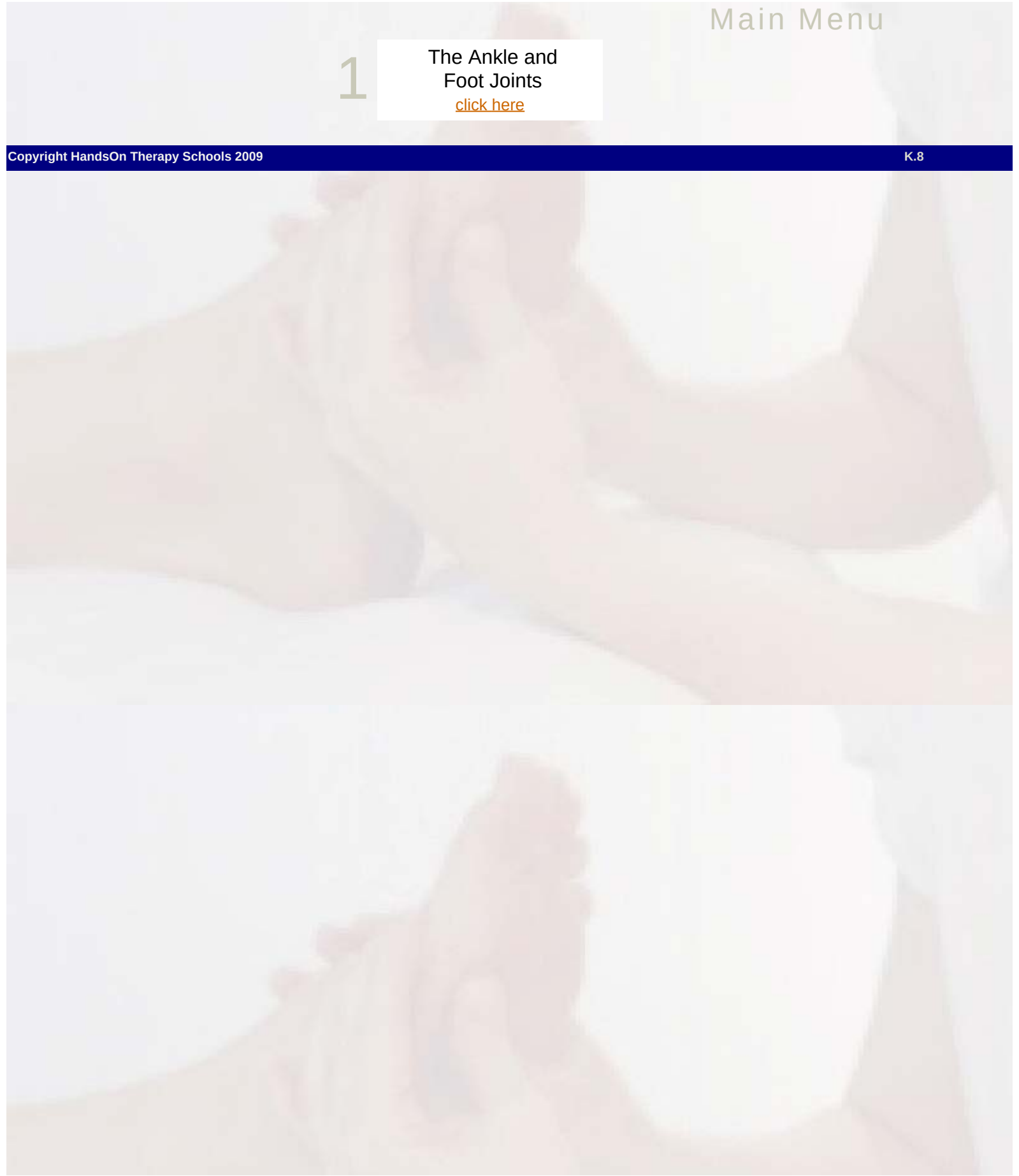






1

The Ankle and
Foot Joints

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K.8

Ankle and Foot Joint

26 bones

19 large muscles

Many small (intrinsic) muscles

More than 100 ligaments

Support and propulsion

- Foot trouble - common ailment

- Poor foot mechanics leads to foot discomfort

- No substitute for adequate muscular development, strength, and proper foot mechanics

Walking and running : Stance phase

- Heel-strike occurs when landing on heel, foot should be in supination

- Midstance immediately follows with foot moving into pronation

- Toe-off follows midstance, foot returns to supination prior to and during push off

Walking and running : Swing phase

- occurs when foot leaves ground & leg moves forward to another point of contact

Problems arise

- foot is too rigid and does not pronate adequately

- foot remains in pronation past midstance

Walking

- one foot is always in contact with ground

Running

- point when neither foot is in contact with ground

Walking

Stance Phase (60% of total)					Swing Phase		
							
Initial Contact (heel contact)	Loading Response	Midstance	Terminal Stance	Pre Swing (toe-off)	Initial Swing	Midswing	Terminal Swing
External Rotation of Tibia	Internal Rotation of Tibia			External Rotation of Tibia			
Supination	Pronation			Supination			

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Bones

26 bones in each foot that form arch

Body weight is transferred from tibia to talus and calcaneus (tarsal bones)

5 other rear and midfoot tarsal bones

Navicular - between talus and 3 cuneiform bones

Cuboid - between calcaneus and 4th and 5th metatarsals

5 metatarsals - anterior to tarsals

5 phalanges : 3 phalanxes in each except 1st toe (2 phalanxes) ; 2 sesamoids beneath 1st metatarsophangeal joint

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Bones

Distal malleoli of tibia and fibula

Enlarged and protrude horizontally and inferiorly

Serve as pulley for posterior tendons to increase mechanical advantage of muscles in performing inversion and eversion actions

Pulley for posterior tendons

Peroneus brevis and peroneus longus - immediately behind lateral malleolus

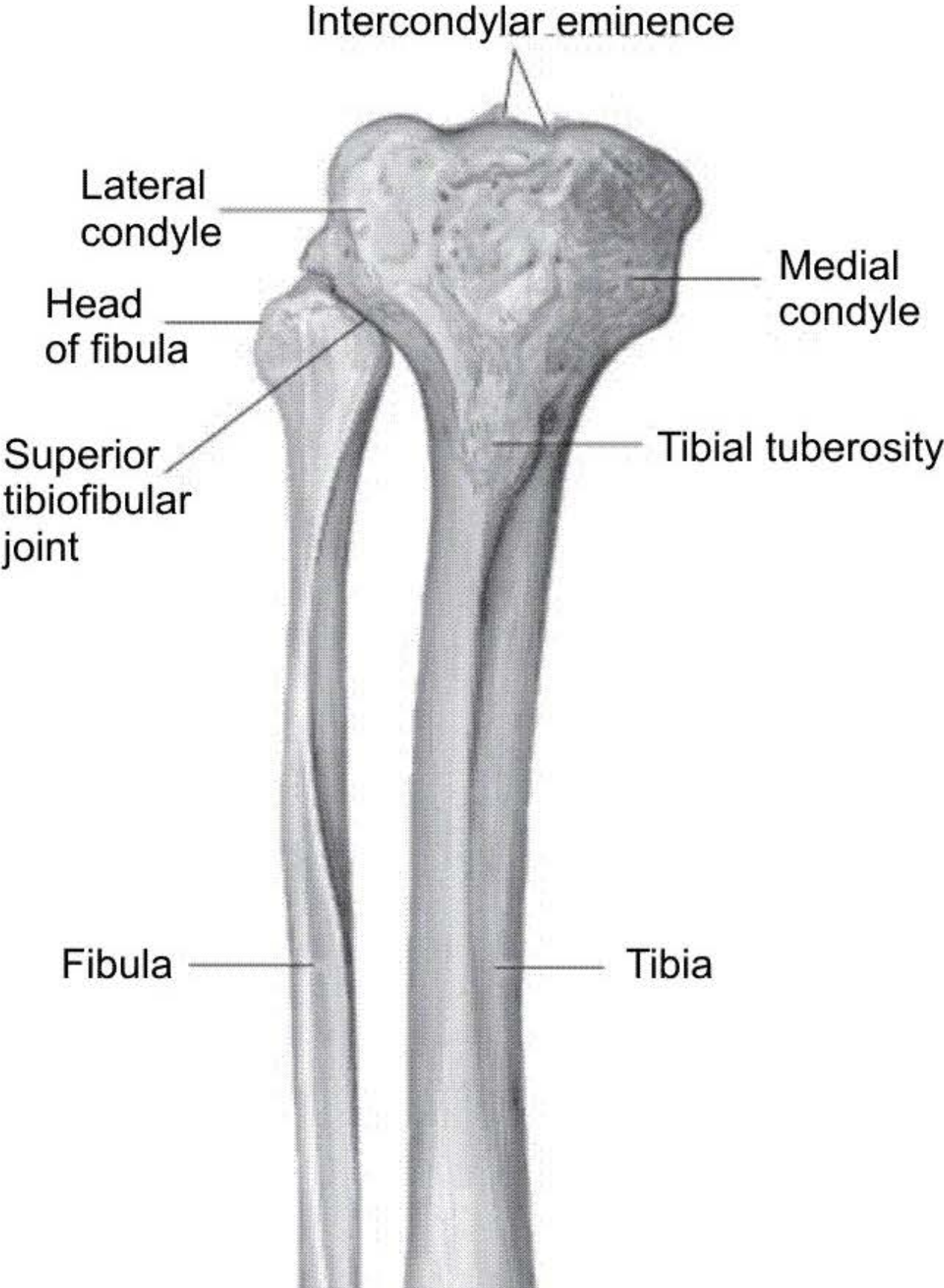
“Tom, Dick and Harry” muscles immediately posterior to medial malleolus : **T**ibialis posterior ; Flexor **d**igitorum longus ; Flexor **h**allucis longus

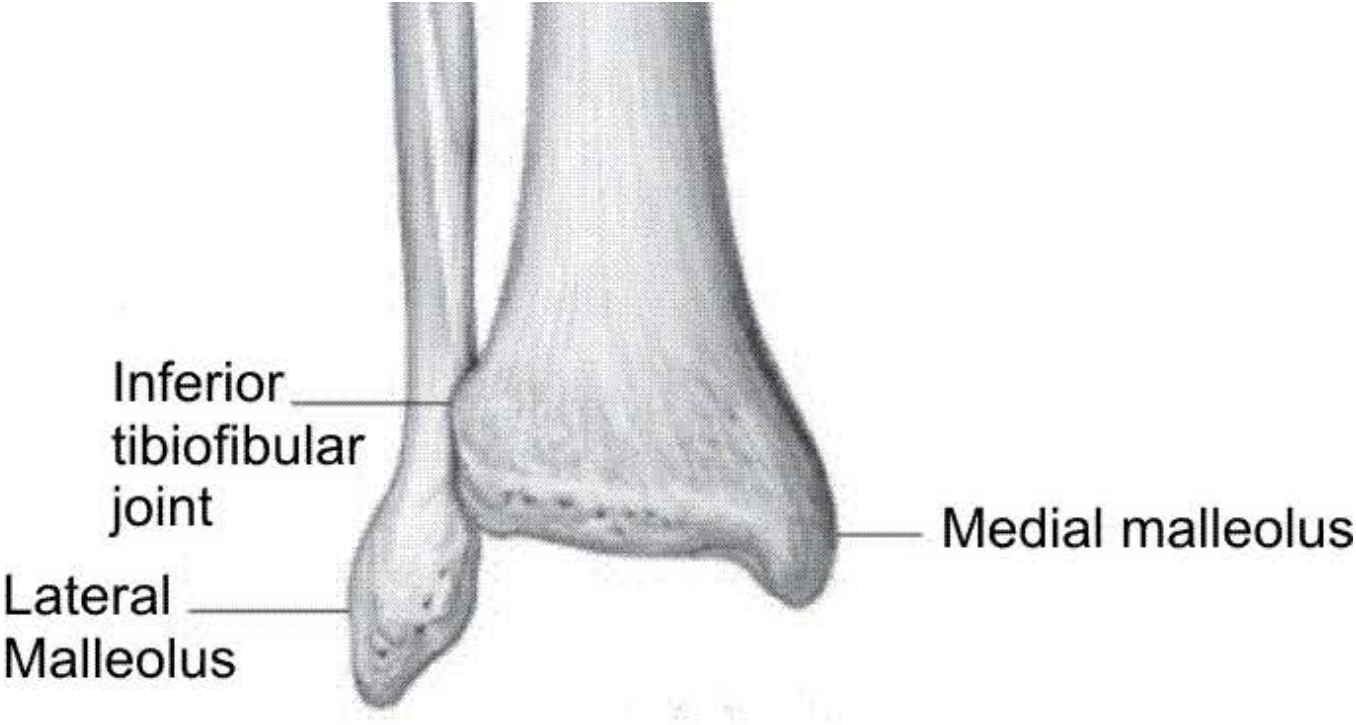
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Bones





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Bones

Base of 5th metatarsal

enlarged and prominent to serve as insertion for peroneus brevis and tertius

Tibialis anterior inserts on inner surface of medial cuneiform and base of 1st metatarsal

Peroneus longus inserts on undersurface of medial cuneiform and 1st metatarsal

Tibialis posterior - multiple insertions on lower inner surfaces of navicular, cuneiform, and 2nd - 5th metatarsal base

Extensor digitorum longus inserts on tops of 2nd - 5th distal phalanxes bases

Flexor digitorum longus inserts on undersurfaces of 2nd - 5th distal phalanxes bases

Extensor hallucis longus inserts on top of 1st distal phalanx base

Flexor hallucis longus inserts on undersurface of 1st distal phalanx base

Posterior surface of calcaneus

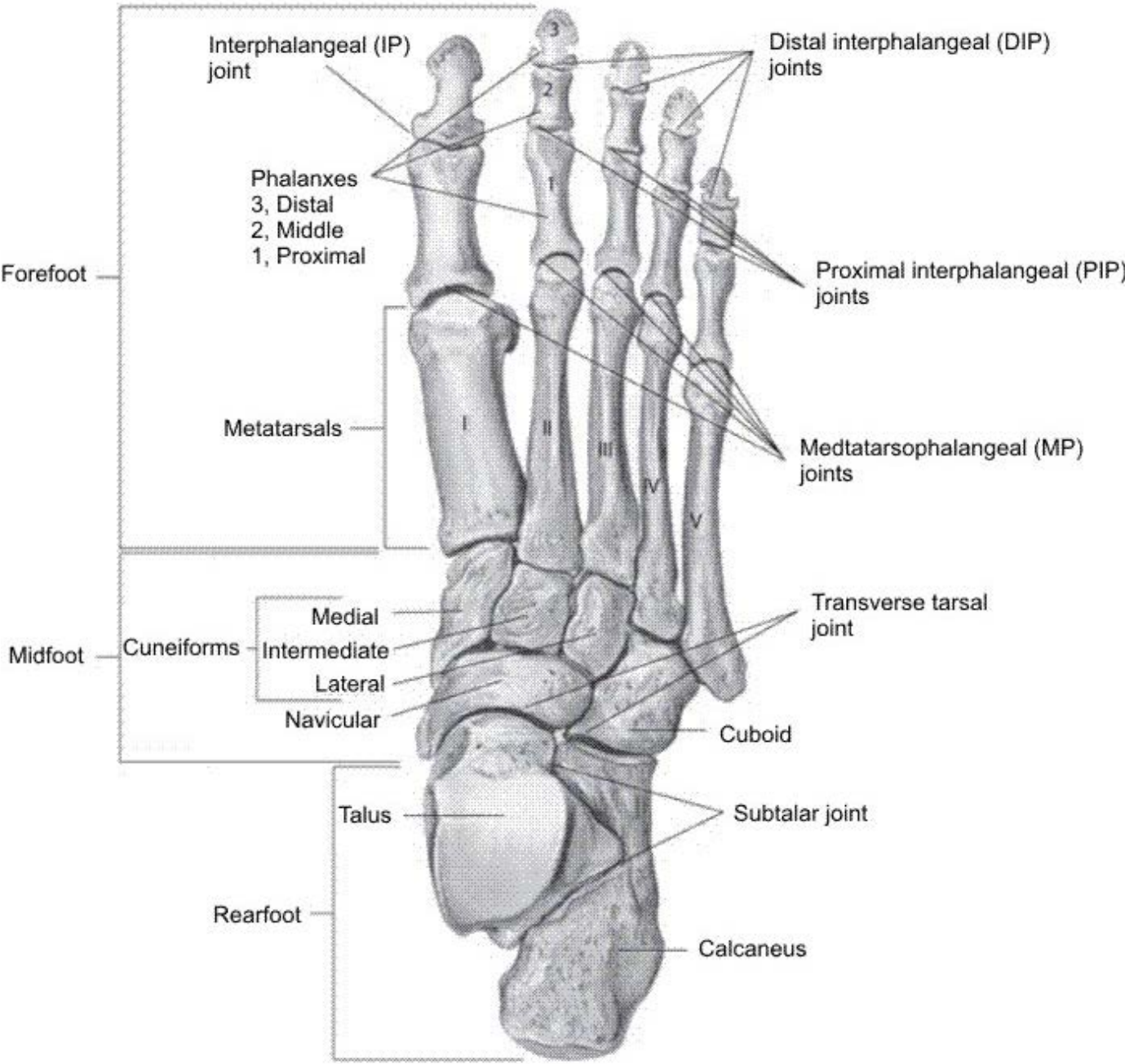
very prominent and serves as insertion for Achilles tendon of gastrocnemius-soleus complex

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Bones



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Joints

Tibiofibular joint

Syndesmotic amphiarthrodial joint

Joined at both proximal and distal tibiofibular joints

Ligaments and a strong, dense interosseus membrane between tibia and fibula shafts provide support

Minimal movement possible

Distal joint becomes sprained occasionally in heavy contact sport

Syndesmosis joint sprain

“High ankle sprain” primarily involves anterior inferior tibiofibular ligament

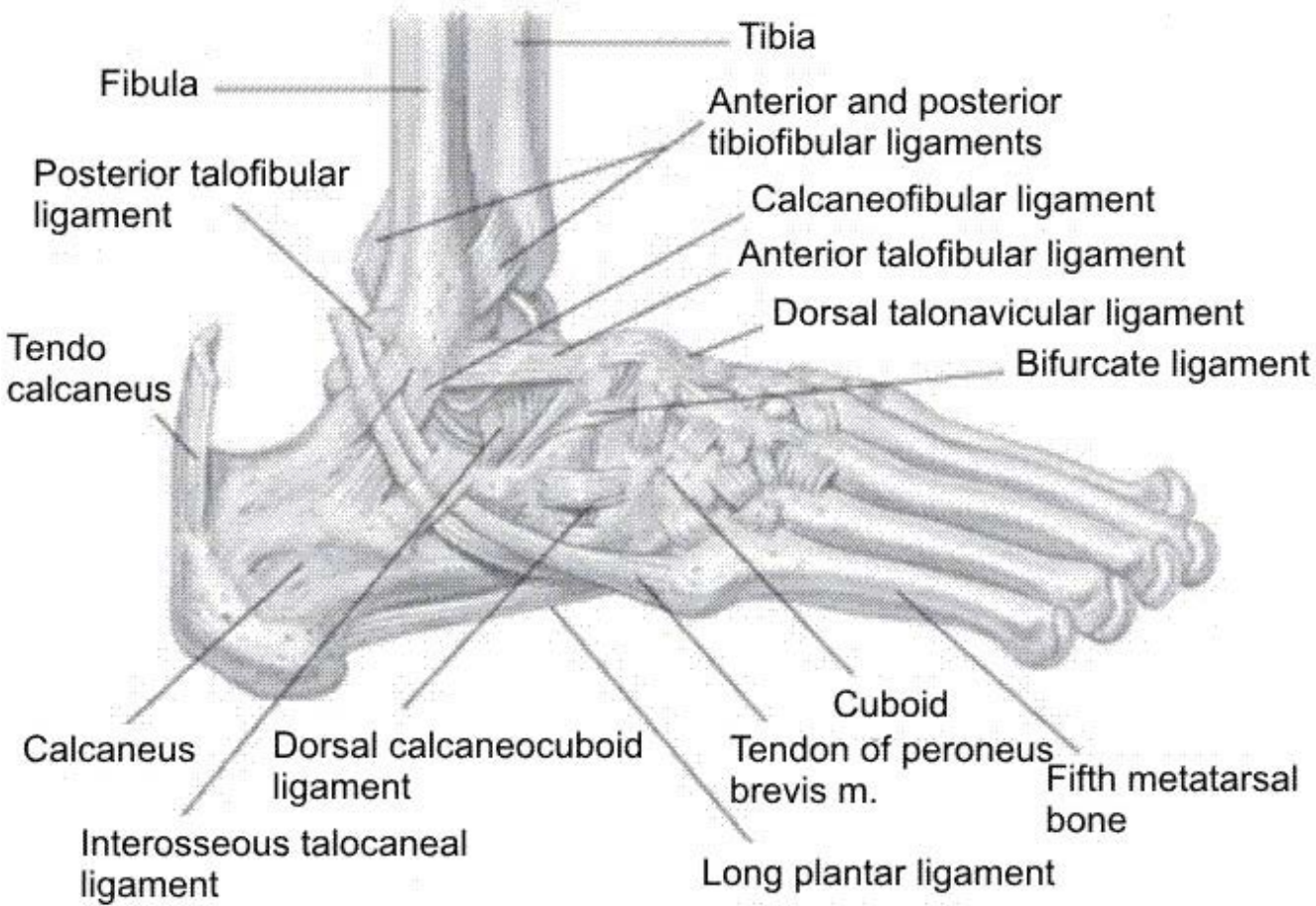
More severe injuries can involve posterior tibiofibular ligament, interosseus ligament, and interosseus membrane

