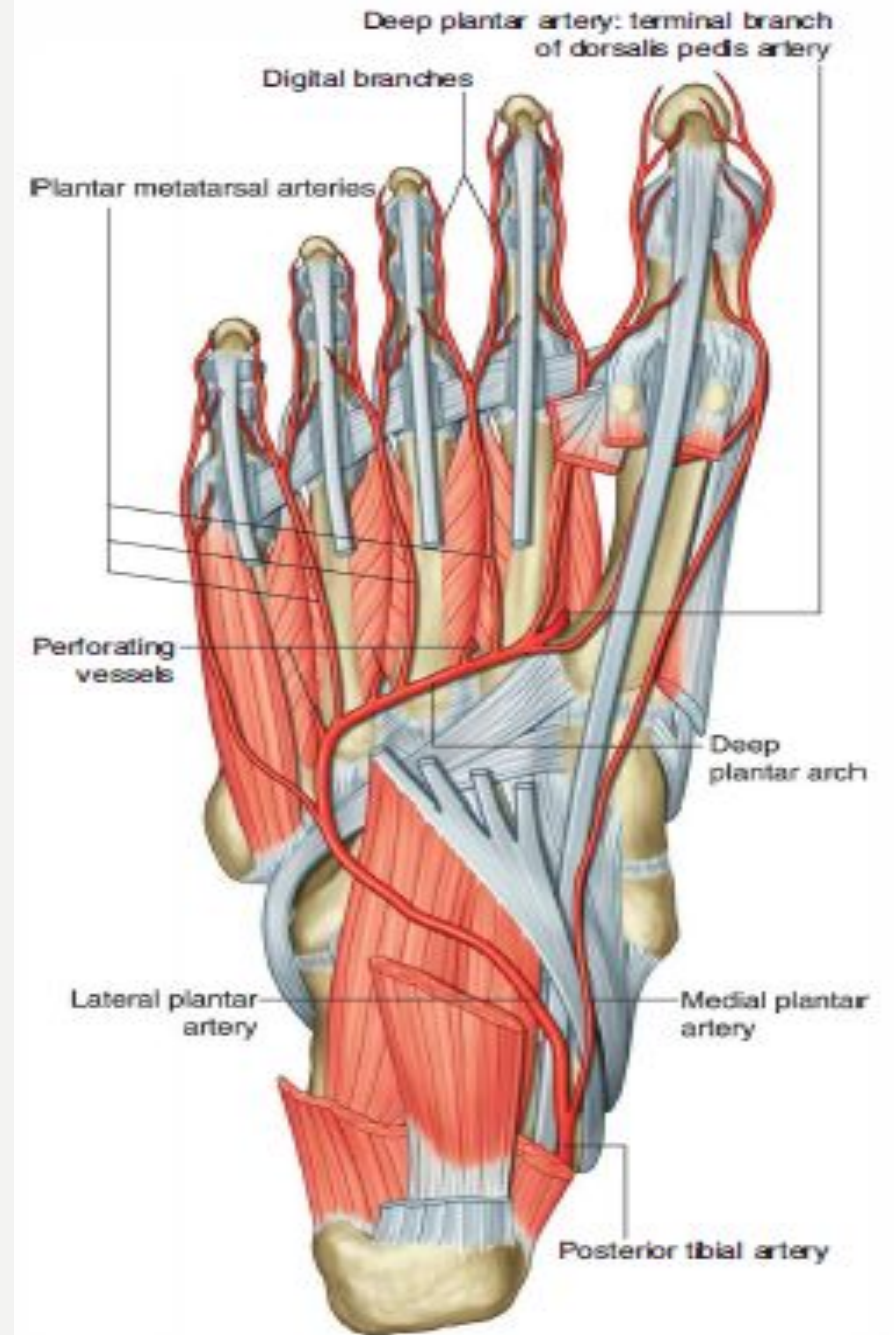


Fig. 6.118 Arteries in the side of the foot.

