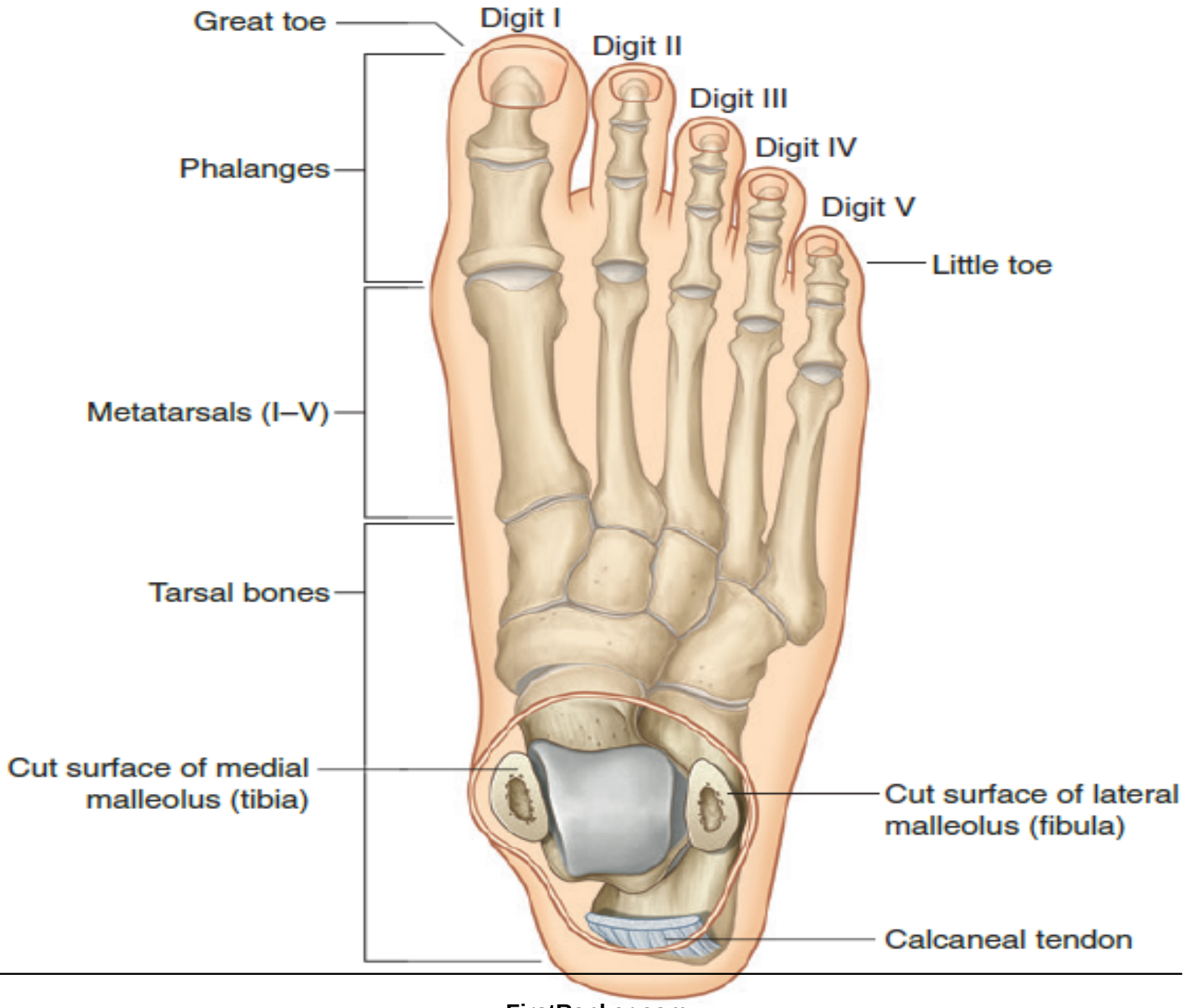
ARCHES OF THE FOOT

SKELETON OF THE FOOT

- The skeleton of the foot from behind forward consists of the following bones:
- **Tarsals**
- **Metatarsals**
- **Phalanges**

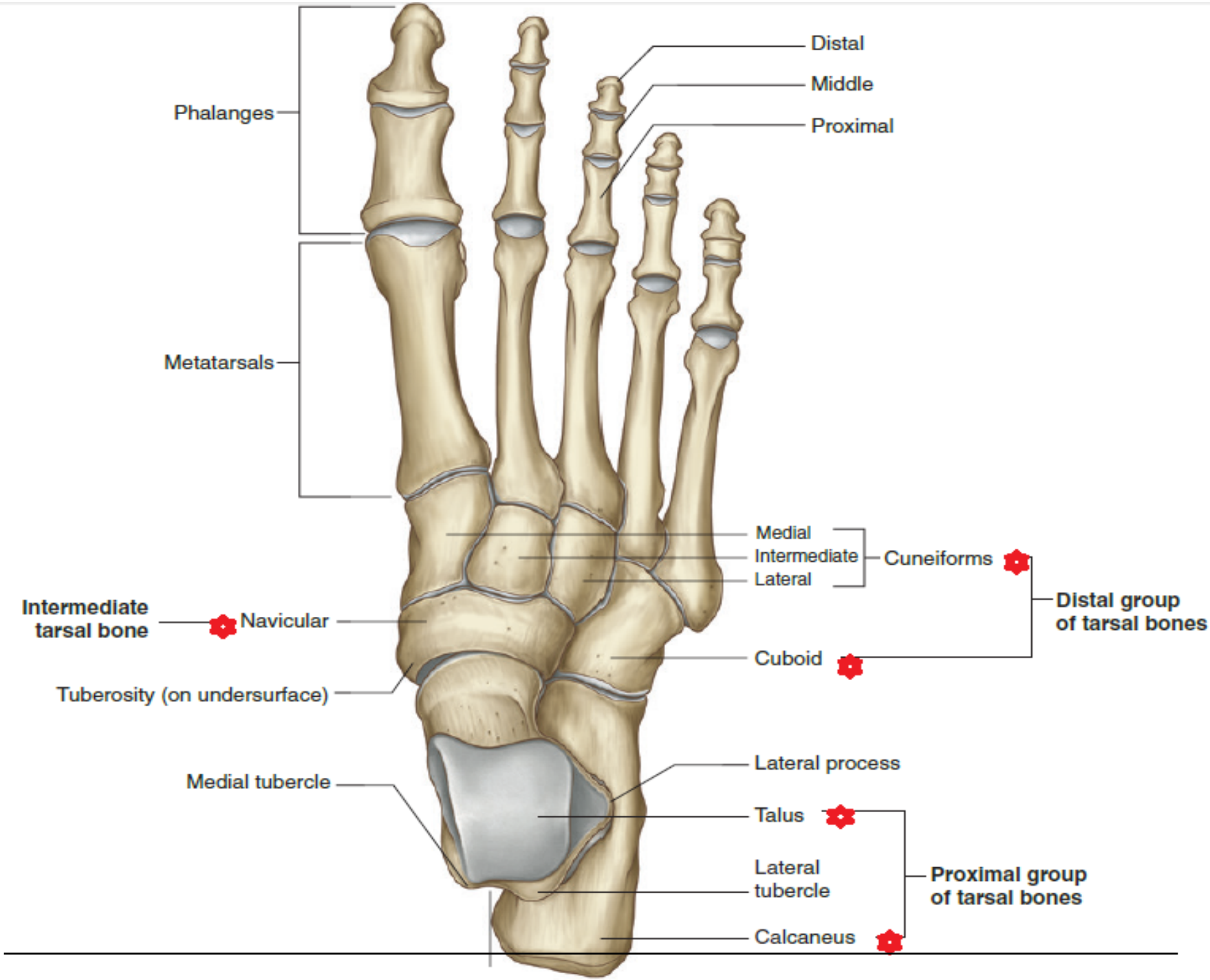


- **TARSAL BONES**
- These are short bones & arranged in three rows:

(a) Proximal row → *Talus and calcaneus.*

(b) *Middle row* → *Navicular.*

(c) *Distal row* → *Three cuneiforms (medial,*
intermediate, and lateral) and cuboid.



