

Chapter 1 Notes : Skeletal Structure

Tibia & Fibula

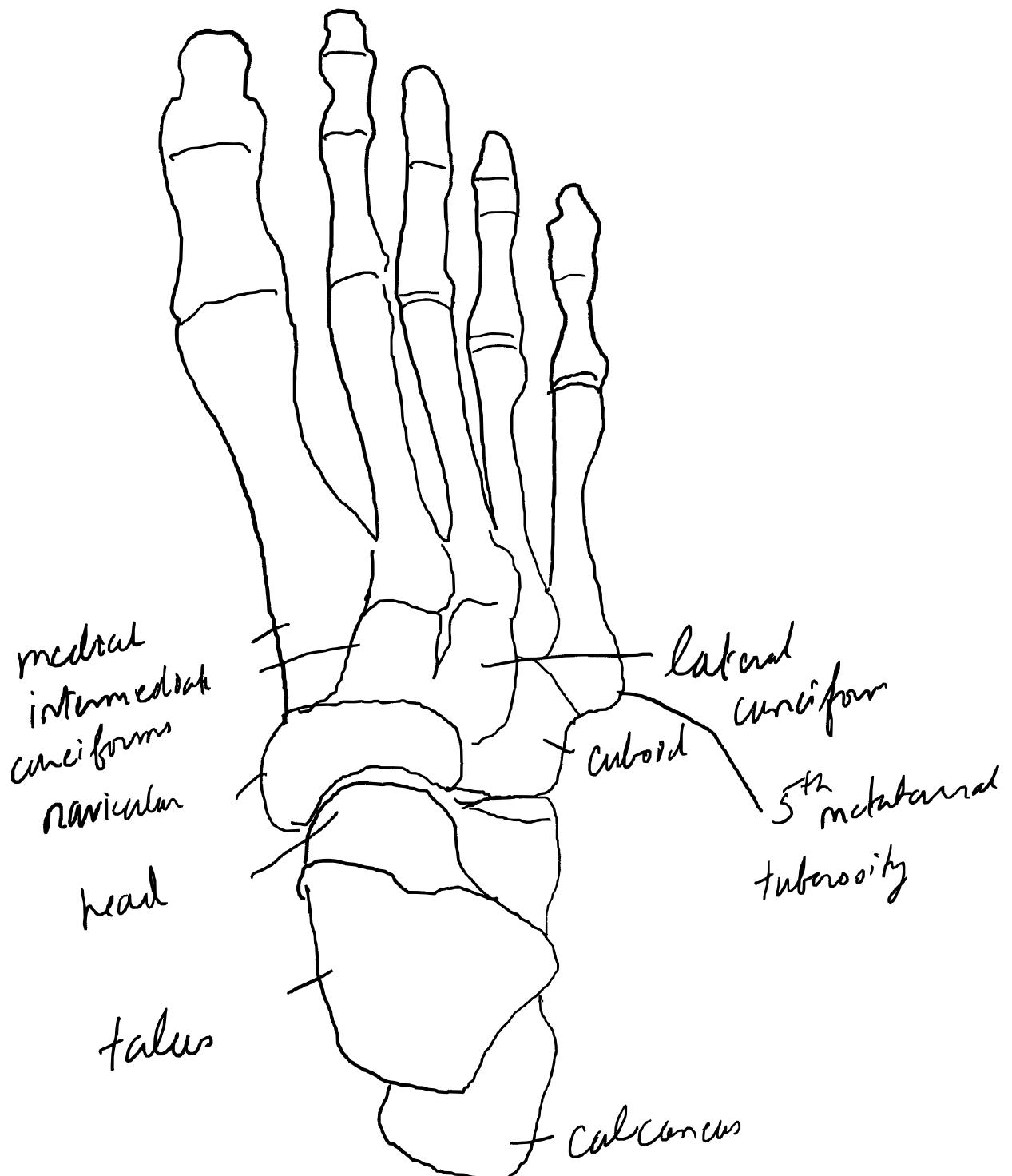
- tibia extends medially to form medial malleolus
- fibula inferior and lateral. distally forms lateral malleolus
- together, hold talus for dors/plantarflexion

Segments

- 7 short bones make up tarsus:
 - calcaneus
 - > hindfoot
 - talus
 - navicular
 - cuboid
 - intermediate cuneiform
 - medial cuneiform
 - lateral cuneiform

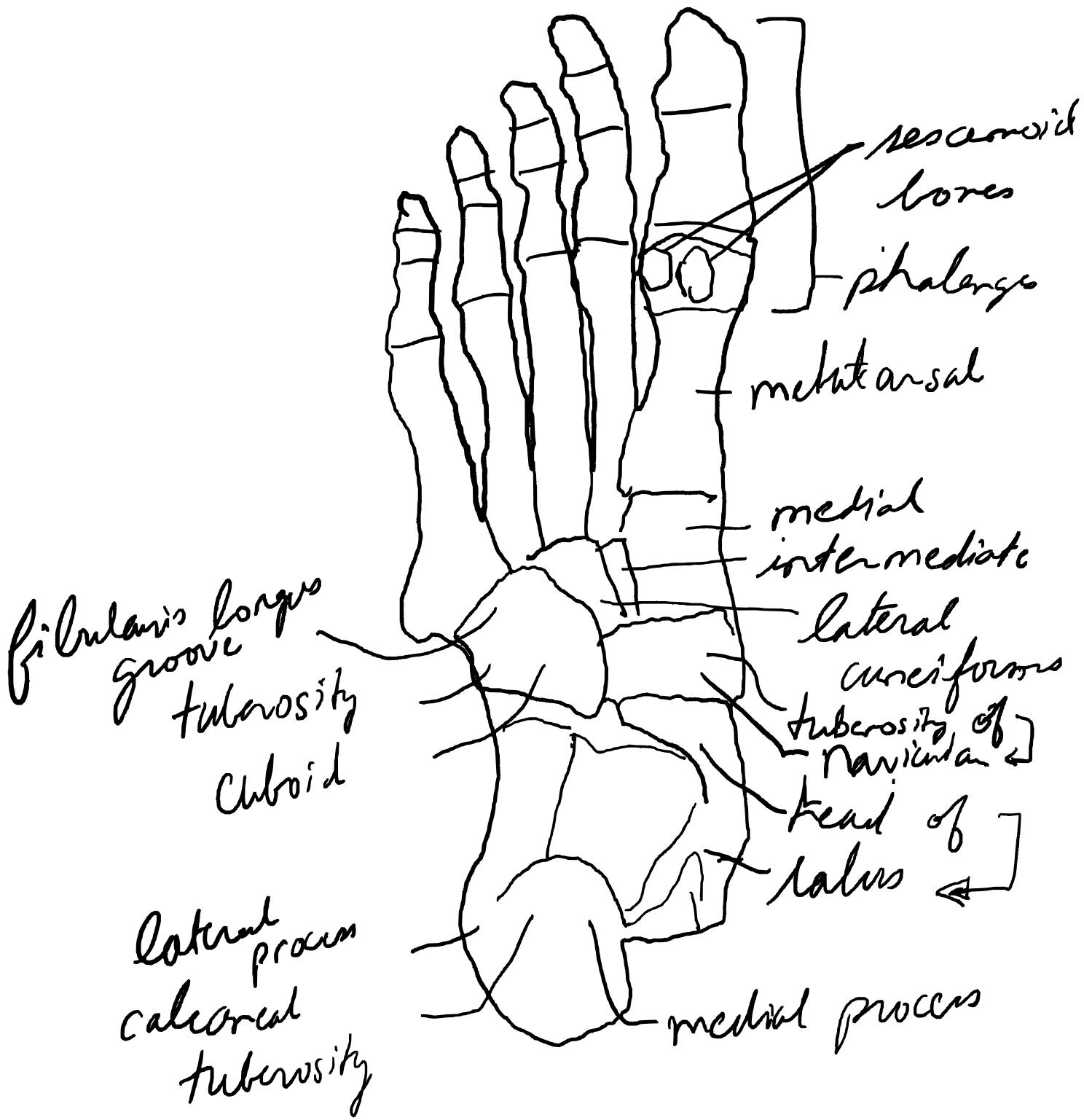
midfoot.

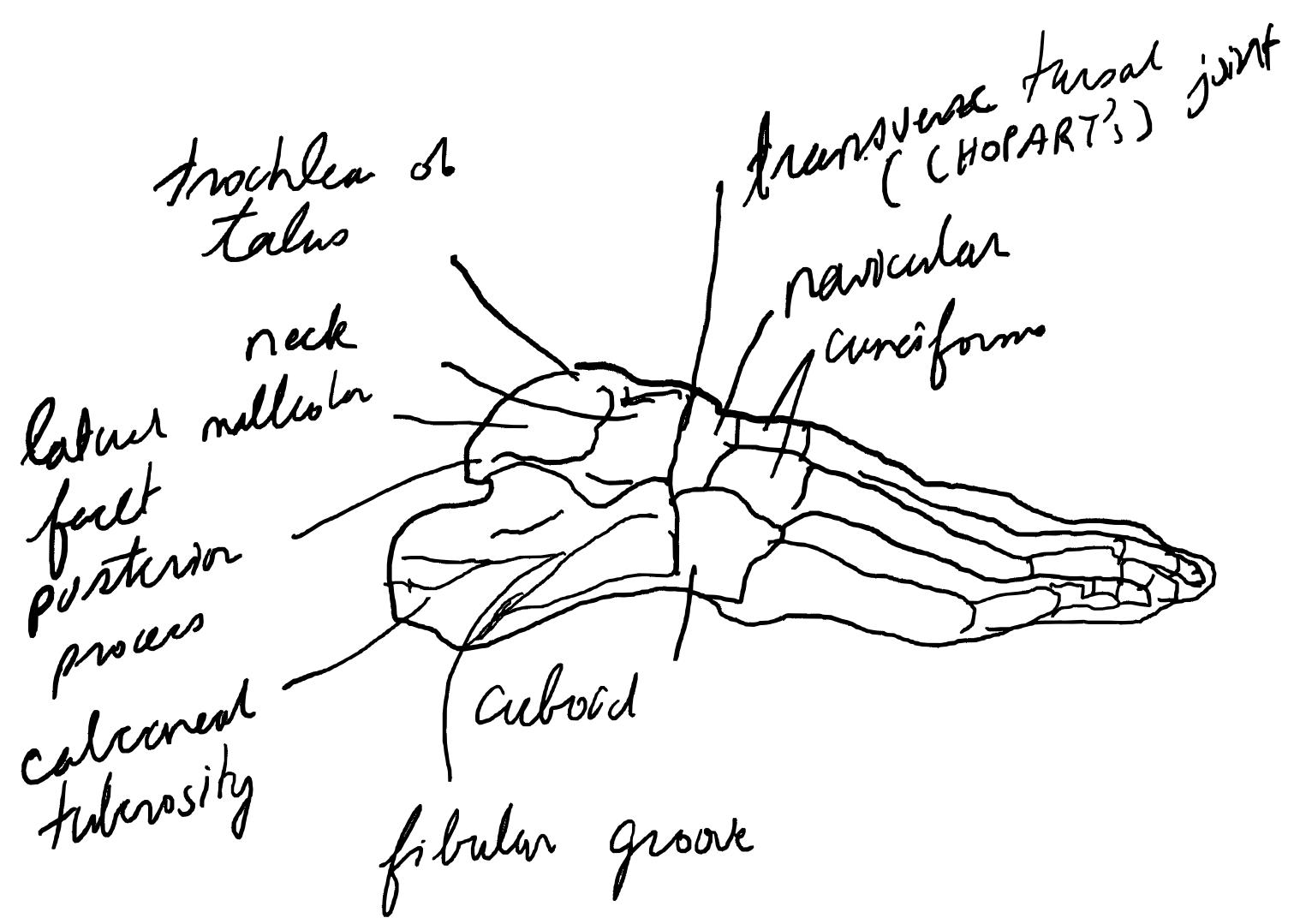
- minimal movement alone, but noticeable in conjunction



Dorsal View

Plantar View





Talus

- 2nd largest foot bone after Calcaneus
- 5 articulating surfaces: Fibula, Calcaneus, Navicular, distal ends of tibia/fibula

Calcaneus

- largest foot bone
- angled upward. Anterior lateral portion scooped out, where talus sits.