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Joints



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Ankle joint (talocrural joint)

Ankle joint (talocrural joint)

Hinge or ginglymus-type joint

Talus, distal tibia, and distal fibula

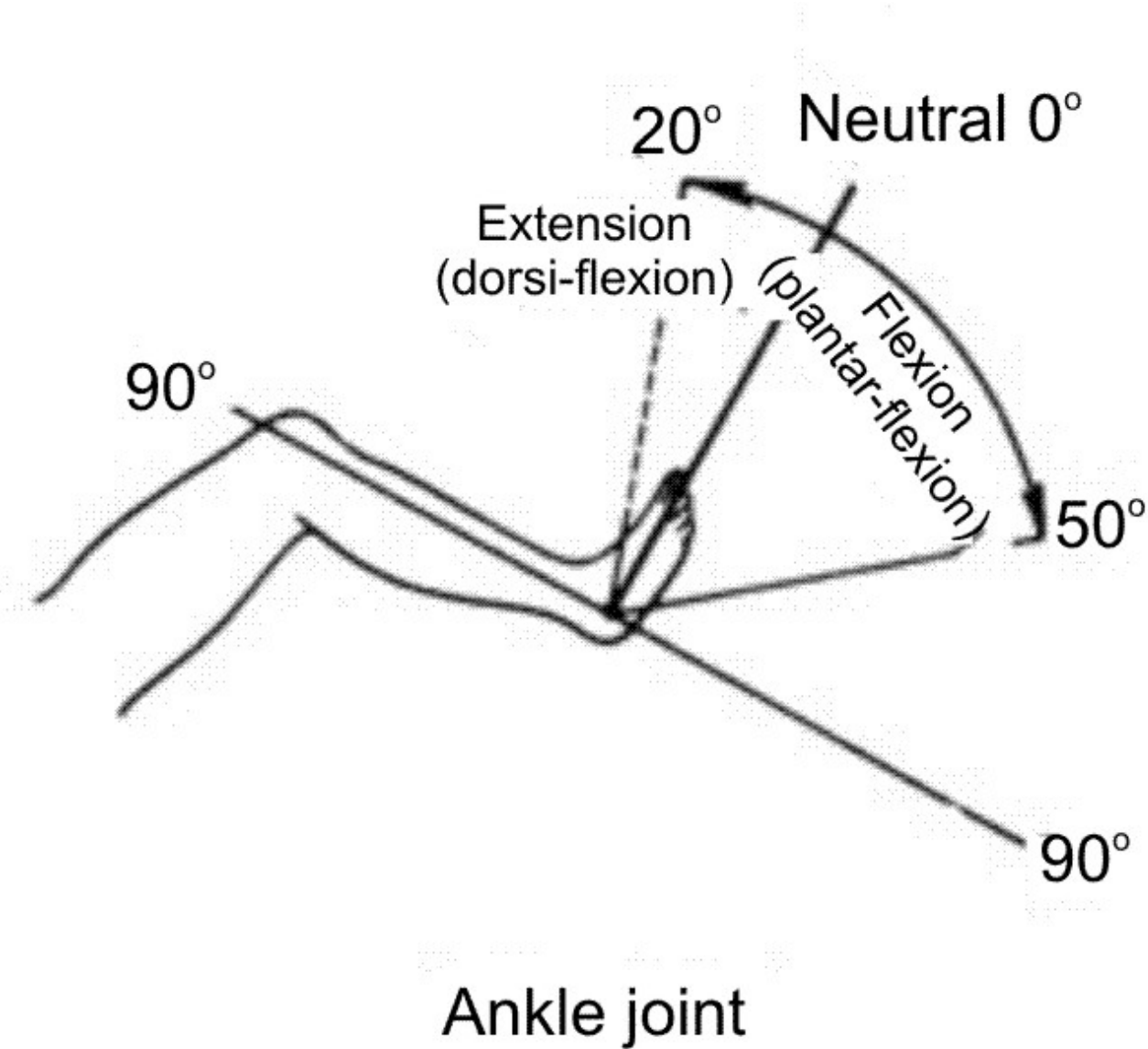
50 degrees of plantar flexion

15 to 20 degrees of dorsiflexion

Greater range of dorsiflexion with knee flexed (reduces gastrocnemius tension)

Fibula rotates 3 to 5 degrees externally with ankle dorsiflexion and 3 to 5 degrees internally during plantarflexion

Syndesmosis joint widens by 1 to 2 millimeters during full dorsiflexion



Subtalar and transverse tarsal joints

Inversion and eversion occurs here

Classified as gliding or arthrodial

Combined movement of

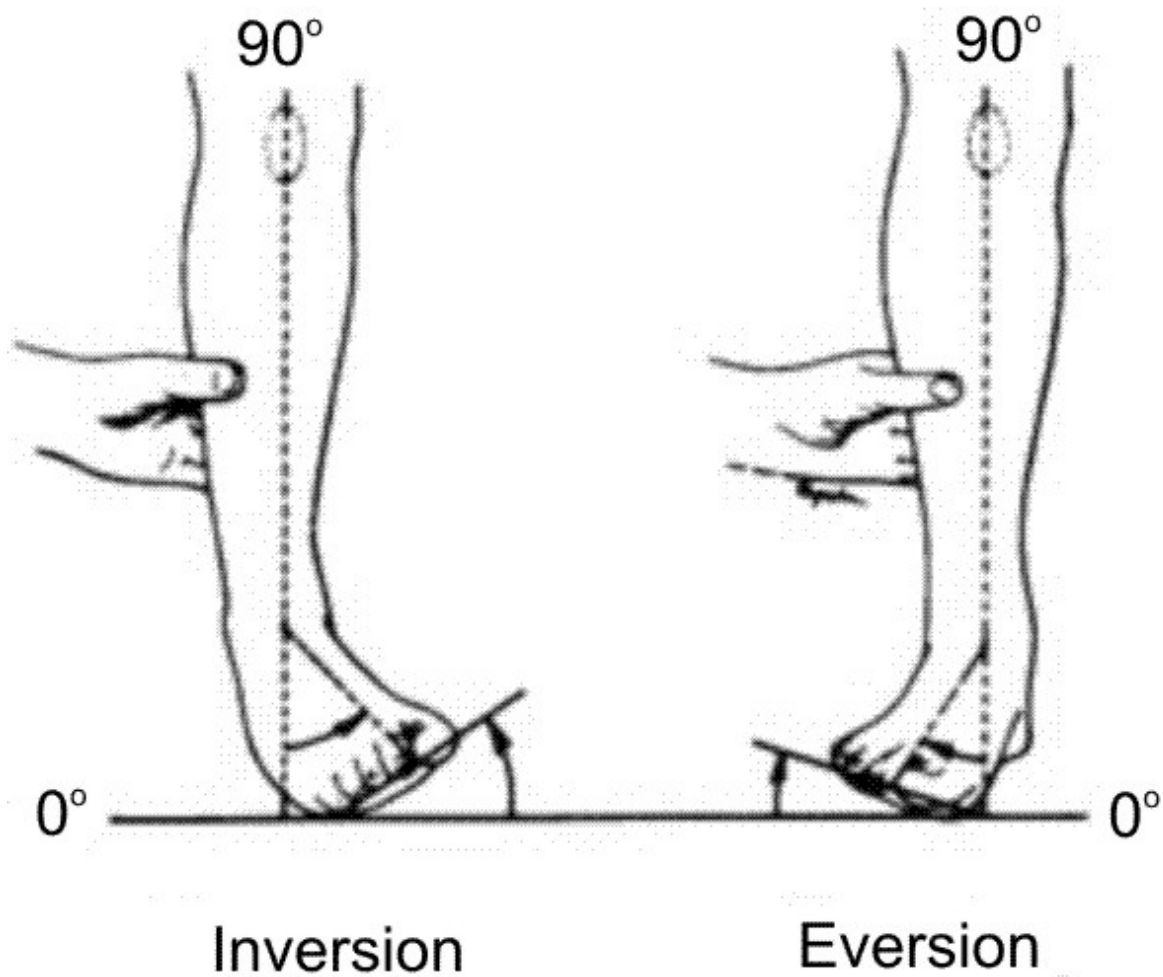
20 to 30 degrees of inversion

5 to 15 degrees of eversion

Intertarsal & tarsometatarsal joints

Arthrodial

Minimal movement



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Metatarsophalangeal joints

I

Phalanges join metatarsals

Classified as condyloid-type joints

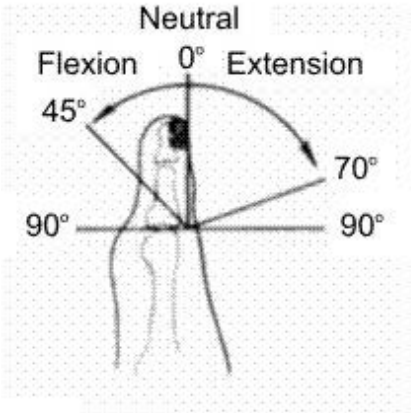
Great toe metatarsophalangeal (MP) joint flexes 45 degrees & extends 70 degrees

MP joints of the four lesser toes

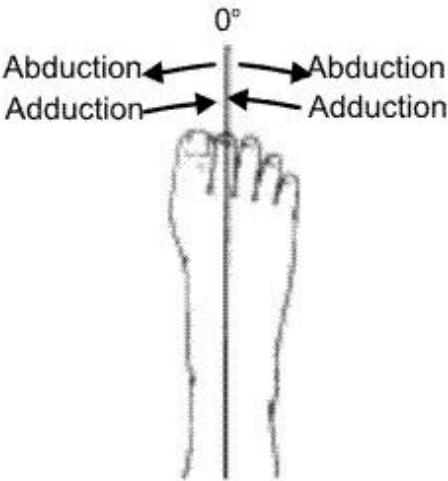
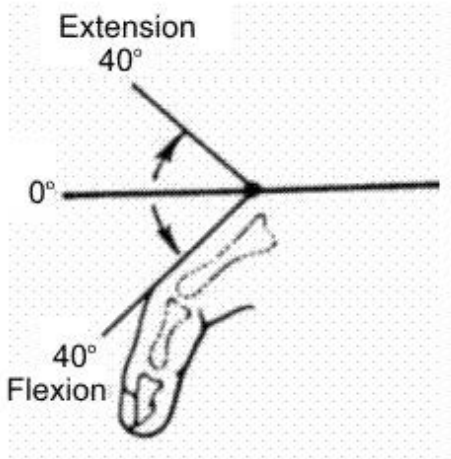
40 degrees of flexion

40 degrees of extension

also abduct & adduct minimally



Metatarsophalangeal joint



Toe Spread

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Metatarsophalangeal joints

I

Phalanges join metatarsals

Classified as condyloid-type joints

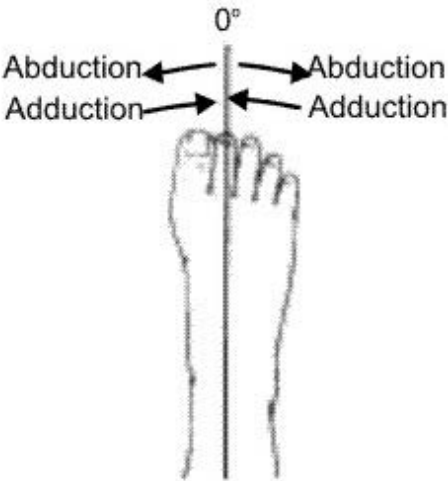
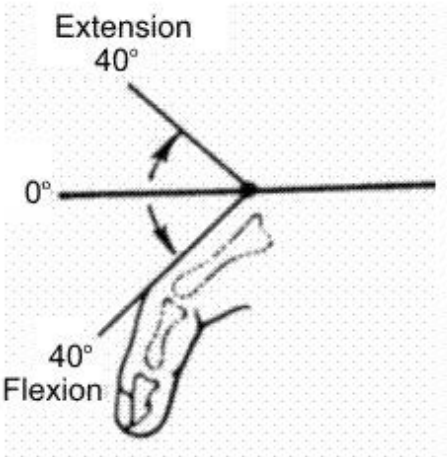
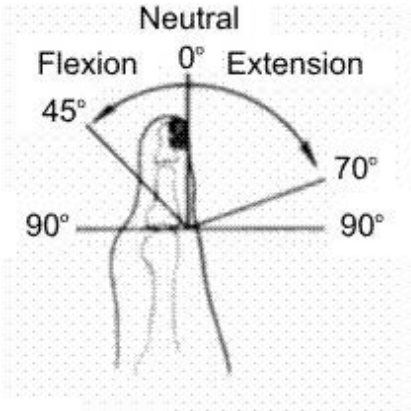
Great toe metatarsophalangeal (MP) joint flexes 45 degrees and extends 70 degrees

MP joints of the four lesser toes

40 degrees of flexion

40 degrees of extension

also abduct & adduct minimally



Metatarsophalangeal joint

Toe Spread

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Great Toe Joint

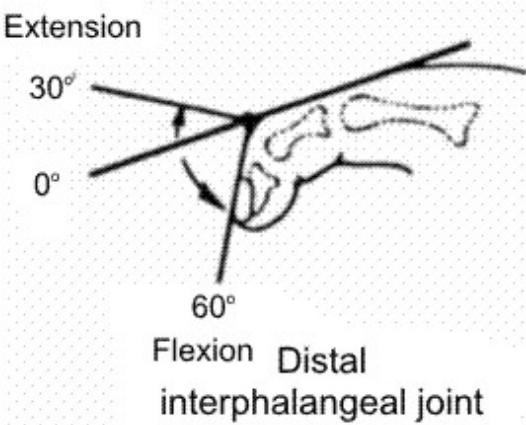
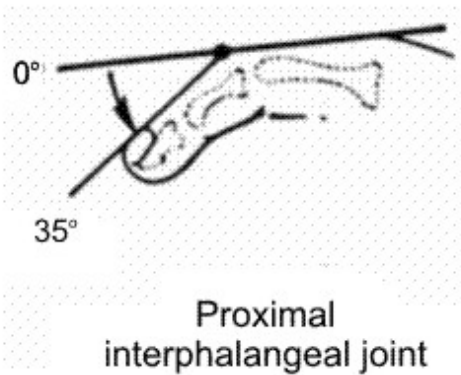
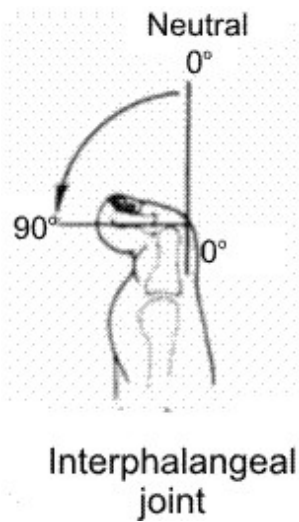
I

Great toe interphalangeal (IP) joint flexes from 0 degrees of full extension to 90 degrees of flexion

Proximal interphalangeal (PIP) joints in lesser toes flexes from 0 degrees of extension to 35 degrees of flexion

Distal interphalangeal (DIP) joints flexes 60 degrees & extend 30 degrees

Much variation from joint to joint & from person to person



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Joints

Ankle sprains very common injury

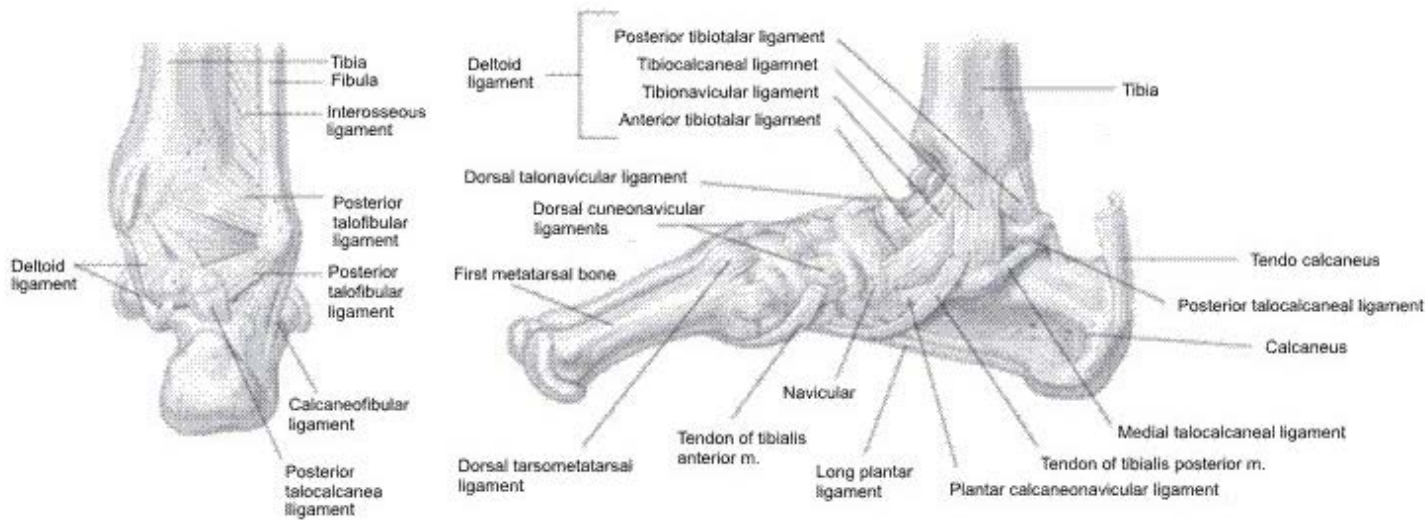
Sprains involve stretching or tearing of one or more ligaments

Most common ankle sprain results from excessive inversion that causes damage to lateral ligamentous structures, primarily anterior talofibular ligament & calcaneofibular ligament

Excessive eversion forces injures deltoid ligament (medially) - less common



Sprains



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Joints

Ligaments in foot and ankle maintain arches

Two longitudinal arches

Medial longitudinal arch - extends from calcaneus bone to talus, navicular, 3 cuneiforms, and proximal ends of 3 medial metatarsals

Lateral longitudinal arch - extends from calcaneus to cuboid and proximal ends of 4th and 5th metatarsals