- **METATARSAL BONES**
- These are five miniature long bones.
- The five metatarsal bones together constitute the **metatarsus.**
- They are numbered from medial to lateral sides as first, second, third, fourth, and fifth.

- **PHALANGEAL BONES**
- The phalangeal bones are miniature long bones.
- They are 14 in number in each foot—two for the great toe and three for each of the other four toes.

- ***The foot performs two major functions***

1. It acts as a pliable platform to support the body weight during standing position.

- For this function foot is designed in the form of elastic arches.

- These arches are segmented so that they can sustain the stress of weight and thrusts at the optimum level.

2. It acts as a lever to propel the body forward during walking, running, and jumping.

- For this function, the foot is so constructed that it is transformable in a lever.

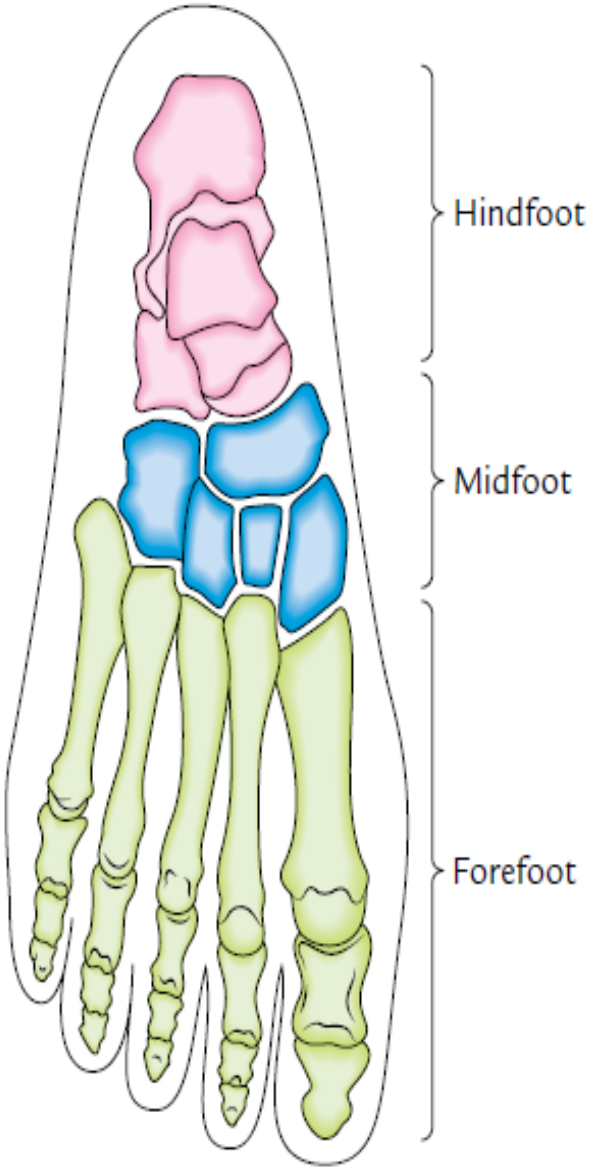
- The segmented arched lever converts the foot into a spring, which is ideally suited for its functions.

- The foot and its bones are divided into three anatomical and functional segments:

1.Hindfoot *consists of* ***talus*** *and* ***calcaneus****.*

2.Midfoot *consists of* ***navicular, cuboid,& cuneiforms****.*

3.Forefoot *consists of* ***metatarsals*** *and* ***phalanges****.*



- The skeleton of the foot is arched both longitudinally and transversely, with the concavity directed towards the plantar surface.

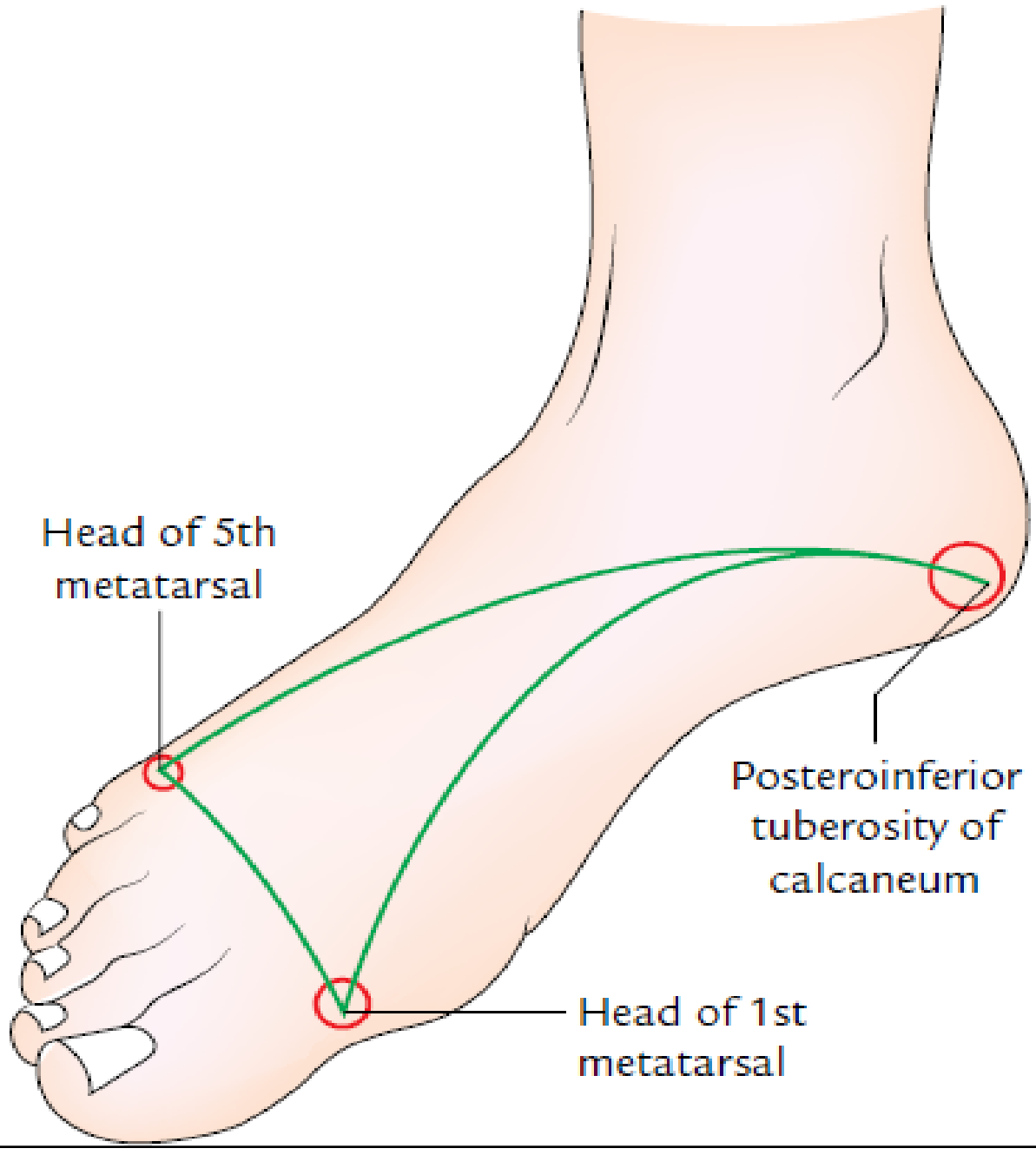
- The presence of arches makes the sole concave both anteroposteriorly and transversely

