

وسهلا



أهلا

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إذن المحرر واي اجراء
يخالف ذلك يقع تحت طائلة
المسؤولية القانونية
جميع المعلومات للاستخدام
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الأستاذ الدكتور يوسف حسين

كلية الطب - جامعة مؤتة - الأردن

دكتورة من جامعة كولونيا المانيا

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Bones of the foot

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Dorsal aspect

Distal phalanx
Proximal phalanx

Distal phalanx
Middle phalanx
Proximal phalanx

14 Phalanges

Medial cuneiform
Intermediate cuneiform
Navicular

Metatarsal
Lateral cuneiform
Cuboid

5 Metatarsal

7 Tarsal

Talus **Calcaneus**

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Tibiofibular joints



- **Tibiofibular Joints**

- 1- Superior (Proximal) Tibiofibular Joint**

- * **Type:** synovial joint, plane variety.
- * **Articular surface:** head of fibula and fibular facet on the lateral condyle of the tibia.
- * **Movement allowed,** sliding movement.

- 2- Middle Tibiofibular Joint**

- This is the interosseous membrane, fibrous joint (syndesmosis) between of the tibia and fibula (No movement).
- **Openings:** 1- At its upper part for anterior tibial vessels
2- Two inches above ankle joint for perforating branch of peroneal artery

- 3- Inferior (Distal) Tibiofibular Joint**

- * **Type;** fibrous joint (syndesmosis).
- * **Articular bones;**
 - 1- Rough impression on the medial side of the lower part of the fibula.
 - 2- Fibular notch on the lower end of tibia.
- * **Movements,** it is an immobile.

Talocalcaneonavicular joint

Talocalcaneonavicular joint

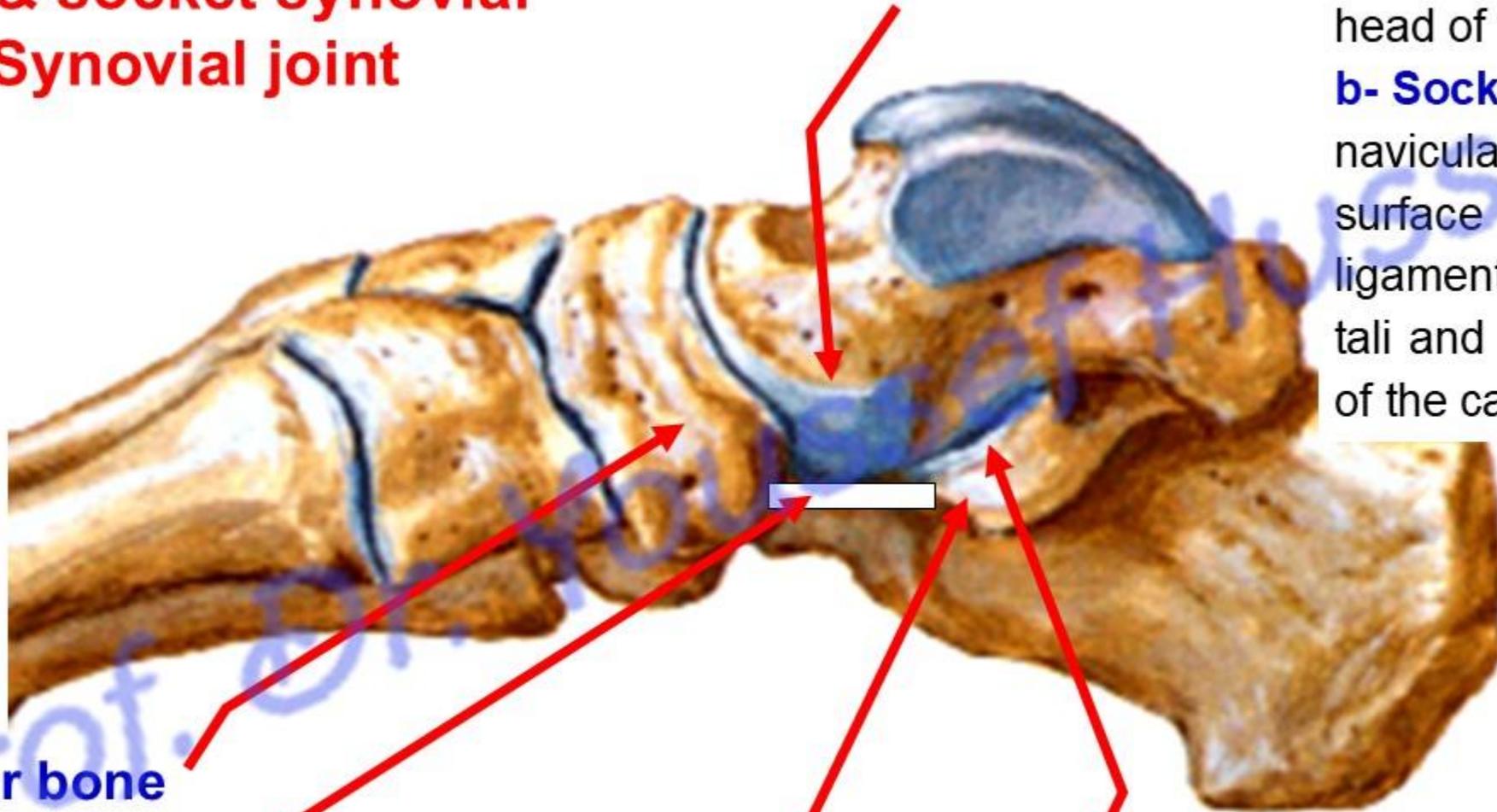
Ball & socket synovial

Synovial joint

Articular surface;

a- Ball is formed by the head of the talus.

b- Socket is formed by navicular bone, upper surface of the spring ligament, sustentaculum tali and superior surface of the calcaneus.



Head of talus

Navicular bone

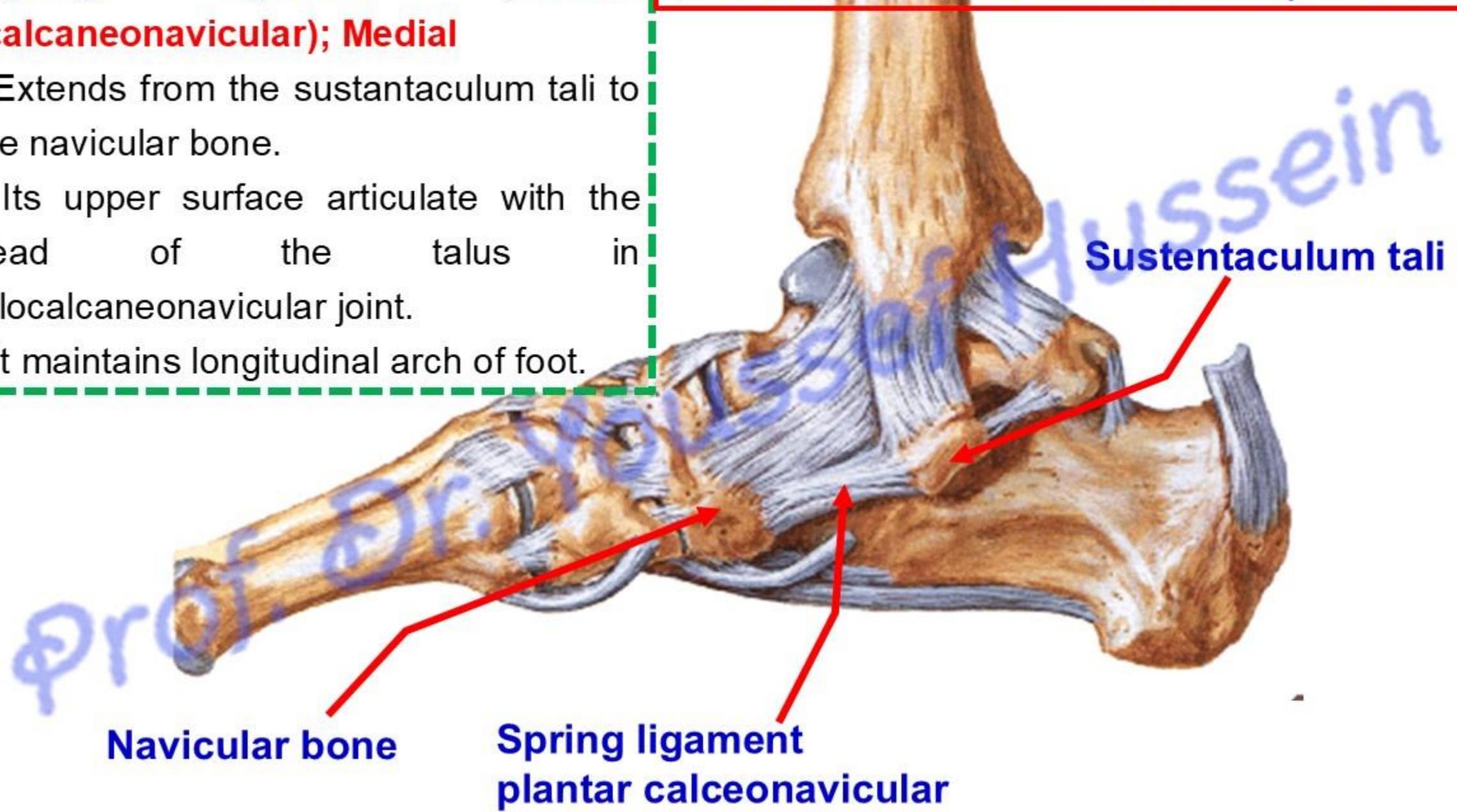
Spring ligament

Sustentaculum tali

Superior surface of calcaneus

• **Spring ligament (Plantar calcaneonavicular); Medial**

- Extends from the sustentaculum tali to the navicular bone.
- Its upper surface articulate with the head of the talus in talocalcaneonavicular joint.
- It maintains longitudinal arch of foot.