Long arches may be high, medium, or low

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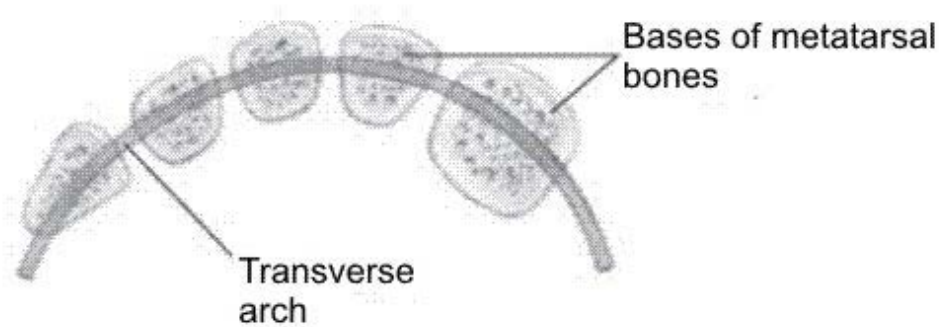
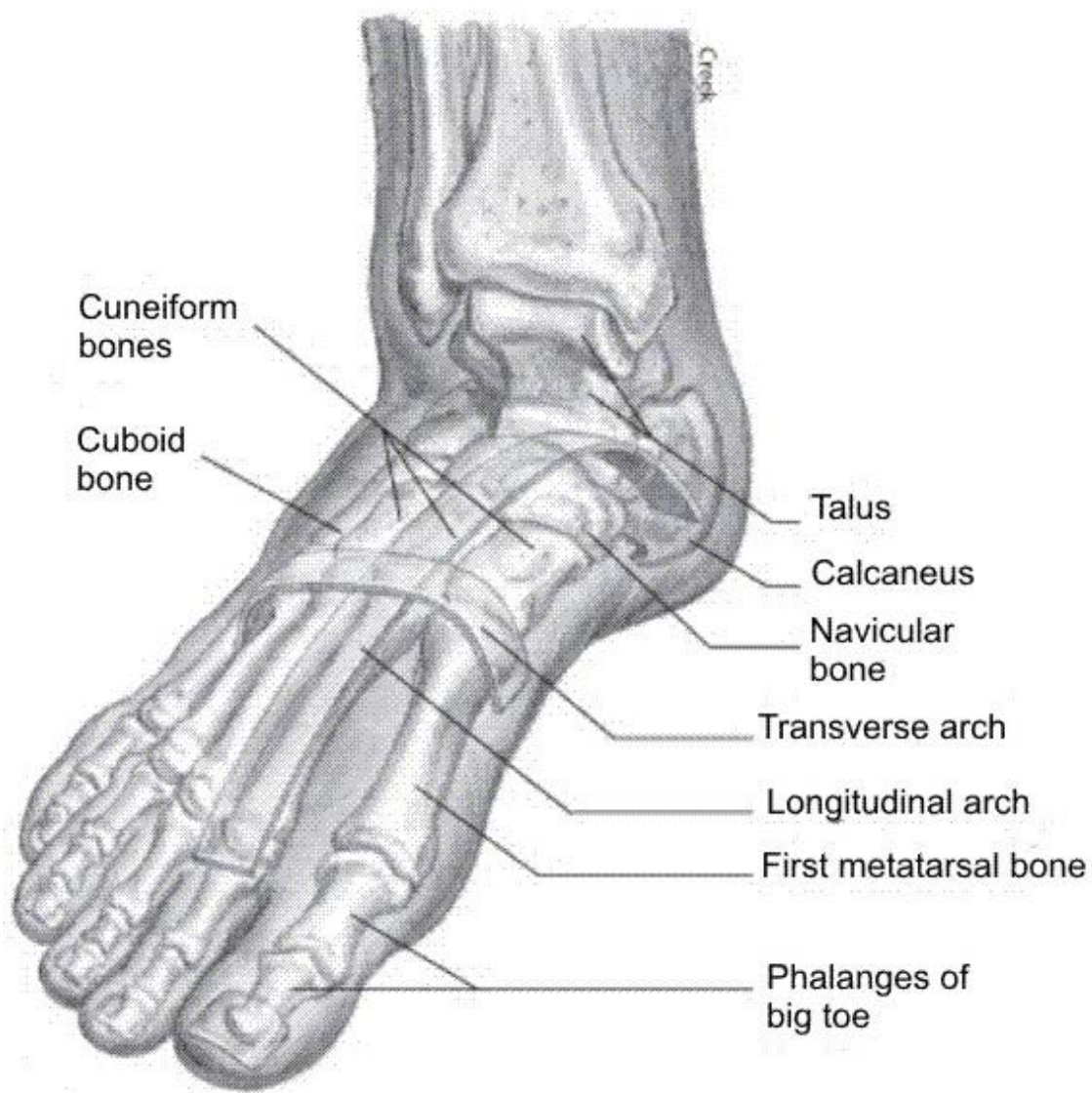
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Arches

Transverse arch

extends across foot from 1st metatarsal to the 5th metatarsal



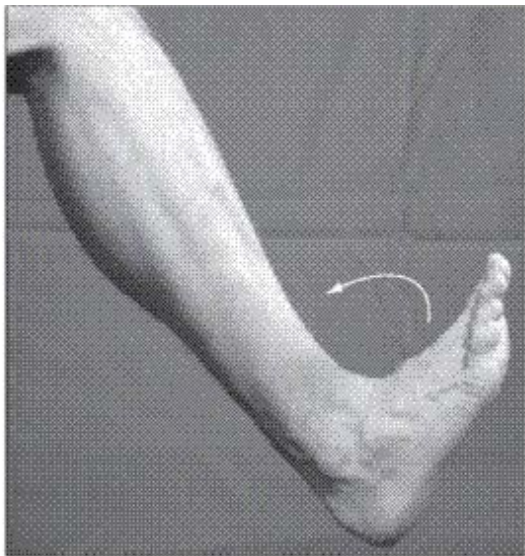
Movements

Dorsiflexion (flexion)

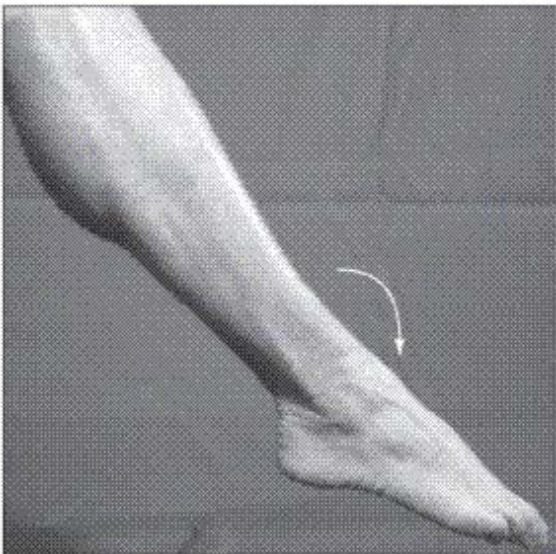
movement of top of ankle and foot toward anterior tibia

Plantar flexion (extension)

movement of ankle and foot away from tibia



Dorsiflexion



Plantar flexion

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Movements

Eversion

turning ankle and foot outward; abduction, away from midline; weight is on medial edge of foot

Inversion

turning ankle and foot inward; adduction, toward midline; weight is on lateral edge of foot



Transverse tarsal and
subtalar eversion



Transverse tarsal and
subtalar inversion

Movements

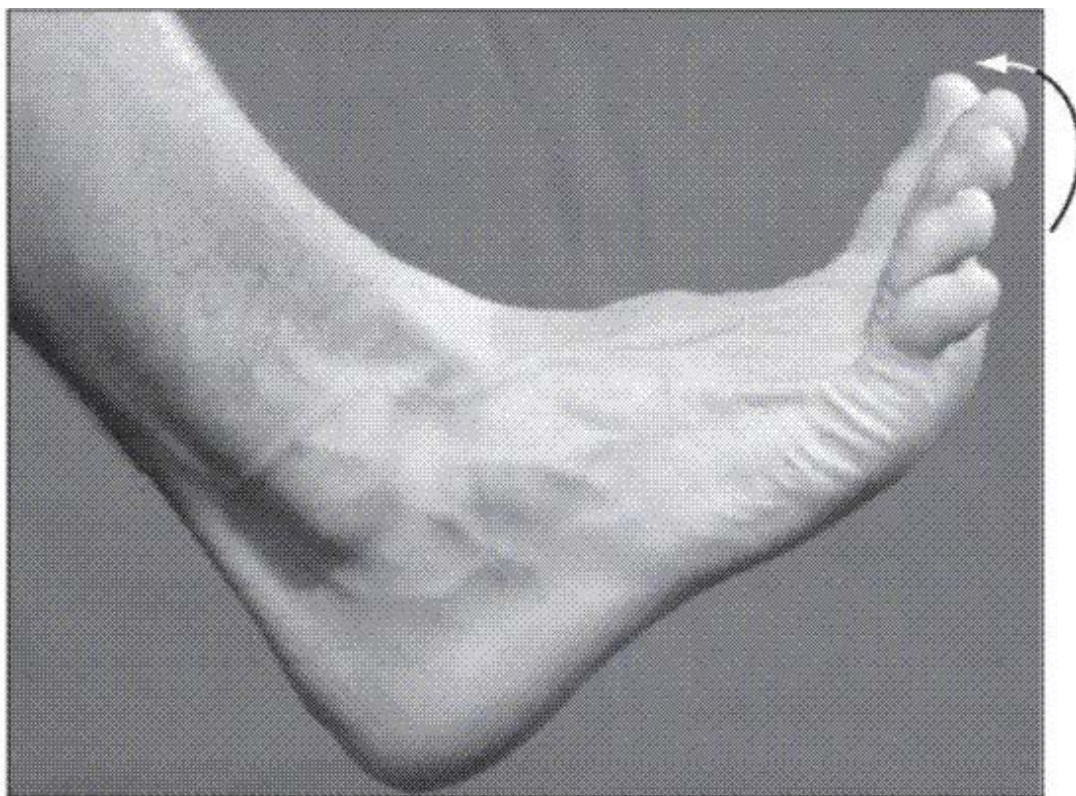
Toe flexion

movement of toes toward plantar surface of foot

Toe extension

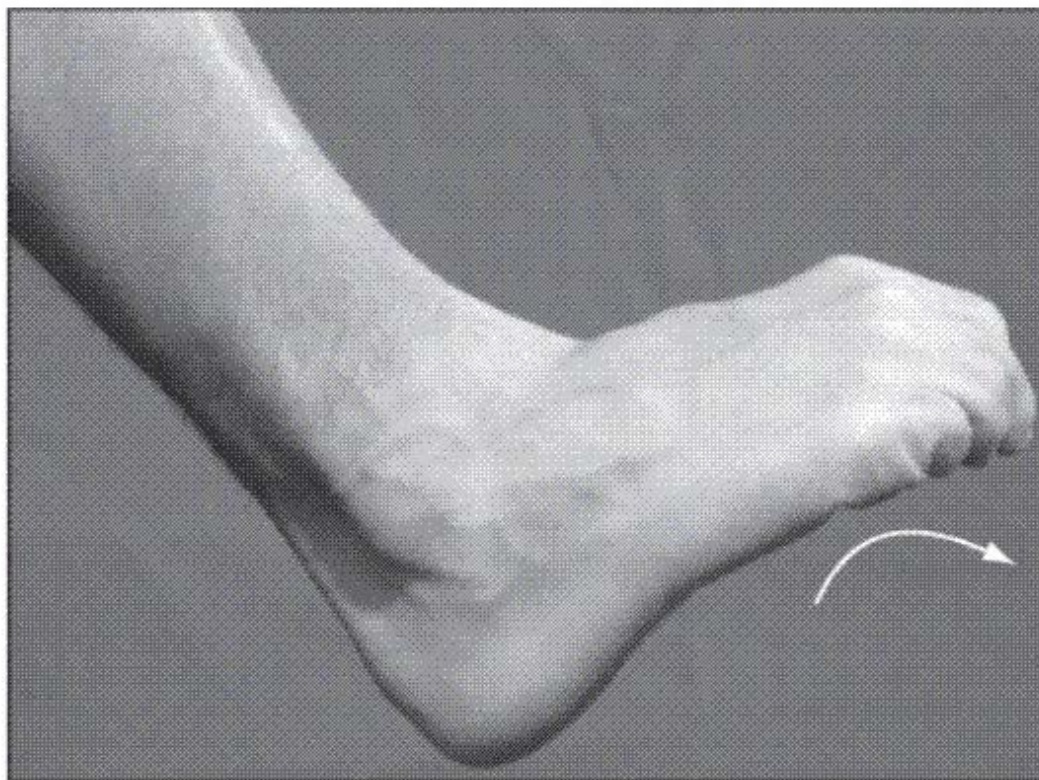
movement of toes away from plantar surface of foot

F



Extension of the toes

E



Flexion of the toes

Movements

Pronation

combination of ankle dorsiflexion, subtalar eversion, and forefoot abduction (toe-out)

Supination

combination of ankle plantar flexion, subtalar inversion, & forefoot adduction (toe-in)



Pronation



Supination

Muscles

Group according to location and function

Anterior ankle and foot - dorsal flexors

Posteriorly - plantar flexors : triceps surae ; gastrocnemius and soleus

Laterally - evertors

Medially - invertors

Lower leg - divided into 4 compartments

Dense fascia - tightly surrounds and binds each

Facilitates venous return and prevents excessive swelling of muscles during exercise

Anterior compartment

Dorsiflexor group - tibialis anterior, peroneus tertius, extensor digitorum longus, and extensor hallucis longus

Lateral compartment

Peroneus longus and peroneus brevis (two most powerful evertors)

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Muscles

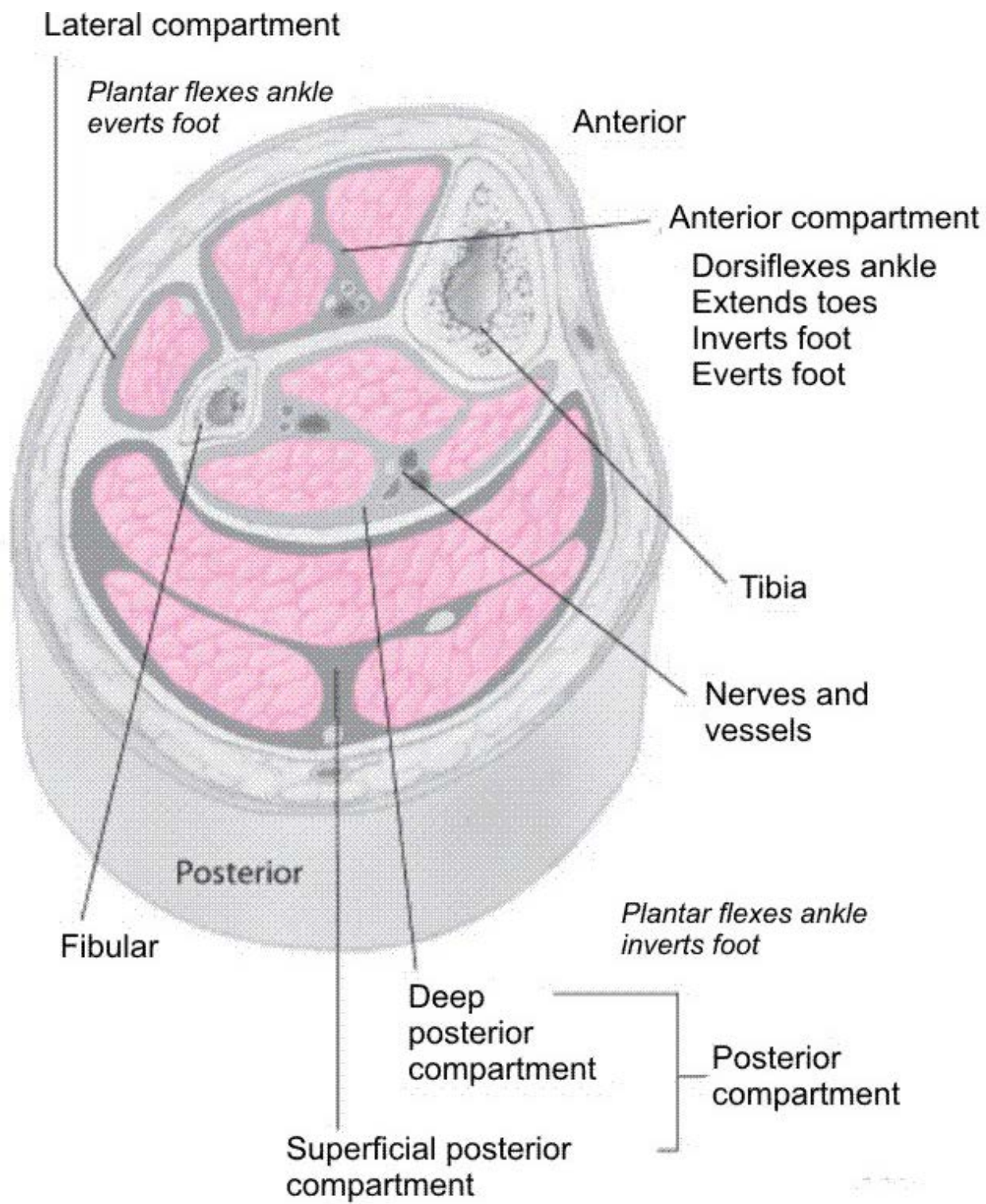
Superficial posterior compartment

Gastrocnemius, soleus, and plantaris - plantar flexors

Deep posterior compartment

Flexor digitorum longus, flexor hallucis longus, popliteus, and tibialis posterior

All are plantar flexors and invertors except popliteus



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Muscles

Acute and chronic injuries are common

“Shin splints” - common term describing painful leg condition often associated with running activities

Not a specific diagnosis

Attributed to a number of different specific musculotendinous injuries

Most often involves tibialis posterior, medial soleus, or anterior tibialis, but may also involve extensor digitorum longus

May be partially prevented by stretching plantar flexors and strengthening dorsiflexors

Painful cramps - acute muscle spasm in gastrocnemius and soleus

Occur somewhat commonly

May be relieved through active and passive dorsiflexion

Complete rupture of Achilles tendon

very disabling injury

Several ankle and foot muscles produce more than one movement

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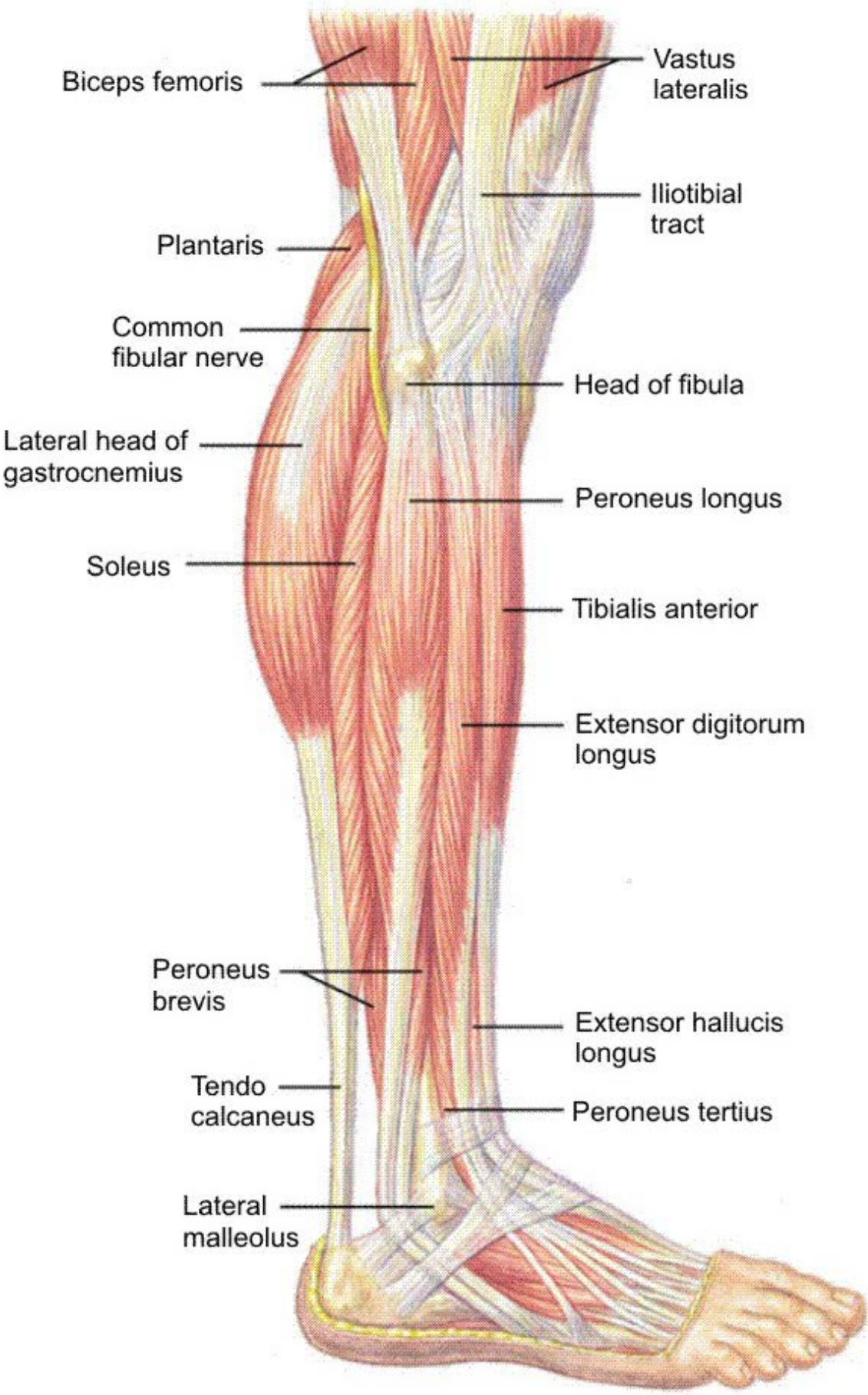
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Muscles

Evertors

- Peroneus (fibularis) longus
- Peroneus (fibularis) brevis
- Peroneus (fibularis) tertius
- Extensor digitorum longus