- During the standing position, the weight of the body is distributed among three points:

(a) Posteroinferior tuberosity of the calcaneum (heel)

(b) Head of first metatarsal, and

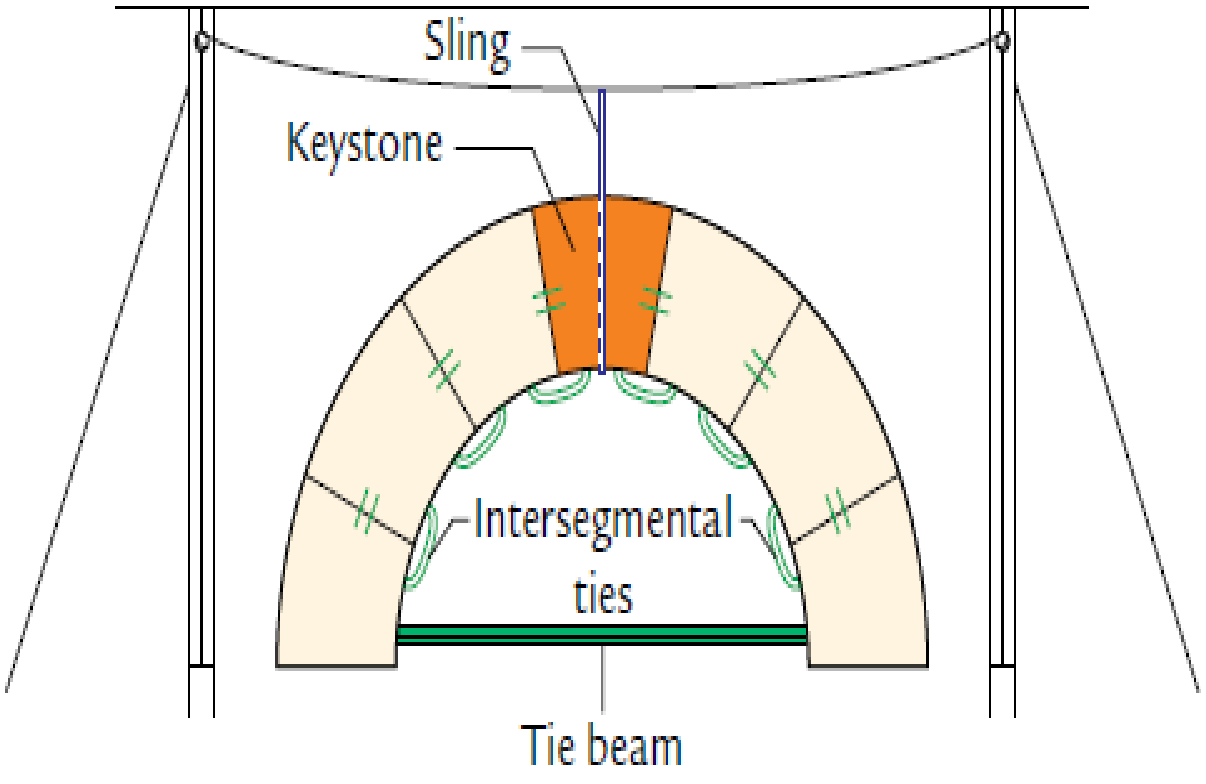
(c) Head of fifth metatarsal



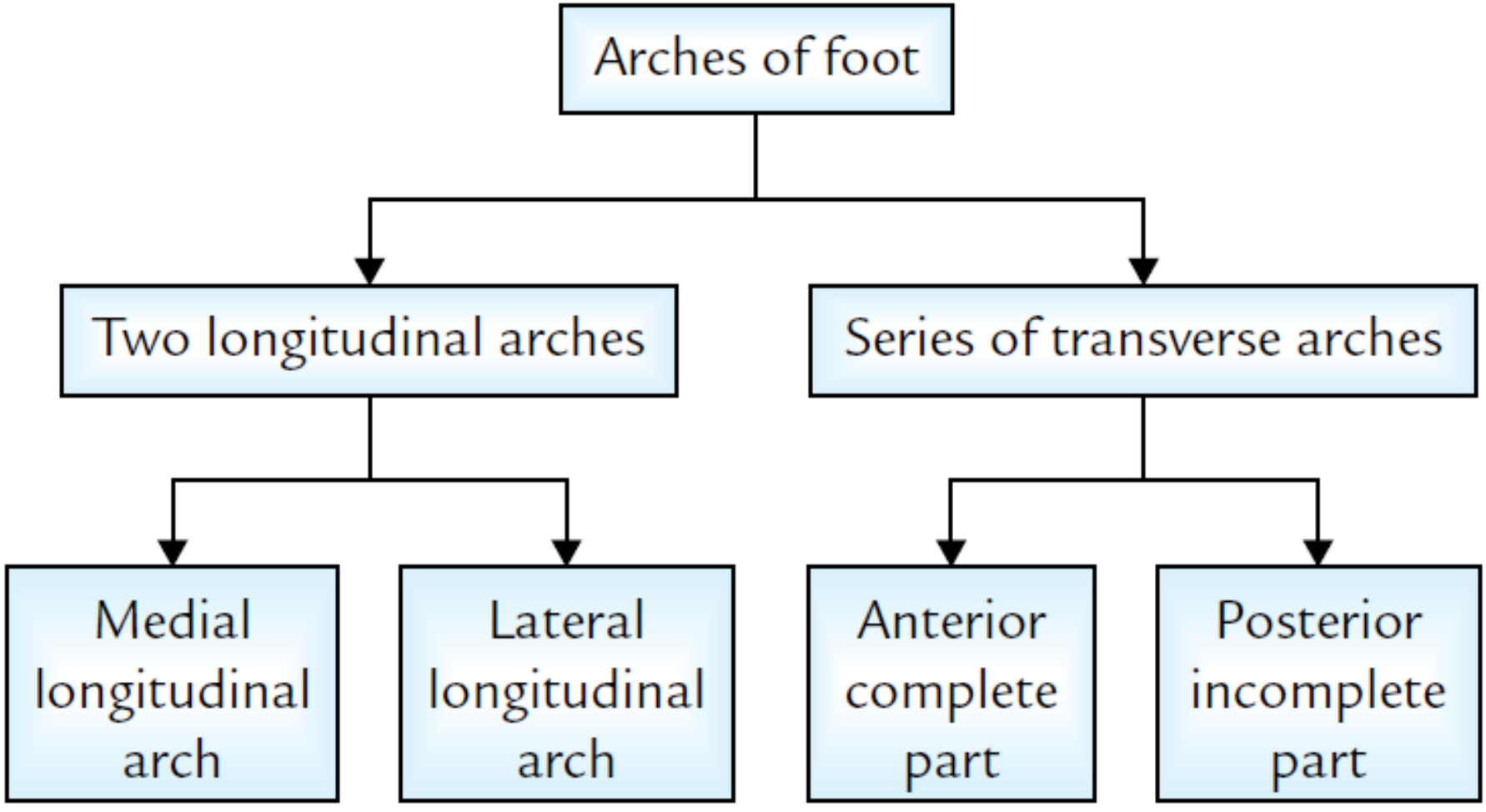
Factors Maintaining the Arches of the Foot

- The devices used to support a stone bridge are:

1. Shape of stones.
2. Intersegmental ties (staples).
3. Slings.
4. Tie beams



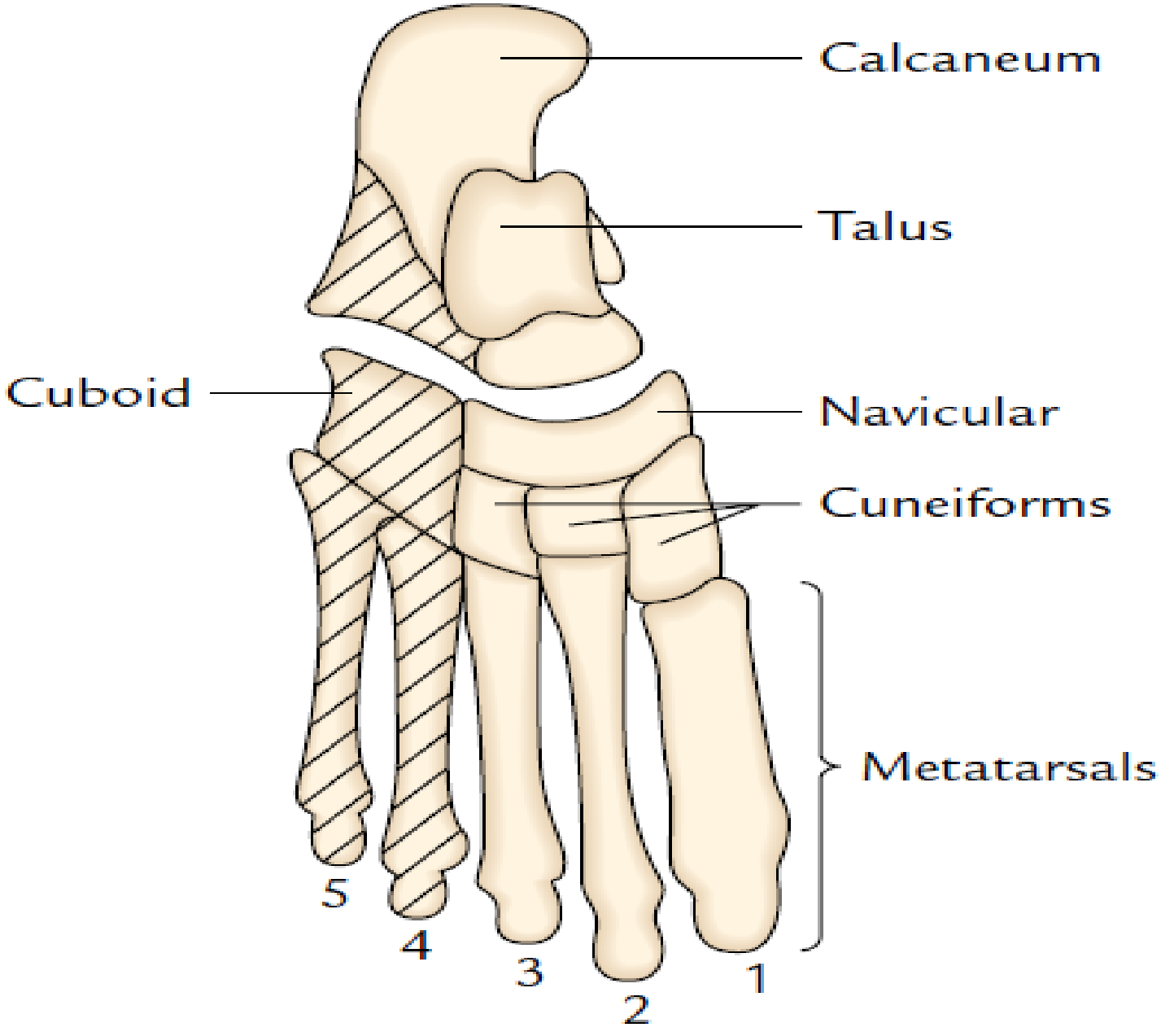
TYPES OF ARCHES

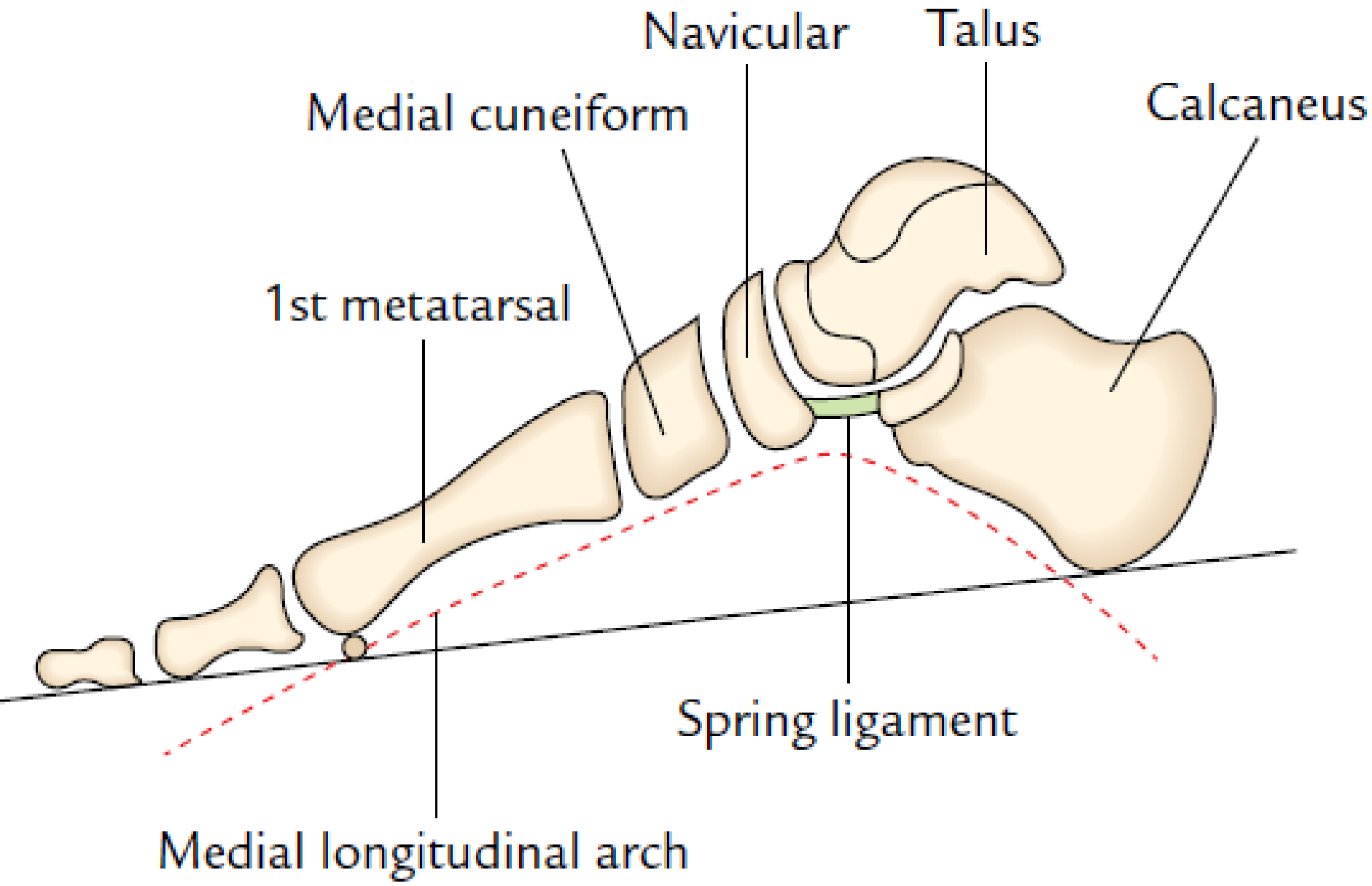


LONGITUDINAL ARCHES

- Each longitudinal arch has: (a) two pillars, (b) a summit, and (c) joints.
- **MEDIAL LONGITUDINAL ARCH**
- Formed by the calcaneum, talus, navicular, three cuneiforms, and medial three metatarsals
- **Pillars**