Sustentaculum tali

Navicular bone

Spring ligament
plantar calcaneonavicular

Lateral view

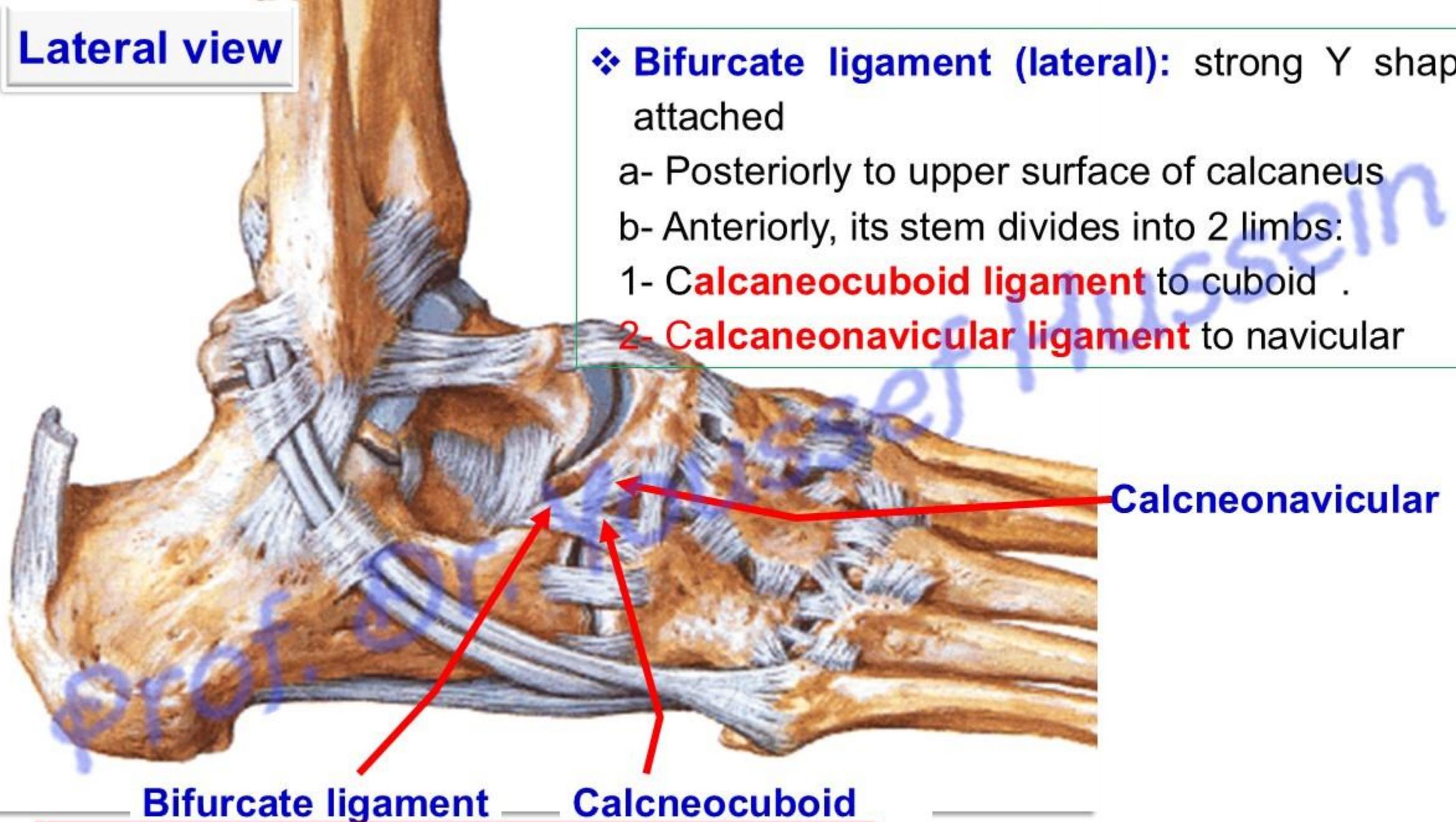
❖ **Bifurcate ligament (lateral):** strong Y shaped attached

a- Posteriorly to upper surface of calcaneus

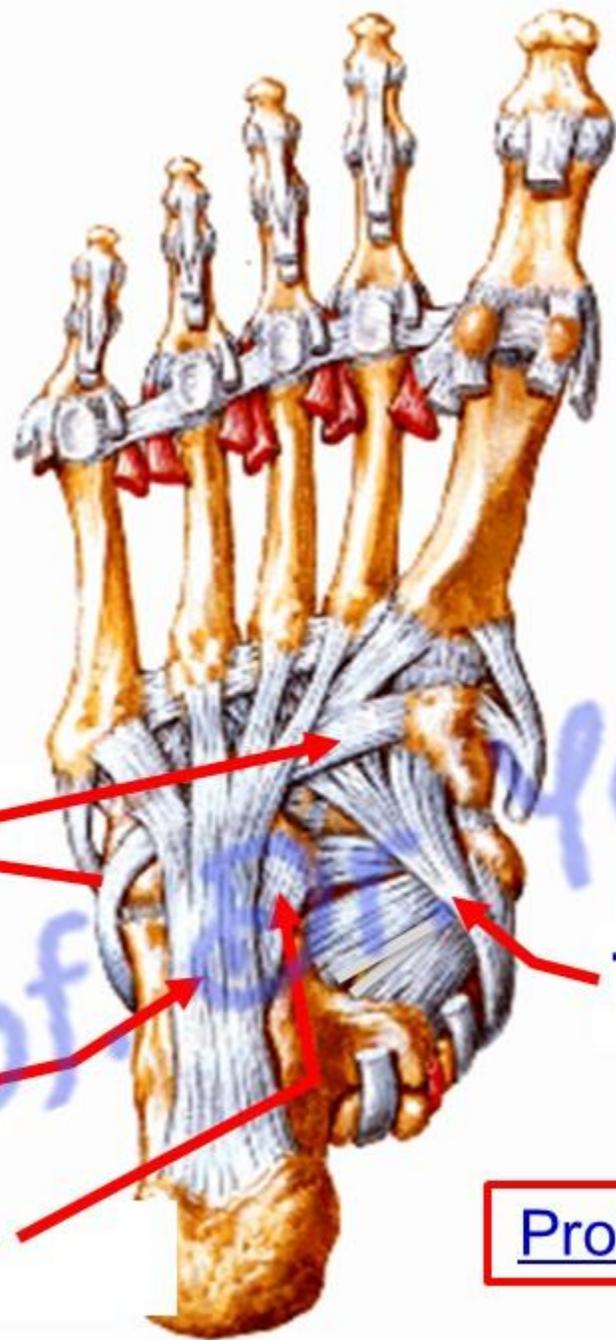
b- Anteriorly, its stem divides into 2 limbs:

1- **Calcaneocuboid ligament** to cuboid .

2- **Calcaneonavicular ligament** to navicular



Bifurcate ligament **Calcneocuboid**



- **Short plantar ligament:** connects the **calcaneus** (heel bone) with the plantar surface of **cuboid**.
- **Long plantar ligament:** a strong ligament
 - Its posterior end (narrow) attached to the plantar surface of the **calcaneus**.
 - Its anterior end to the bases of the 2nd, 3rd and 4th and 5th **metatarsal bones**.
- * **Function;** It plays an important role in supporting the longitudinal arch of the foot.

Peroneus longus

Tibialis Posterior

Long plantar ligament

Short plantar ligament

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• Inversion and eversion of the foot

1- Inversion; medial rotation of the foot and the sole looks inwards. It is done by

- a) **Tibialis** anterior.
- b) **Tibialis** posterior.
- c) Flexor **hallicus longus**.
- d) Extensor **hallicus longus**.

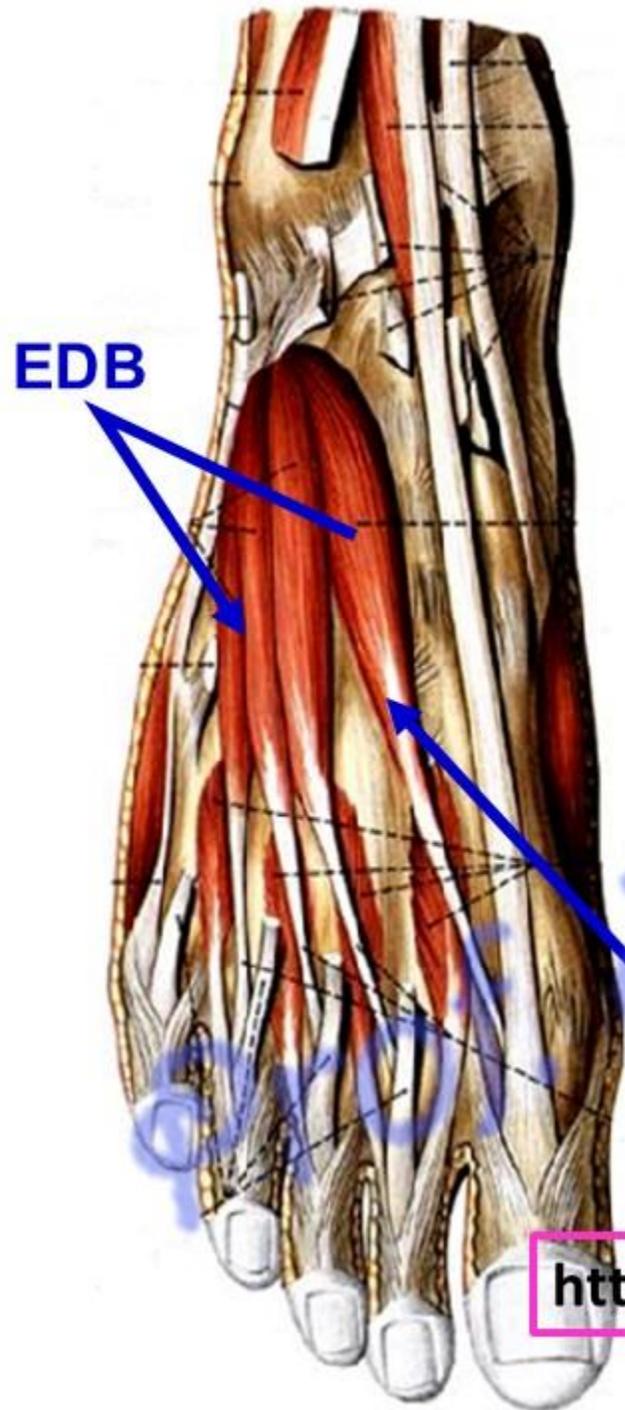
2- Everson: Lateral rotation of the foot and the sole looks outwards (laterally); It is done by

- a) **Peroneus** longus.
- b) **Peroneus** brevis.
- c) **Peroneus** tertius.