ARTERIAL SUPPLY

2- Dorsalis pedis artery:

- **Origin:** anterior tibial artery
- **Branches of the dorsalis pedis artery include:**
 1. Tarsal branches
 2. Arcuate artery
 3. First dorsal metatarsal artery
- **The arcuate artery** give rise to **dorsal metatarsal arteries, and dorsal digital arteries**

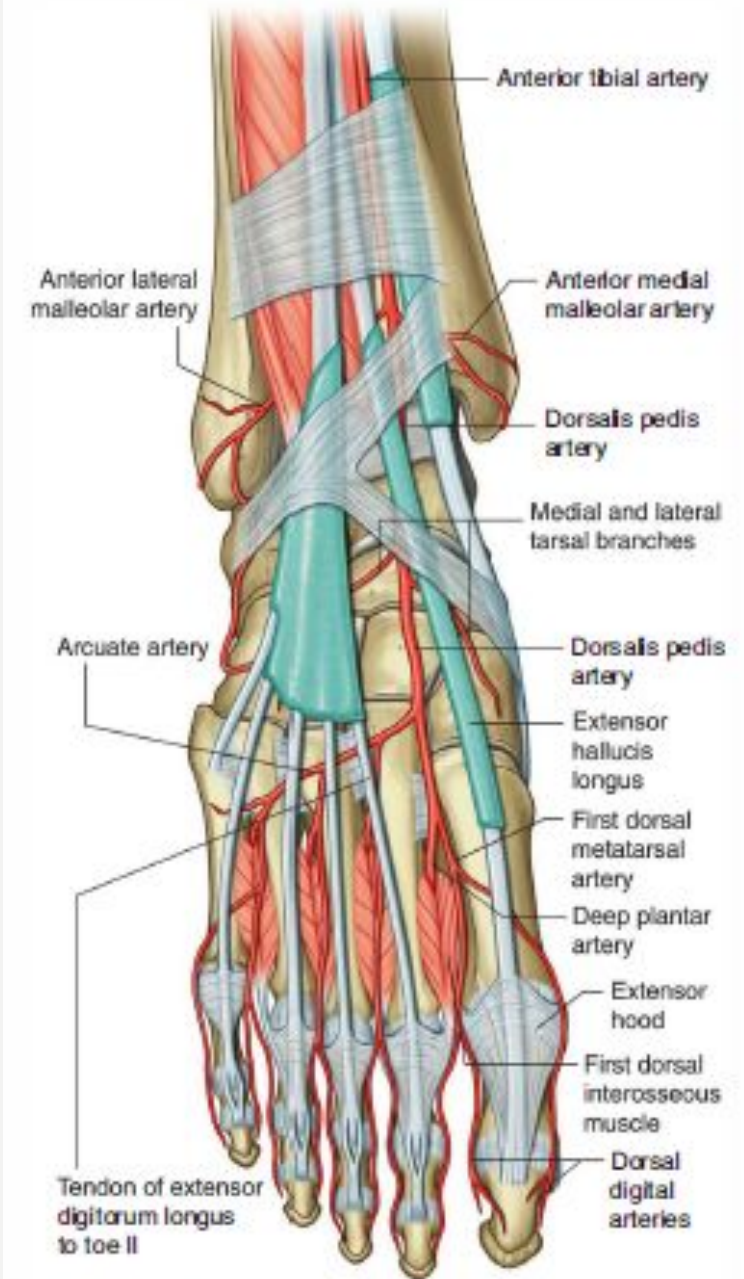


Fig. 6.119 Dorsalis pedis artery.

PLANTAR ARCH

- The plantar arch (or deep plantar arch) is a circulatory anastomosis formed from:
 1. the dorsalis pedis artery
 2. lateral plantar artery
- The plantar arch runs from the 5th metatarsal and extends medially to the 1st metatarsal (of the big toe).
- lies deep to the plantar aponeurosis, superficial to the long tendons (between the first and second anatomical layers)
- The arch is formed when the lateral plantar artery turns medially to the interval between the bases of the first and second metatarsal bones, where it unites with the dorsalis pedis artery, thus completing the plantar arch.
- Branches: plantar metatarsal arteries