1. **Posterior pillar**→ medial half of calcaneum**.**
2. **Anterior pillar**→ heads of the medial three metatarsals**.**





- **Summit**
- The talus lies at the summit of this arch. Therefore, the ***talus is the keystone*** of this arch**.**

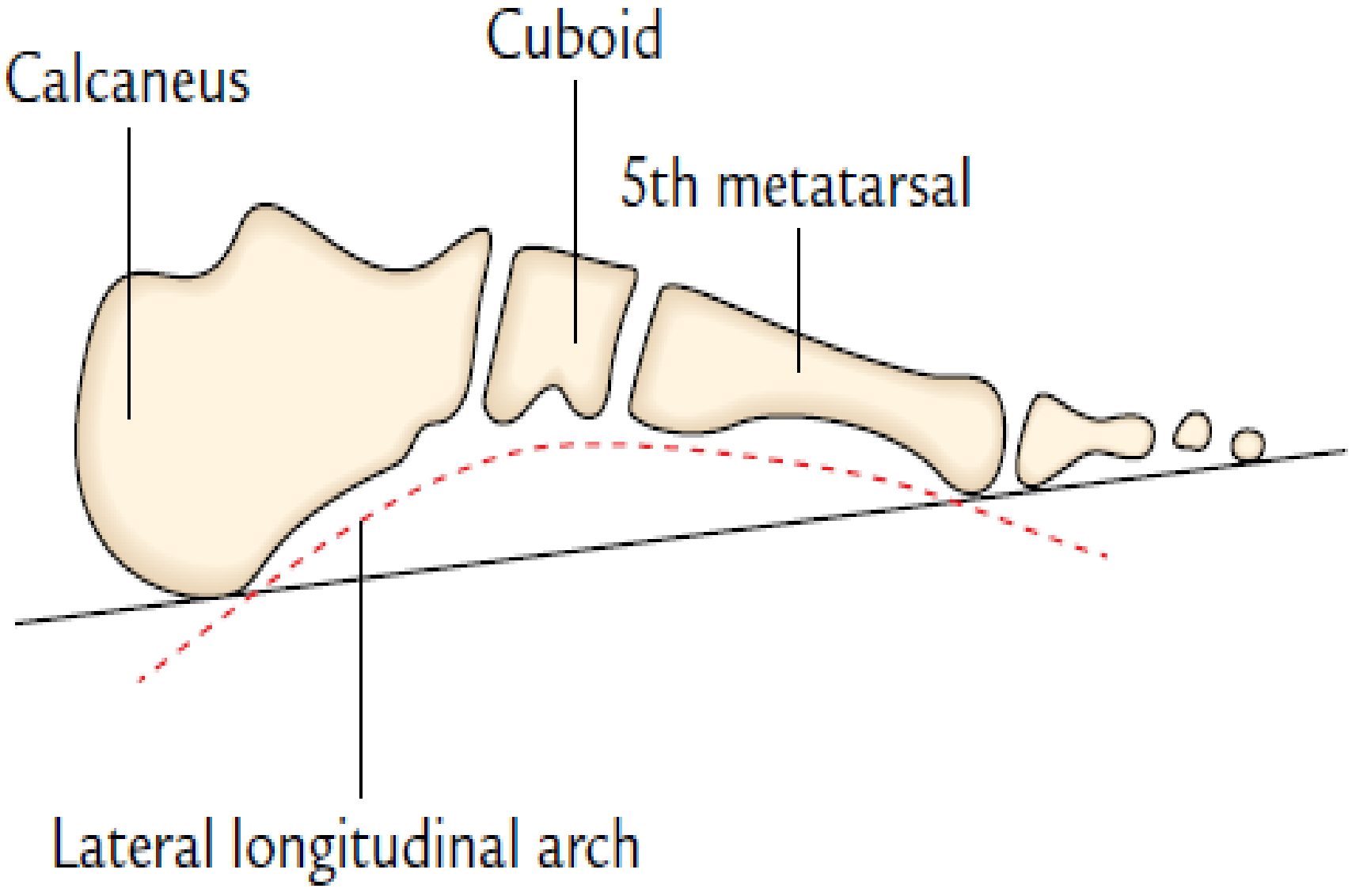
- **Joints**
- The main joints of the medial longitudinal arch are ***talocalcaneonavicular*** and ***subtalar*** joints**.**

- **LATERAL LONGITUDINAL ARCH**

- Formed by the calcaneum cuboid and lateral two metatarsals.

- It is characteristically low and almost touches the ground.

- It is involved in receiving and supporting the body weight during walking and running.



- **Pillars**
- **Posterior pillar**→lateral tubercle of the calcaneum
- **Anterior pillar**→heads of the lateral 2 metatarsals.

- **Summit**
- Lies at the level of articular facets on the superior surface of the calcaneum.

- **Joints**
- The main joint of the arch is **calcaneocuboid joint.**

FACTORS MAINTAINING THE LONGITUDINAL ARCHES

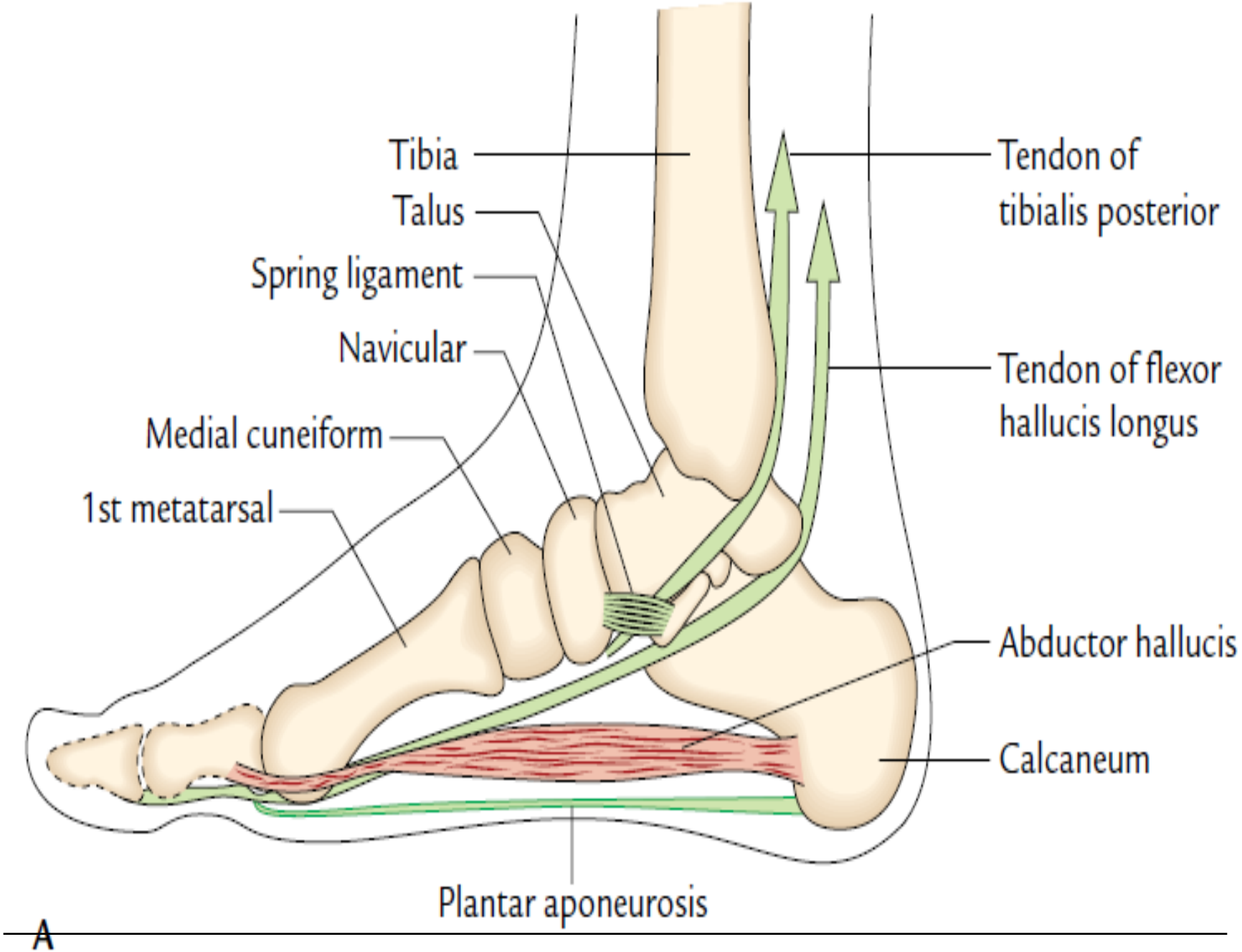
- **Factors Maintaining the Medial Longitudinal Arch**
- ***Bones***
- The sustentaculum tali partly support the head of talus.
- ***Ligaments***