**** Significance:** They occur at talocalcaneonavicular joint, mainly during walking on the **rough** ground.

N.B:- The degree of inversion is more than eversion because Lateral malleolus is Lower than the medial malleolus



• Extensor Digitorum Brevis

** **Origin;** anterior surface of the calcaneus and inferior extensor retinaculum.

** **Insertion:** It divides into 4 slips for the **medial 4 toes**.

1- The medial slip is inserted into dorsum of the base of the proximal phalanx of the **big toe (extensor hallucis brevis)**.

2- The lateral 3 slips are inserted into the extensor expansion of the 2nd, 3rd and 4th toes.

** **Nerve supply;** **lateral branch** of the deep peroneal nerve

** **Actions,** Extension of the medial 4 toes.

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Sole of the foot

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- **Plantar Aponeurosis**

- It is a thickening of the deep fascia of the sole of the foot.

**** Attachment;**

- **Posteriorly** (apex) to the both tubercles of the calcaneus.
- **Anteriorly**, (base) it becomes wider and divides into **5 slips** to:
 - Bases of the proximal phalanges of the toes.
 - Transverse metatarsal ligament.
 - Fibrous flexor sheath.

**** Functions of the plantar aponeurosis,**

- 1- Protracts the deeper structures
- 2- Gives origin to the muscles of the first layer.
- 3- Helps in maintaining the longitudinal arches of the foot.

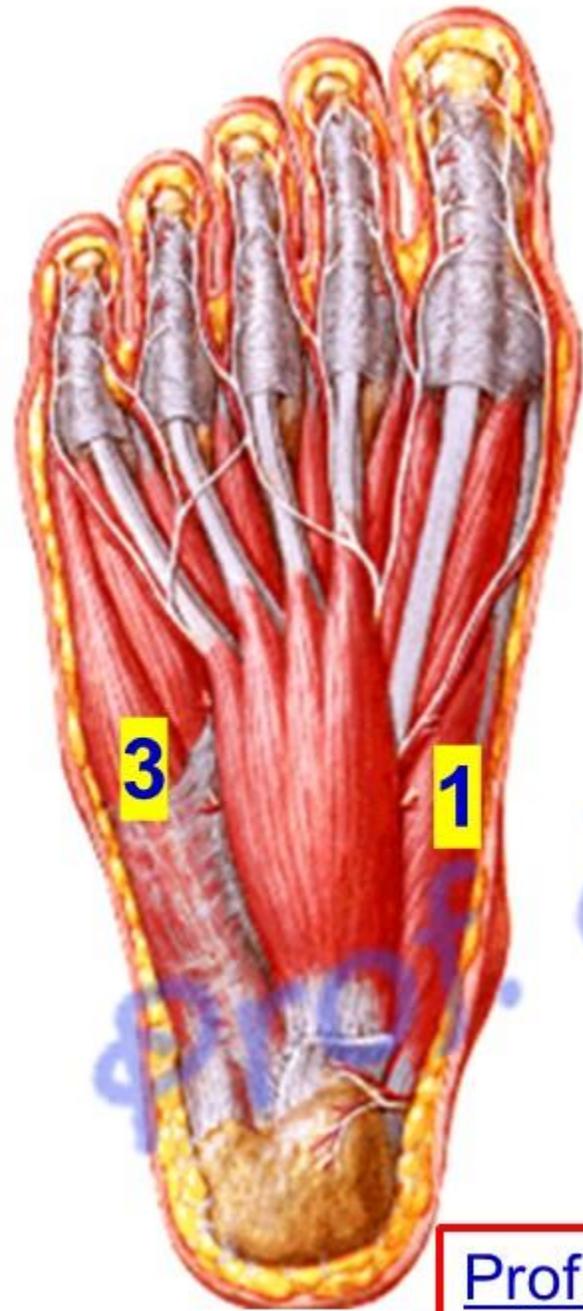
- **Muscles of the First Layer**
- **3 muscles (2 Abductor +1 FDB)**

**Abductor digiti
minimi**

Abductor hallucis

**Flexor digitorum
brevis**

**Plantaris
aponeurosis**



- **1- Abductor Hallucis (medial)**

- ** **Origin:** from the medial tubercle of calcaneus.
- ** **Insertion:** into the medial side of the base of the proximal phalanx of the big toe.
- ** **Nerve supply;** medial plantar nerve.
- ** **Actions:** Abduction of the big toe.

- **3- Abductor digiti minimi (lateral)**

- ** **Origin;** from both medial and lateral tubercles of the calcaneus.
- ** **Insertion;** into the lateral side of the base of the proximal phalanx of the little toe.
- ** **Nerve supply,** lateral plantar nerve.
- ** **Action:** Abduction of the little toe.



2- Flexor digitorum brevis (middle)

** **Origin;** from the medial tubercle of calcaneus.

** **Insertion;** It divides into 4 tendons to the margins of the **middle phalanges** of the lateral 4 toes.

- Each tendon splits to give passage for a tendon of the flexor digitorum longus inserted into distal phalanges.

** **Nerve supply,** medial plantar nerve.

** **Actions,** Flexion of the metatarsophalangeal and **proximal interphalangeal** joints of the lateral four toes.

- **The second Layer**

- This layer includes; **2 tendons and 5 muscles;**

Lumbricalis

**Tendon of flexor
hallucis longus**

**Tendon of flexor
digitorum longus**

**Flexor digitorum
accessories**

• The second Layer

1- Flexor digitorum accessorius

- ** **Origin;** by two heads from the medial and plantar surfaces of the calcaneus.
- ** **Insertion;** into the tendon of flexor digitorum longus.
- ** **Nerve supply,** lateral plantar nerve.
- ** **Action;** it helps in the action of flexor digitorum longus (brings the tendons of muscle more in a straight line with the toes).

**Flexor digitorum
accessories**

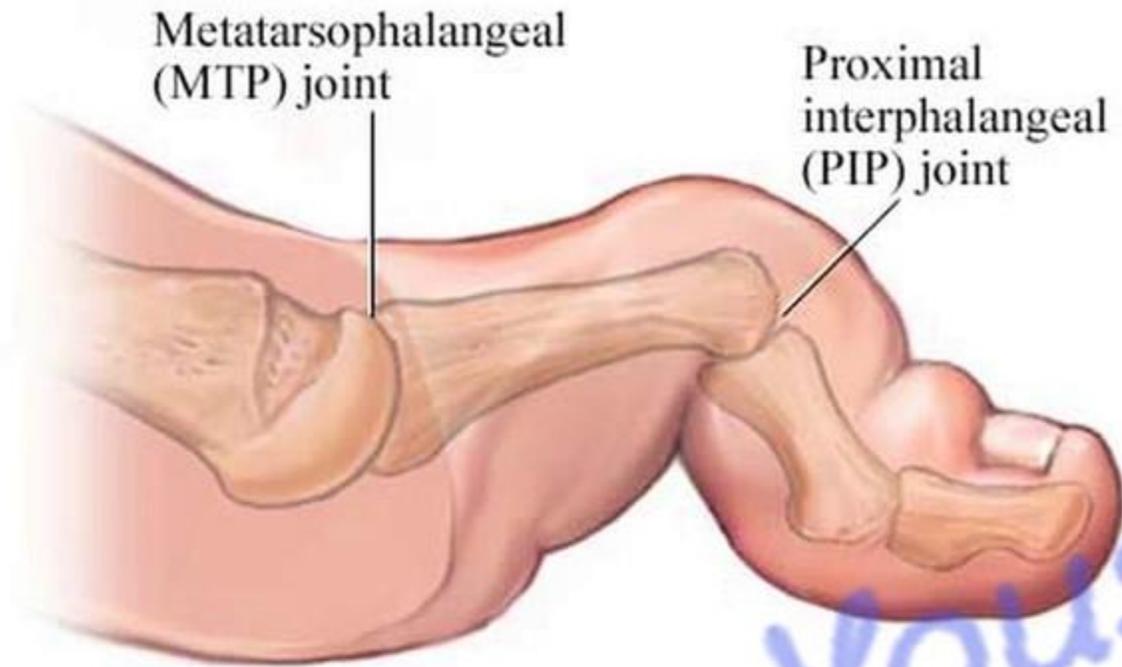


Lumbricalis

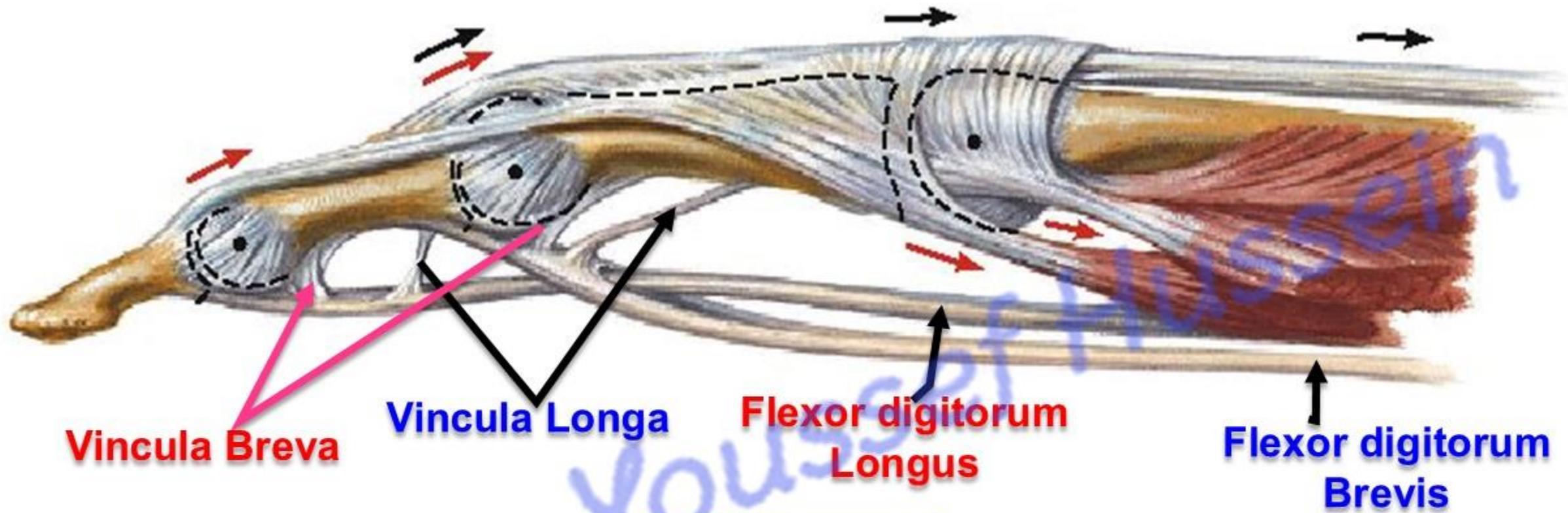


2 - Lumbrical muscles (4 muscles)

- ** **Origin;** from tendons of the flexor digitorum longus.
 - They arranged 1st to 4th from medial to lateral side.
- ** **Insertion;** base of proximal phalanges and extensor expansions of the lateral 4 toes.
- ** **Nerve supply;**
 - 1- The 1st is supplied by medial plantar nerve.
 - 2- The lateral 3 are supplied by lateral plantar nerve.
- ** **Actions;**
 - 1- Flexion of metatarsophalangeal joints of lateral 4 toes.
 - 2- Extension of interphalangeal joints of lateral 4 toes.