Muscles

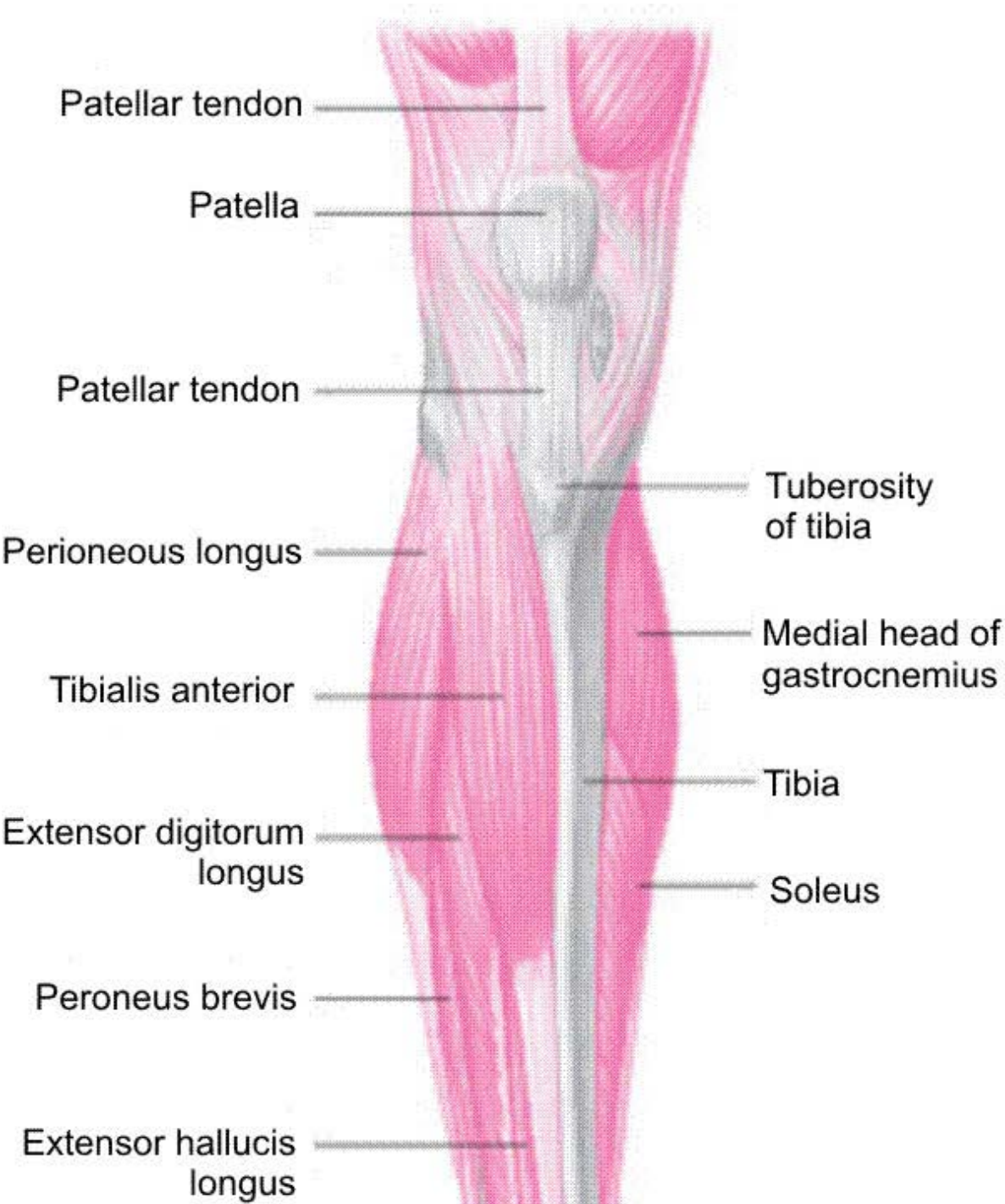
Dorsiflexors

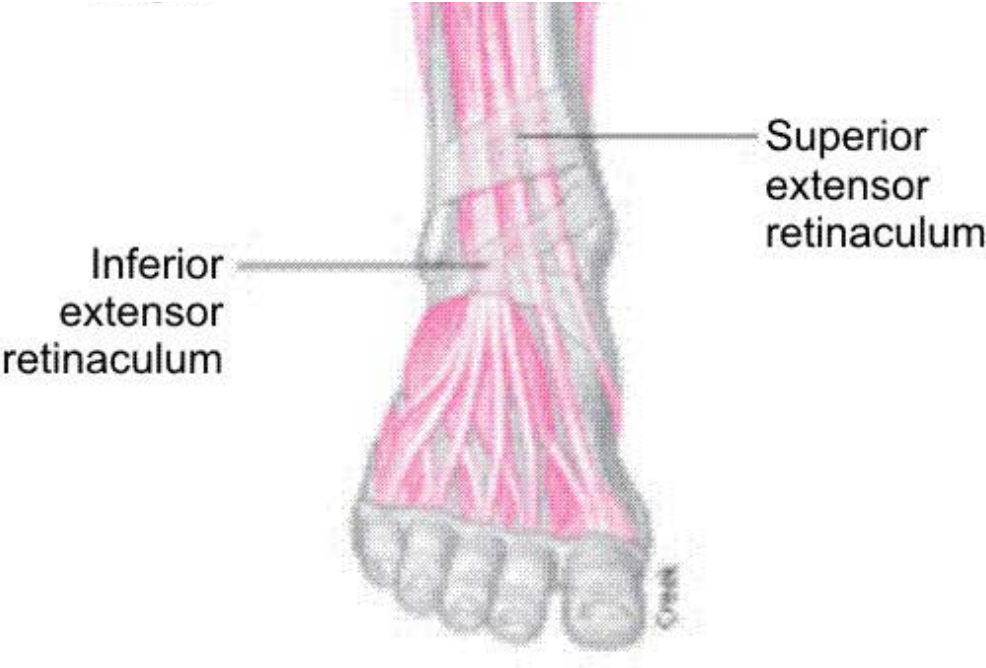
Tibialis anterior

Peroneus (fibularis) tertius

Extensor digitorum longus (extensor of lesser toes)

Extensor hallucis longus (extensor of great toe)





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Muscles

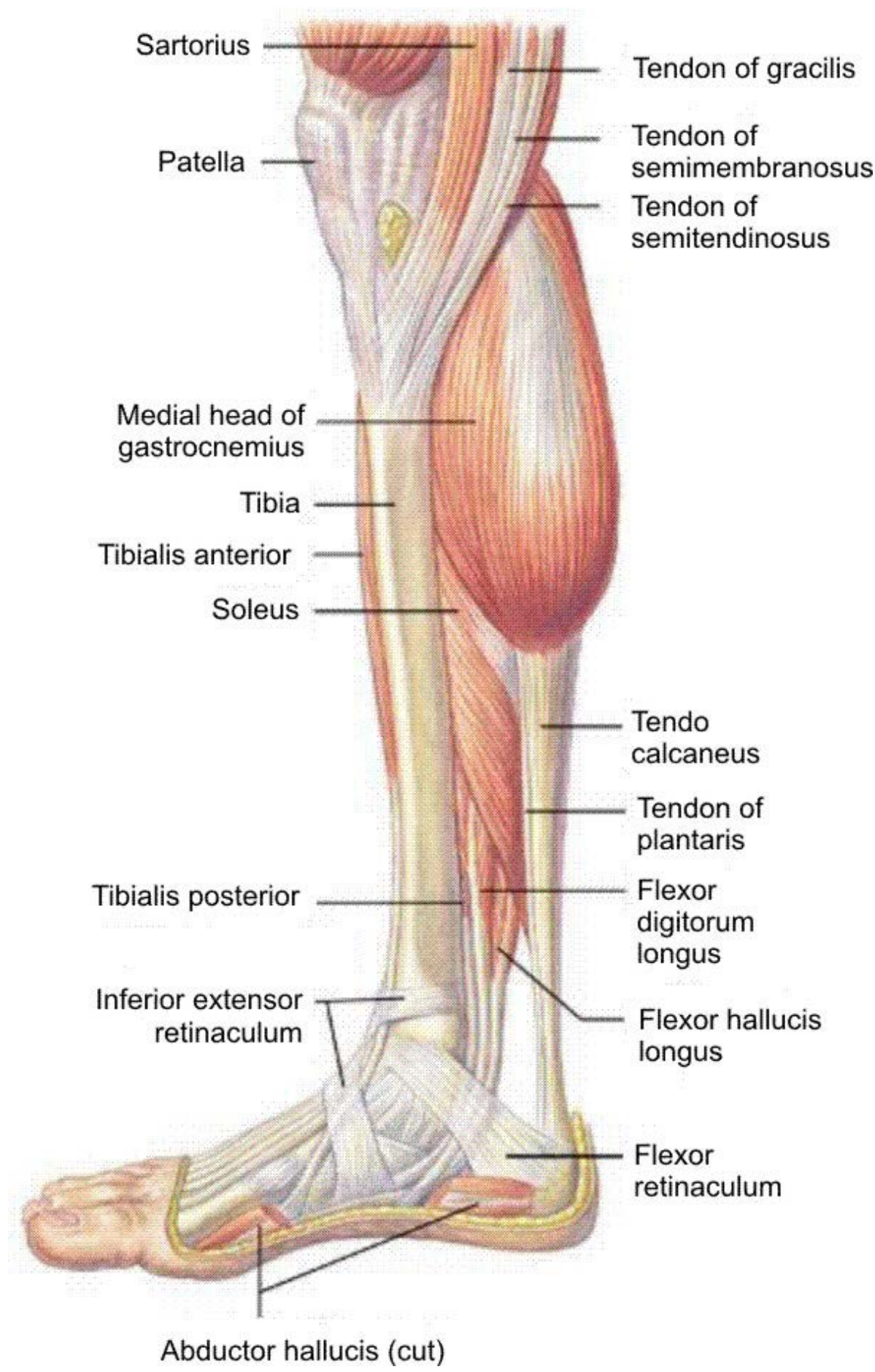
Invertors

Tibialis anterior

Tibialis posterior

Flexor digitorum longus (flexor of lesser toes)

Flexor hallucis longus (flexor of great toe)



Muscles

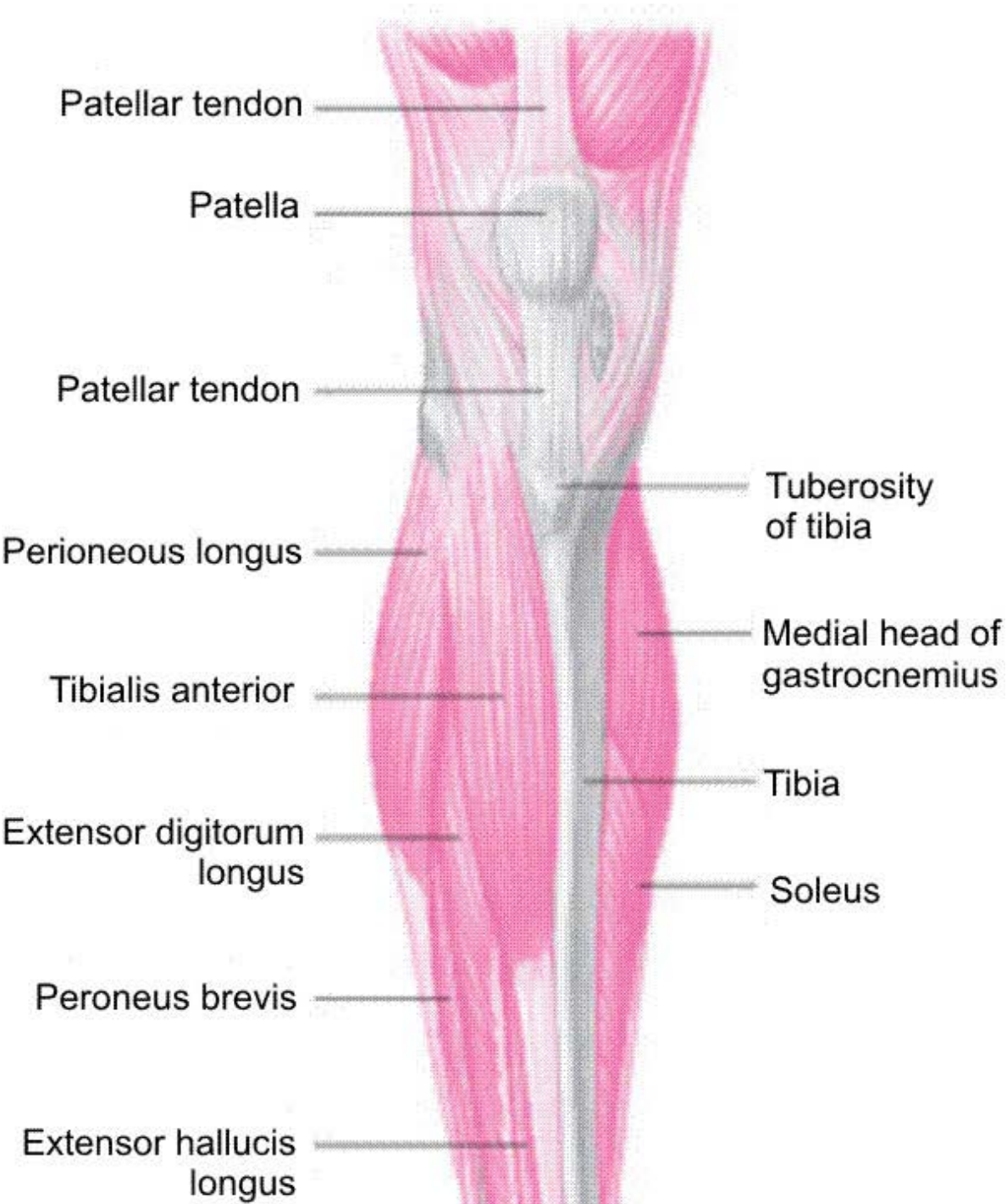
Anterior compartment

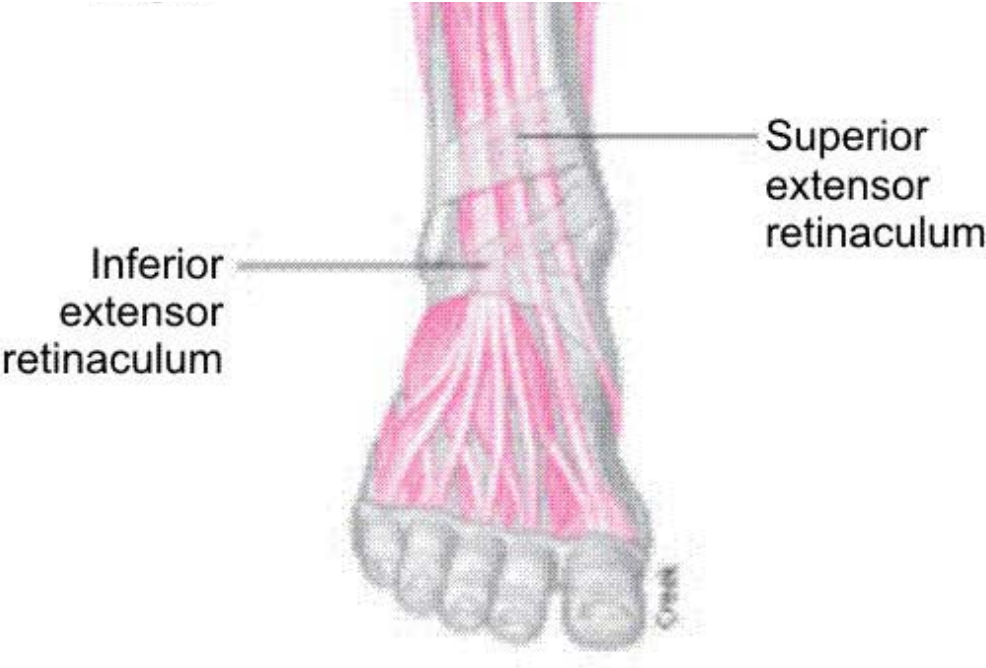
Tibialis anterior

Extensor hallucis longus

Extensor digitorum longus

Peroneus (fibularis) tertius





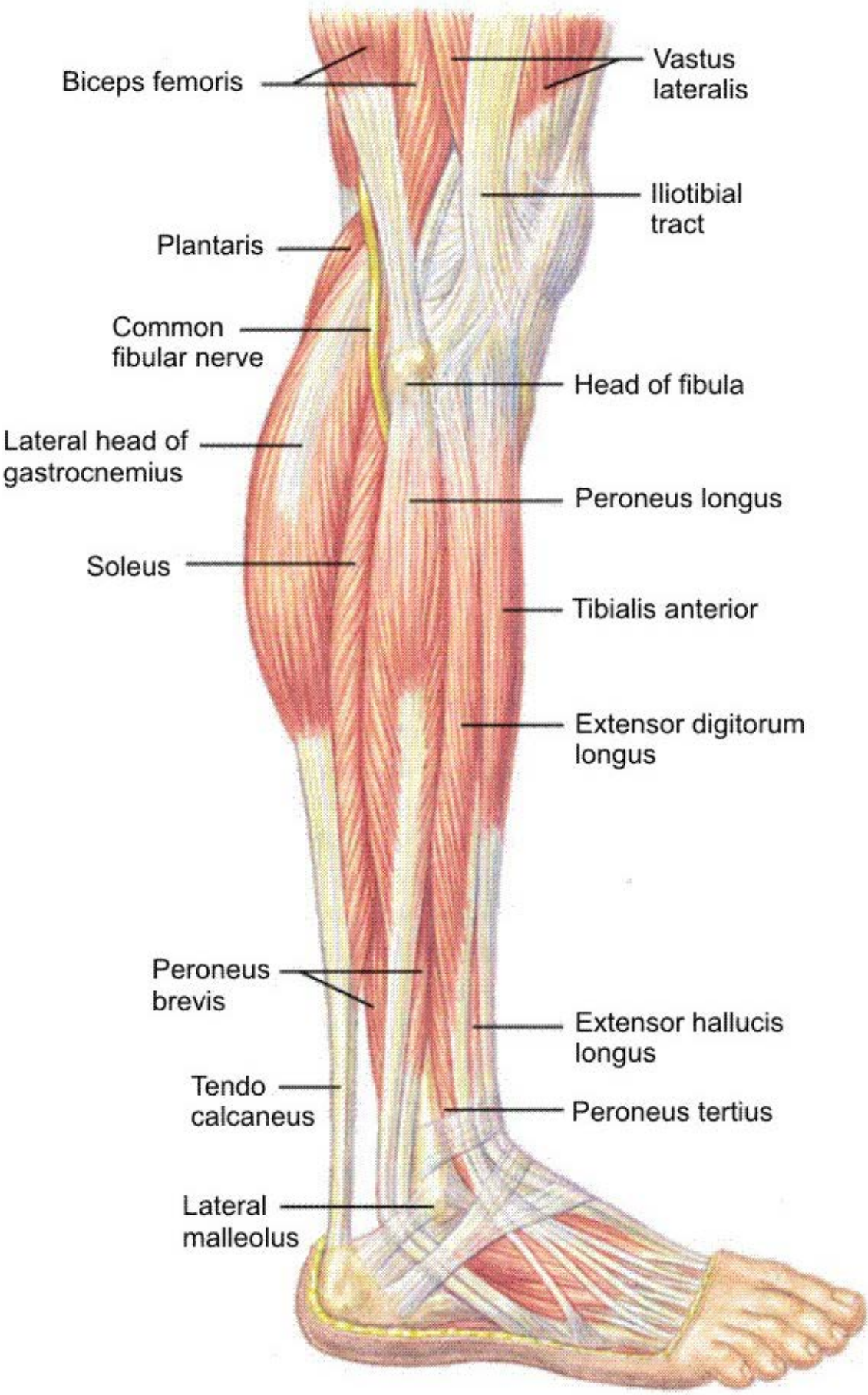
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Muscles