Navicular

- slight vertical ridges for cuneiforms
- articulates with cuboid, sometimes calcaneus

Cuboid

- pyramidal
- sulcus: groove or fissure
- lateral surface has deep notch continuous with fibular sulcus
- plantar surface, deep groove parallel to anterior border for peroneus longus tendon

Medial Cuneiform

- medial surface has shallow groove for tibialis anterior tendon

Intermediate / Lateral Cuneiform

- nothing particular about muscle/tendinous groups / insertions

Metatarsals

- proximal end superior (higher) than distal,
so only ends contact tissue/skin
- First Metatarsal
 - articulates with sesamoids of flexor hallucis brevis
 - medial surface has small tubercle near its center, insertion for tib ant.
 - medial & lateral surface of base most plantarly forming tuberosity where peroneus longus inserts

- plantar aspect of heel has two grooves separated by ridge
- navicular bones of FAB slide in
- ignoring 2nd, 5th as descriptions are purely structurally. Refer to text if precise description required.

Phalanges

- Proximal
 - all same form. Hallux larger?
 - reflects joint pressure and force transmission
- Middle
 - only exist on lateral 4 toes

- Distal

- second phalanx of hallux and 3rd of digits
- hallux shift 15° deg anteriorly.
 - appears mostly in bone, slightly in joint.
- plantar surface V shaped ridge where flexor hallucis longus inserts

joints

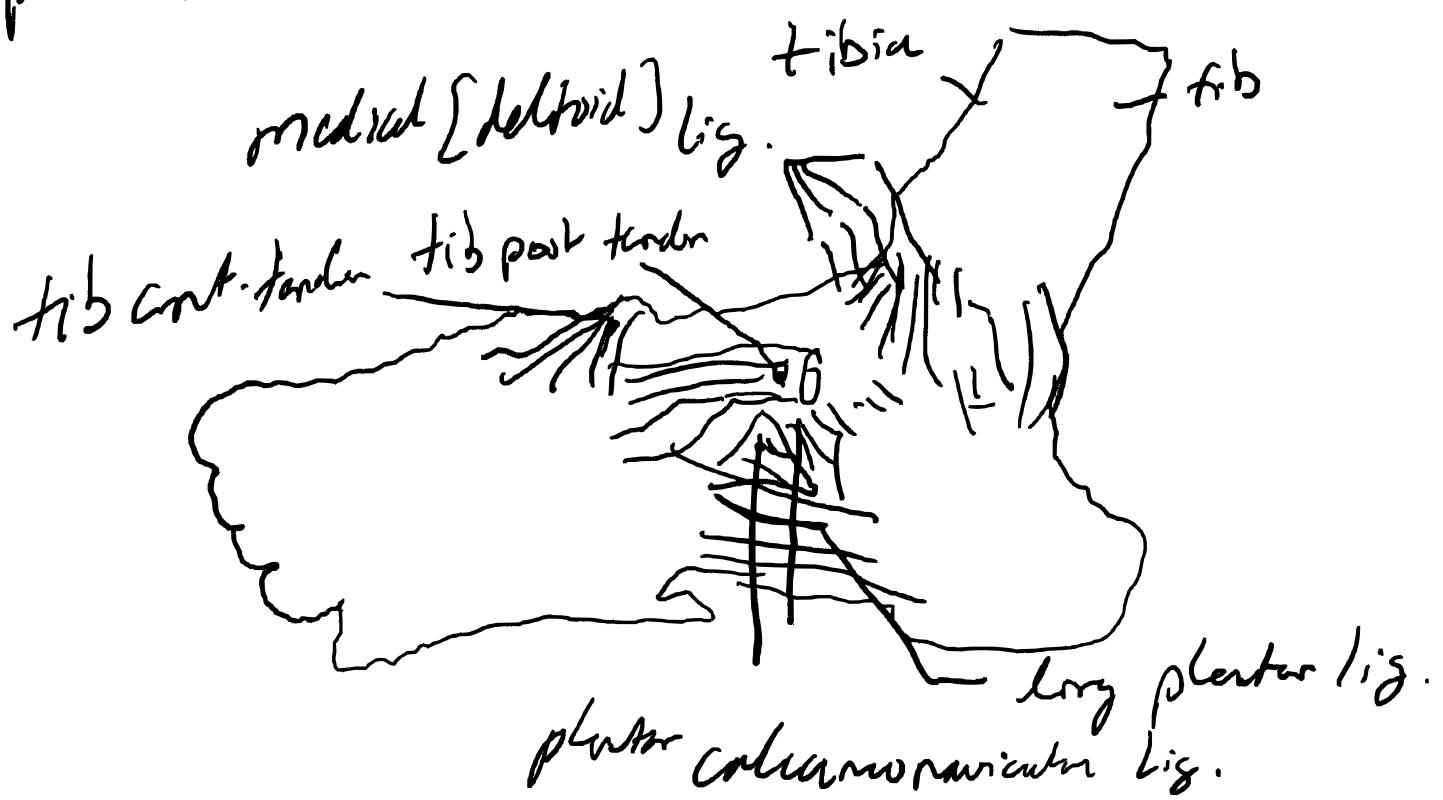
- Fibrofibular syndesmosis

- joint distal ends of tibia and fibula
- fibrous joint.
- interosseous ligament: many strong bands prevent upward glideslitch of tibia between leg bones

- Ankle joint (Taloocrural)

- talus trochlea fits into fibula + tibia
- deltoid and lateral ligament strongly reinforce sides of ankle

- connects to navicular, calcaneus, talus from medial malleolus.

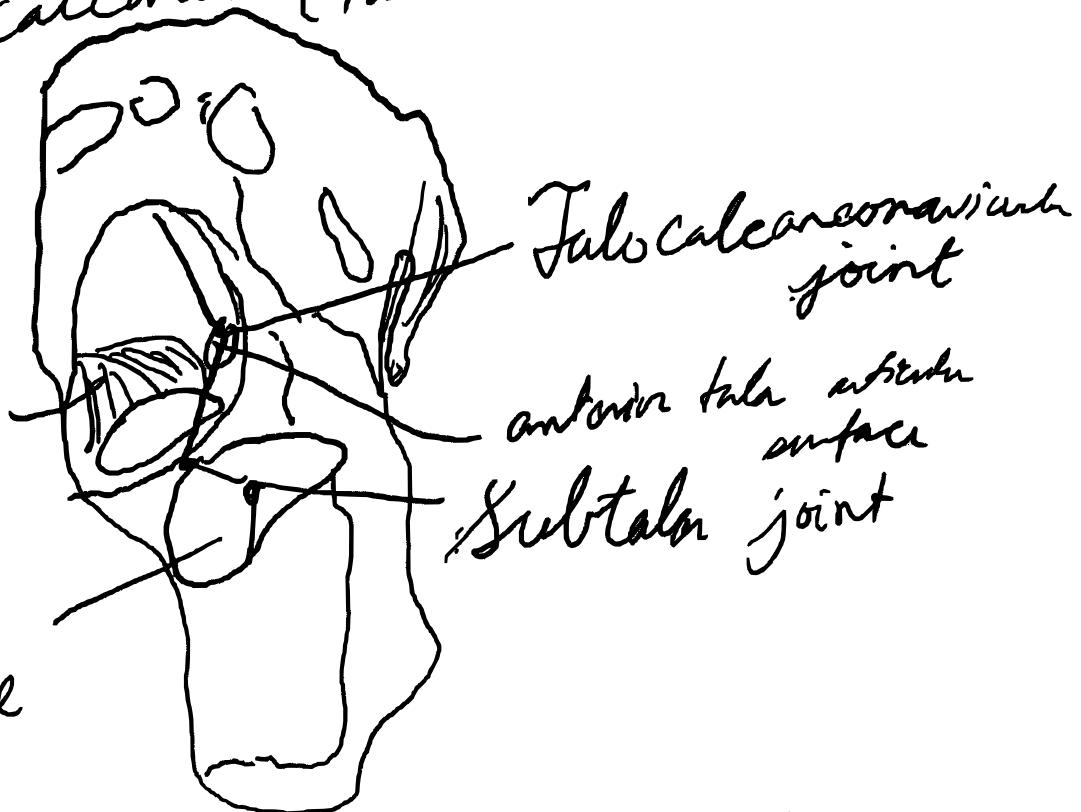


- lateral aspect often "fibiospring lig" supports plantar calcaneonavicular lig., maintaining talonavicular pos. protecting arch.