- **Paralysis of lumbricals** muscles will lead to **Hammer toes** (only lateral 4 toes)
- **Extension** of metatarsophalangeal joint
- **Flexion** of proximal interphalangeal joint.



- **Vincula tendinum**

- These are small fibrous bands which connect the flexor tendons in the toes with the phalanges.

**** Function,** - They carry blood supply to the flexor tendons.

A- Vincula longa: slender fibrous bands connecting the tendons with the proximal and distal phalanges,

b- Vincula breva: triangular fibrous bands occupying the angles between the tendons and the bones at the sites of Insertion.

• The third Layer

- It includes 3 muscles (2 Flexor + Adductor),

**Flexor digiti
minimi brevis**

**Medial head of flexor
hallucis brevis**

**Lateral head of flexor
hallucis brevis**

**Transverse head of
adductor hallucis**

**Oblique head of
adductor hallucis**

- **Flexor hallucis brevis (medial)**

** **Origin;** from the cuboid bone and the tendon of tibialis posterior.

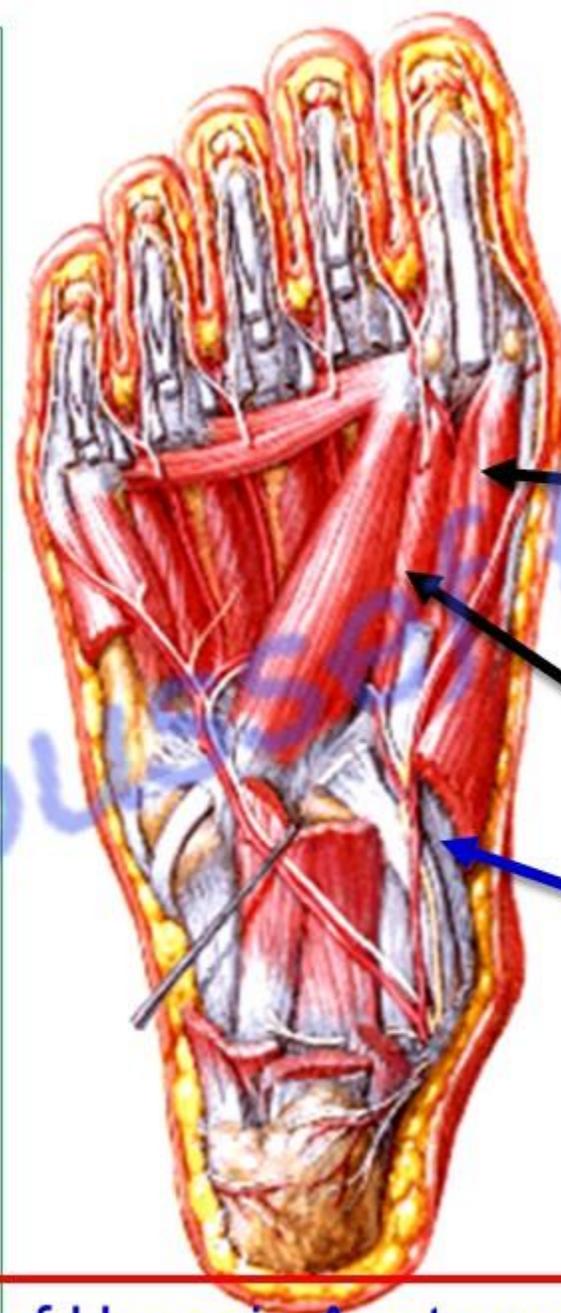
** **Insertion;** It divides into 2 parts.

a- Medial part inserted with **abductor** hallucis into **medial** side of base of proximal phalanx of big toe.

b- Lateral part inserted with **adductor** hallucis into **lateral** side of base of proximal phalanx of big toe.

** **Nerve supply;** medial plantar nerve.

** **Action;** flexion of the big toe.



- **The third Layer**

Medial head of flexor hallucis brevis

Lateral head of flexor hallucis brevis

Tendon of tibialis posterior

2- Adductor hallucis (middle)

**** Origin; by 2 heads**

a- Transverse head from the plantar ligaments of the metatarsophalangeal joints.

b- Oblique head arises from bases of the 2nd, 3rd and 4th metatarsal bones and from fibrous sheath covering the tendon of peroneus longus.

**** Insertion;** with the **lateral part of flexor hallucis brevis** into the **lateral side** of the base of the proximal phalanx of big toe.

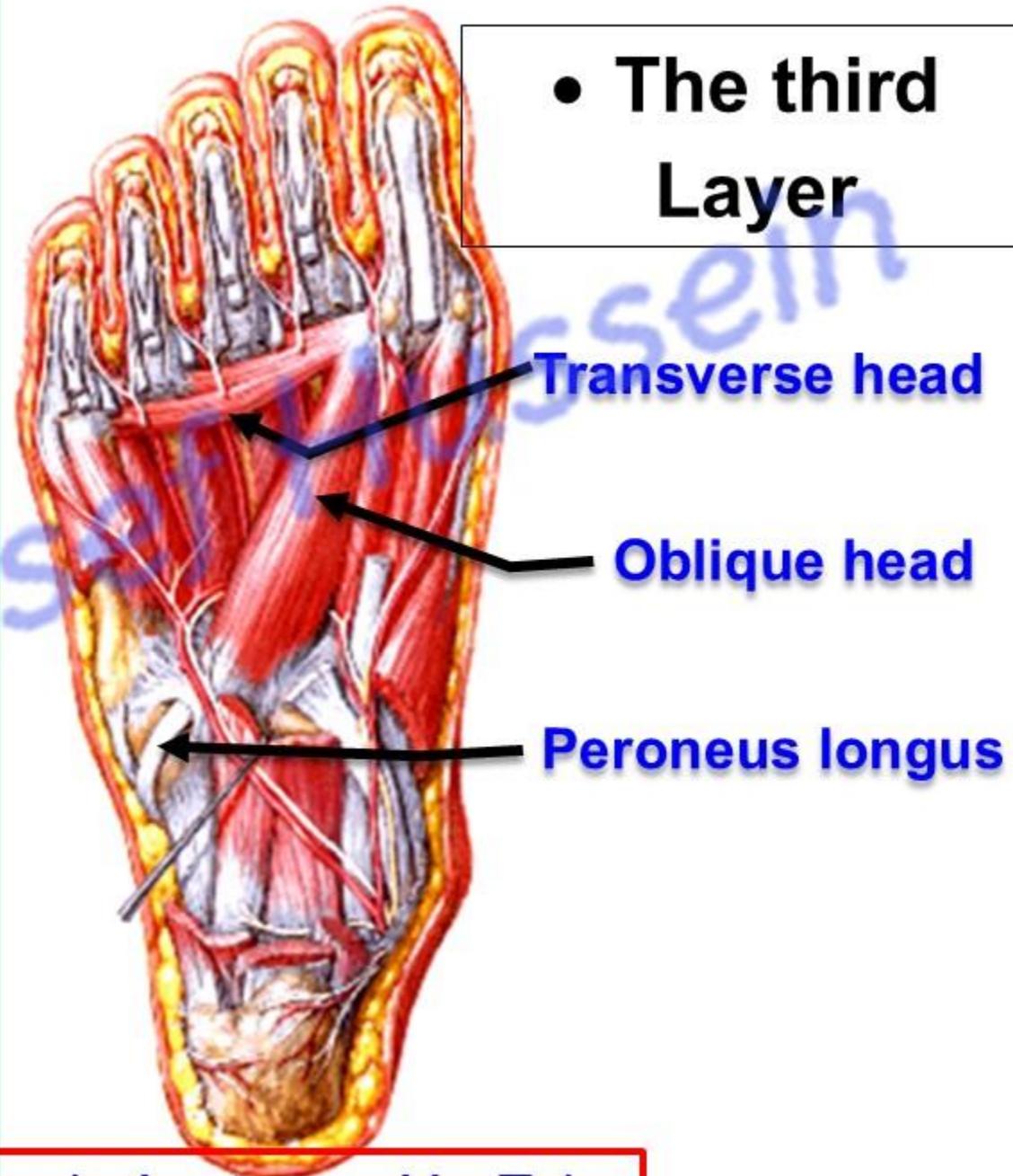
**** Nerve supply;** lateral plantar nerve.