Lateral compartment

Peroneus (fibularis) longus

Peroneus (fibularis) brevis



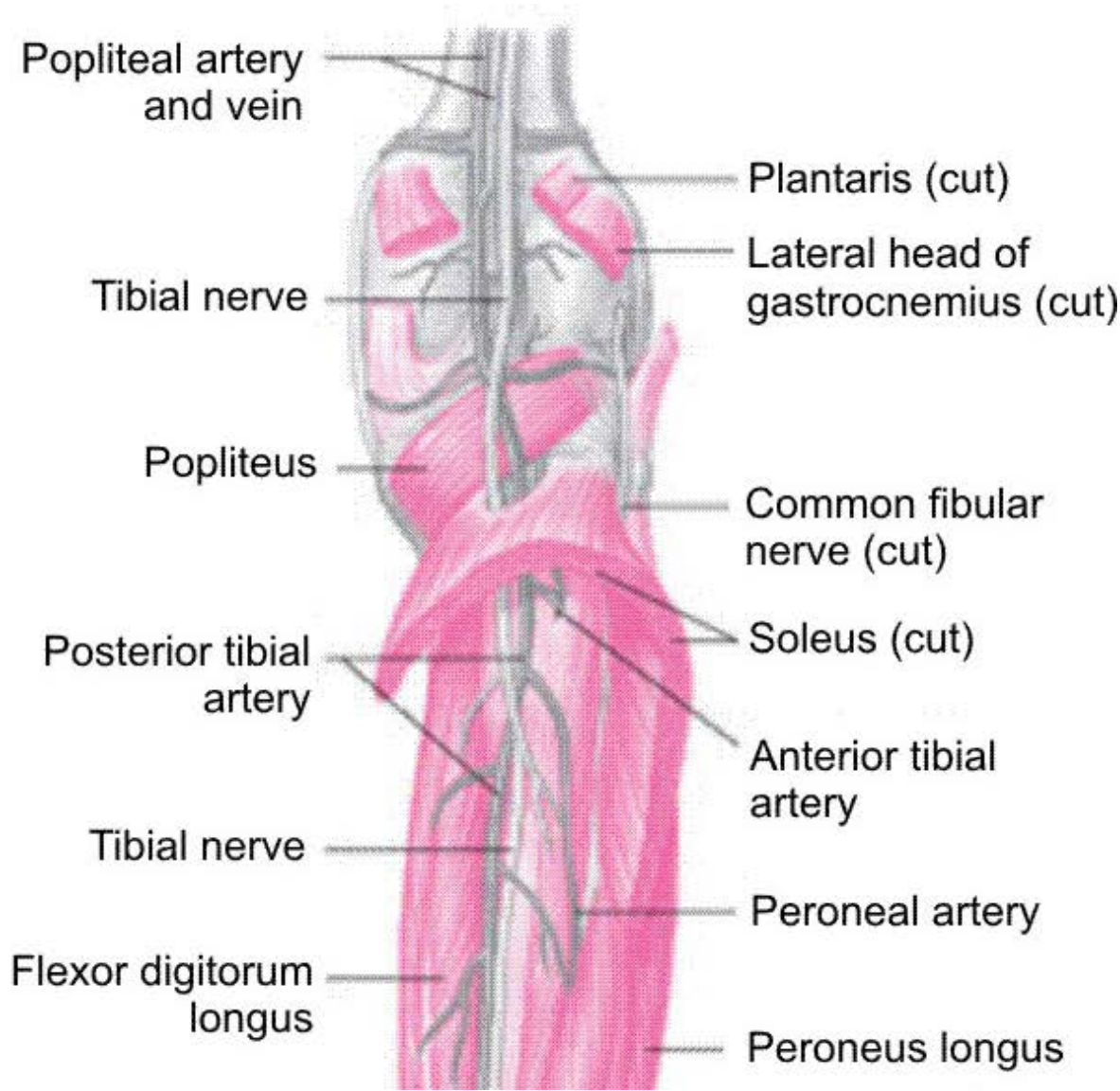
Muscles

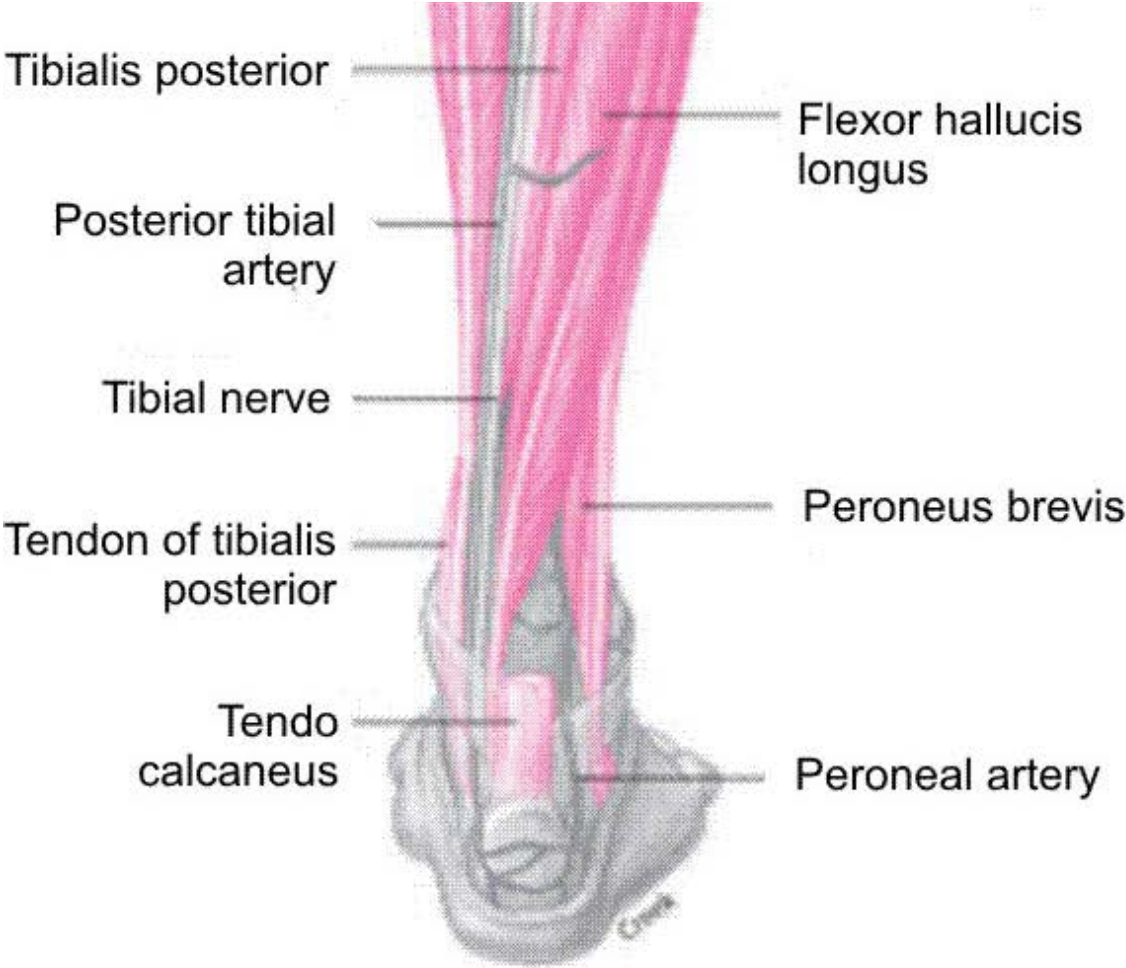
Deep posterior compartment

- Flexor digitorum longus
- Flexor hallucis longus
- Tibialis posterior

Superficial posterior compartment

- Gastrocnemius (medial head)
- Gastrocnemius (lateral head)
- Soleus





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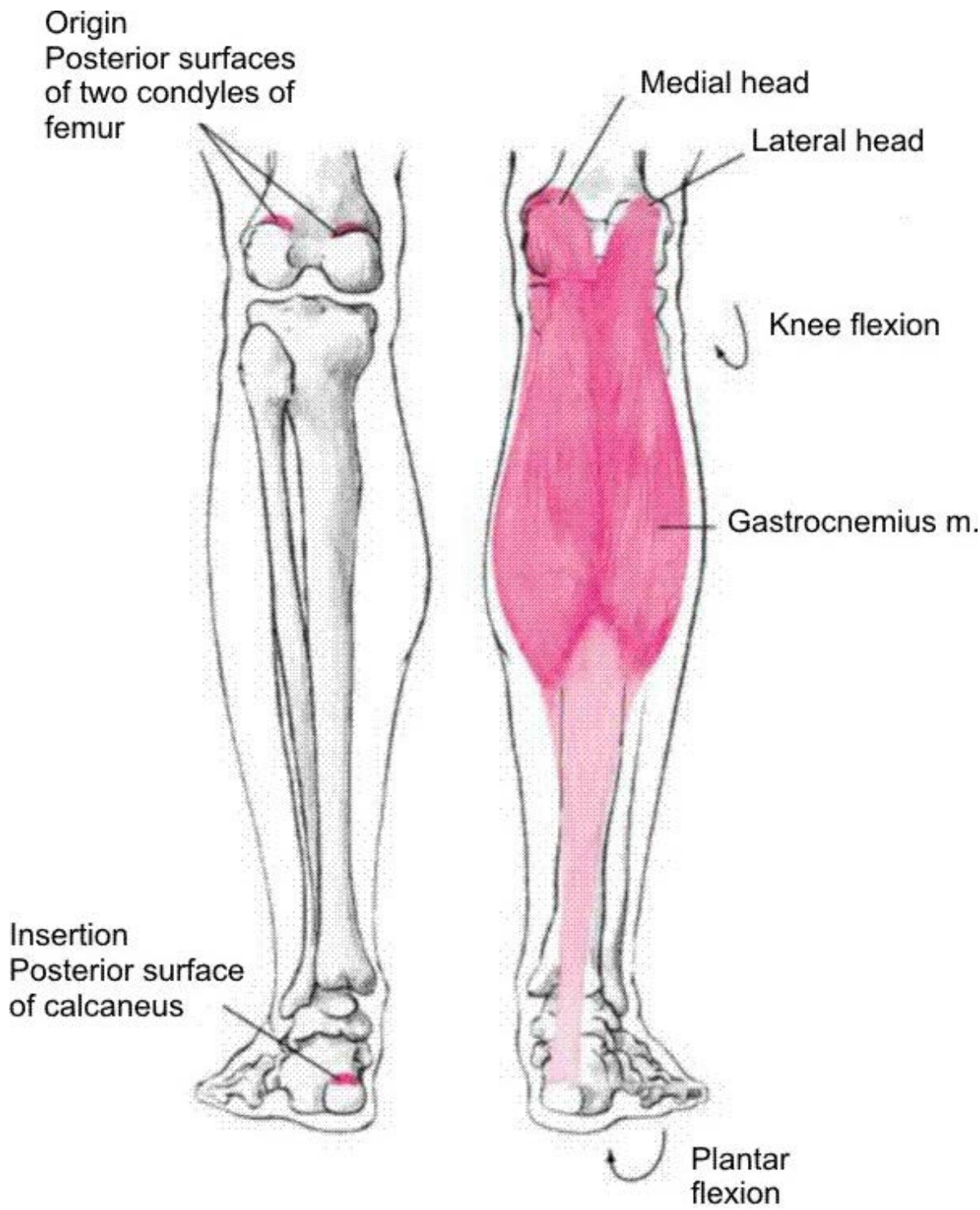
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Gastrocnemius Muscle

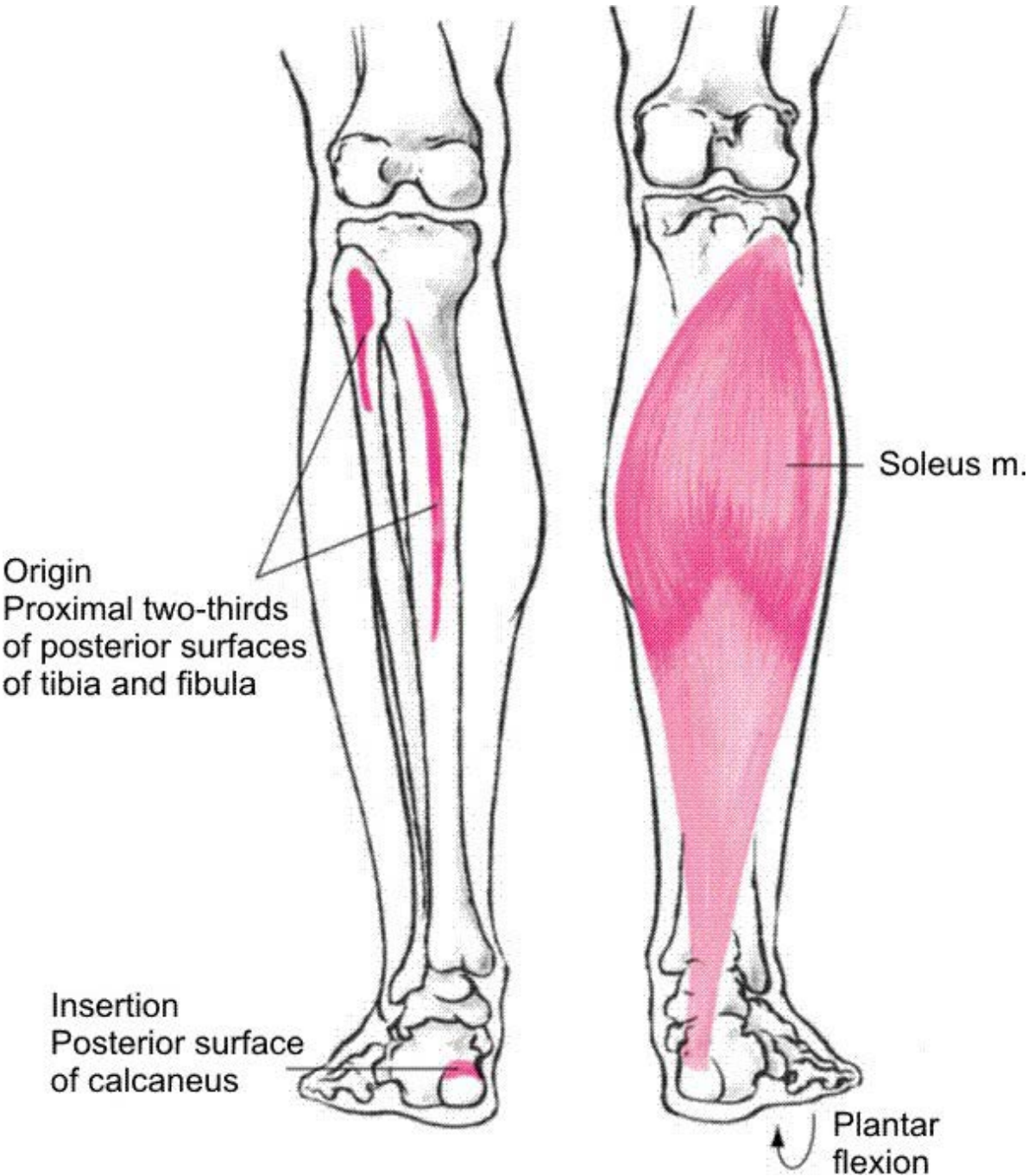
Plantar flexion of ankle

Flexion of knee



Soleus Muscle

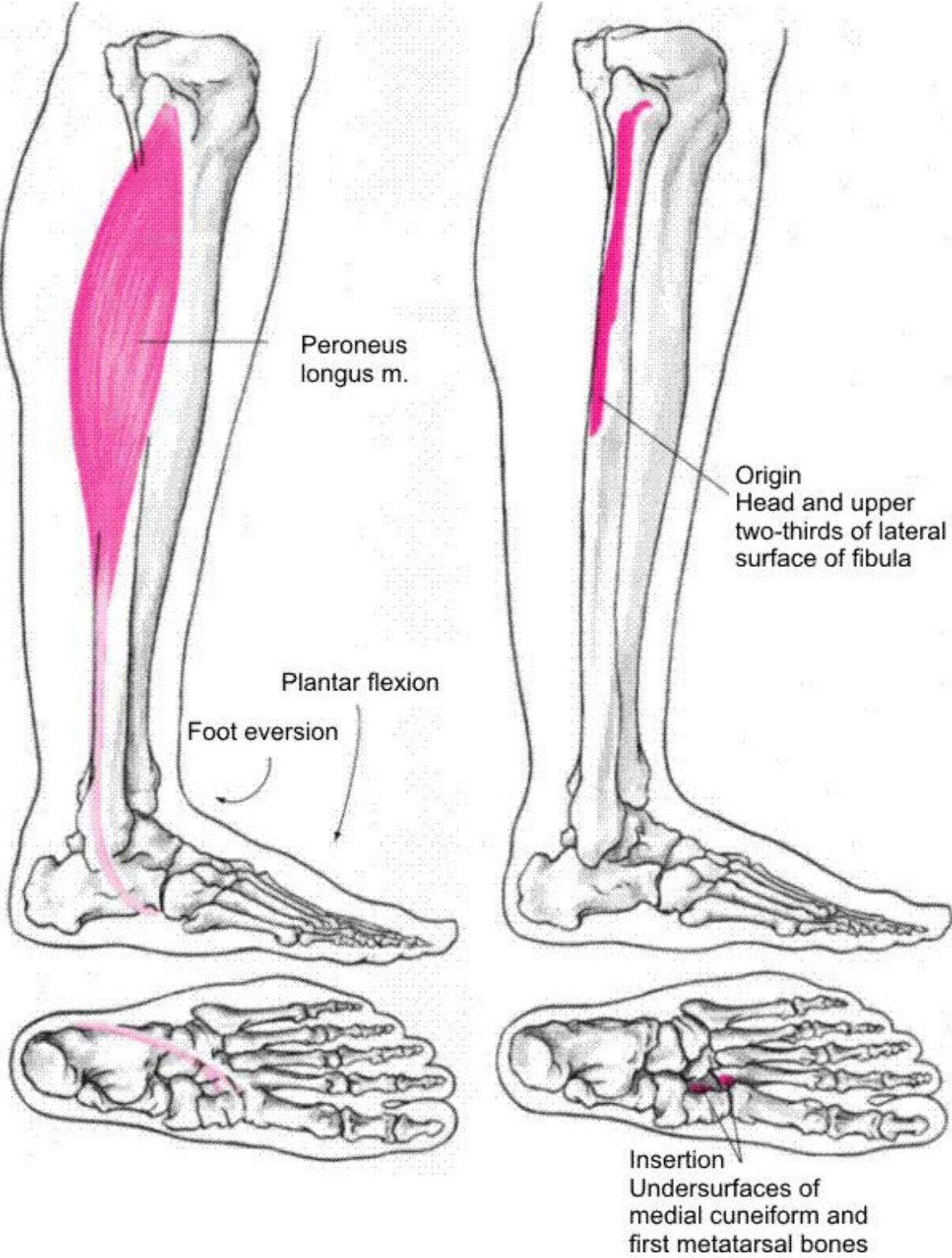
Plantar flexion of ankle



Peronius longus (fibularis) Muscle

Eversion of foot

Plantar flexion of ankle

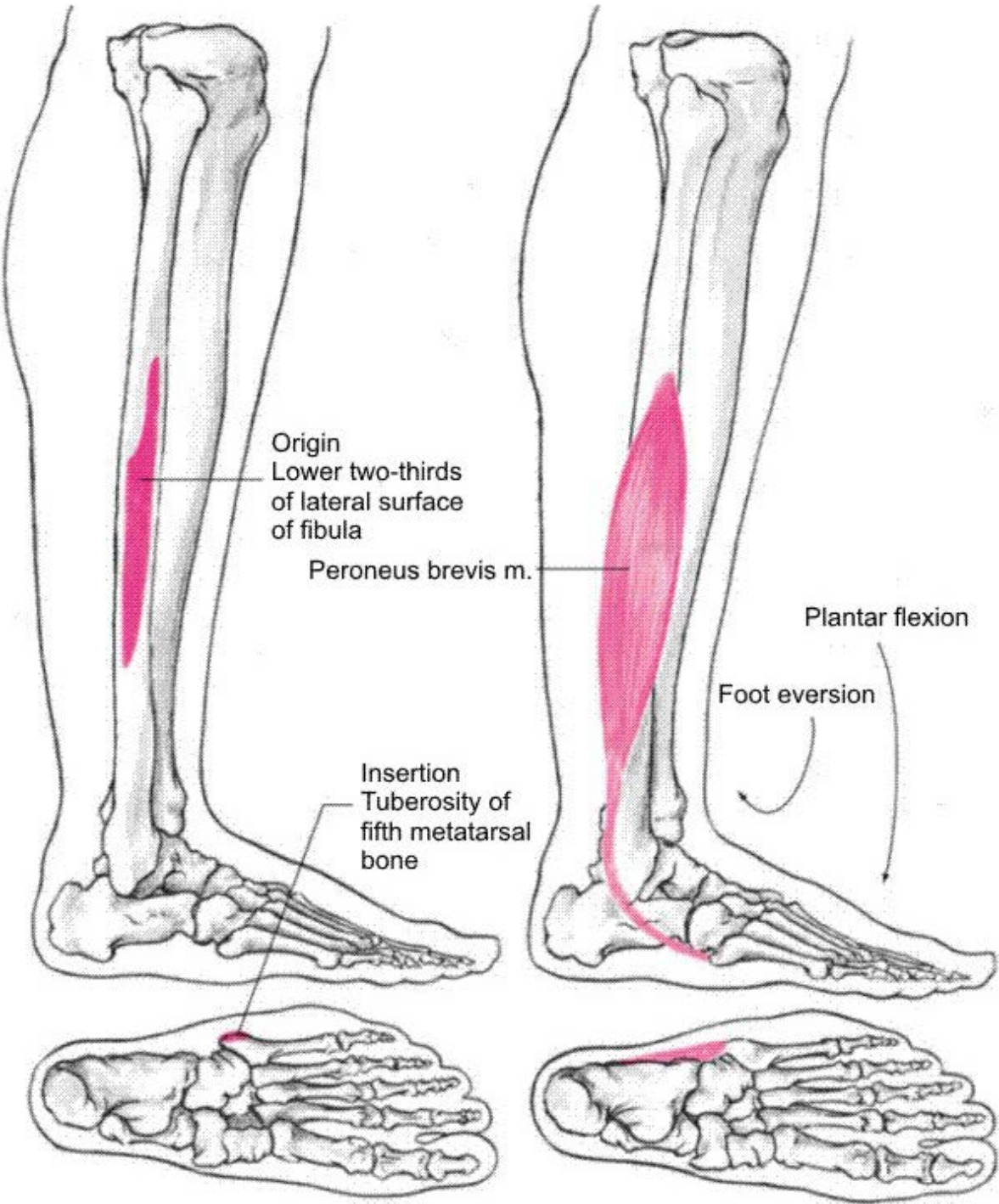


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Peronius brevis (fibularis) Muscle