(a) Plantar calcaneonavicular ligament (spring ligament) which provides dynamic support to the head of talus

(b) Interosseous ligaments connecting the adjacent bones

(c) Interosseous talocalcanean ligament, connecting these bones.

- These ligaments act as **intersegmental ties.**



- ***Muscles, tendons, and aponeurosis***

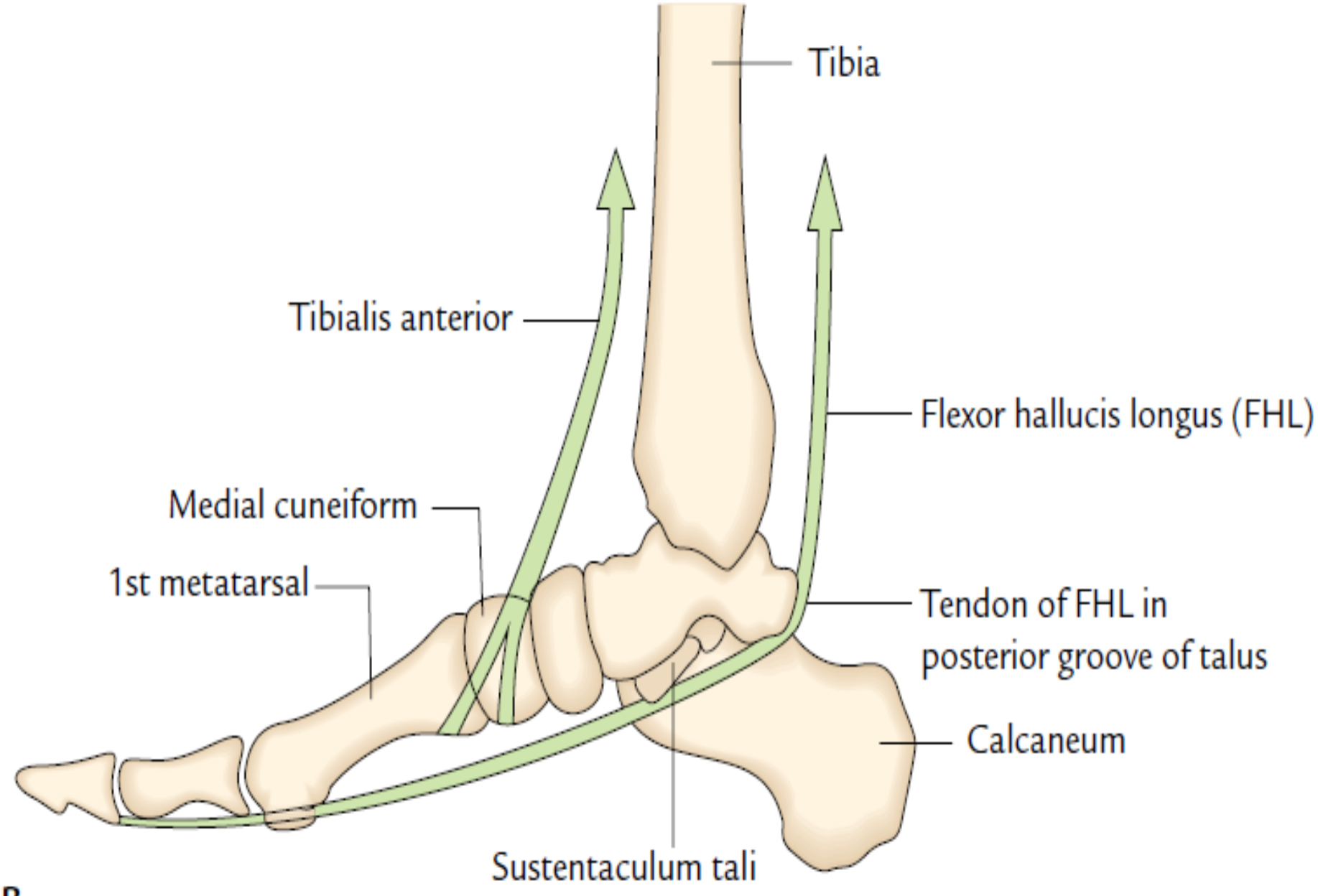
1. Acting as slings (suspending arch from above):

- The tendon of tibialis posterior lying below the spring ligament provides supports to the head of talus and suspends the arch from above.
- The flexor hallucis longus muscle, has three functions to support the medial longitudinal arch.

(a) It stretches the arch like the string of a bow.

(b) It supports the calcaneus by passing underneath the sustentaculum tali.

(c) It supports the talus by passing along its posterior groove



B

- The tendon of tibialis anterior also exerts a sling action.

- **2. Acting as tie beams (structures which prevent separation of the pillars):**
- The medial part of the plantar aponeurosis and abductor hallucis assisted by the flexor hallucis brevis act as tie beam to maintain the height of the medial longitudinal arch.