**** Actions;**

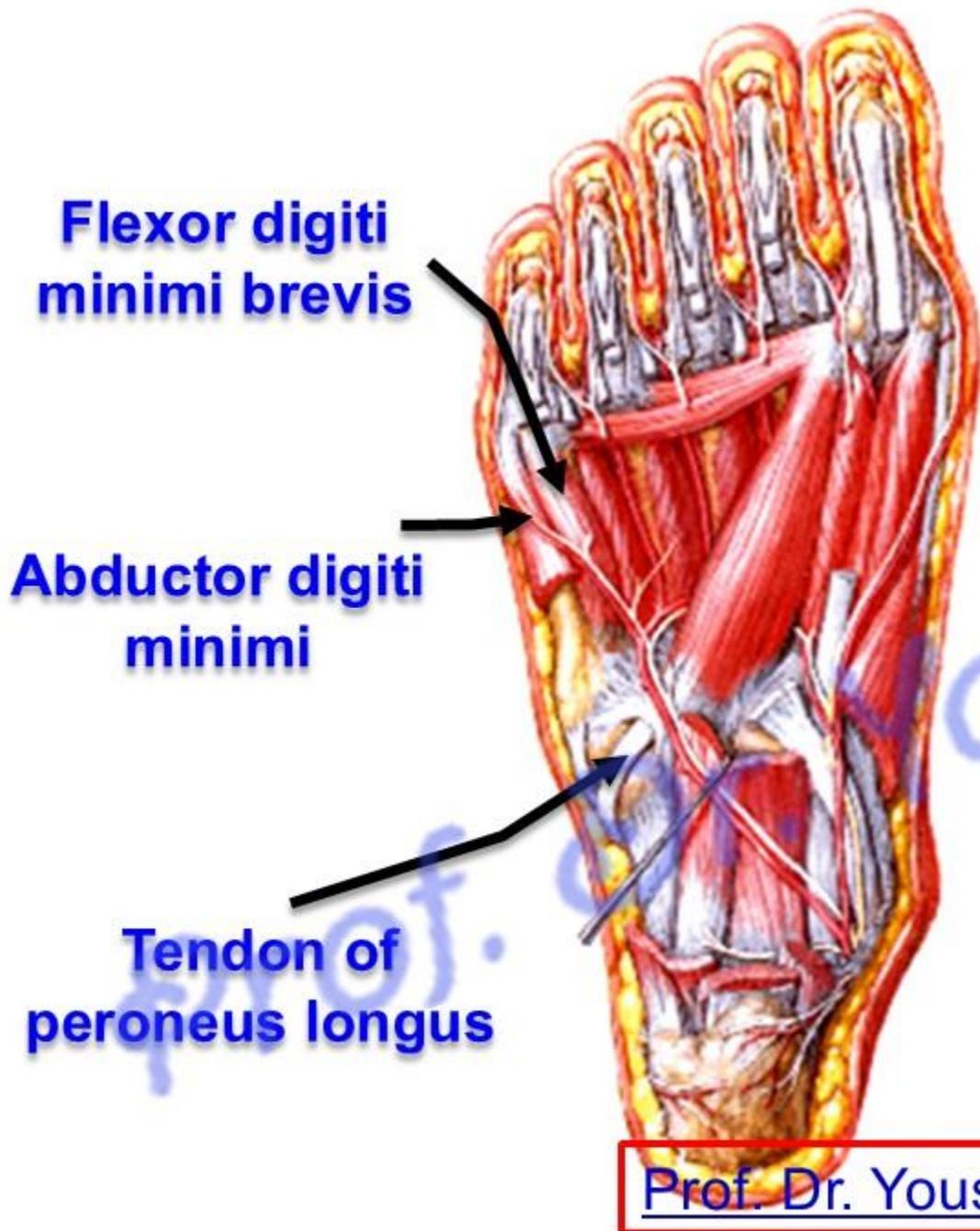
a- Oblique head: adduction of big toe.

b- Transverse head: supporting the

transverse arch of the foot. [Prof. Dr. Youssef Hussein Anatomy - YouTube](#)



• The third Layer



• **Flexor digiti minimi brevis (lateral)**

** **Origin**; from the plantar surface of the base of the 5th metatarsal bone and the fibrous sheath of the tendon of peroneus longus.

** **Insertion**, with the **abductor digiti minimi** into the **lateral side** of the base of the proximal phalanx of the little toe.

** **Nerve supply**; lateral plantar nerve.

** **Action**; flexion of the little toe.

- **The fourth Layer**
- **It includes 2 ligaments, 2 tendons and 2 types of muscle**

**Plantar interossei
(3 muscles)**

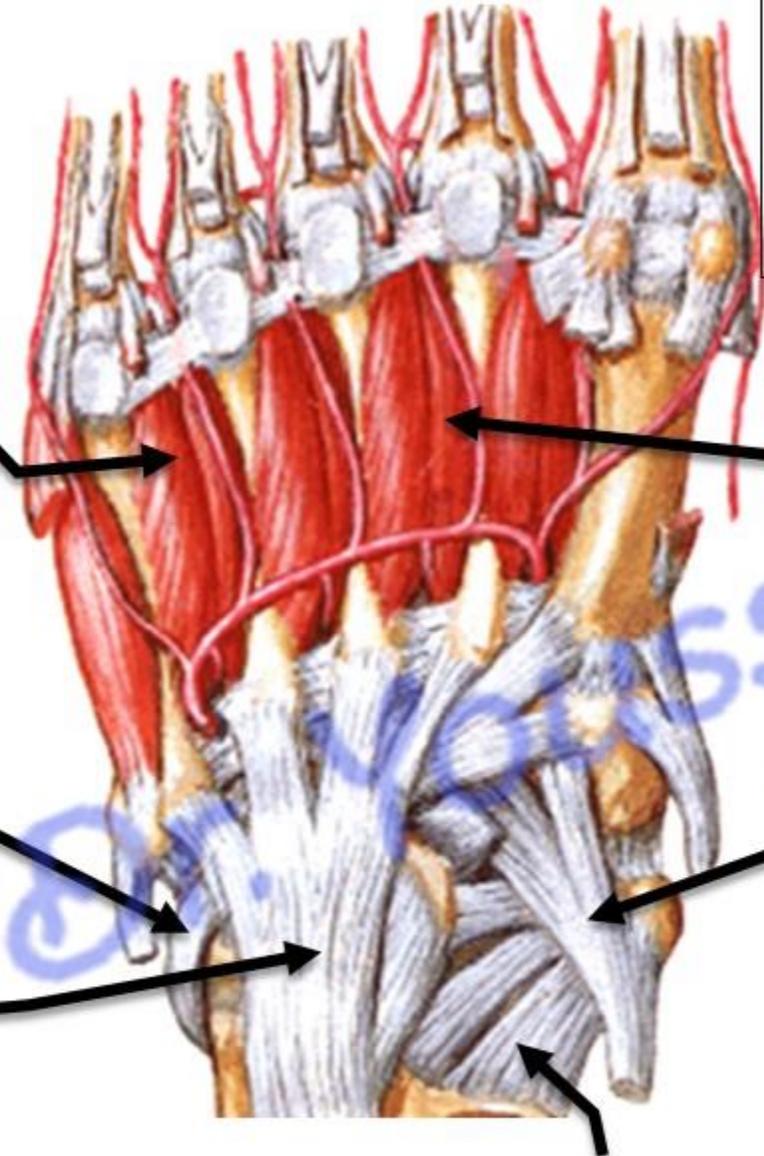
**Dorsal interossei
(4 muscles)**

**Tendon of
peroneus longus**

**Tendon of Tibialis
posterior**

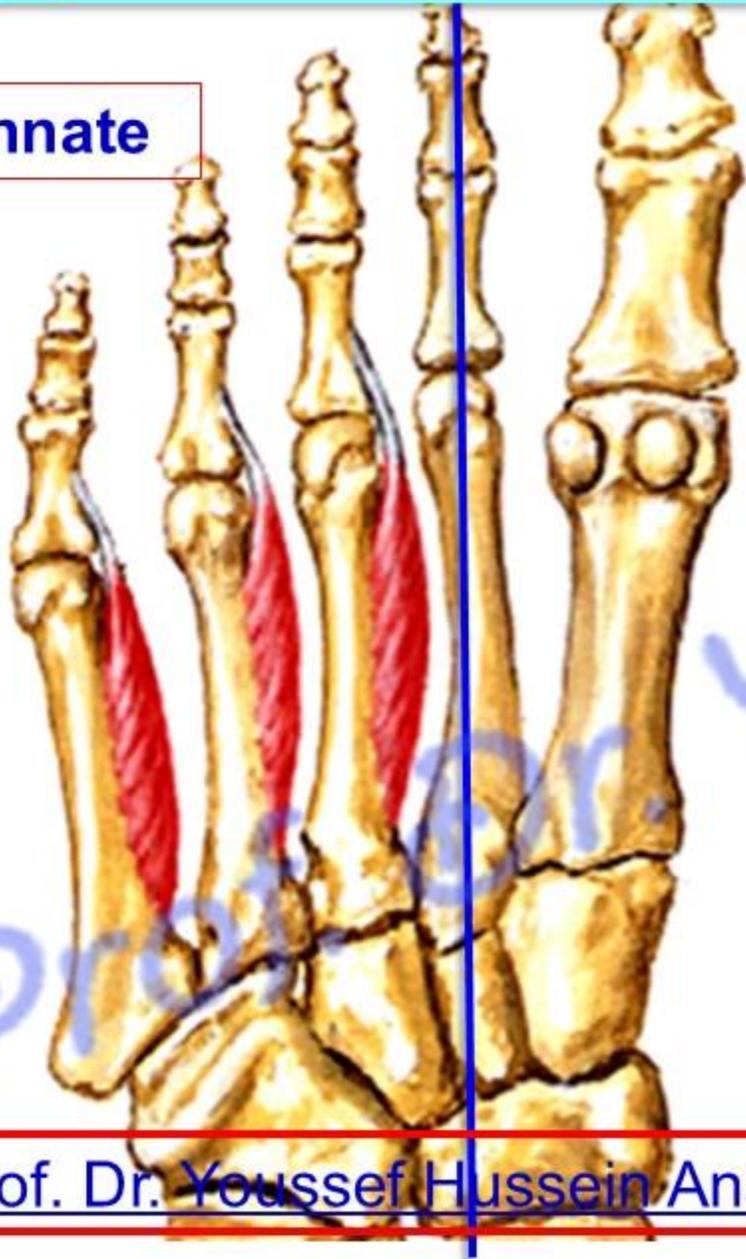
**Long plantar
ligament**

Spring ligament



Plantar interossei

Unipennate



- **Plantar interossei (3 muscles)**

** **Origin;** from the shafts of the 3rd, 4th and 5th metatarsal bones.

** **Insertion;** base of the **medial side** of the proximal phalanx of the 3rd, 4th and 5th toes.

** **Nerve supply,** lateral plantar nerve.

** **Action;** Adduction of the lateral 3 toes (the 2nd toe is the axis of the foot).

- **Dorsal interossei (4 muscles)**

**** Origin,** from the adjacent sides of the two metatarsal bones.

**** Insertion;**

- **The 1st muscle** into the **medial side** of the base of the proximal phalanx of the **2nd toe** and extensor expansion.
- **The 2nd muscle** into the **lateral side** of the base of the proximal phalanx of the **2nd toe** and extensor expansion.
- **The 3rd muscle** into the **lateral side** of the base of the proximal phalanx of the **3rd toe** and extensor expansion.
- **The 4th muscle** into the **lateral side** of the base of the proximal phalanx of the **4th toe** and extensor expansion.