Eversion of foot

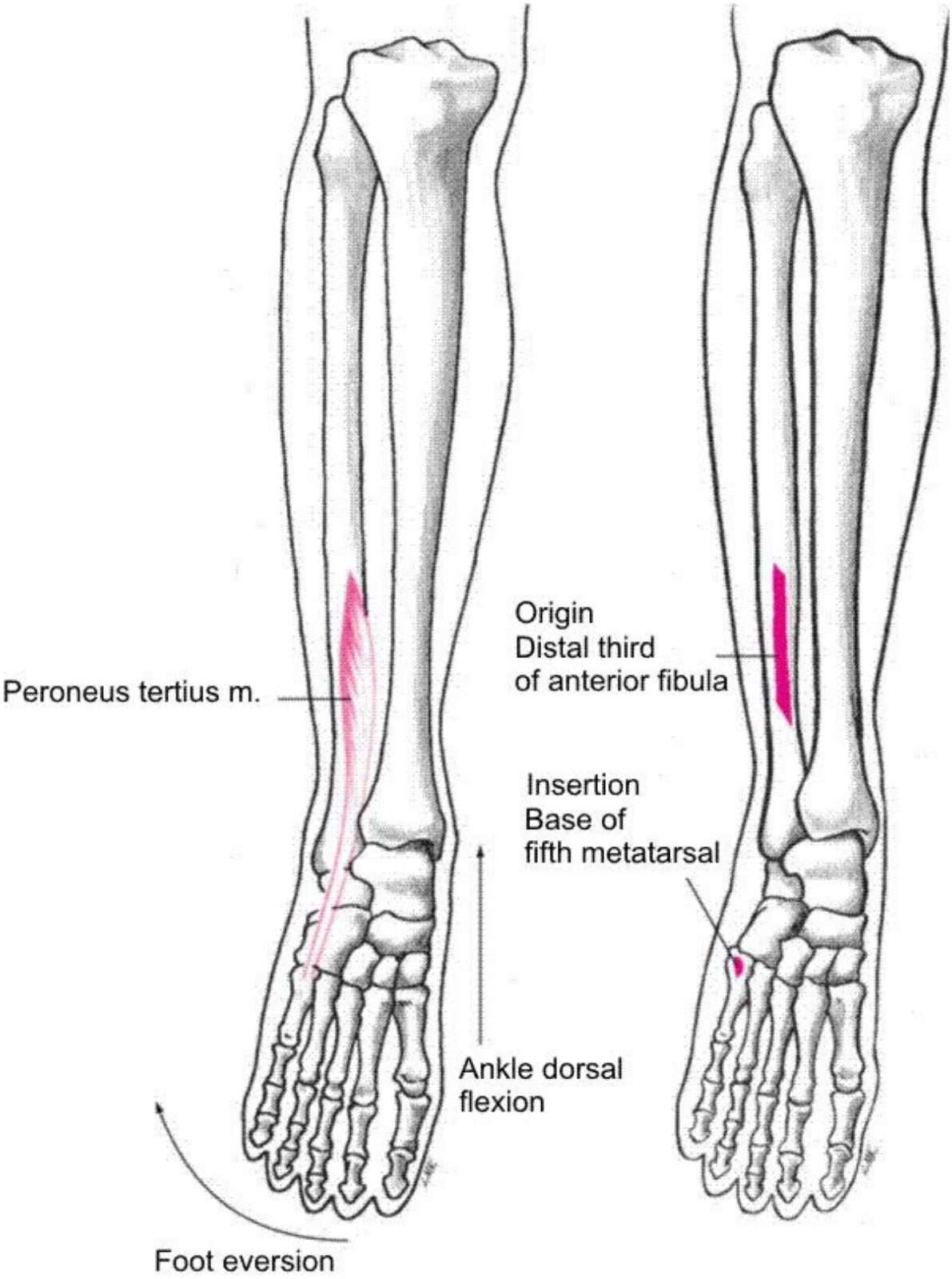
Plantar flexion of ankle



Peronius tertius (fibularis) Muscle

Eversion of foot

Dorsiflexon of ankle



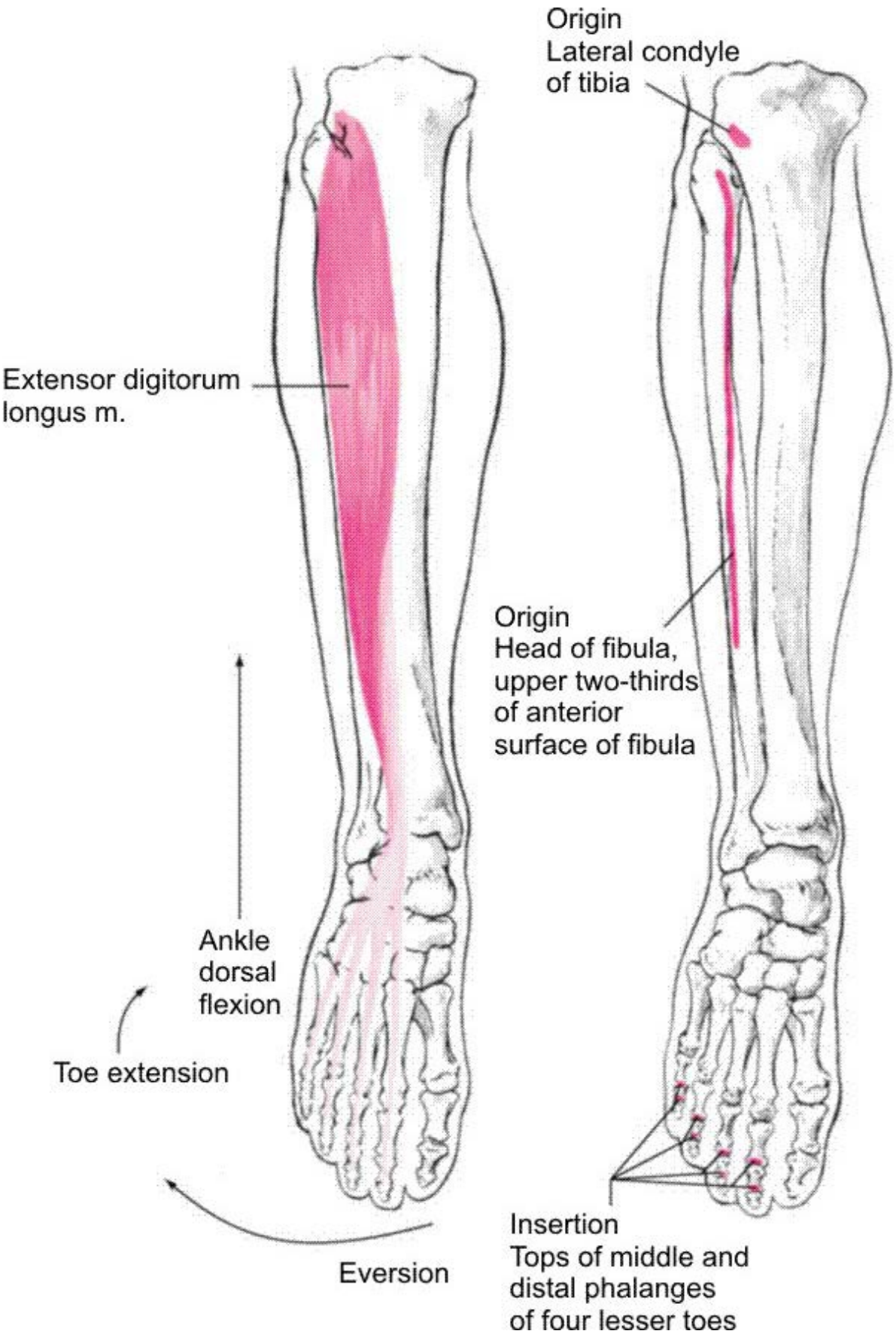
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Extensor Digitorum Longus Muscle

Extension of four lesser toes at metatarsophalangeal, proximal and distal interphalangeal joints