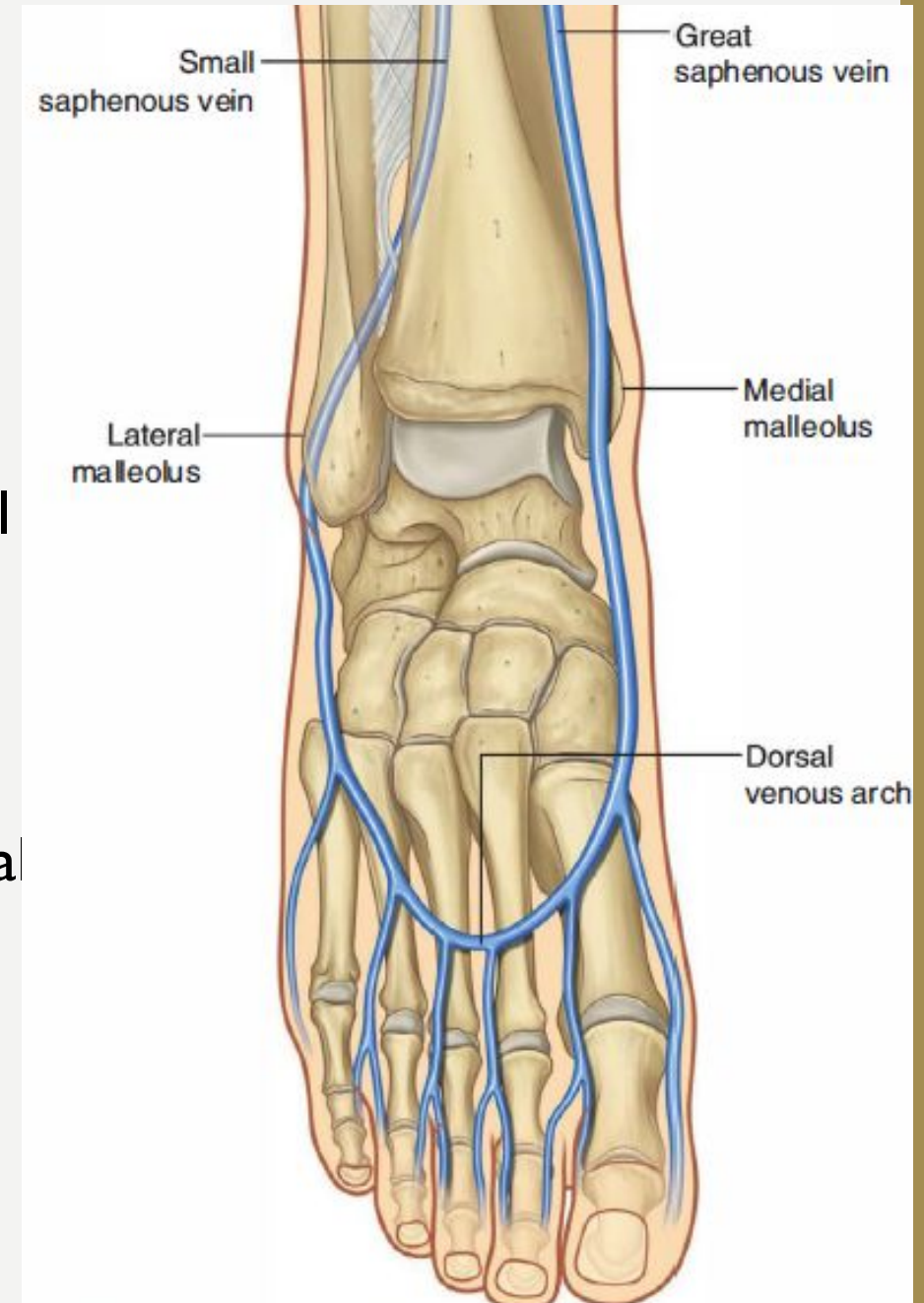
VENOUS DRAINAGE

I. Deep plantar venous arch:

- **Origin:** plantar digital veins □ the plantar metatarsal veins □ Deep plantar venous arch
- Once formed it continues proximally as the medial and lateral plantar veins which give rise to the posterior tibial and the peroneal veins.