**** Nerve supply;** lateral plantar nerve.

**** Action;**

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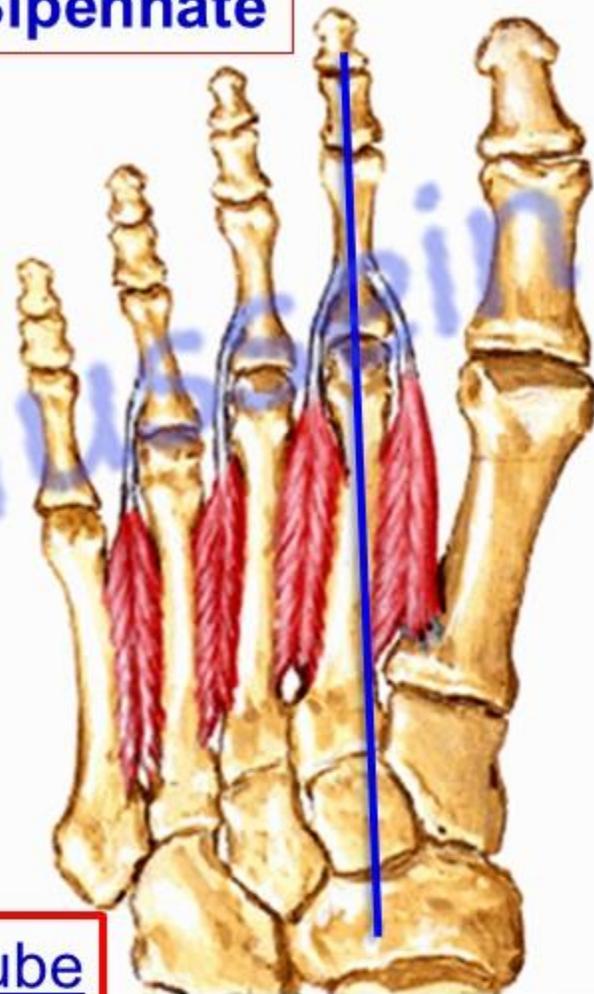
1- Abduction of the toes. (The 2nd toe is the axis of the foot).

2- ~~Acting with lumbricalis muscles through extension expansion,~~

a- ~~Flexion of the metatarsophalangeal joints.~~

b- ~~Extension of the interphalangeal joints.~~

Bipennate



- **No** interossei muscles for the **big toe**.
- **No Planter** interossei muscles to the **2nd toe** as it is the axis of the toes.
- **No Dorsal interossei** muscles of the **little toes** as they have their own abductor.

- **Nerve supply**

- **All muscles** of foot (18 muscles) supplied by **lateral plantar nerve** **except 4 muscles** supplied by medial plantar nerve

1- **1st lumbrical** muscle (2nd layer).

2- **Abductor hallucis** muscle (1st layer).

3- **Flexor hallucis** brevis muscle (3rd layer).

4- **Flexor digitorum brevis** muscle (1st layer).

dr_youssefhussein@yahoo.com



Arches of the foot

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- **Arches of the Foot**

- The skeleton of the foot is built up in an arched form.

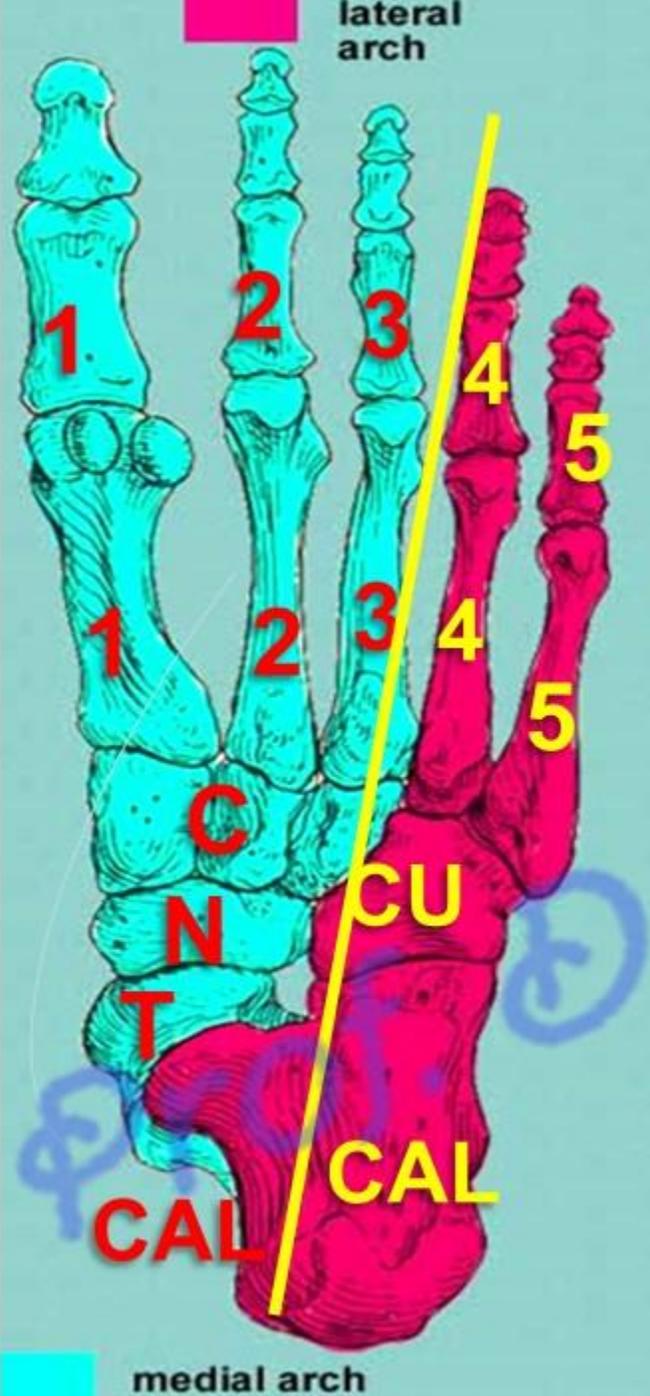
**** Functions;**

1- Distribution of the body weight on the bones of the foot.

2- Protection of the structures in the sole of the foot especially plantar nerves, vessels and muscles.

3- Absorption of shock in falling and jumping.

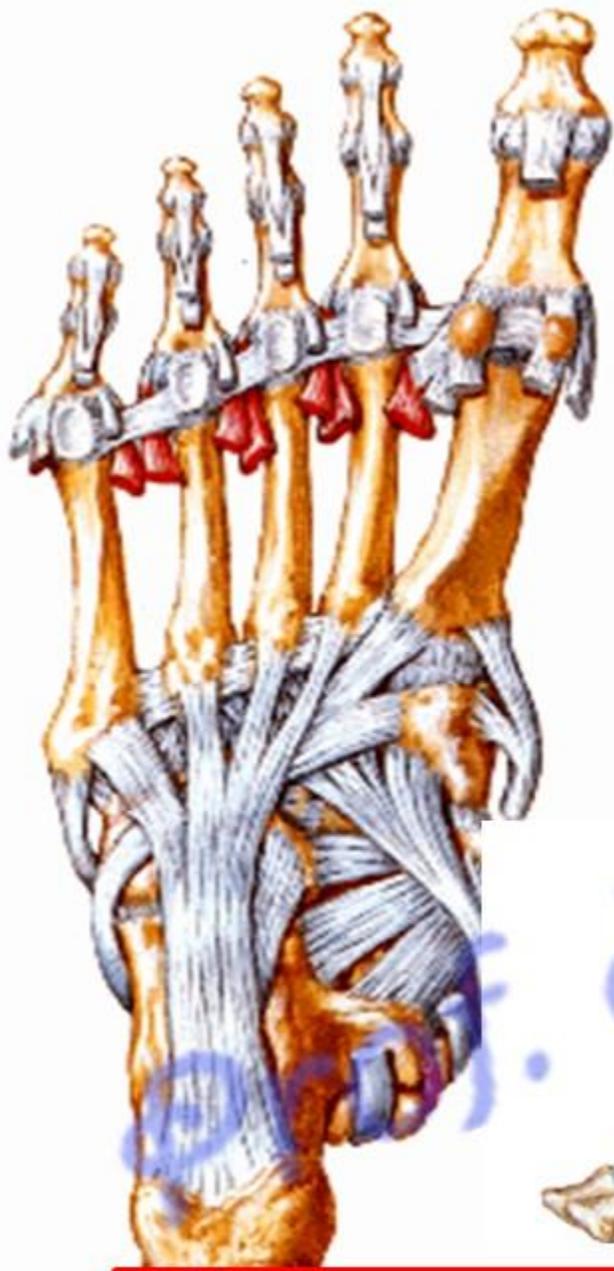
4- Act as lever as it propels the body forward in walking and running.