Eversion of foot

Dorsiflexion of ankle

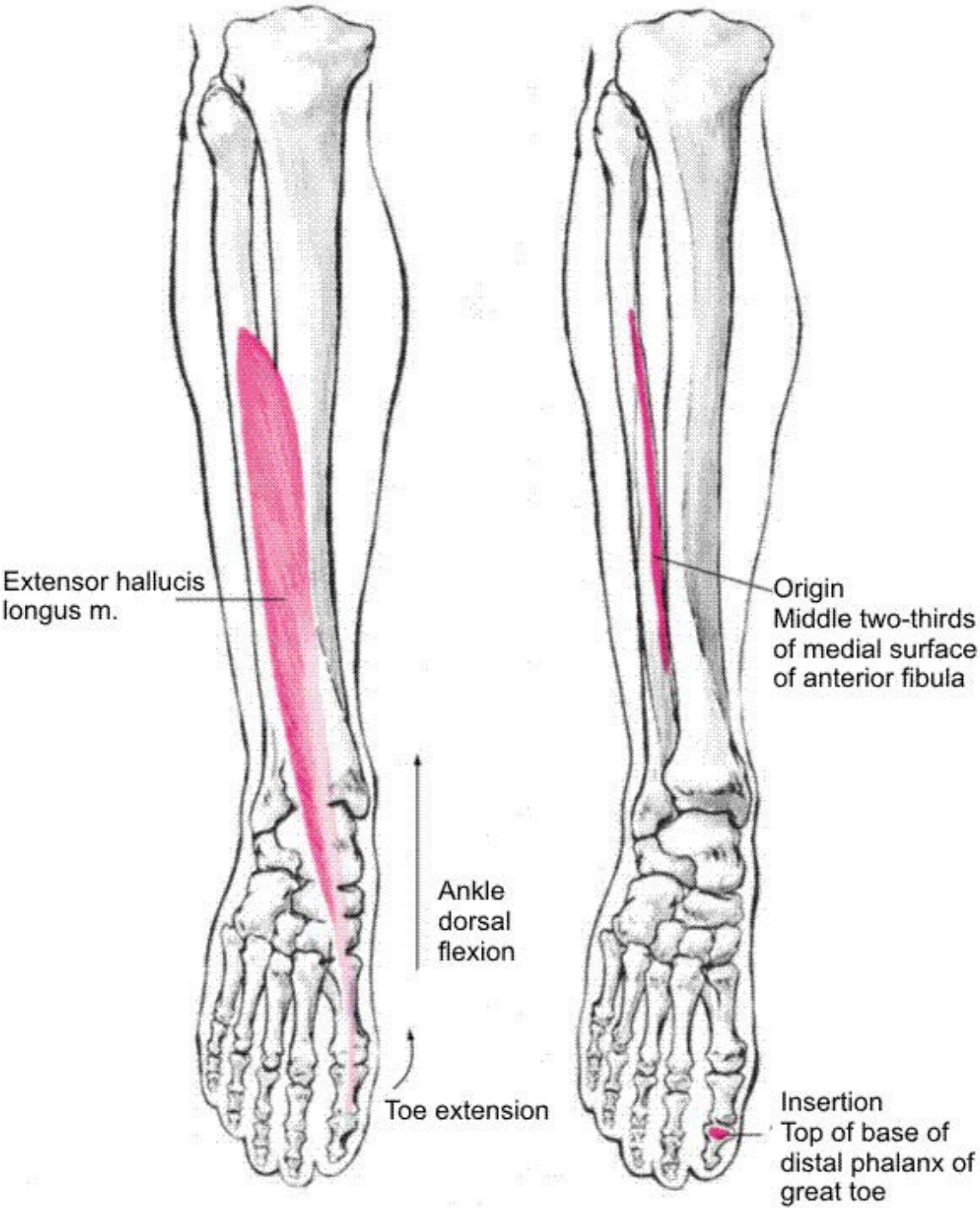


Extensor Hallucis Longus Muscle

Extension of great toe at metatarsophalangeal, and interphalangeal joints

Weak inversion of foot

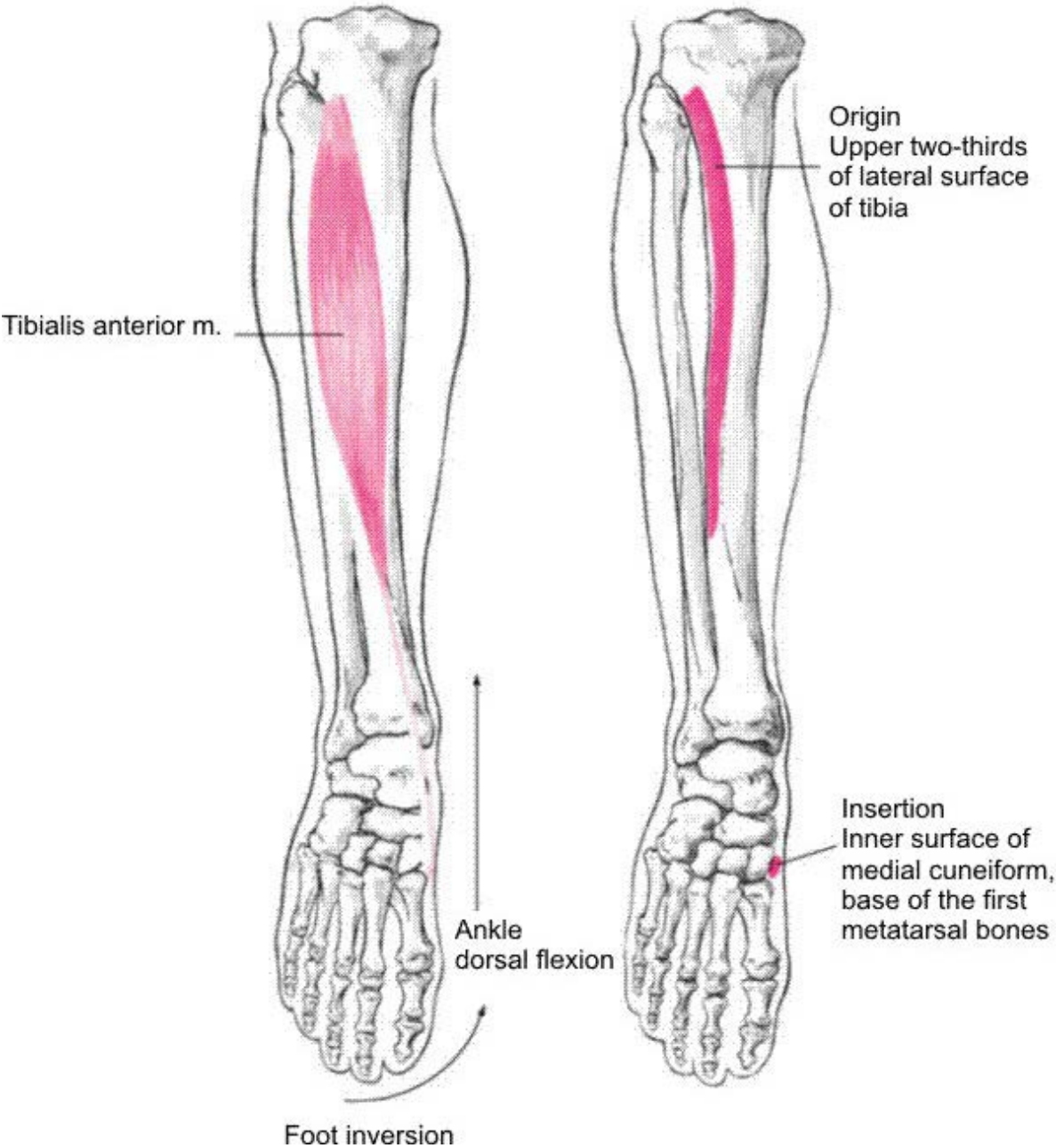
Dorsiflexion of ankle



Tibialis Anterior Muscle

Inversion of foot

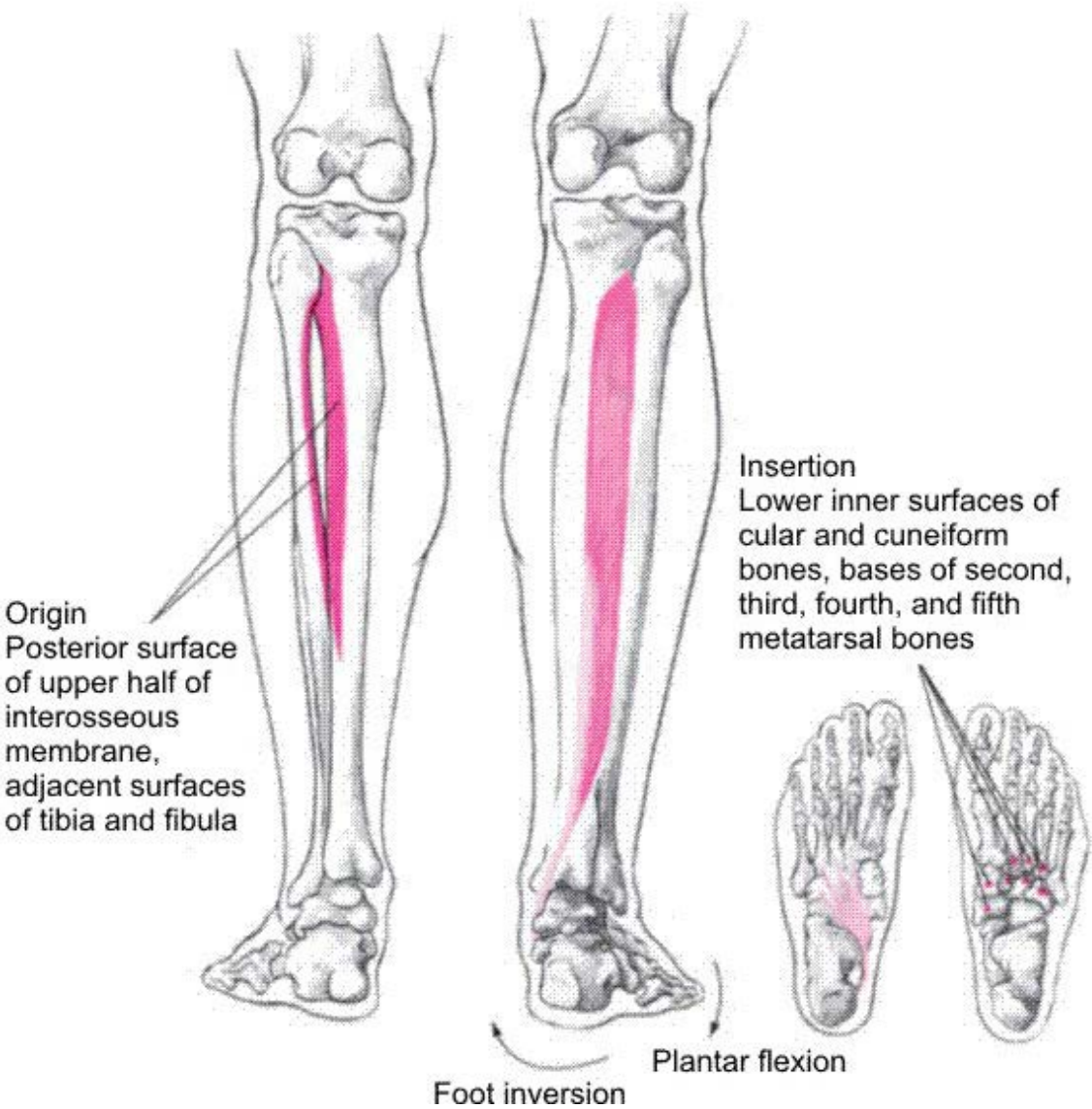
Dorsiflexion of ankle



Tibialis Posterior Muscle

Inversion of foot

Plantar flexion of ankle



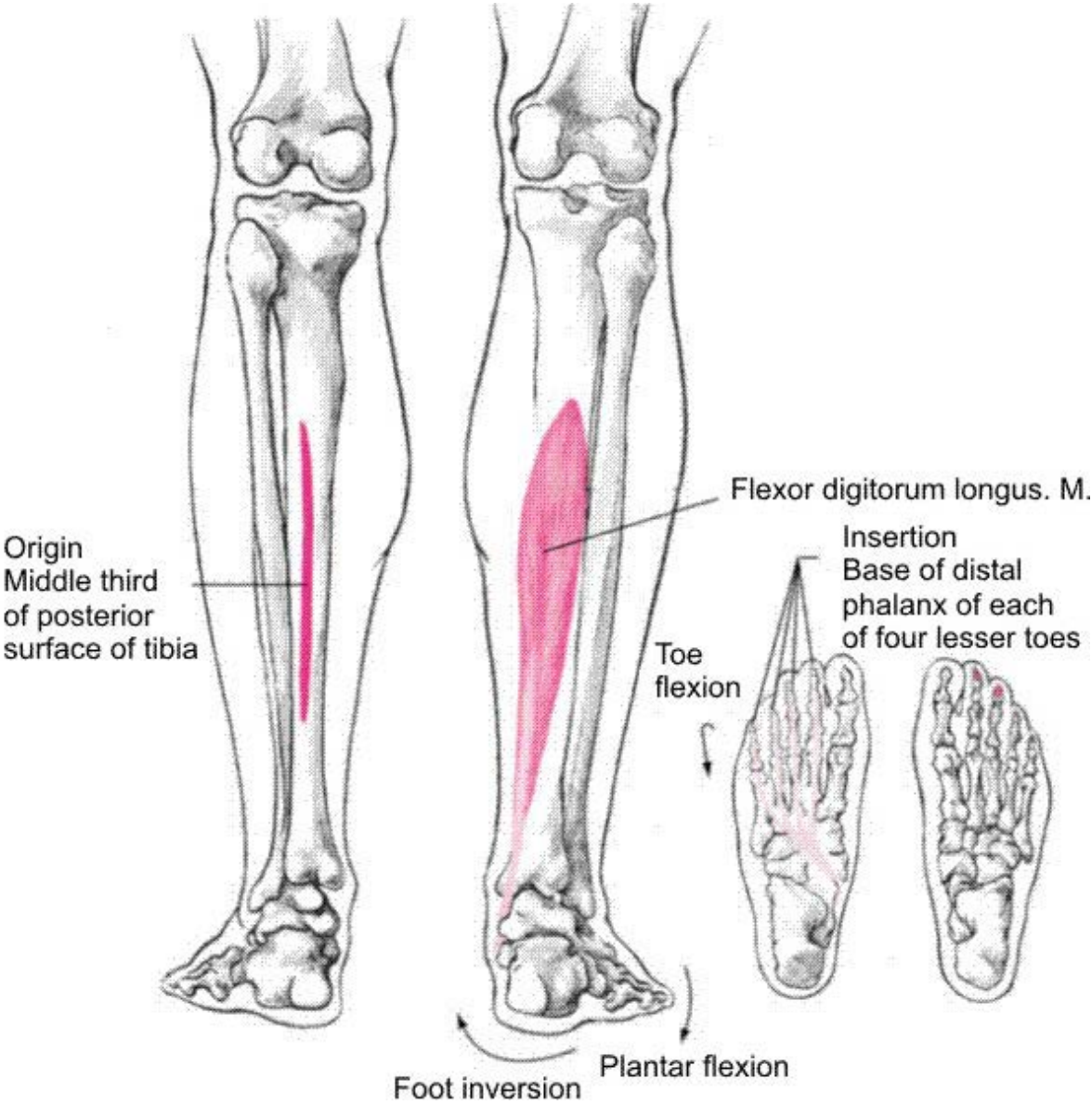
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Flexor Digitorum Longus Muscle

Inversion of foot

Plantar flexion of ankle

Flexion of 4 lesser toes at metatarsophalangeal, proximal and distal interphalangeal joints

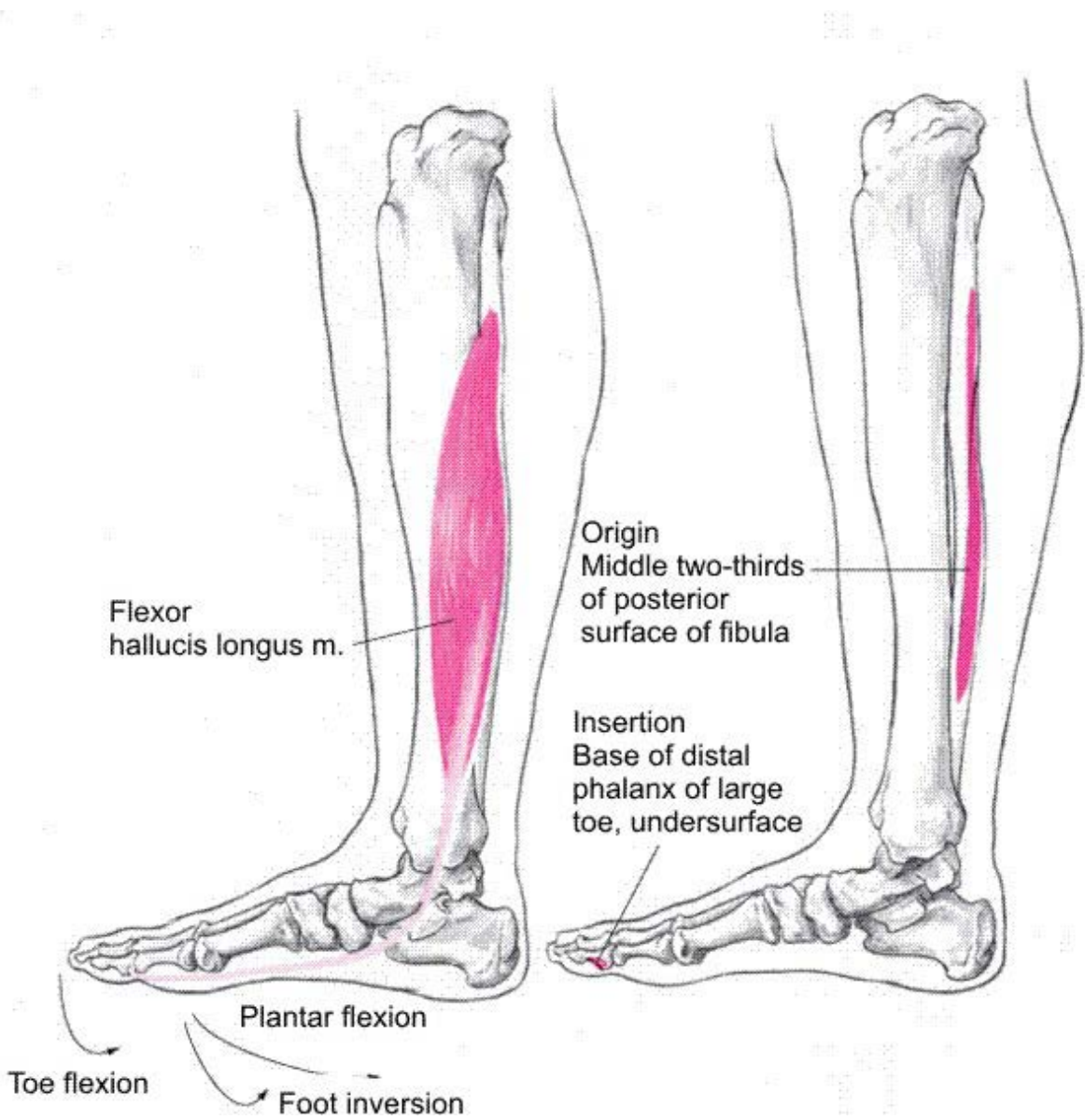


Flexor Hallucis Longus Muscle

Inversion of foot

Plantar flexion of ankle

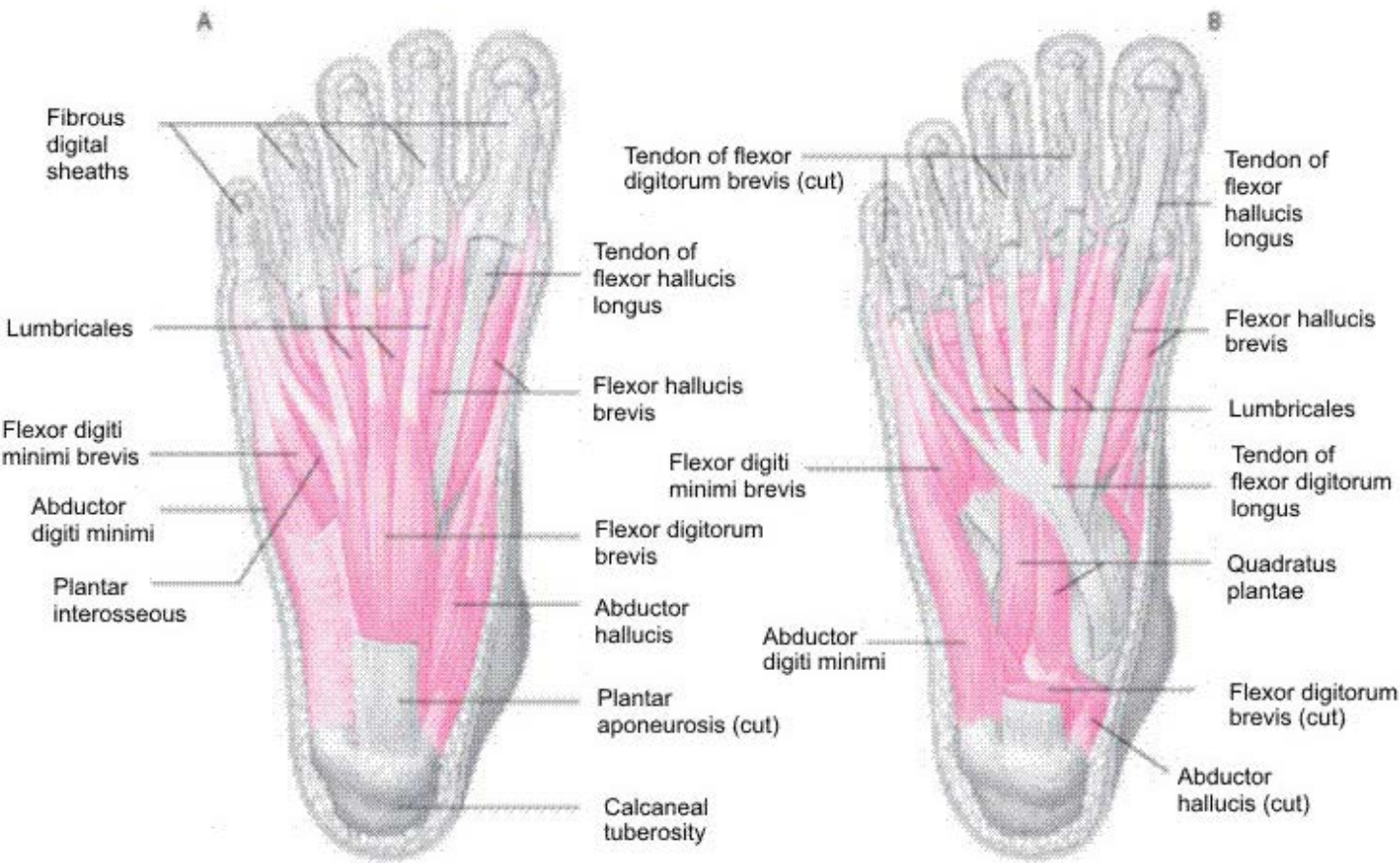
Flexion of great toe at metatarsophalangeal, andl interphalangeal joints



Intrinsic Muscles of the Foot

First (superficial) layer: Abductor hallucis, flexor digitorum brevis, abductor digiti minimi (quinti)

Second layer: Quadratus plantae, lumbricales (4)



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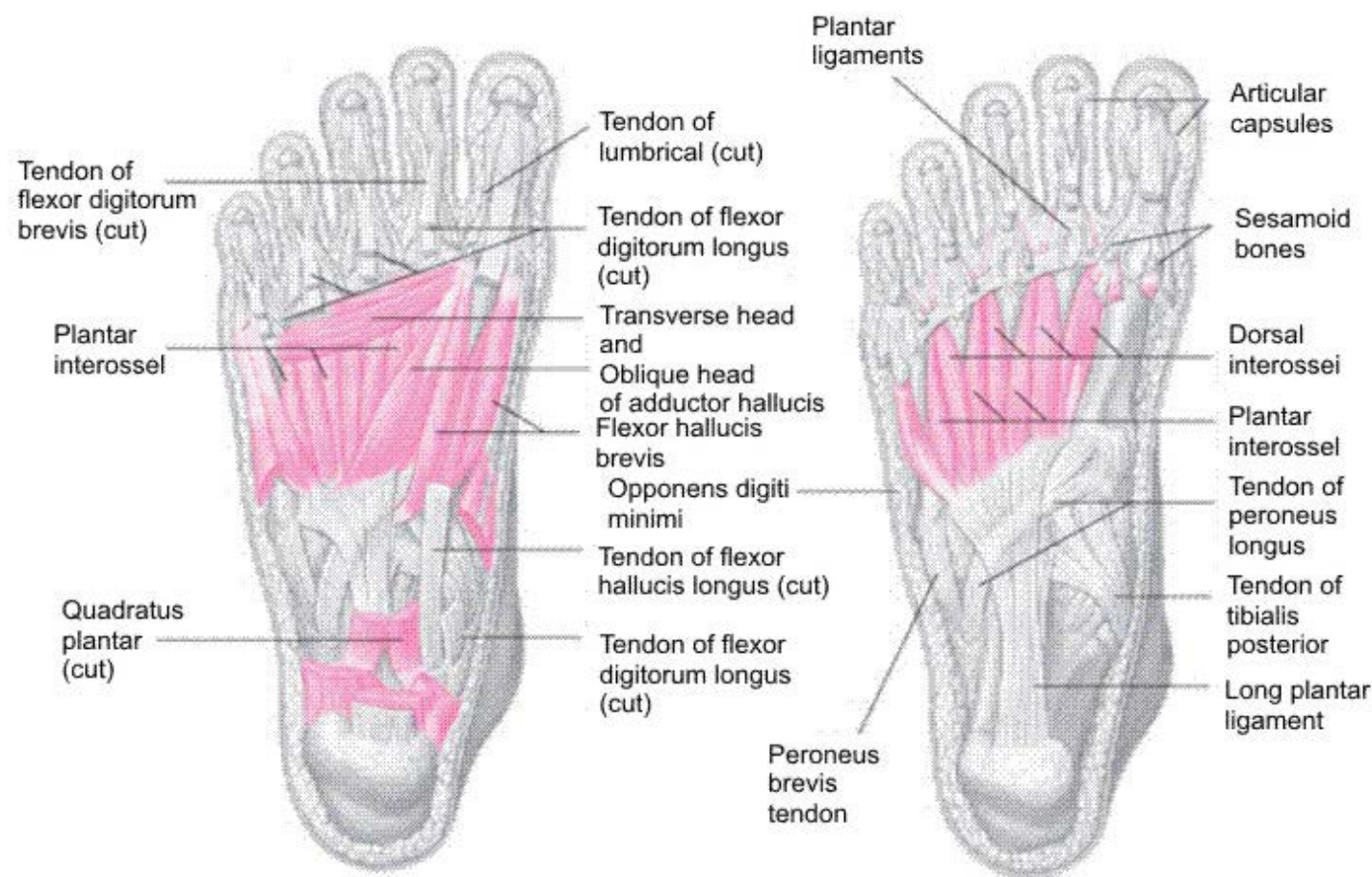
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Intrinsic Muscles of the Foot

Third layer: Flexor hallucis brevis, adductor hallucis, flexor digiti minimi (quinti) brevis

Fourth (deep) layer: Dorsal interossei (4), plantar interossei (3)



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Intrinsic Muscles of the Foot

Grouped by location

Medial - attach to great toe proximal phalanx

Abductor hallucis and flexor hallucis brevis - medially

Adductor hallucis - centrally beneath metatarsals

Central location

Beneath the foot : Quadratus plantae, 4 lumbricales, 4 dorsal interossei, 3 plantar interossei, flexor digitorum brevis

Dorsal compartment : Extensor digitorum brevis

Lateral – attach on lateral aspect of base of 5th phalange proximal phalanx

abductor digiti minimi, flexor digiti minimi brevis

quinti is sometimes used instead of minimi

Grouped by action

4 muscles act on great toe

abductor hallucis - abduction of great toe and assists flexor hallucis brevis in flexing great toe at MP joint

adductor hallucis - adduction of great toe

extensor digitorum brevis - extension of great toe at MP joint

4 lumbricales

flexors of the 2nd, 3rd, 4th, and 5th phalanges at MP joints

quadratus plantae

flexors of 2nd, 3rd, 4th, and 5th phalanges at DIP joints

3 plantar interossei

adductors and flexors of proximal phalanxes of 3rd, 4th, and 5th phalanges

4 dorsal interossei

abductors and flexors of 2nd, 3rd, and 4th phalanges MP joints

flexor digitorum brevis

flexes middle phalanxes of 2nd, 3rd, 4th, and 5th phalanges

extensor digitorum brevis

extends great toe and 2nd, 3rd, 4th phalanges at MP joints

5th toe muscles

abductor digiti minimi abducts proximal phalanx

flexor digiti minimi brevis flexes proximal phalanx

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Ankle Dorsiflexion

Agonists

Tibialis anterior

Extensor digitorum longus

Peroneus (fibularis) tertius : Extensor hallucis longus



Ankle Plantar Flexion

Agonists

Gastrocnemius

Soleus :