- Lateral ligament: 3 bands
 - post. talofibular stronger
 - separates ankle and subtalar joints
 - lateral malleolar fossa to post. lateral talar tubercle.
- ligaments may cross multiple joints, synovial spaces are separate
- anterior/posterior spaces have fat to allow for movement

- Subtalar joint
 - talus and calcaneus (talo calcaneal joint)

Plantar
Calcaneonavicular
ligament.
Posterior talan
Articular surface

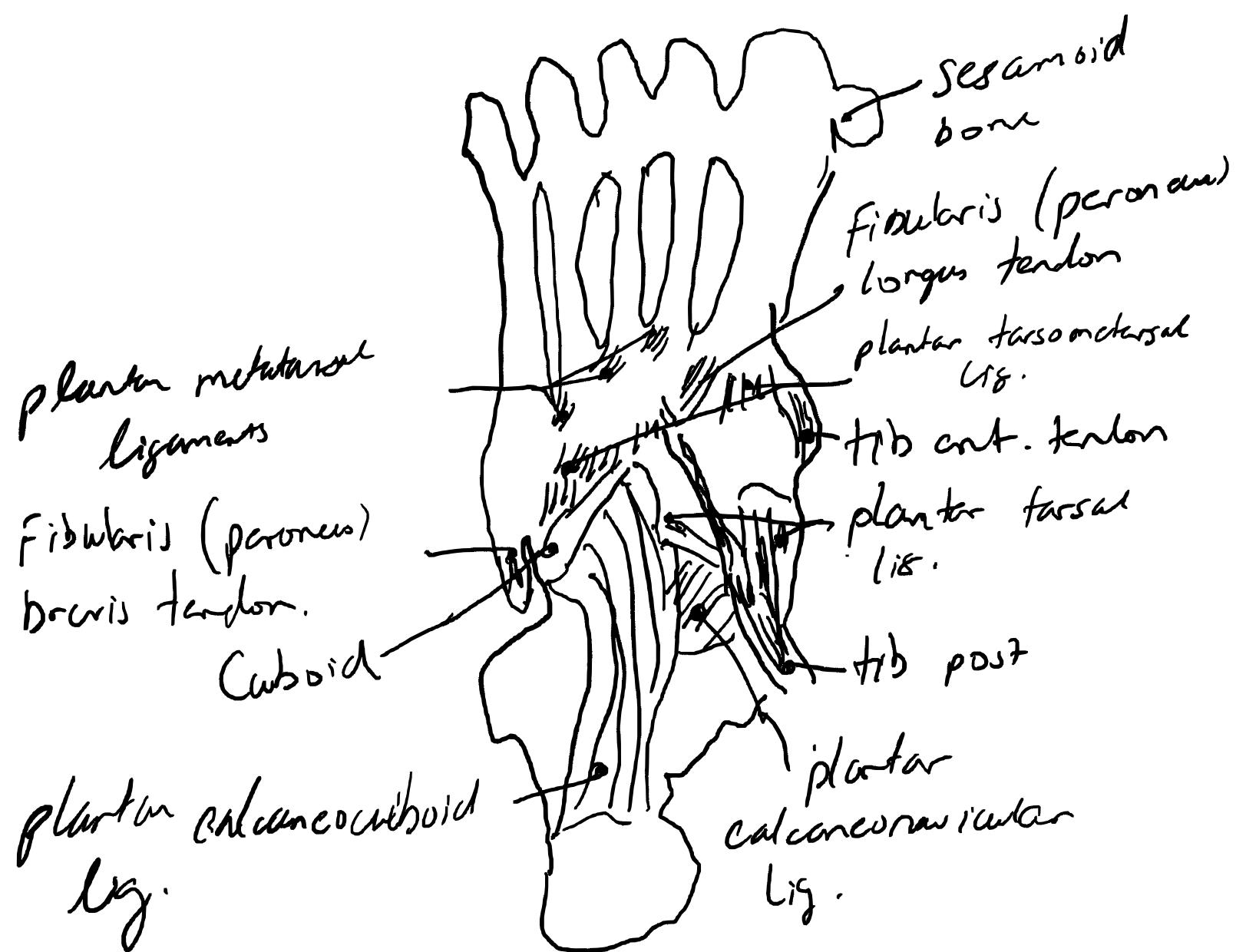


Dorsal ligaments of ankle and tarsal

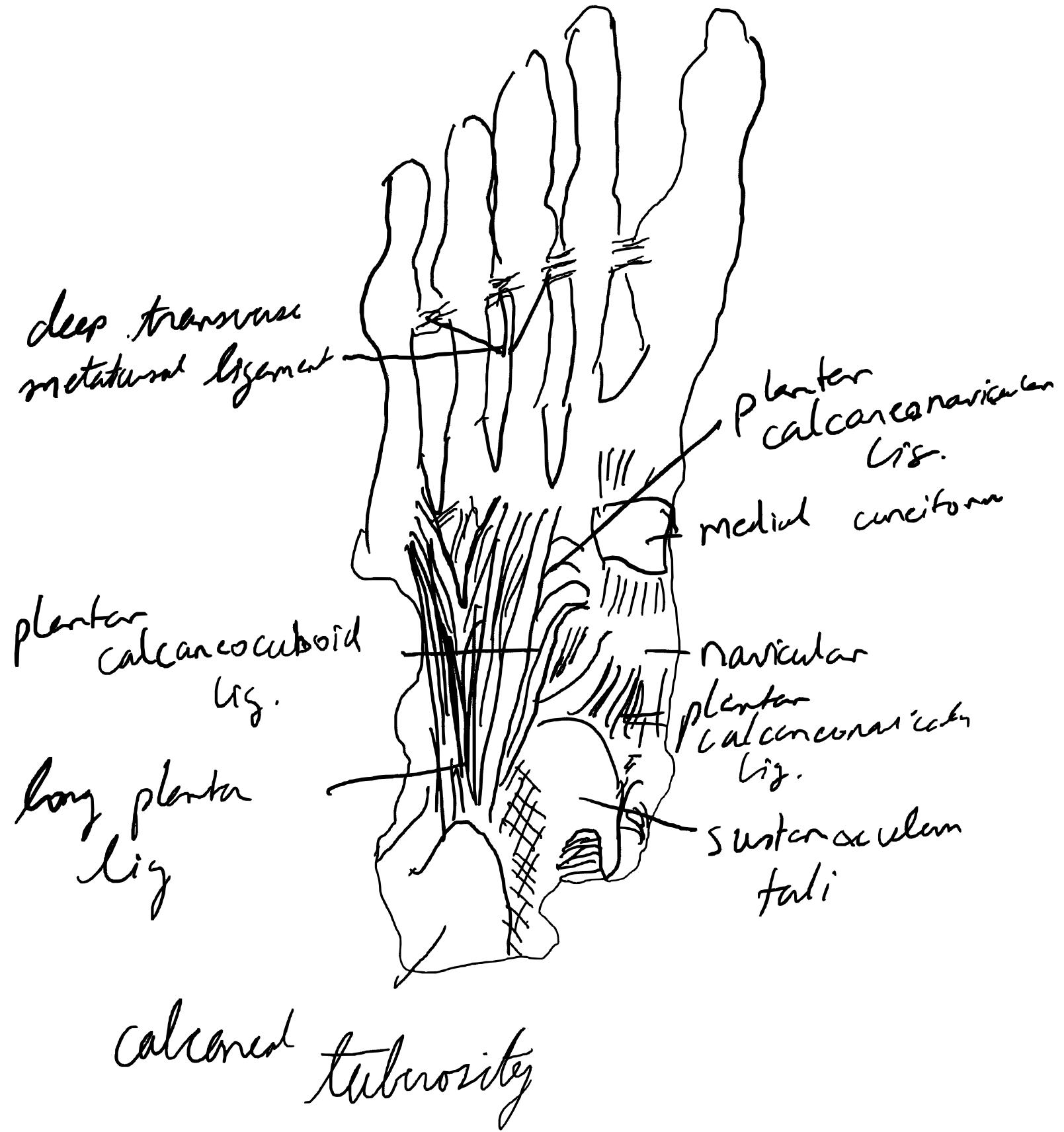
- only posterior surface, not medial or anterior
- thickness of the capsule create indistinct ligaments
 - posterior
 - lateral: extremely weak
 - medial
- 2 extracapsular ligaments
 - interosseous
 - cervical (strong): calcaneus to neck of talus
- Talocalcaneonavicular joint
 - where talus fits into calcaneus, navicular, and plantar calcaneonavicular lig.
 - more mobility than expected
 - extracapsular ligaments
 - reinforced by fibronavicular & fibrocalcaneal parts of deltoid lig on medial side
 - strong lateral ligament: calcaneonavicular lig. of bifurcate lig.

Calcaneocuboid Joint

- sellar joint: saddle joint
- dorsal + plantar calcaneocuboid lig.
- long planta
- calcaneocuboid of bifurcate



Deep Plantar ligaments



- Cubonavicular Joint

- sometimes plane synovial, other syndesmosis
- ligaments present regardless of joint type
- 3 liggs:
 - dorsal, start dorsal lateral of navicular to lateral cuneiform, medial posterior cuboid
 - plantar
- interosseous

- Cuneonavicular joint

- small movement, interface via wedges on navicular
- dorsal ligaments to each cuneiform
- plantar ligaments do the same
- synovial cavity is continuous = great tarsal synovial cavity
- post. fib. merge + reinforce plantar lig.

- Cuneiform & Cuneocuboid

- little movement, strong attachment
- help create strong & stable arch.

. Tarsometatarsal Joints

- "Lisfranc's joints"
- 3 joints in a strict sense (separate synovial cavities)
 - medial Cuneiform → first metatarsal
 - intermediate + lateral → 2nd/3rd metatarsal
 - cuboid → 4th/5th
- variety in interosseous ligament presentation
- "Lisfranc's Ligaments" Strongest and most important.
 - lateral surface of medial cuneiform to medial surface of 2nd metatarsal base

. Proximal clavometatarsal Joints

- 4 lateral firmly held in place at proximal and dorsal, plantar, interosseous liggs.
 - interosseous strongest, dorsal, transverse, weakest

- Distal Intermetatarsal Joints

- no serious description
- deep Transverse metatarsal lig, often seen as 1 lig instead of individual

- Lesser Metatarsophalangeal joints

- fibrous capsule attachment at neck
 - loose dorsally and plantarly, wide ROM.
- Plantar lig strong attachment to proximal phalanx, loose at metatarsal.
 - move with phalanges, even loss connection w/
metatarsal

- Hallucal Metatarsophalangeal joint

- accommodates 2 sesamoid bones embedded in tendon of flexor hallucis brevis + weight bearing
- plantar side of head, two grooves for sesamoids
 - medial larger
- sesamoids embedded in flexor hallucis brevis, but also have fibers from ad/abductr hallucis