- **Longitudinal arch:**

- 1- **Medial longitudinal arch:** is formed by
 - **3 bones:** calcaneus العقب, talus القعب & navicular الزورقي.
 - **3 cuneiform** الاسفيني bones.
 - **3 medial metatarsal** المشطيات bones
 - **Phalangeal bones of the medial 3 toes.**
- 2- **Lateral longitudinal arch:** is formed of
 - **2 bones:** calcaneus and cuboid المكعب.
 - **2 lateral metatarsal bones**
 - **Phalangeal bones of the lateral 2 toes.**

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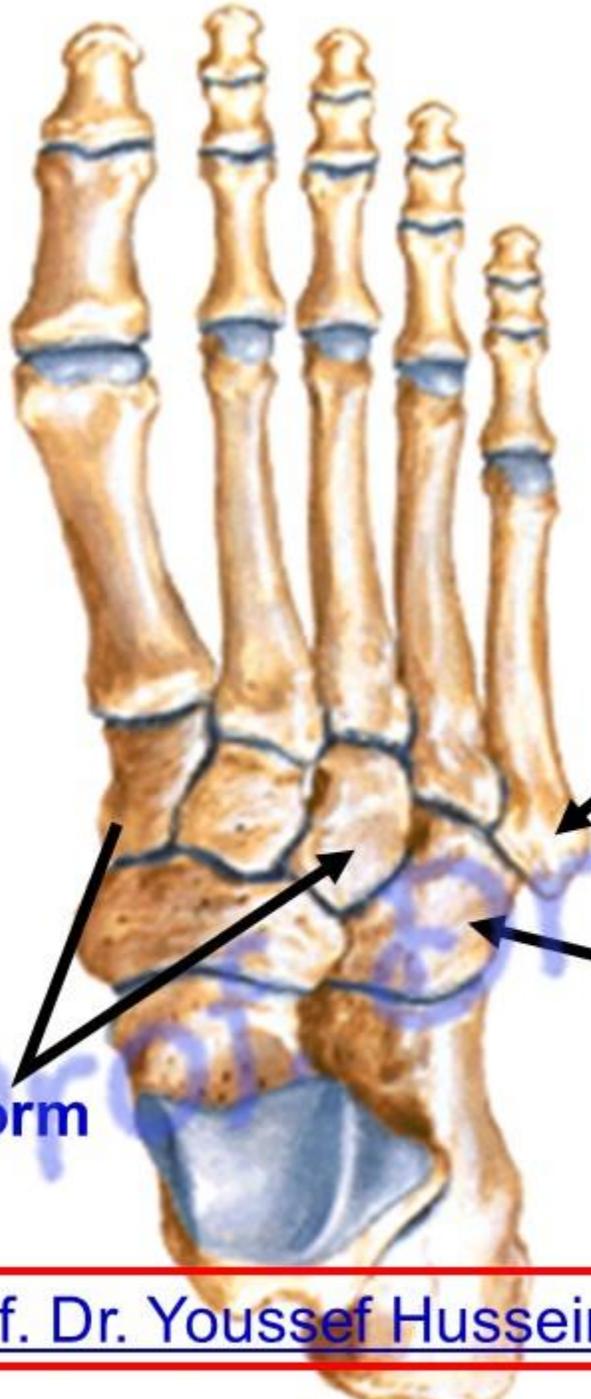
1- Medial longitudinal arch:

- It is **higher** than the lateral.
- **Posterior pillar** ركيزة medial tubercle of the calcaneus.
- **Anterior pillar**, head of the 1st metatarsal bone.
- **Summit** (highest point), talus.

2- Lateral longitudinal arch:

- **Posterior pillar** ركيزة, lateral tubercle of the calcaneus.
- **Anterior pillar**, head of the 5th metatarsal bone.





- **Transverse arch:**

- It is formed of:

a- Proximal: cuboid and three cuneiform bones.

b- Distal: bases of the metatarsal bones.

Base of Metatarsal bones

Cuboid

Cuneiform

**** Factors supporting the arches of the foot;**

1- Shape of the bones.

2- Plantar aponeurosis

3- Muscles

A. Muscles support the longitudinal arch:

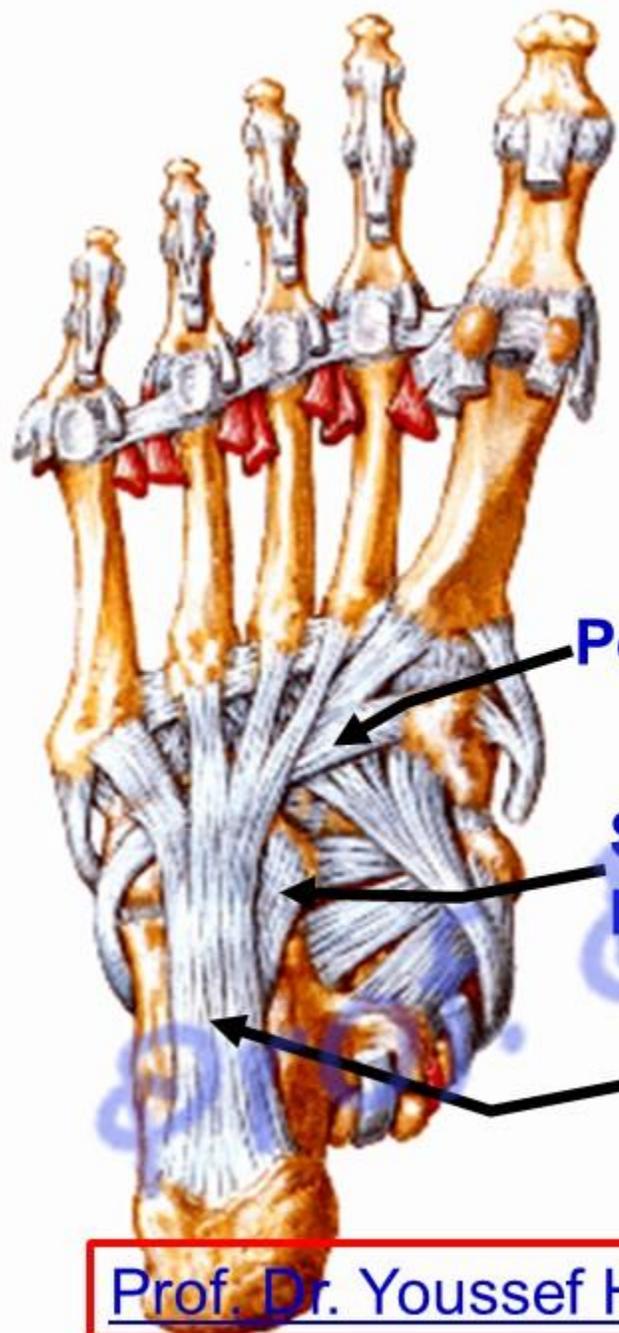
- 1- Flexor digitorum longus and flexor hallucis longus.
- 2- Tendons of tibialis anterior and posterior.
- 3- Short muscles of the sole of the foot

B. Muscles support the transverse arch

- 1- Peroneus longus.
- 2- Transverse head of adductor hallucis

4- Ligaments;

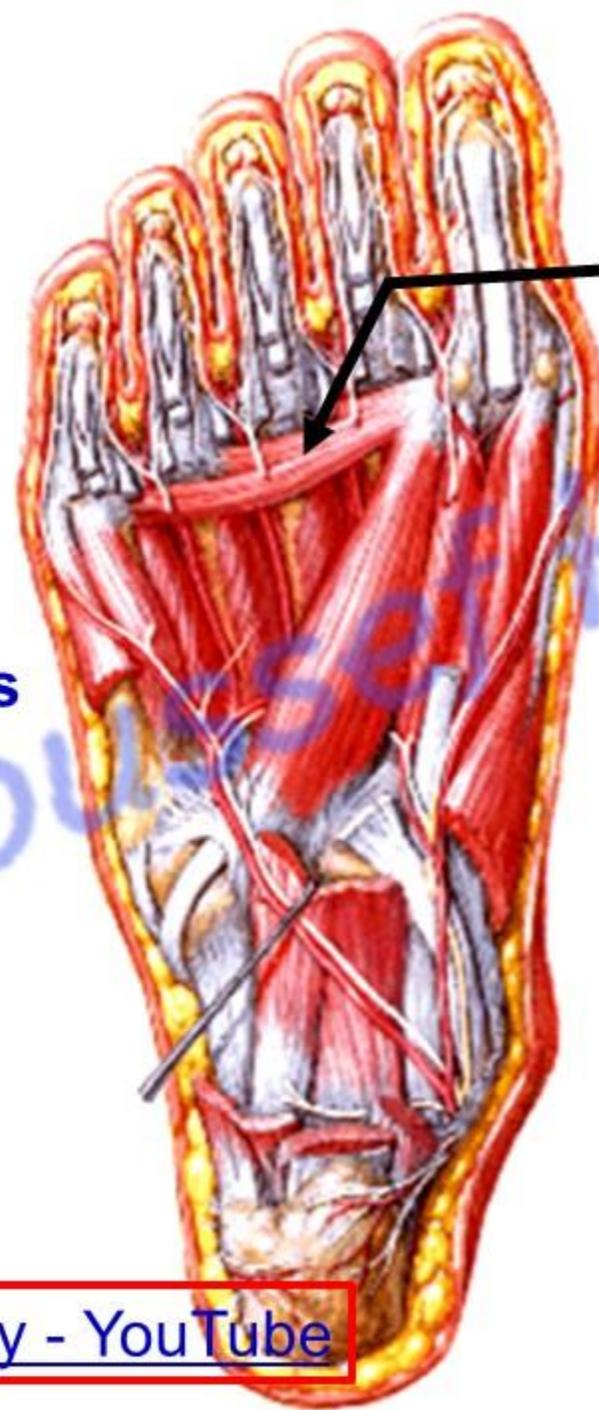
- a- Deltoid ligament.
- b- Spring ligament.
- c- Short and Long plantar ligaments.
- d- Superficial and deep transverse metatarsal ligaments