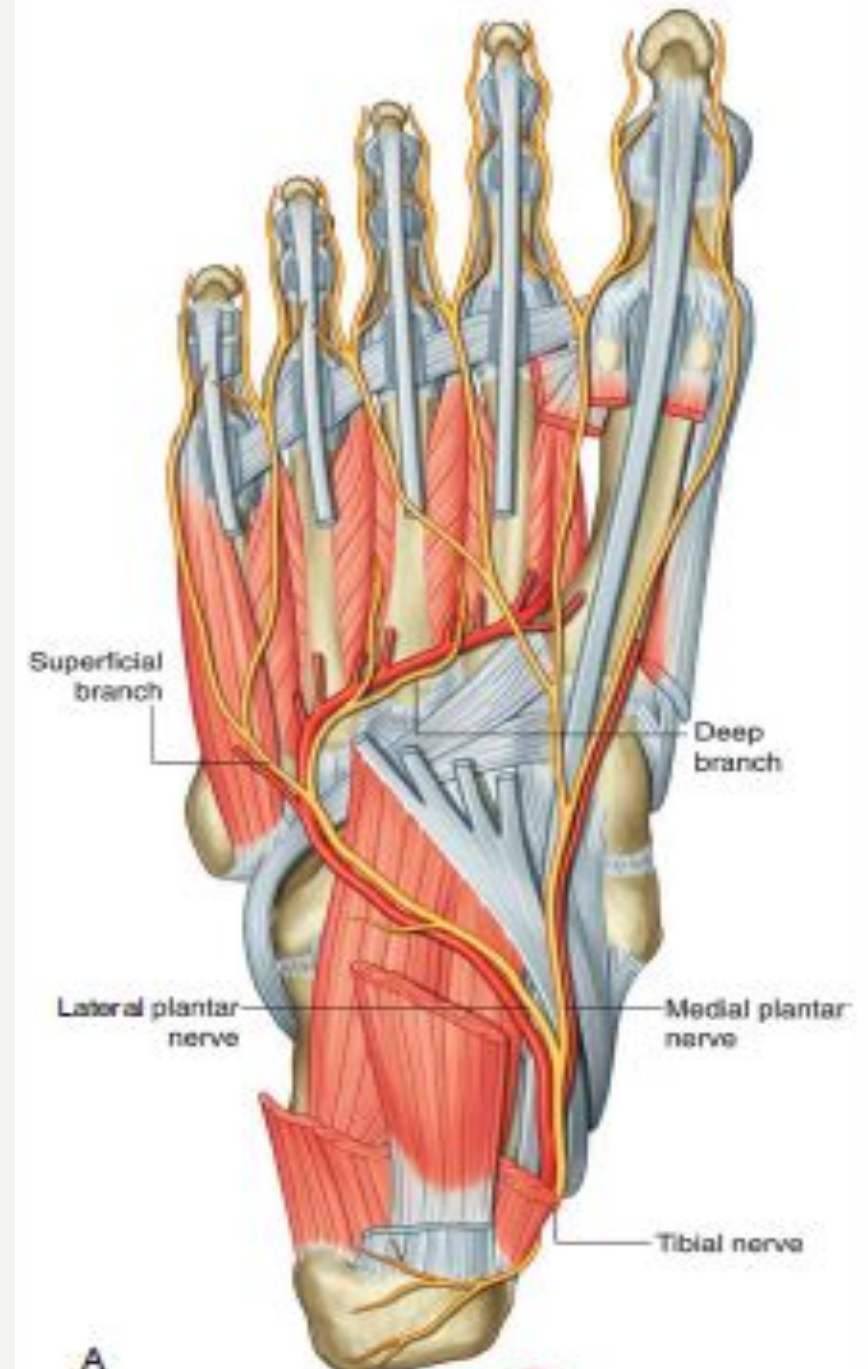
II. Dorsal venous arch:

- **Origin:** dorsal digital veins □ the dorsal metatarsal veins □ Deep dorsal venous arch
- continues proximally as the medial and lateral marginal veins of the foot to become the great saphenous vein and small saphenous vein respectively



NERVES

- The foot is supplied by **the tibial, deep fibular, superficial fibular, sural, and saphenous nerves.**
- All five nerves contribute to **cutaneous or general sensory innervation.**
- **The tibial nerve** innervates all intrinsic muscles of the foot **except for the extensor digitorum brevis,** which is innervated by **the deep fibular nerve.**



TARSAL TUNNEL SYNDROME

Definition:

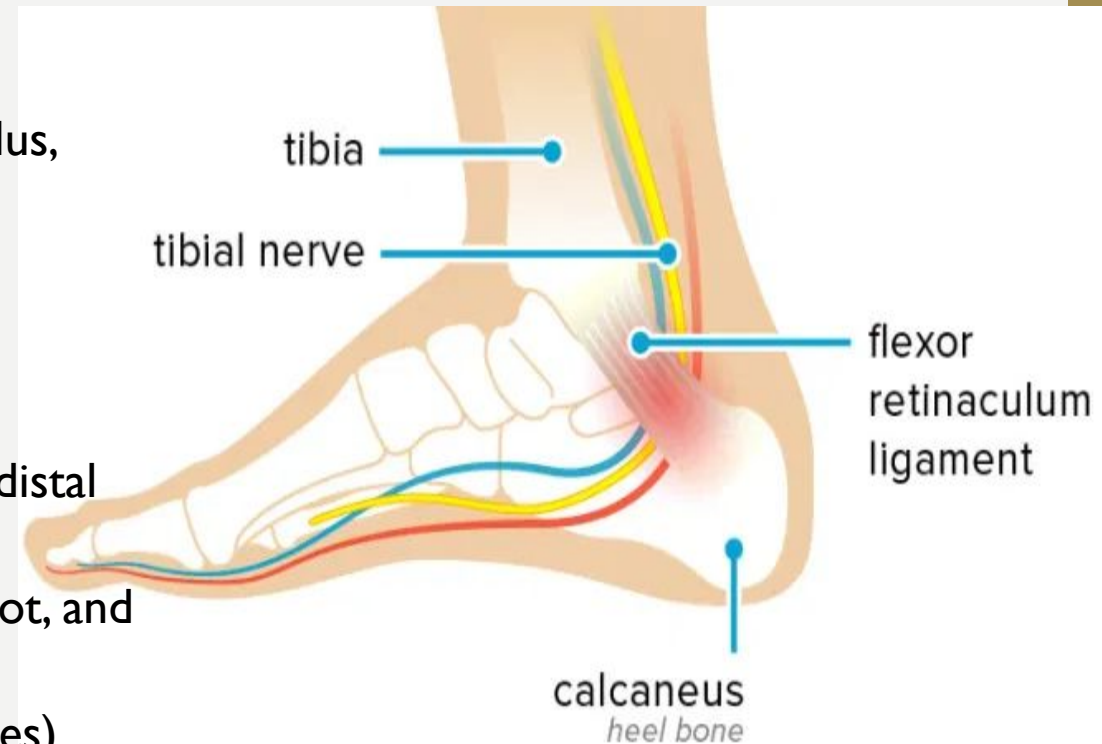
- Peripheral neuropathy caused by chronic or acute compression of the tibial nerve by the flexor retinaculum of the foot at the medial ankle.

Etiology

- Trauma (most common): fracture or sprain of the ankle (talus, calcaneus, medial malleolus).
- Rheumatoid arthritis.
- Bone spurs, tumors, cysts, nerve ganglions.

Clinical features

- Symptoms develop in areas innervated by the tibial nerve (distal to the medial malleolus):
- Neuropathic pain and paresthesia in the heel, sole of the foot, and first three toes
- Weakness and atrophy of intrinsic foot muscles (severe cases)
- Symptoms worsen with walking, prolonged standing, and at night



TARSAL TUNNEL SYNDROME

Diagnostics:

- **Usually a clinical diagnosis:**
- ❖ **Positive Tinel sign:** radiating paresthesia triggered by tapping the flexor retinaculum posterior to the medial malleolus
- ❖ Pain upon foot dorsiflexion with eversion
- ❖ Diminished sensation on the plantar area of the foot
- **Nerve conduction studies:** slow conduction velocity in the medial and lateral plantar nerves

Treatment:

- **Initially conservative**
- Rest, NSAIDs, physiotherapy, use of orthotic shoes
- Corticosteroid injection (if no improvement)
- **Surgery**
- **Indications:** lack of response to conservative treatment or documented entrapment of the tibial nerve
- **Procedure:** Division of the flexor retinaculum of the foot to decompress the tibial nerve

STRESS FRACTURES

Mechanism

- Fracture develops as a result of repetitive microtrauma.

Risk factors / Causes

- Repetitive high-intensity physical activity
- Improper technique during physical activity
- ill-fitting footwear
- Poor nutrition and/or low calorie intake (e.g., in anorexia nervosa)
- Calcium and/or vitamin D deficiency
- Female sex

STRESS FRACTURES

Clinical features

Location:

- Lower extremities (most common, >50%): tibia, tarsal navicular, metatarsals (March fracture), femur, fibula, pelvis □ most commonly in the 2nd metatarsal bone
- Upper extremities (least common): humerus, scapula, ribs

Symptoms:

- Pain that worsens with activity and resolves with rest
- Fractures may be asymptomatic.