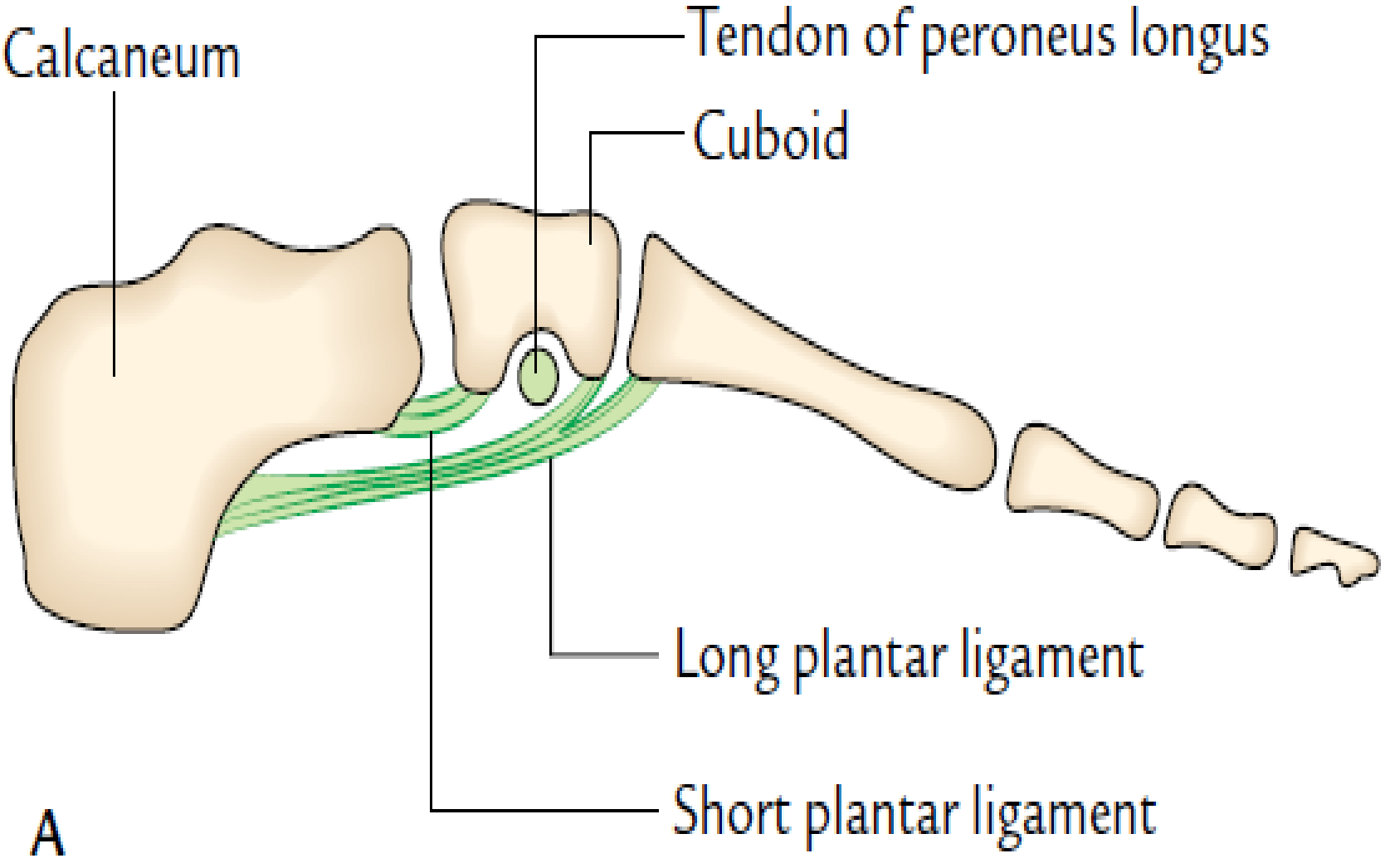
- **Factors Maintaining the Lateral Longitudinal Arch**
- ***Bones***
- The proper shaping of the distal end of calcaneus and proximal end of cuboid. The **cuboid** is the **keystone** of longitudinal arch.
- ***Ligaments***

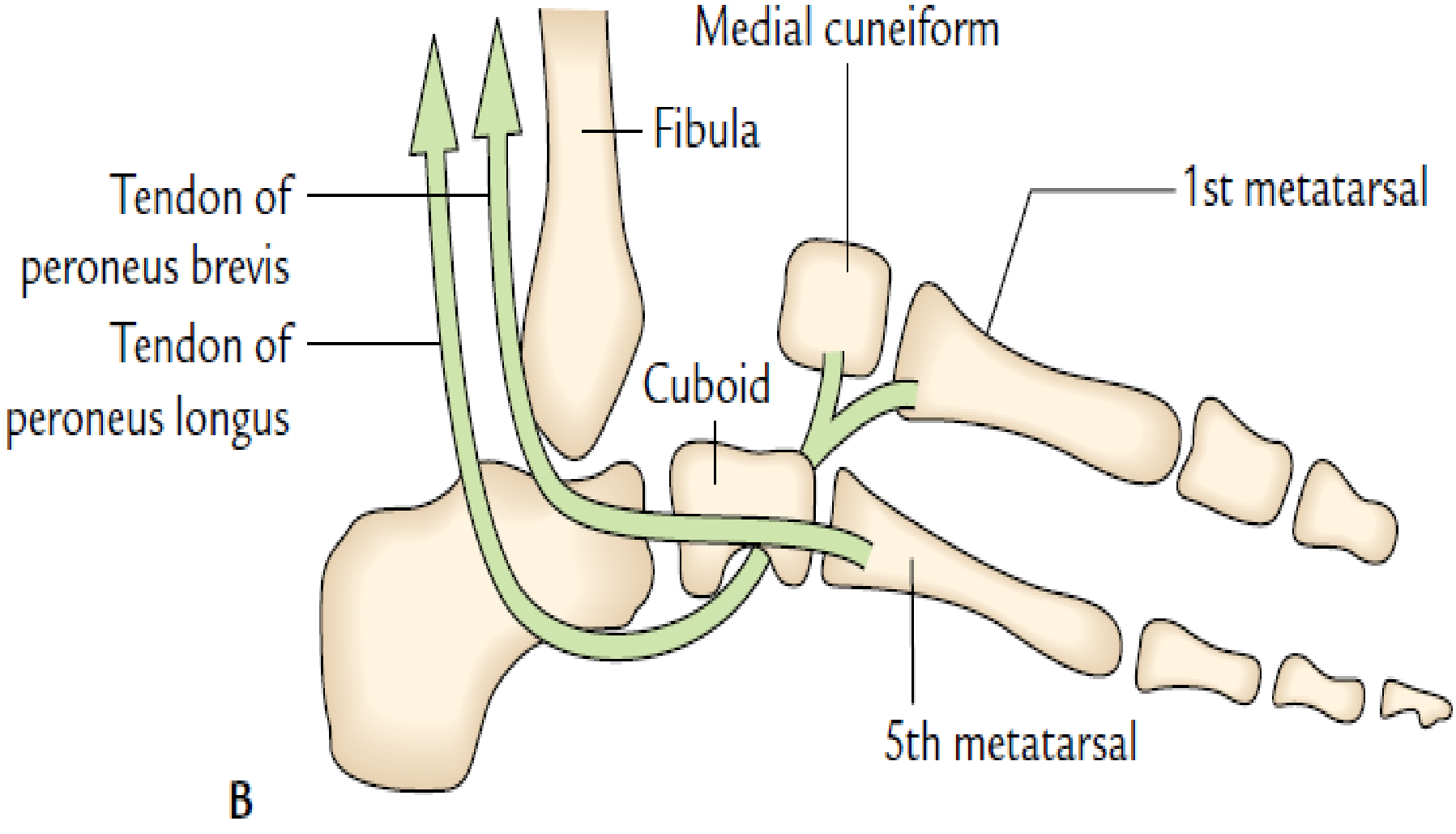
1. **Short plantar ligament:** broad and thick.

   It lies deep to the long plantar ligament and supports the calcaneocuboid joint from below.

2. **Long plantar ligament:** long and supports the joints between the calcaneum, cuboid, and relate metatarsals

- These ligaments act as **intersegmental ties.**





- ***Muscles, tendons, and aponeurosis***

1. **Acting as tie beams:**

- The lateral part of the plantar aponeurosis and the intrinsic muscles of the little toe (lateral part of the flexor digitorum brevis, abductor digiti minimi brevis, and flexor digiti minimi brevis) function as tie beams of this arch**.**

2. **Acting as slings:** The tendons of peroneus brevis and peroneus tertius, which are inserted on the base of the fifth metatarsal, act as weak slings from above.