- fibrous capsule. Same properties as others in dorsal/planta nature

Interphalangeal joints

- ginglymus: freely moving in a plane (hinge)
- don't care too much about these

Muscles And Tarsal Specializations

- extrinsic: shank origin, foot insertion
- intrinsic: both in foot

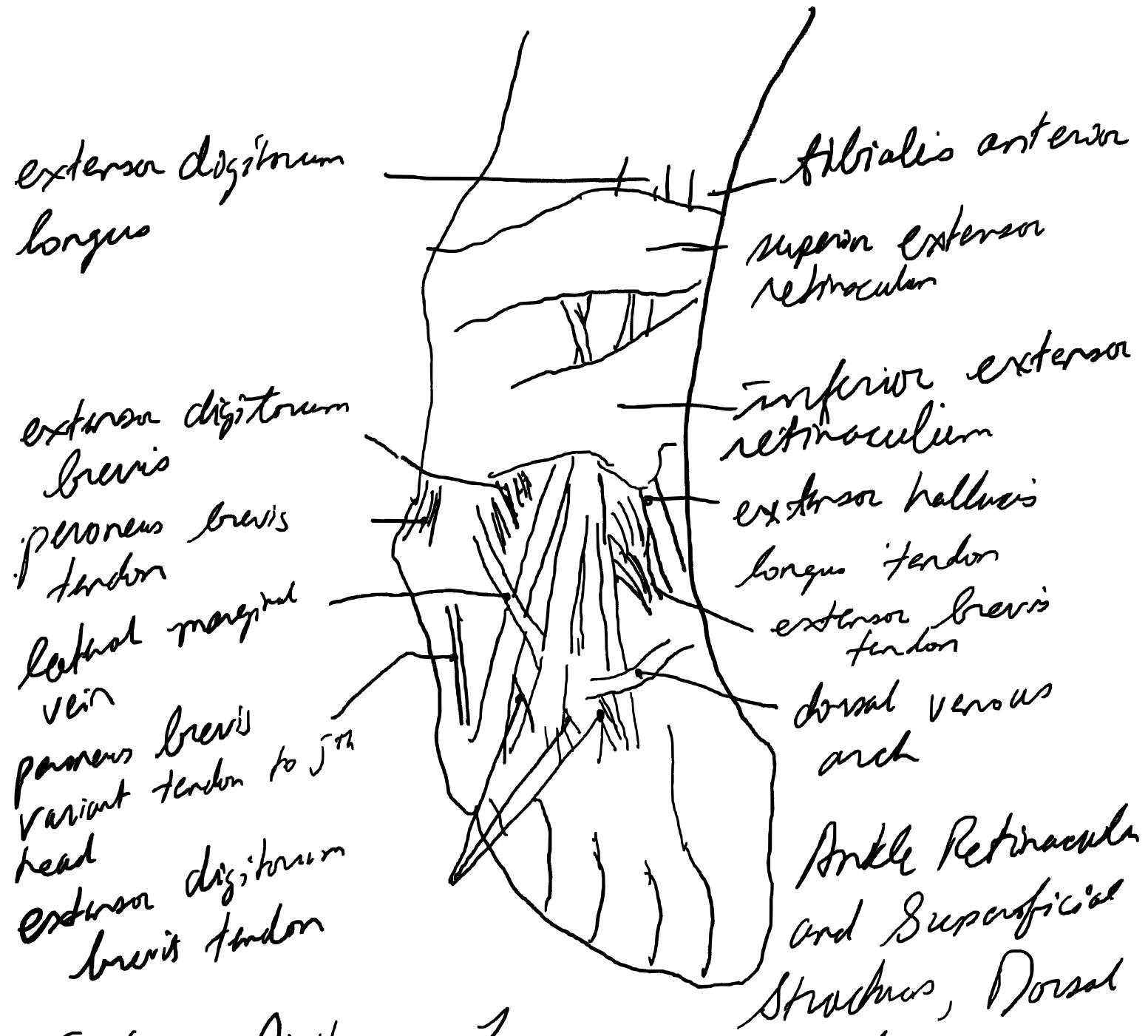
Fascial Specialization

- superficial fascia = loose connective tissue
 - thick in the sole
- deep fascia covers superficial muscle, also thickest in sole (plantar aponeurosis)
- separates muscle groups
 - anterior compartment: extensors / dorsiflexors of ankle and toes
 - posterior superficial: flex knee, plantarflex ankle
 - deep: plantarflexors, toe flexors, invert/evert
 - lateral: plantarflexors / evertors
- Sole, 3 parts:
 - medial: 2 Hallux muscles
 - lateral: 2 little toe muscles
 - intermediate: rest of digits
- return for more notes if necessary

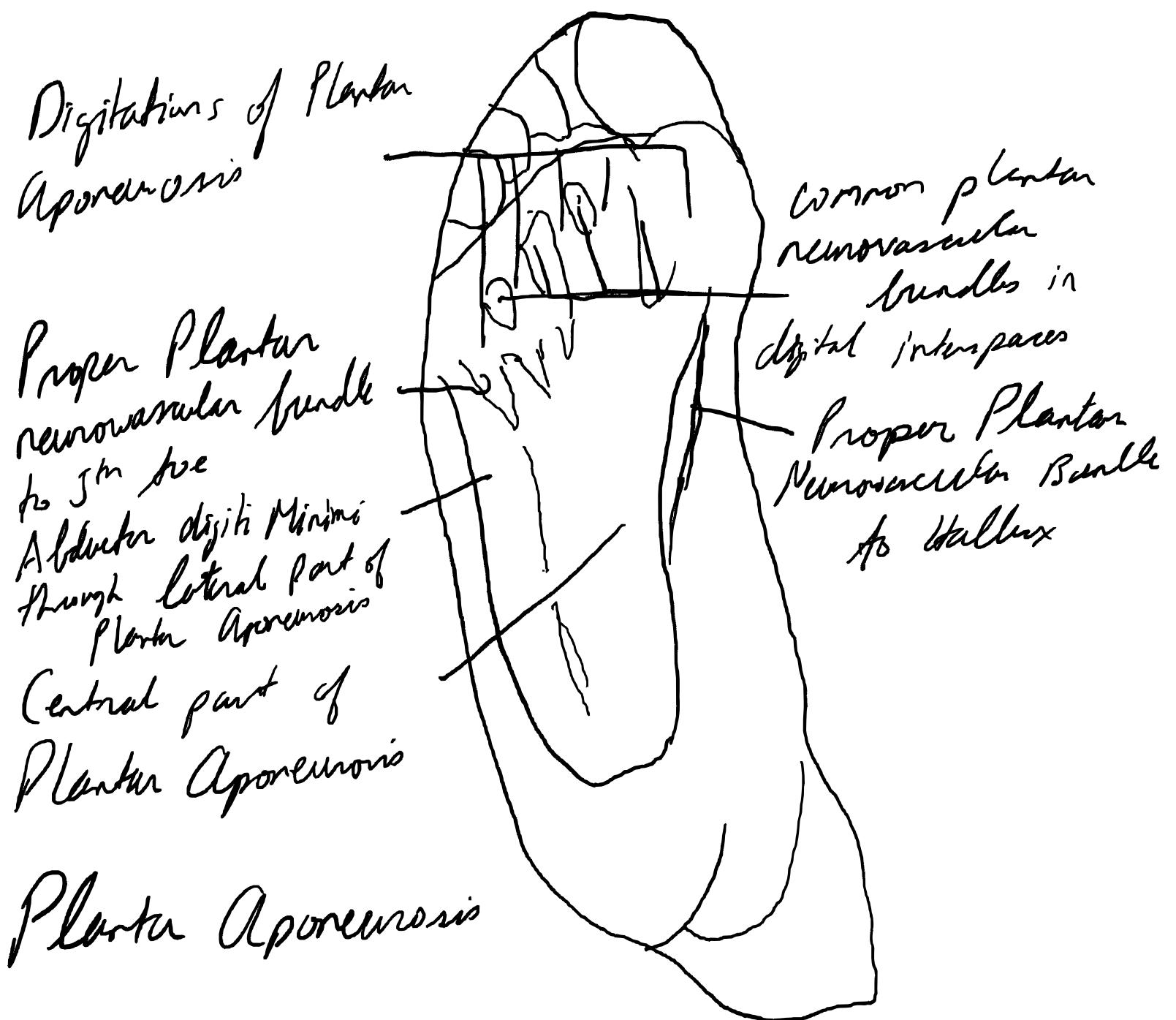
Extrinsic Dorsal Muscles

- Fibialis Anterior
 - origin lateral condyle, proximal lateral tibia shaft
 - inserts medial/plantar surfaces of medial cuneiform and first metatarsal base

- primarily dorsiflexor but also inverter
- becomes tendon about midway down leg



- Extensor Digitorum Longus
- lies medial to fib. ant.
- extensor origin from lateral tibial condyle, fibular head, $2\frac{1}{3}$ rd of medial fibular surface, proximal interosseous membrane, crural fascia, etc.
- appears medial belly of leg, drops vertically



Plantar Aponeurosis

- intertwine with brevis tendons when inserting into proximal/distal phalanges
- main contributor to a membranous sheet which covers lateral toes.