Flexor digitorum longus

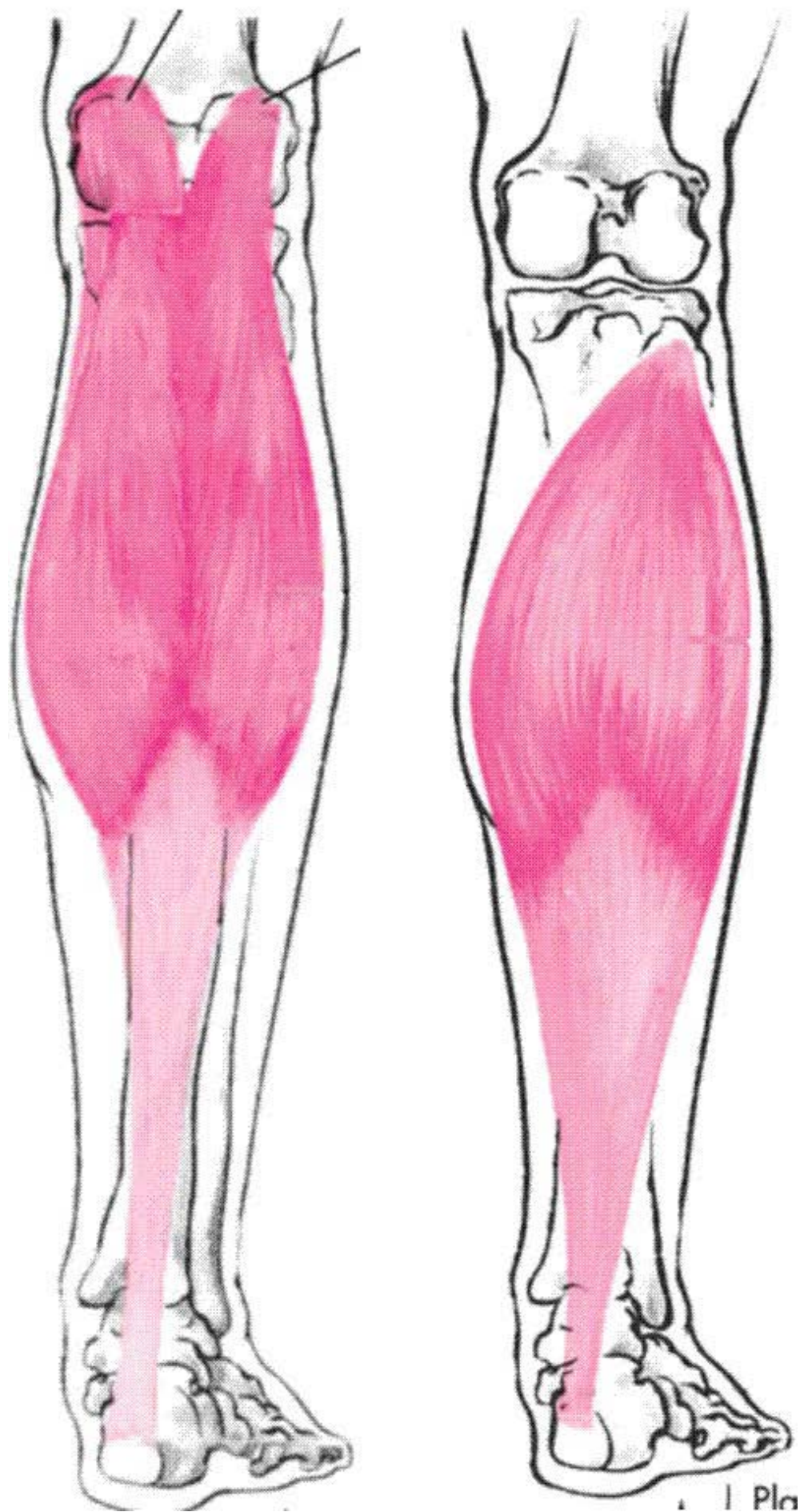
Flexor hallucis longus

Peroneus (fibularis) longus

Peroneus (fibularis) brevis

Plantaris

Tibialis posterior



Transverse Tarsal and Subtalar Inversion

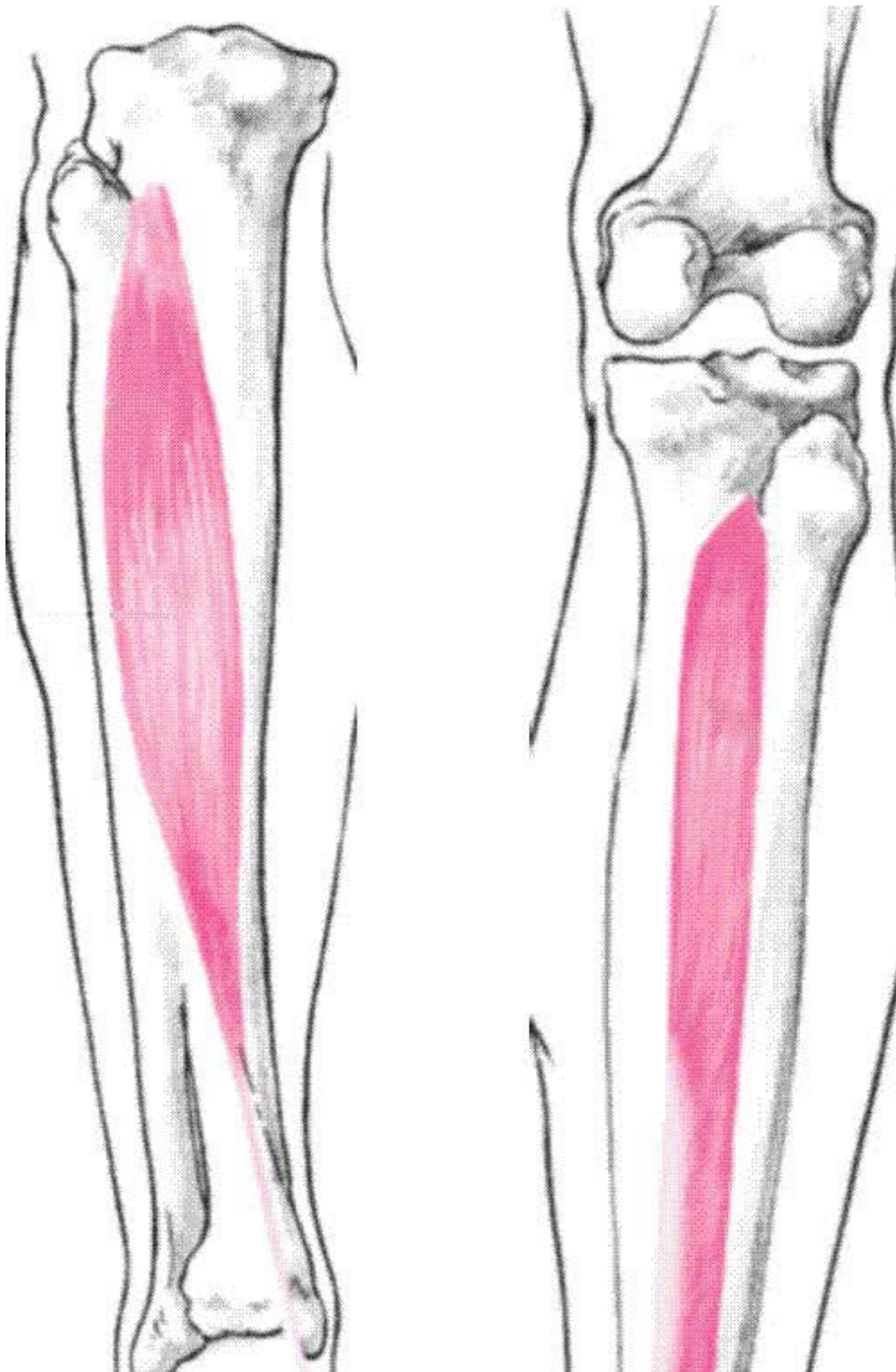
Agonists

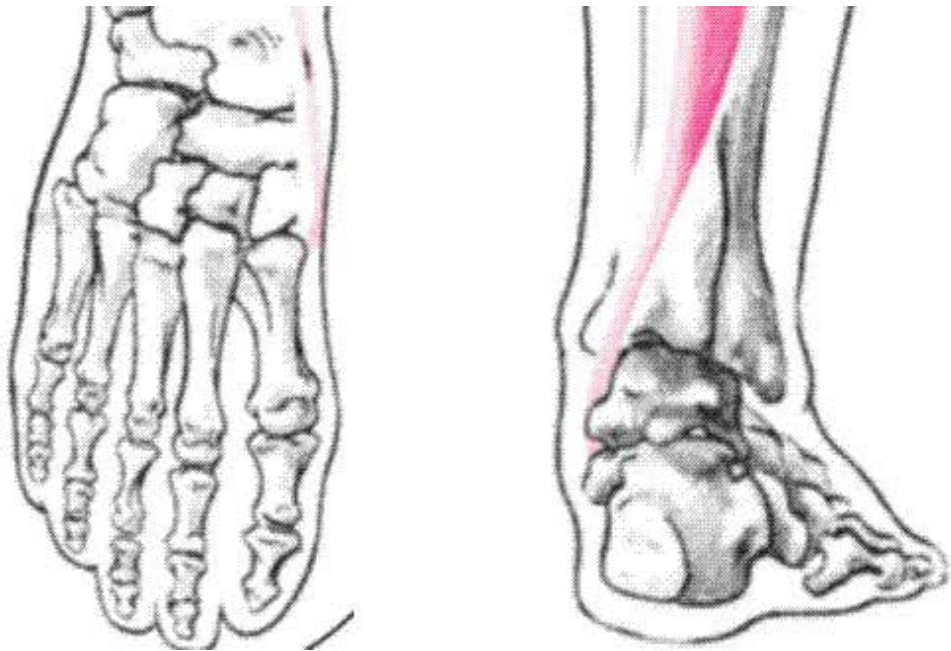
Tibialis anterior

Tibialis posterior :

Flexor digitorum longus

Flexor hallucis longus





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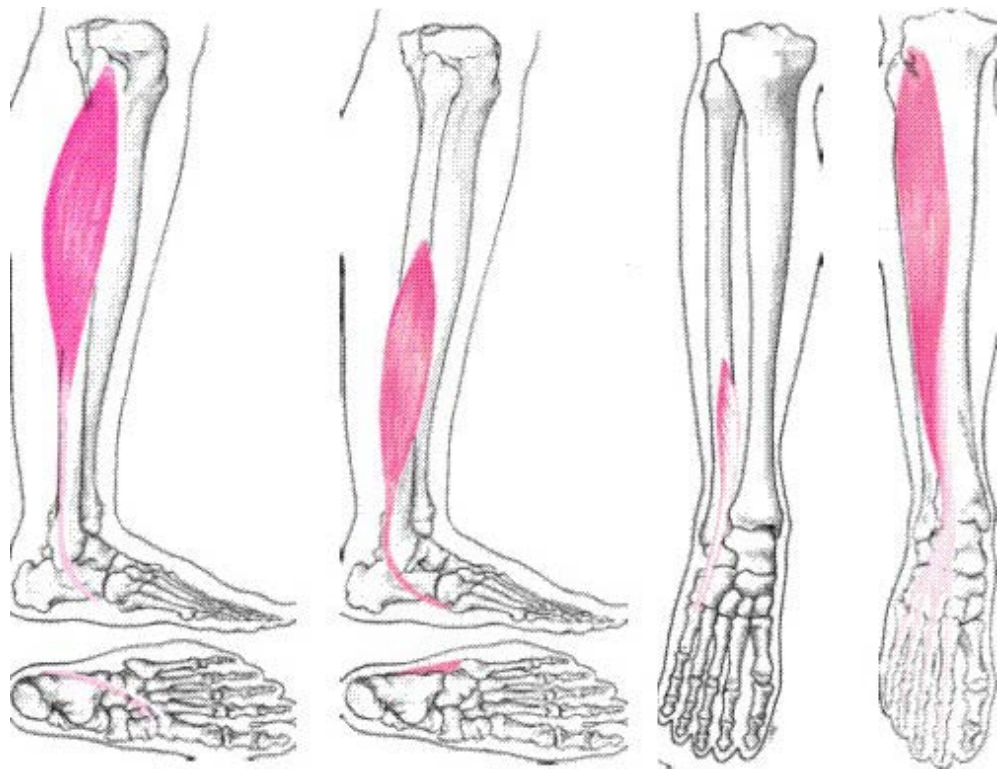
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Transverse Tarsal and Subtalar Eversion

Agonists

- Peroneus (fibularis) longus
- Peroneus (fibularis) brevis
- Peroneus (fibularis) tertius
- Extensor digitorum longus



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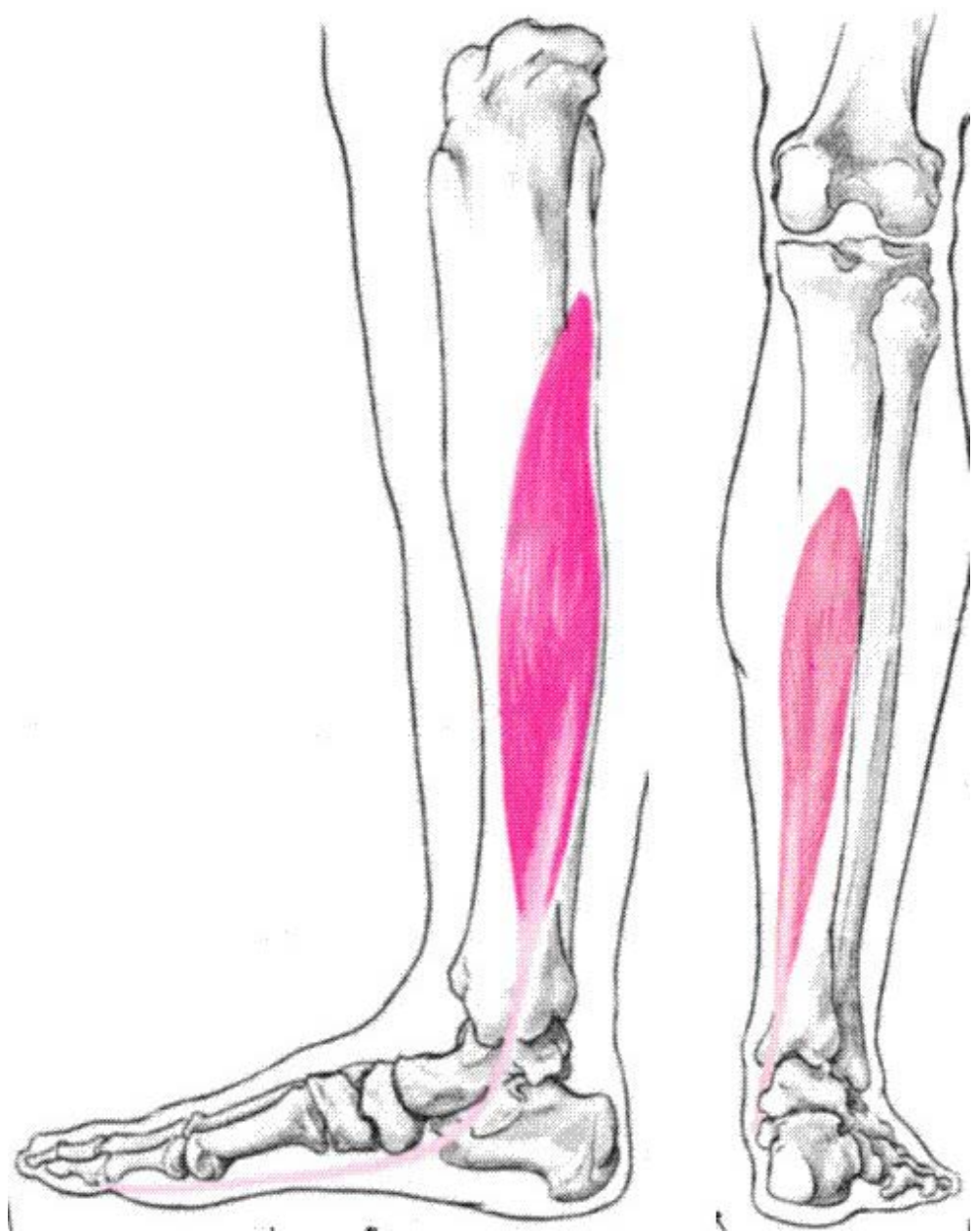
[Next](#)

Toe Flexion

Agonists

Flexor hallucis longus

Flexor digitorum longus



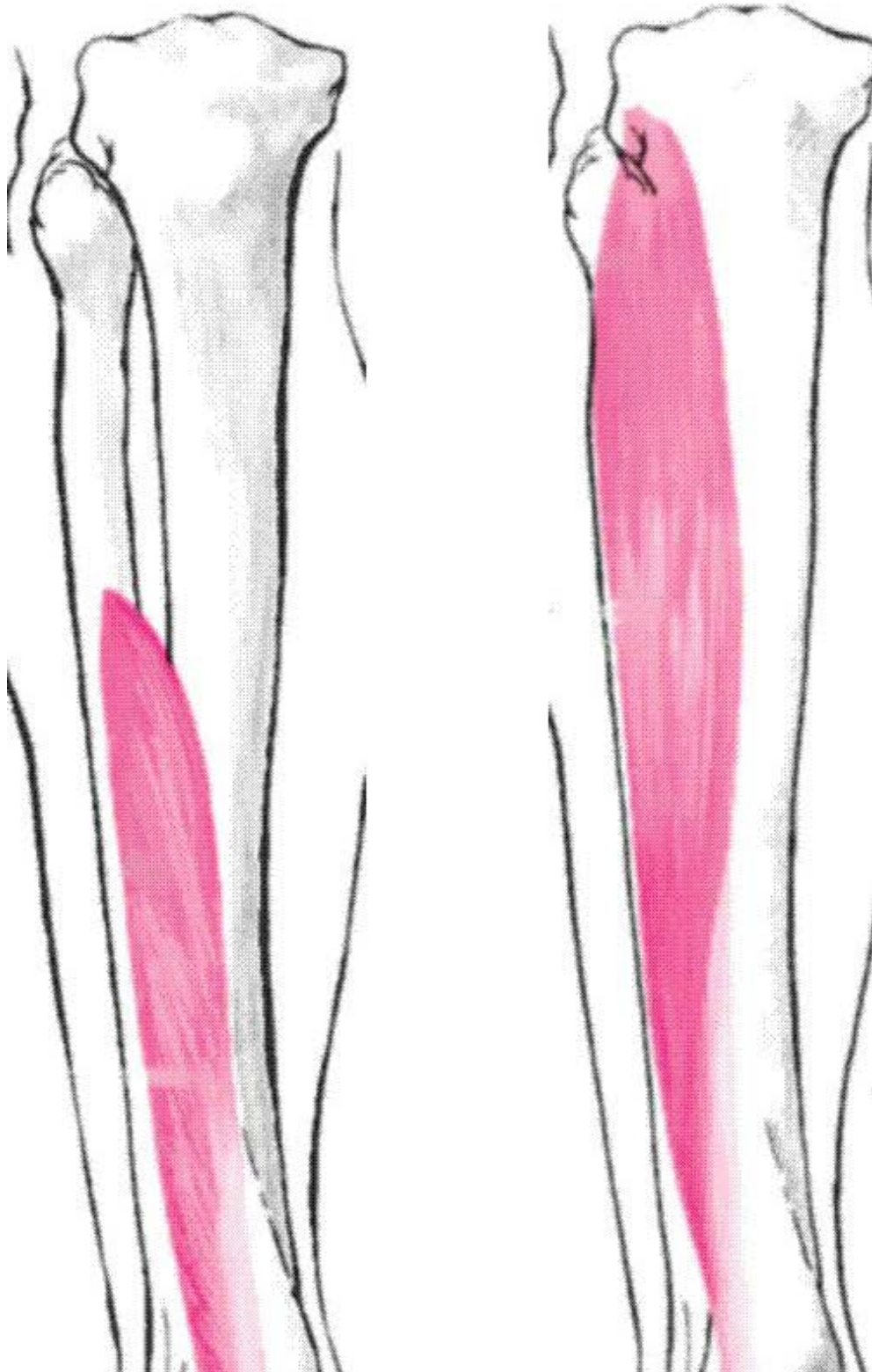
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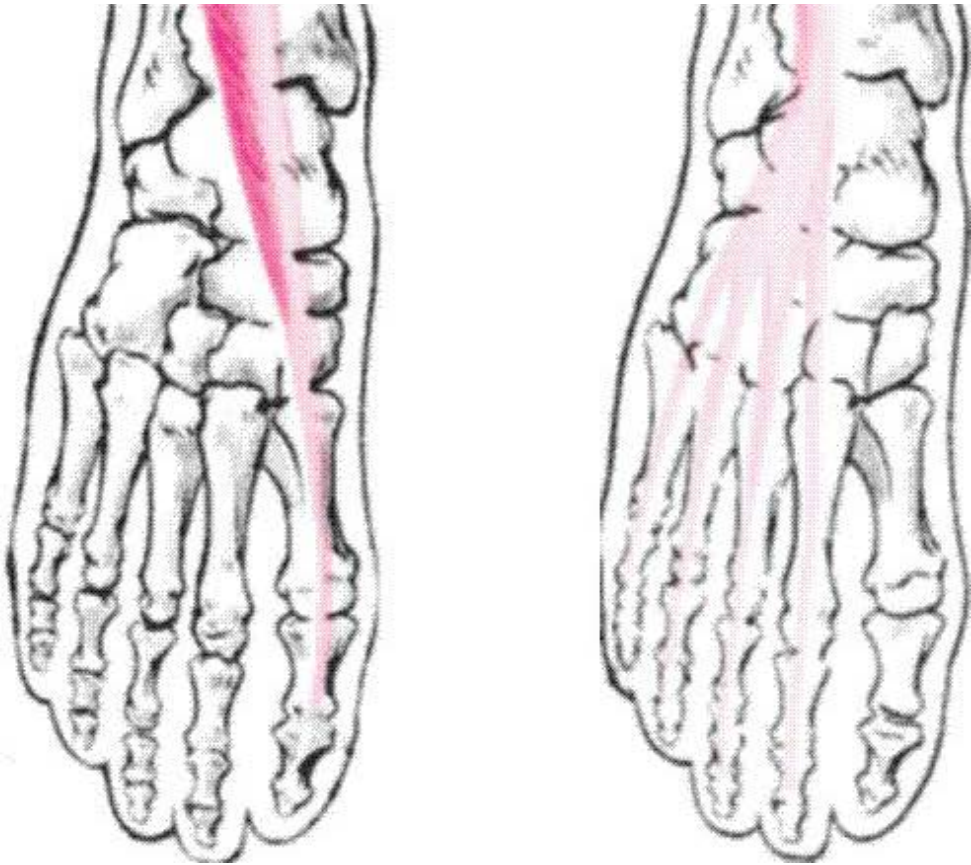
Toe Extension

Agonists

Extensor hallucis longus

Extensor digitorum longus





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