- The tendon of peroneus longus supports the cuboid bone from above through its pulley-like action

Differ. between the medial and lateral longitudinal arches

Medial longitudinal arch	Lateral longitudinal arch
Formed by more bones and more joints	Formed by less bones and less joints
Characteristic feature is resiliency	Characteristic feature is rigidity
Higher and more mobile	Lower and less mobile
Involved in propulsion during locomotion (initiating the next step during walking)	Involved in receiving and supporting the body weight
Summit is formed by the talus	Summit is formed by the calcaneum
Main joint is talocalcaneonavicular joint (the most vulnerable part of the arch)	Main joint is calcaneocuboid (the most vulnerable part of the arch)

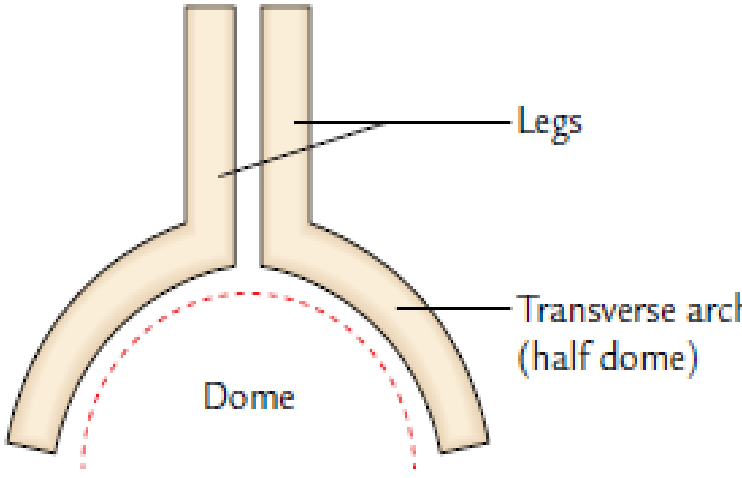
TRANSVERSE ARCHES

- **Anterior Transverse Arch**

- Formed by the heads of the metatarsals.

- It is a complete arch because during standing position the heads of first and fifth metatarsals come into contact to the ground and form the two ends of the arch.

- **Posterior Transverse Arch**
- Formed by greater parts of the tarsus and metatarsus.
- It is an incomplete arch because only its lateral end comes into contact with the ground during standing position.
- The complete dome is formed when the two feet are brought together



Factors Maintaining the Transverse Arches

- ***Bones***
- Tarsal and metatarsal bones maintain the concavity on the plantar aspect of the foot skeleton.

- ***Ligaments***
- Superficial and deep transverse metatarsal ligaments at the heads of metatarsals function as intersegmental ties to maintain the shallow arch at the heads of metatarsals.

- ***Muscles and tendons***

1. **Acting as tie beams:**

   The tendons of peroneus longus and tibialis posterior support the transverse arch as tie beam.

2. **Acting as slings:**

   The peroneus tertius and peroneus brevis on the lateral side and tibialis anterior on the medial side support the transverse arch as slings.

3. **Acting as intersegmental ties:**

   The dorsal interossei act as intersegmental ties.

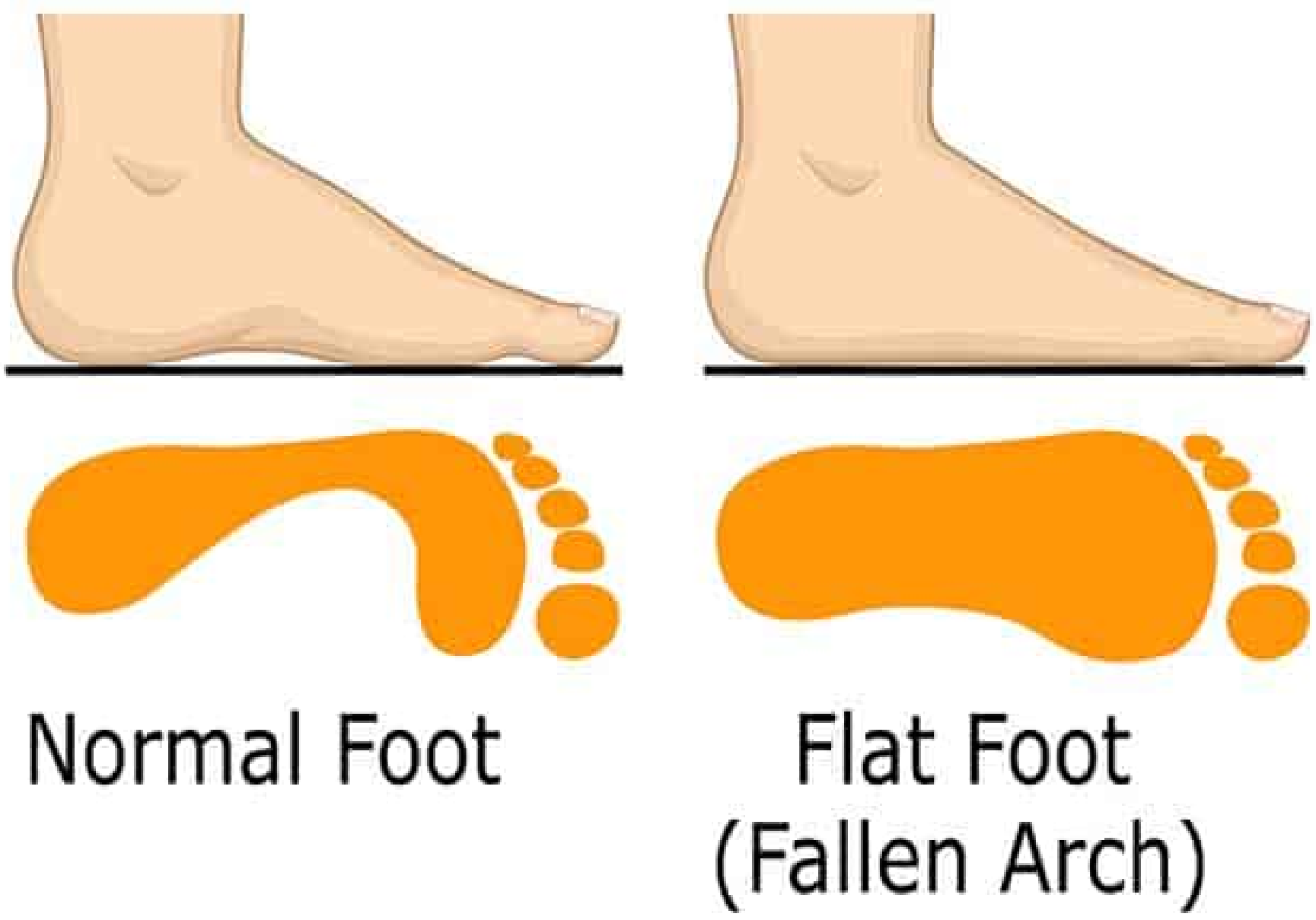
FUNCTIONS OF THE ARCHES

1. Distribute the body weight to the weight-bearing points of the sole
2. Act as shock absorber during jumping by their spring like action
3. The medial longitudinal arch provides a propulsive force during locomotion.
4. The lateral longitudinal arch functions as a static organ of support and weight transmission.
5. The concavity of the arches protects the nerves and vessels of the sole.

CLINICAL CORRELATION

- **Flat foot (pes planus):**

- Commonest problem of foot.
- It occurs due to collapse of medial longitudinal arch.
- During long periods of standing the plantar aponeurosis and spring ligament are overstretched.
- As a result, the support of the head of talus is lost and is pushed downward between the calcaneus and the navicular bones. This leads to flattening of the medial longitudinal arch with lateral deviation of the foot.



- ***The effects of the flat foot are***:

(a) The person usually has clumsy shuffling gait due to the loss of spring in the foot.

(b) Liable to trauma due to loss of the shock absorbing function.

(c) The compression of the nerves and vessels of the sole is due to the loss of concavity of the sole.

- The compression of the communication between the medial and lateral plantar nerves leads to neuralgic pain in the forefoot (**metatarsalgia).**

- **High arched foot (pes cavus)**

- The exaggeration of the longitudinal arch of the foot causes *pes cavus.*
- *This* usually occurs because of a contracture (plantar flexion) at the transverse tarsal joint. When the patient walks with a high arched foot there is dorsiflexion of the metatarsophalangeal joints and the plantar flexion of th interphalangeal joints of the toes.