Extensor Tendons of Foot

Dorsal Digital
Arteries

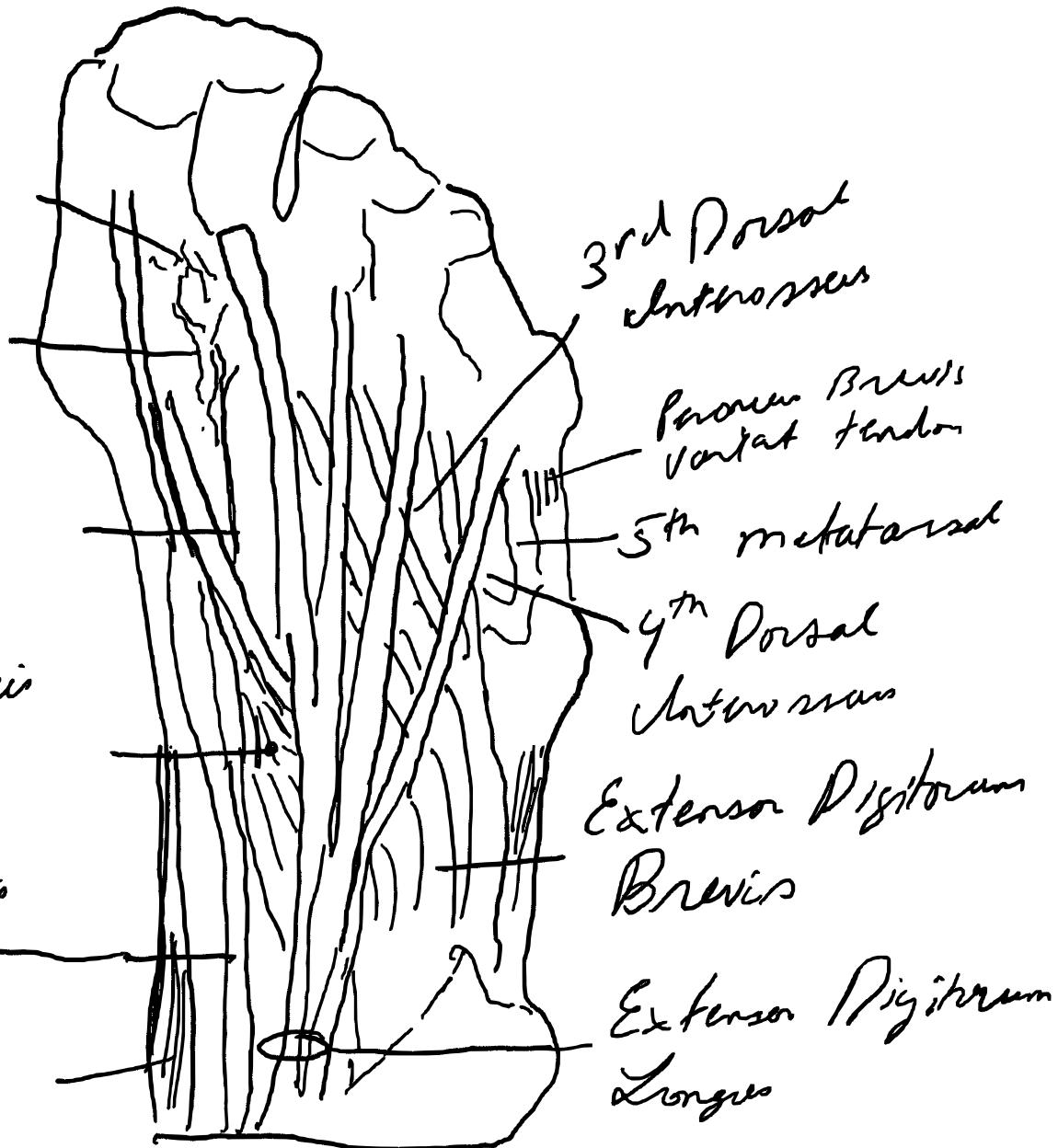
1st Dorsal Metatarsal
Artery

Common Dorsal
Digital Nerve to
First Interosseous

Extensor Hallucis
Brevis

Extensor Hallucis
Longus

Tibialis Anterior

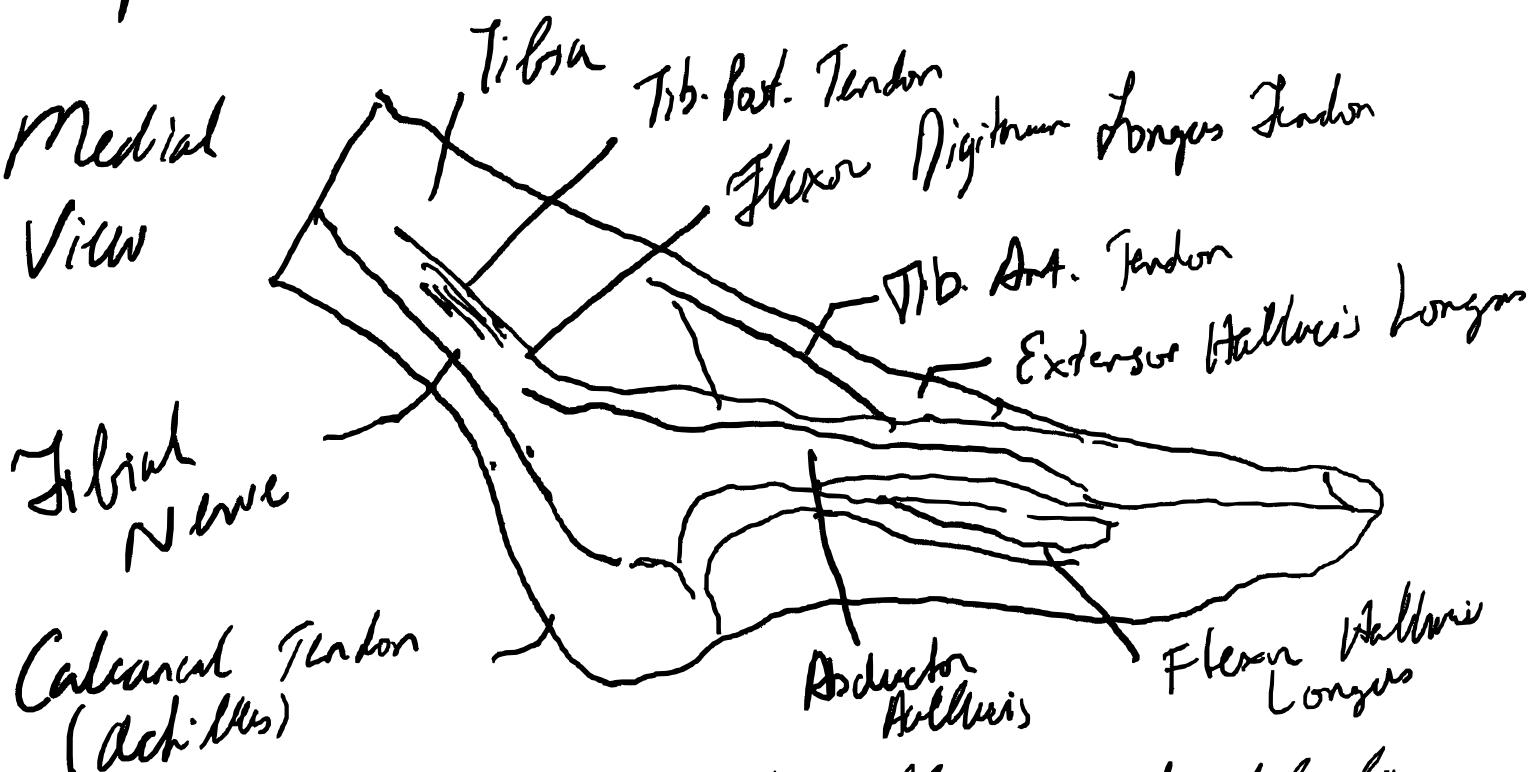


- helps keep tendons in place and provides way to extend toes
- other stats include extensor dig & extensor long
- also dorsiflexes and extends lesser toes
- Extensor Hallucis Longus

- origin: middle medial surface of fibula
- deep to fib. ant. and extensor digitorum longus
- tendon passes through septum extensor retinaculum, etc.
- insertion, dorsal distal 1st phalanx & medial slip into joint.
- hallux & interphalangeal joint are extended.
- Pronator teres
- variably fused with extensor digitorum longus
- origin: inferior 1/3 of medial fib. surface, fused belly inserts 5th metatarsal, sometimes 4th
- weak dorsiflexor and evensor

Extensor Plantar Muscles

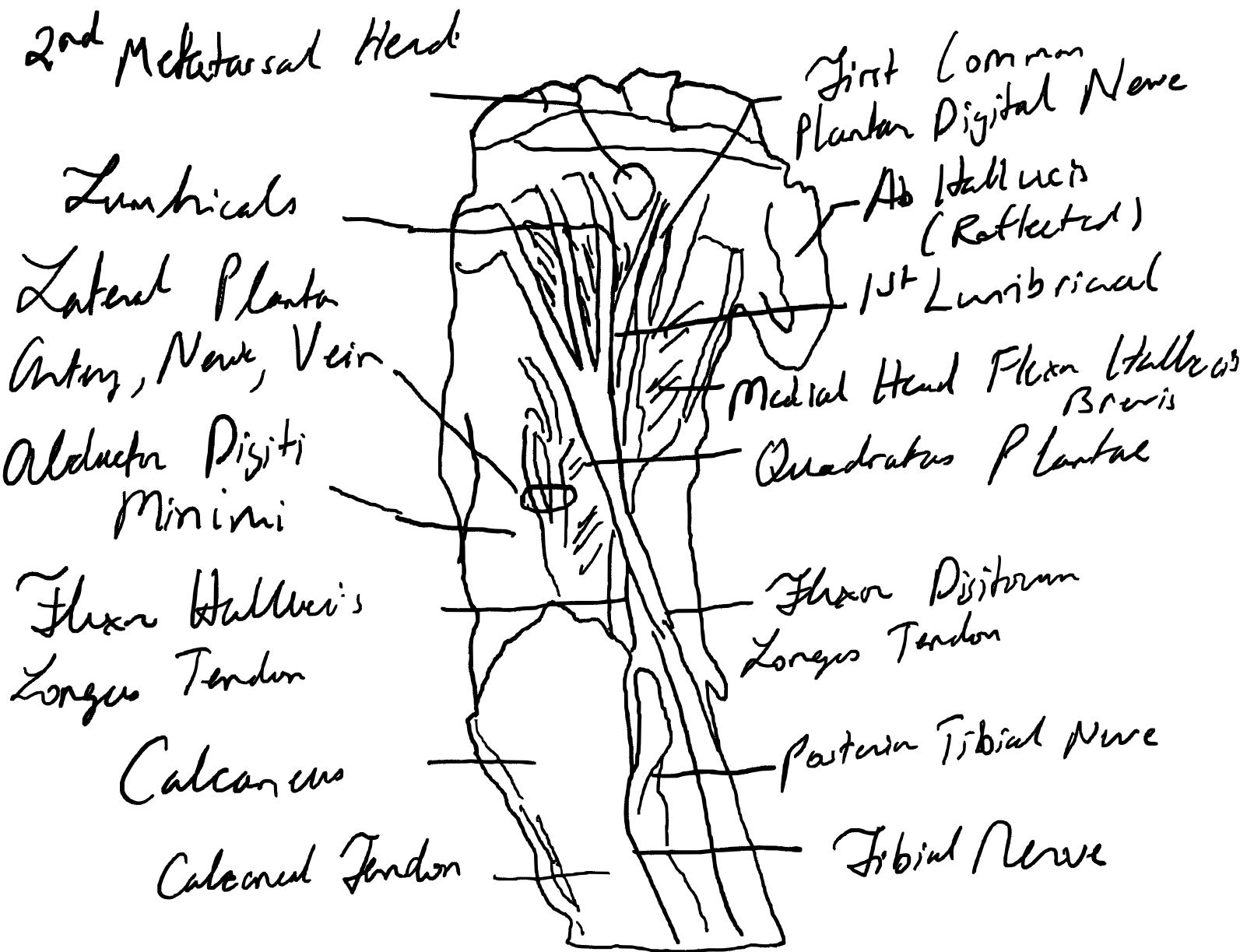
- superficial posterior compartment: gastroc, soleus, plantaris: connect to calcaneus



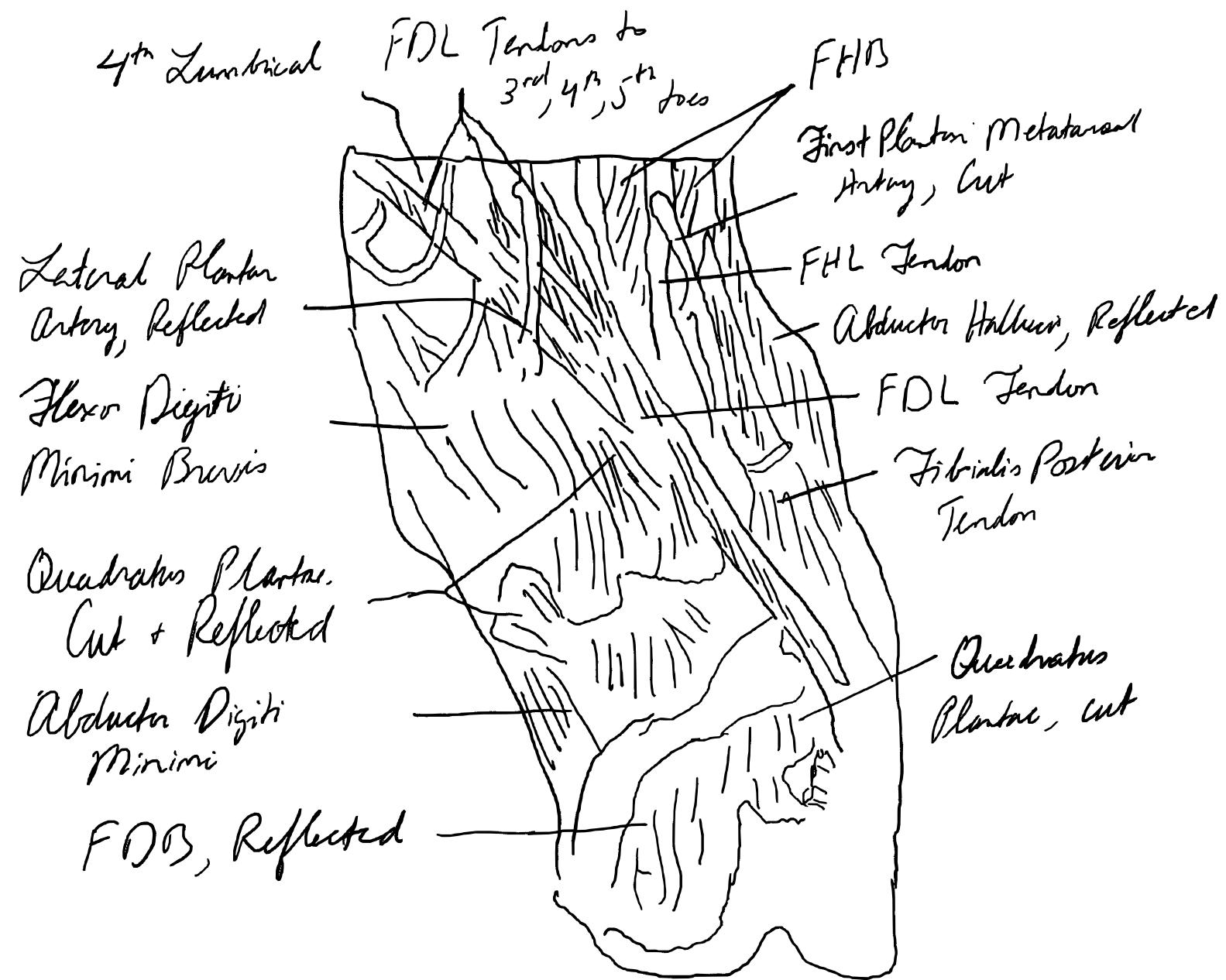
- deep compartment: digital flexors and abductors
- posterior
- Triceps Sural
 - soleus + gastroc combine into Achilles tendon