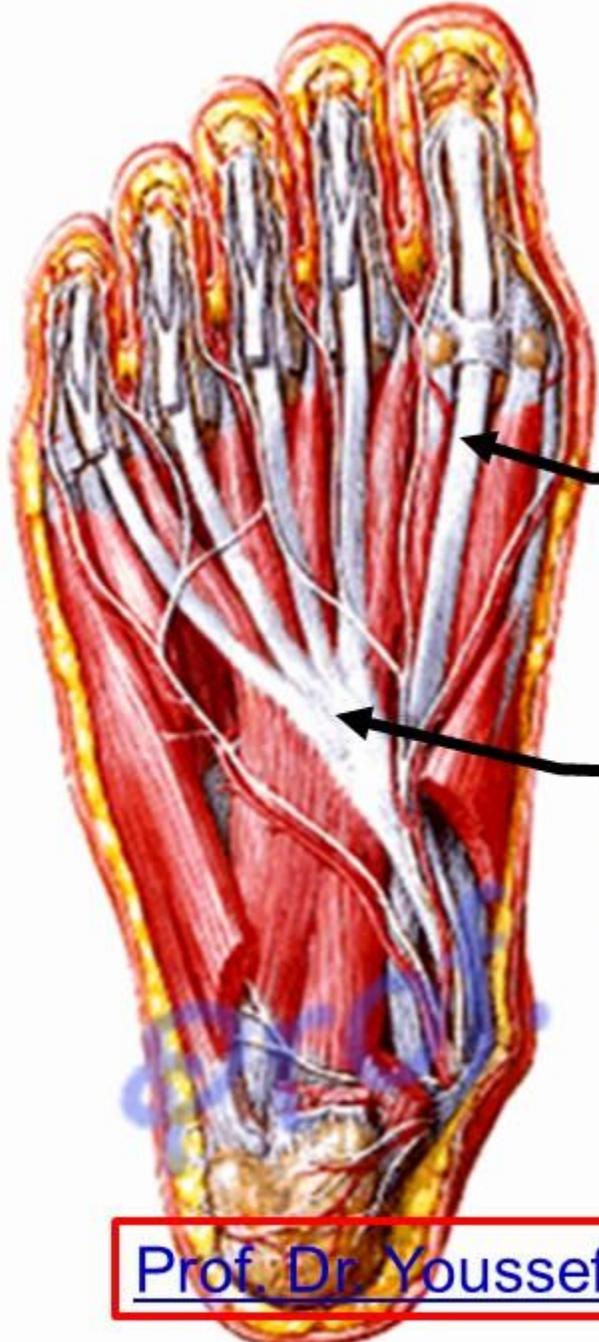
Peroneus longus

Short plantar ligament

Long plantar ligament



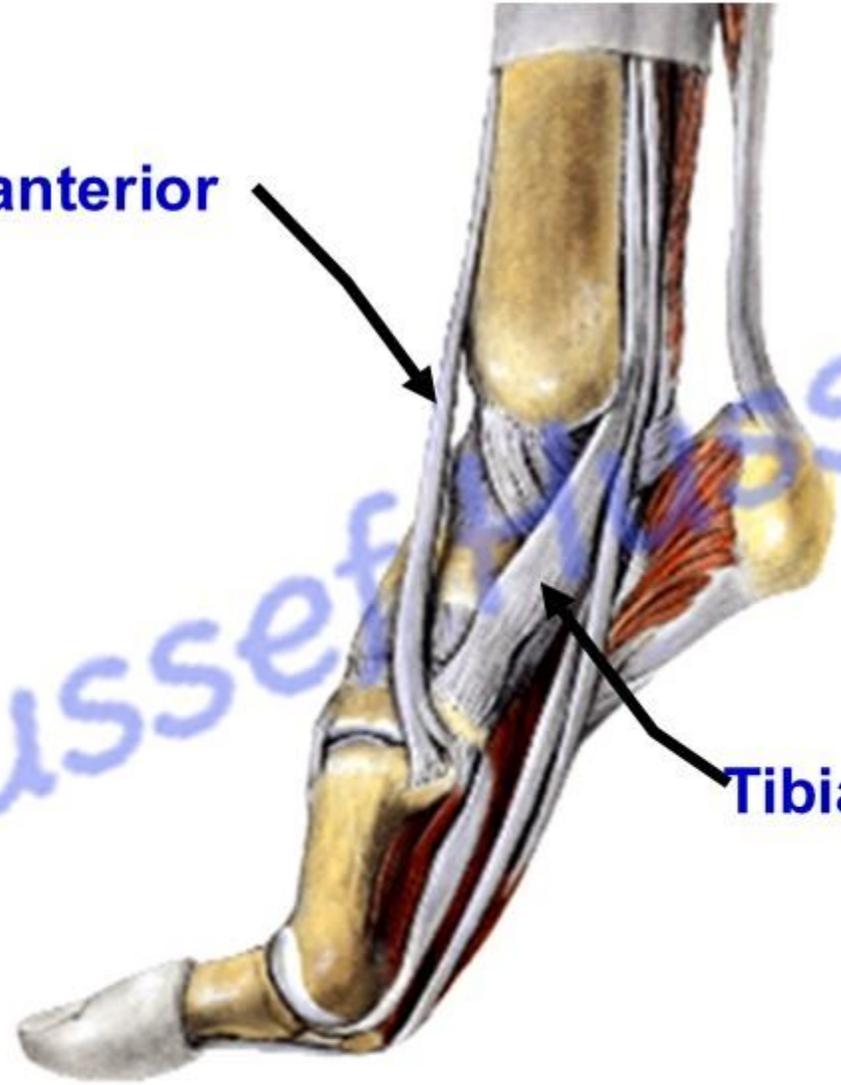
Transverse head of adductor hallucis



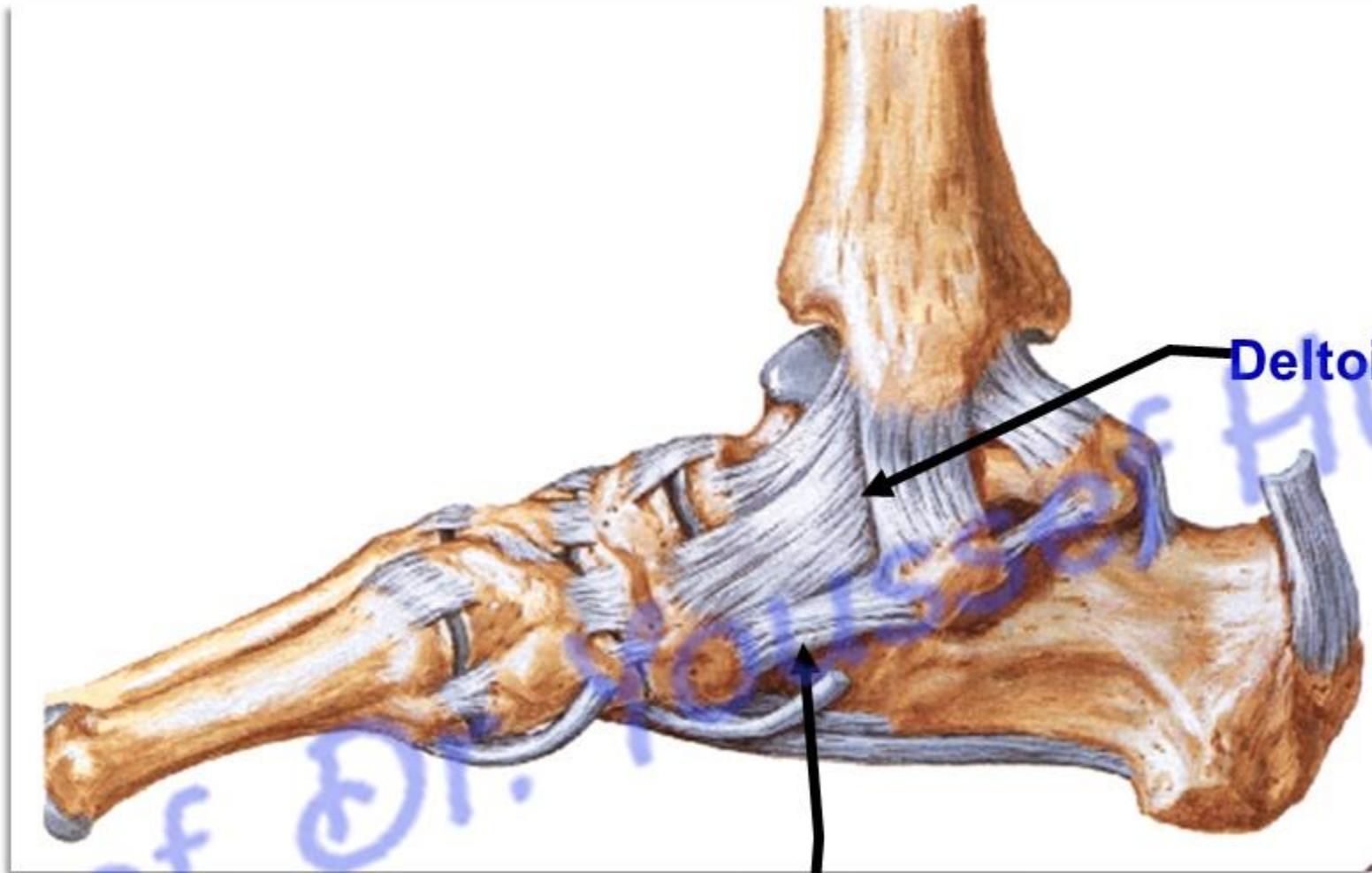
Flexor hallucis longus

Flexor Digitorum longus

Tibialis anterior



Tibialis posterior



Deltoid ligament

Spring ligament



Mechanism of walking

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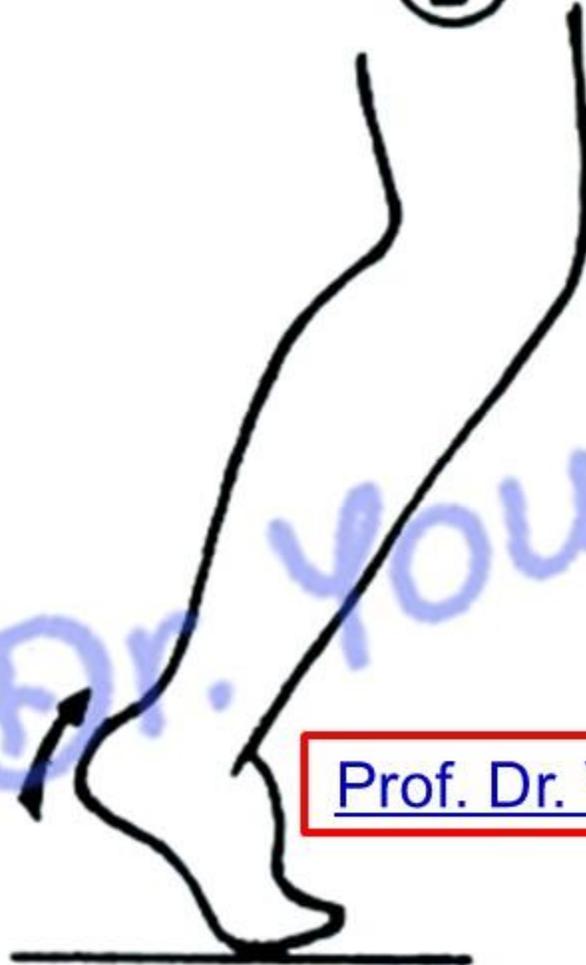
Stance phase

①



Weight bearing foot

②



Heel off

A- Stance phase;

- Occupies 60% of gait cycle

1- Weight bearing foot: The foot is on the ground.

2- Heel off: The weight of the body is transmitted forwards from the heel to the metatarsal bones.

- The heel is elevated but the toes is still in contact with the ground.

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Swing phase



B- Swing phase

- The limb is off the ground
- **3-Toe off**, the toes are raised from the ground accompanied by slight flexion of the hip and knee joints and plantarflexion of the ankle joint.
- **4- Heel strike**: The leg is propelled forwards. The swing phase ends when the heel comes in contact with the ground again.

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