Signs:

- Focal bone tenderness, erythema, and/or soft tissue swelling

STRESS FRACTURES

Diagnostics

X-ray:

- Often normal in the first 2–3 weeks of disease onset

MRI:

- High sensitivity and specificity
- Findings include fracture lines, damage to surrounding tissue, and edema



MANAGEMENT

Fractures at High-risk sites

- A stress fracture in a location associated with a high rate of fracture progression.
- ~~These sites include:~~
 - ~~the 5th metatarsal.~~
 - ~~The superolateral femoral neck~~
 - ~~Patella~~
 - ~~Anterior tibia~~
 - ~~Medial malleolus~~
 - ~~Talus, navicular, and~~
- Manage like an acute fracture □ Immobilize the affected extremity (e.g., cast, splint).
- Advise avoidance of weight-bearing activities.
- Risk factor modification (e.g., improved nutrition, calcium and vitamin D supplementation)

Fractures at low-risk sites

- Sites with a lower risk of healing complications (e.g., nonunion, delayed healing).
- ~~These sites include:~~
 - ~~the 2nd-4th metatarsal shafts~~
 - ~~Fibula~~
 - ~~Lateral malleolus~~
 - ~~Medial femoral neck~~
 - ~~Calcaneus, cuneiform, and cuboid~~
- **Cease inciting activity.**
- **Pain control (e.g., acetaminophen, ice packs)**
- **Risk factor modification (e.g., improved nutrition, calcium and vitamin D supplementation)**

CALCANEAL SPUR (HEEL SPUR) / مسمار العظم

العظم

- **Definition:**

- ossification of tendon insertions at the calcaneus bone

- **Pathogenesis:**

- idiopathic; repetitive microtrauma of the tendon insertion has been suggested as an underlying cause

- **Etiology:**

- abnormal strain, obesity, foot deformities, reactive arthritis, psoriatic arthritis

- **Clinical features:**

- localized pain

- **Types:**

1. Inferior calcaneal spur: affects the insertion of the plantar fascia, on the inferior aspect of the calcaneus bone (most common form)
2. Posterior calcaneal spur: affects the insertion of the Achilles tendon, on the posterior aspect of the calcaneus bone



مسمار العظم / CALCANEAL SPUR (HEEL SPUR)

Treatment:

- First-line treatment is conservative
 1. NSAIDs
 2. Immobilization, sports restriction, avoidance of tight, uncomfortable footwear
 3. Cryotherapy in cases with acute painful inflammation; otherwise thermal therapy (therapeutic ultrasound)
- Surgical removal of the spur

ACHILLES TENDON TEAR

- **Anatomy:**
- The calcaneal tendon, commonly known as the Achilles tendon, is the strongest and largest tendon of the human body.
- The calcaneal tendon forms by the merging of fibers of the gastrocnemius and the soleus muscles, forming the tendon that inserts into the posterosuperior aspect of the calcaneus.
- **Mechanism:**
- usually traumatic injury during a sporting event may occur with sudden forced plantar flexion or violent dorsiflexion in a plantar flexed foot



ACHILLES TENDON TEAR

- **Diagnosis:**

- ❖ **Clinical presentation:**

- Typically patients present with sudden onset of pain and swelling in the Achilles region, often accompanied by an audible snap during forceful dorsiflexion of the foot.
- **The Thompson test:** examines the integrity of the Achilles tendon by squeezing the calf.

- ❖ **Radiology:** X-ray, US, MRI

□ **Ultrasound:** used to determine complete or partial ruptures.

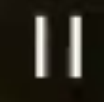
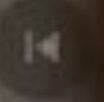
- **Treatment:**

- Treatment depends on the extent of the tear:

1. Partial thickness tears can initially be treated conservatively.
2. Full-thickness tears are normally surgically repaired.

Simmonds Triad of tests for a suspected Achilles tendon rupture

Stanmore Foot and Ankle Centre



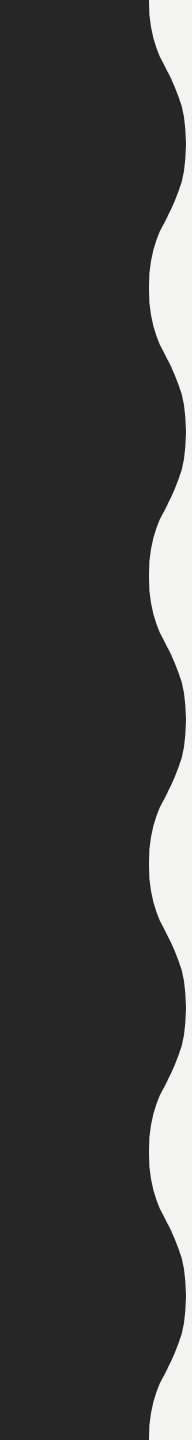
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THE END