- medial gastrocnemius head from medial femoral condyle
- lateral head: lateral femoral epicondyle
- soleus bony origin: medially along soleal line, middle 3rd of medial tibia, laterally from fibula head + postero-lateral head of post. fib. surface
- calcaneal tendon (achilles) spirals.
 - sol. subfascia medial gastrocnemius lateral
- plantar flexes + slight invertors due to ankle's oblique axis
- gastrocnemius flexes knee (femur origin) weaker than sol. unless knee is extended
- Plantaris
 - weak, small belly, long tendon, medial calc. insertion, inferomedial to triceps surae
- Flexor Digitorum Longus
 - most medial deep muscle, origin post. surface of fib.
 - goes through medial cable to sole, between 1st/3rd intrinsic layers
 - fibers divide by "knot of Henry" under navicular
 - insertion for quadratus plantae, then slips for lumbricals
 - share sheath with brevis, split slightly for insertion
- Flexor Hallucis Longus
 - origin distal 2/3rd of postero-lateral surface of fibula + many other parts
 - runs anteriorly, inferior to lateral head of flexor hallucis brevis
 - passes through sesamoids

Plantar View



- sends fibers to digitorum longus, so can help flex other toes
- V shape insertion into phalanges, plantar flexion
- Tibialis Posterior
 - origin: crural interosseous membrane + posterior surface of tibia + fibula
 - conveys tendons deep to FDL, passes through first compartment of flexor retinaculum
 - inserts into all tarsals except talus + 2 or 3 metatarsals

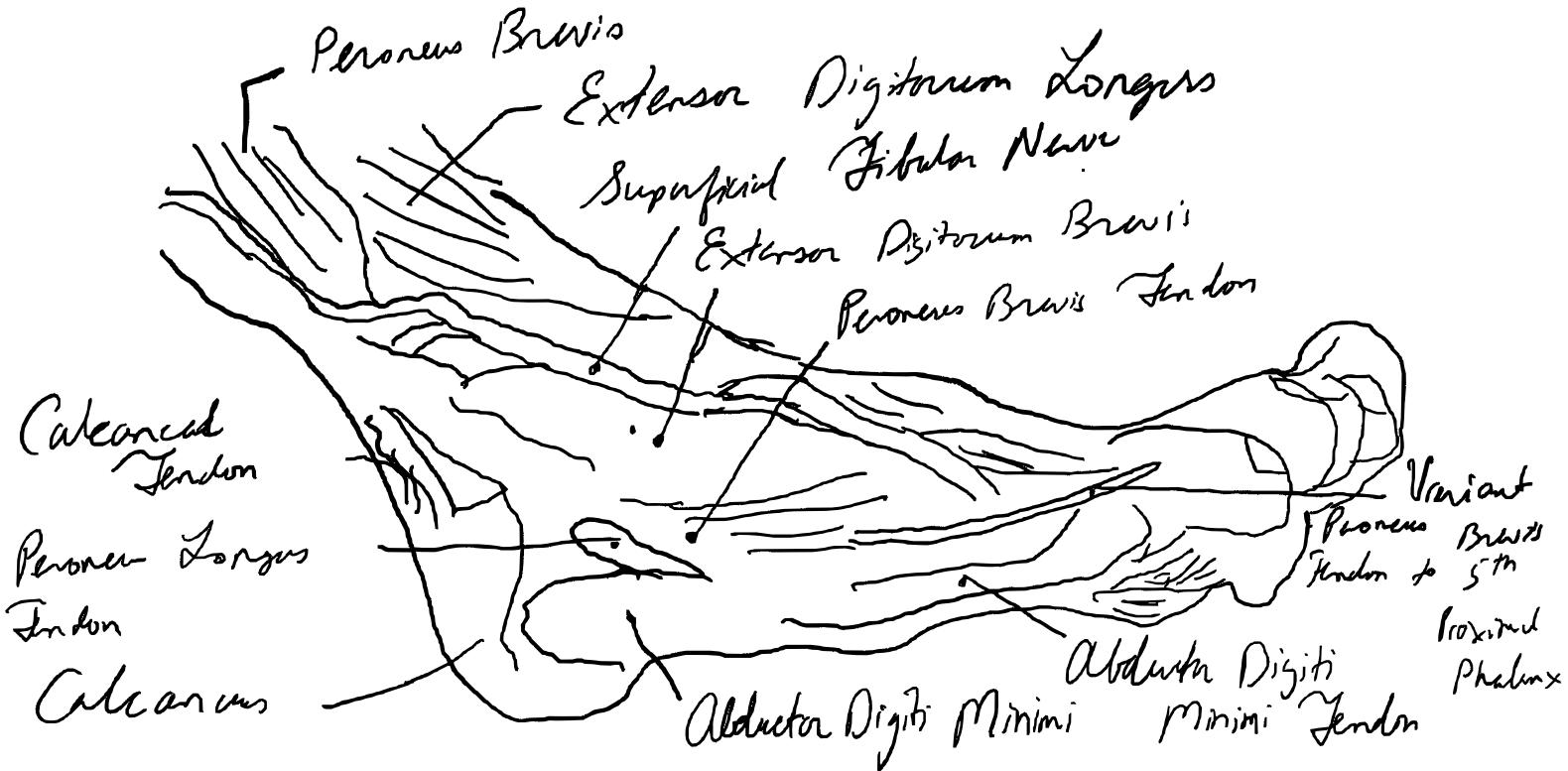


- tendon has strong band going to sustentaculum tali
 - 2 other bands
 - superficial, wider band to navicular tuberosity and inferior medial cuneiform
 - deep part becomes origin for FDB, inserts into metatarsals
 - plantar flex and strongest inverter

Extensor Lateral Muscles

- fibula origin, ventrally down, behind lateral trachea has
- Pronator Longus
 - origin: head of fib, lateral condyle of tib.

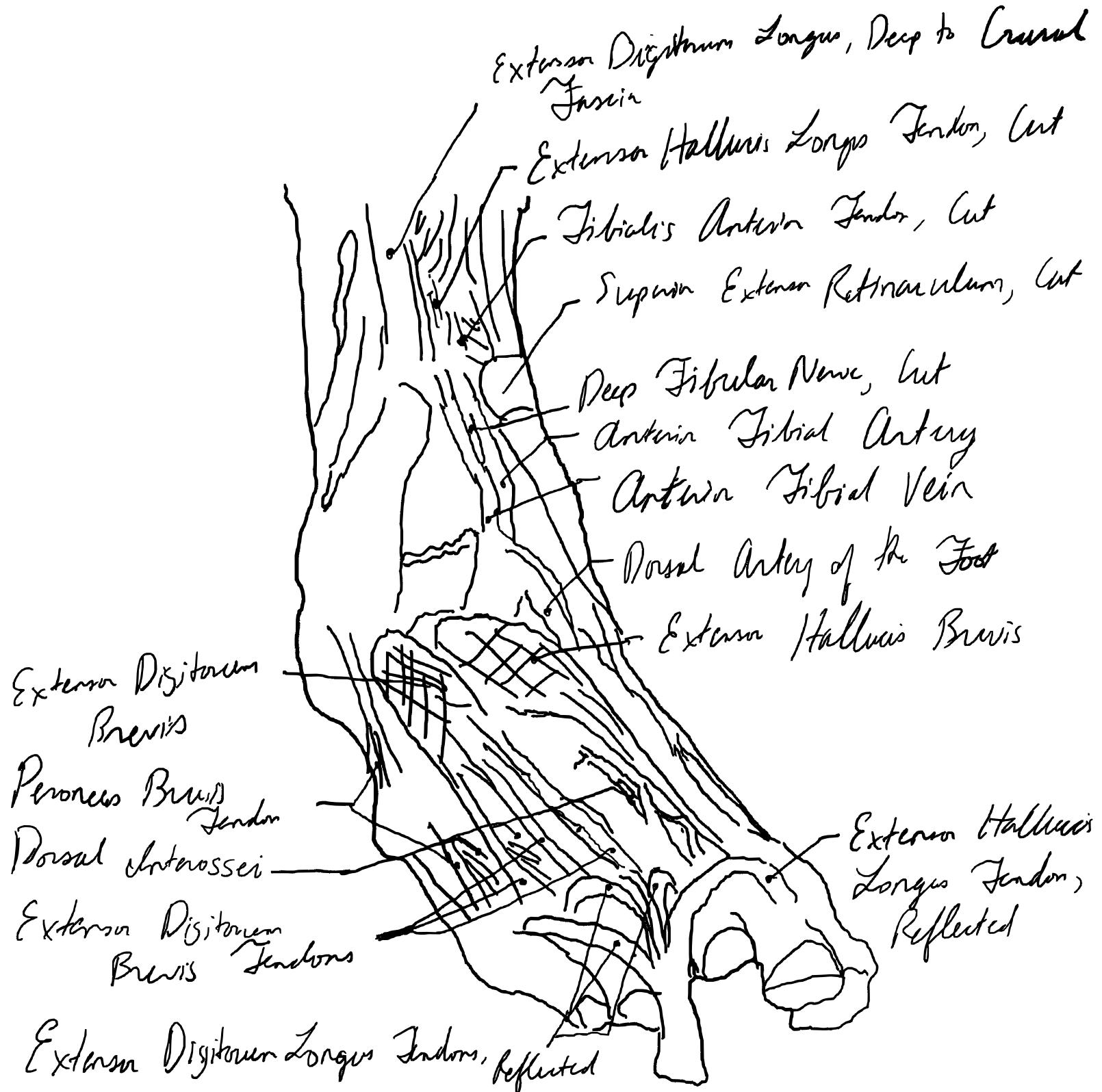
Lateral View



- tendon goes behind lateral malleolus, along lateral calcaneus
 - as far as fibular notch of lateral tibial border
- insertion: tuberosity of lateral first metatarsal bone, plantarly
 - smaller slips insert lateral aspect of medial cuneiform + 1st metatarsal neck
- plantar flexor + evertor (tendon crosses sole lateral to medial)
 - maintains longitudinal + transverse plantar arch via tendon orientation
- Pronator Brevis
 - arises lateral 2/3rd fib. surface
 - bipennate attachment on talon above lateral malleolus
 - along calcaneus inserts into 5th metatarsal tuberosity dorsally
 - plantarflexor + evertor

Intrinsic Dorsal Foot Muscles

- Extensor Hallucis Brevis and Extensor Digitorum Brevis
- Only one muscle mass on foot dorsum, from calcaneus splits
 - 4 ways to hallux + 3 toes
- Hallux split considered own muscle

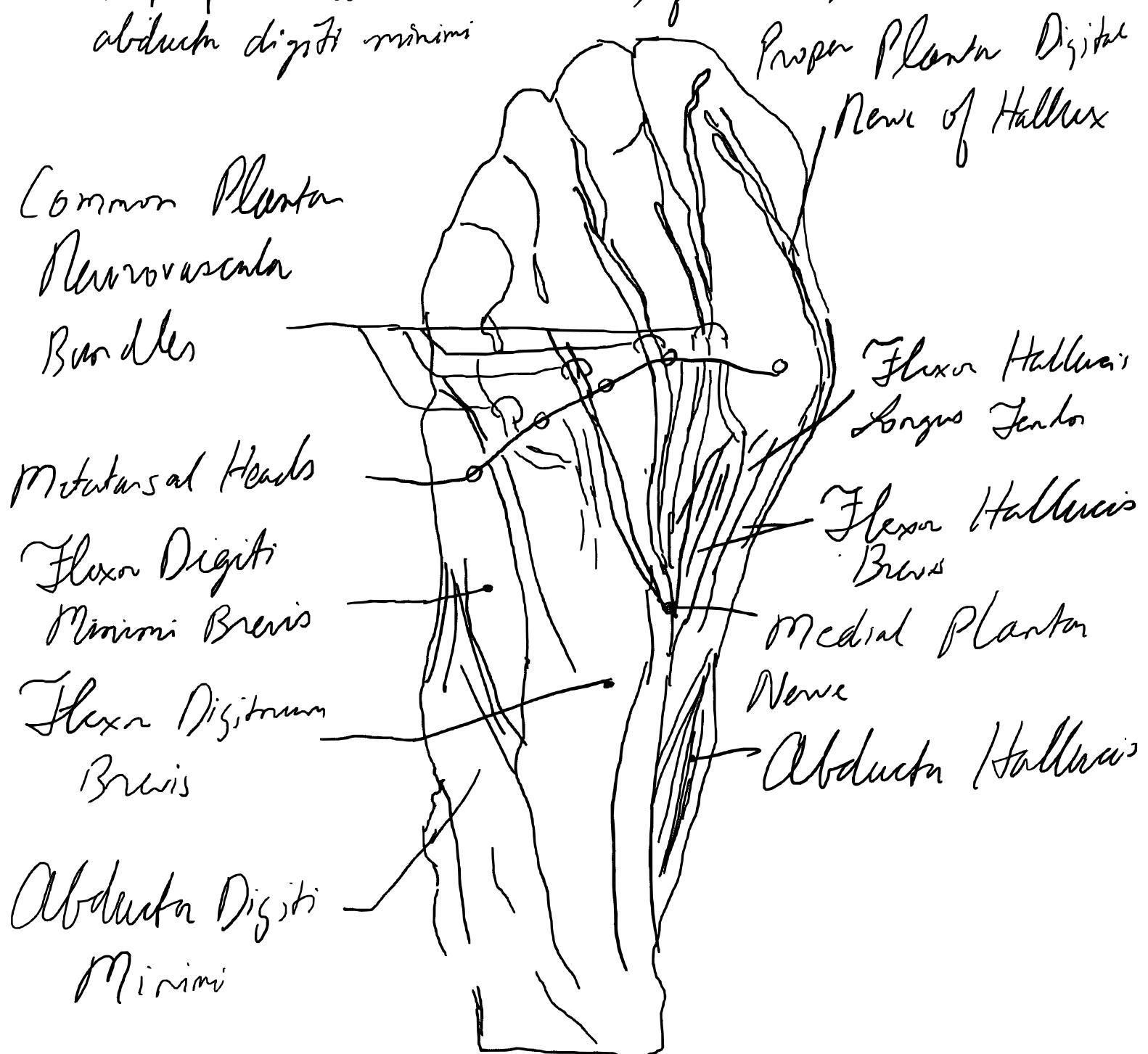


Extensor Digitorum Longus Tendons, reflected

- arise from lateral calcaneus, deep to EDL + PT
- long + short extensor tendons pass in digits
- hallucis tendon dorsal insertion proximal phalanx
- digits tendons trifurcate:
 - central dorsal middle phalanx
 - medial + lateral recombine to distal phalanx base
- extends great toe + toes on metatarsals at interphalangeal joint.

Intrinsic Plantar Muscles

- 18 arise and insert into sole
- start from plantar aponeurosis, 4 layers
 - 1. superficial: abductor hallucis, flexor digitorum brevis, abductor digiti minimi

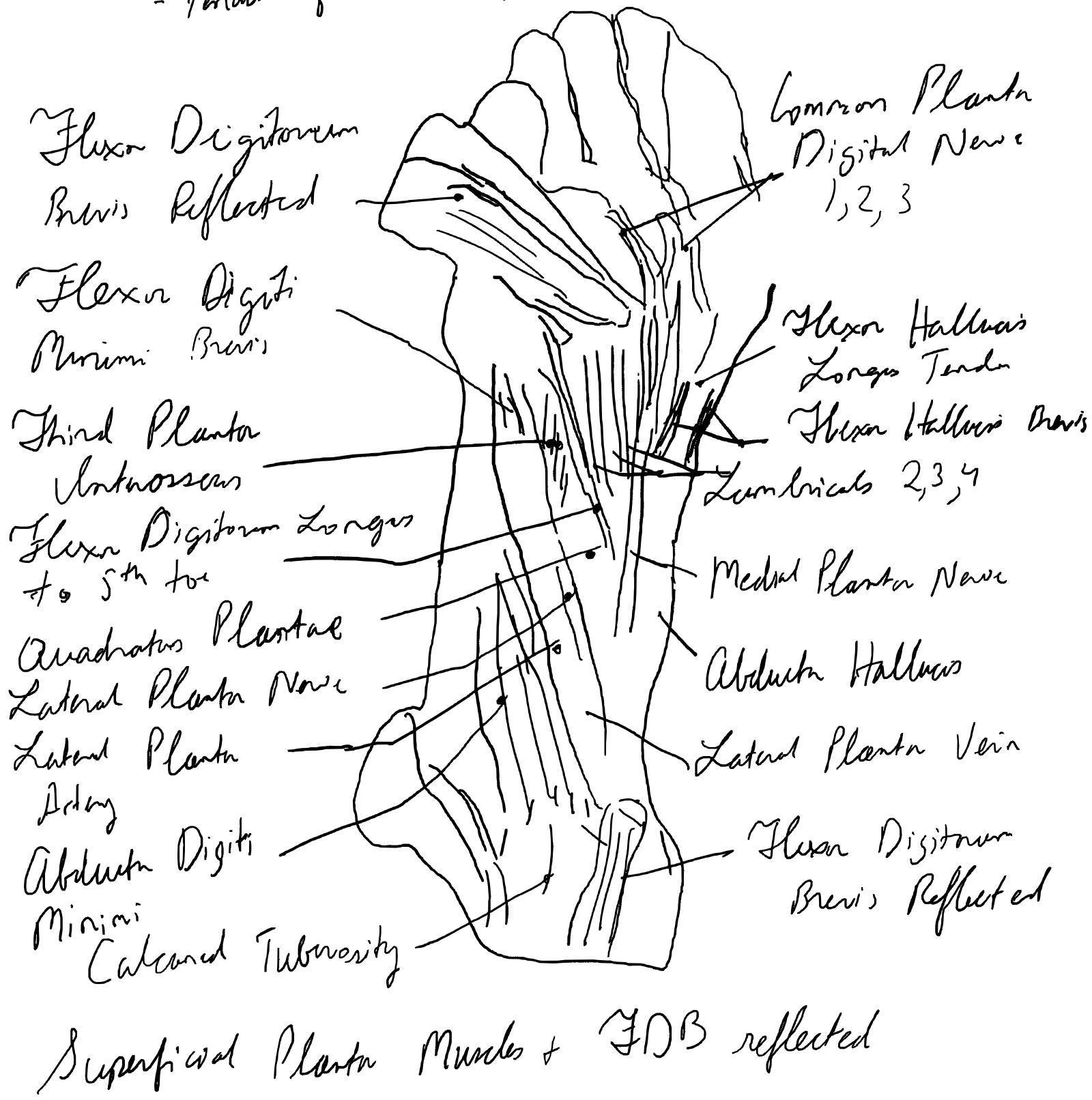


Superficial Plantar Muscles

2. 5 muscles: quadratus plantae + 4 lumbricals.
- tendons of FHL + DL in this layer

3. Flexor Hallucis Brevis, Flexor Digiti Minimi Brevis, 2 headed adductor hallucis

4. Deepest: 4 dorsal + 3 plantar interosseous
- tendons of Peronius Longus + Post. fib. in this layer



- Abductor Hallucis

- medial bulging muscle on sole
- origin: calcaneal tuberosity, medial + fascia plantar
- runs anteriorly, runs tendons through tarsal tunnel
- inserts into plantar lig & medial sesamoïd.
- merges with FHL at metatarsophalangeal joint

- Flexor Digitorum Brevis

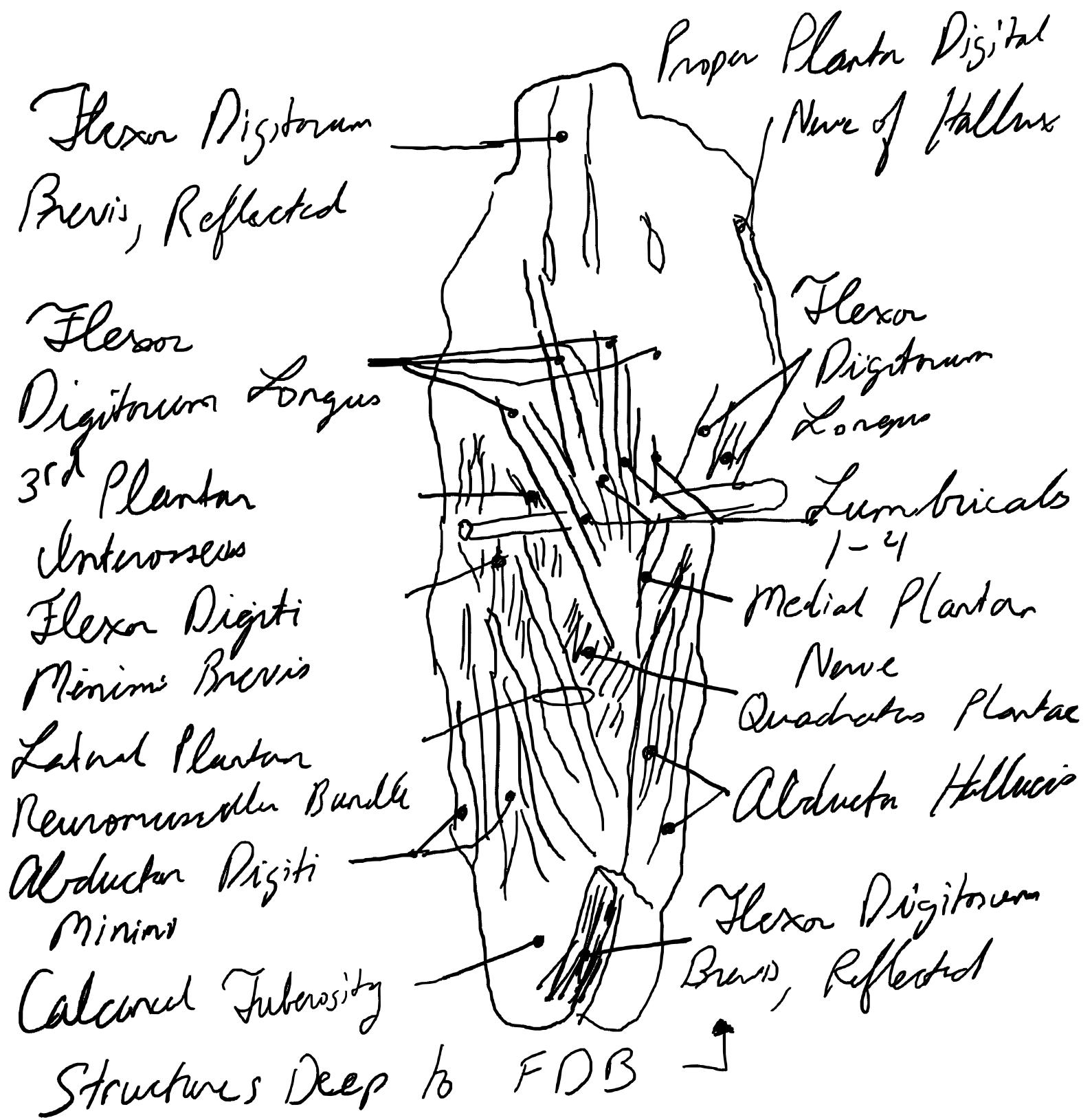
- origin Calcaneal tuberosity, proximal intermedial plantar aponeurosis, interosseous lam septa.
- runs anterior, 4 way split to each toe. Plantar to FDL
- tendon splits to let FDL enter superficially.
 - reforms insertions at sides of middle phalanges, plantar
- plantarflex

- Abductor Digiti Minimi

- slender muscle from lateral calcaneal tuberosity
- tendon starts on 1 calcaneocuboid joint, thick insertion into 3rd proximal phalangeal base, plantar
- likely stronger flexor than abductor

- Quadratus Plantae

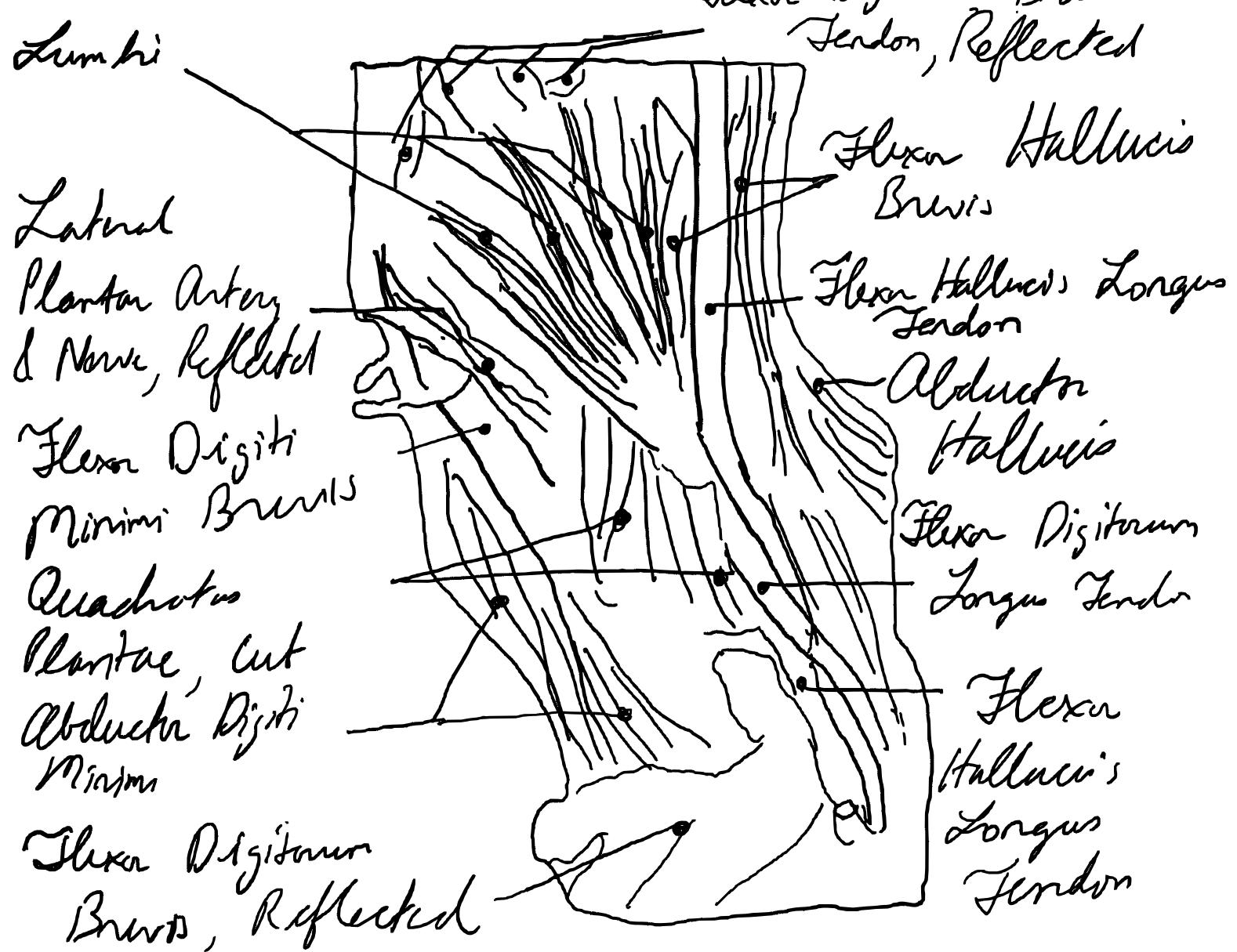
- "flexor accessorius"
- V shaped, from medial and lateral calcaneus (2 heads)
- inserts into FDL tendons
- traction to FDL makes QP move too.



- Lumbricals

- 4 worm shaped muscles, 2-5th toes
- soft tissue origin and insertion

Relationships of the Long Flexor Tendons



- FDL tendon medial origin.

- all bipennate except 1st, largest

- Insert medially into extensor expansion

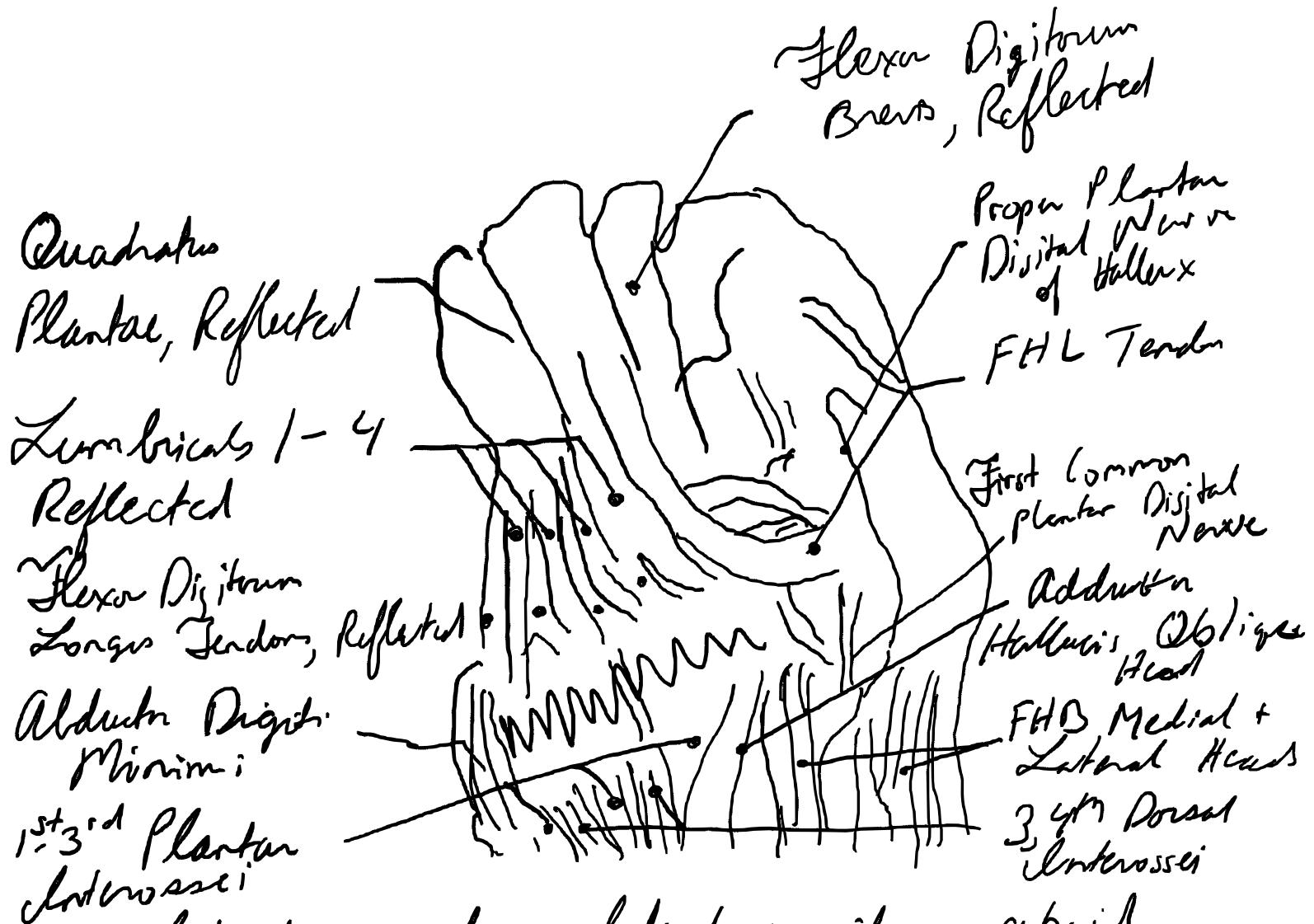
- flex metatarsophalangeal and extend interphalangeal joints.

- 2nd toe abductor, others adduct (due to resting axis)

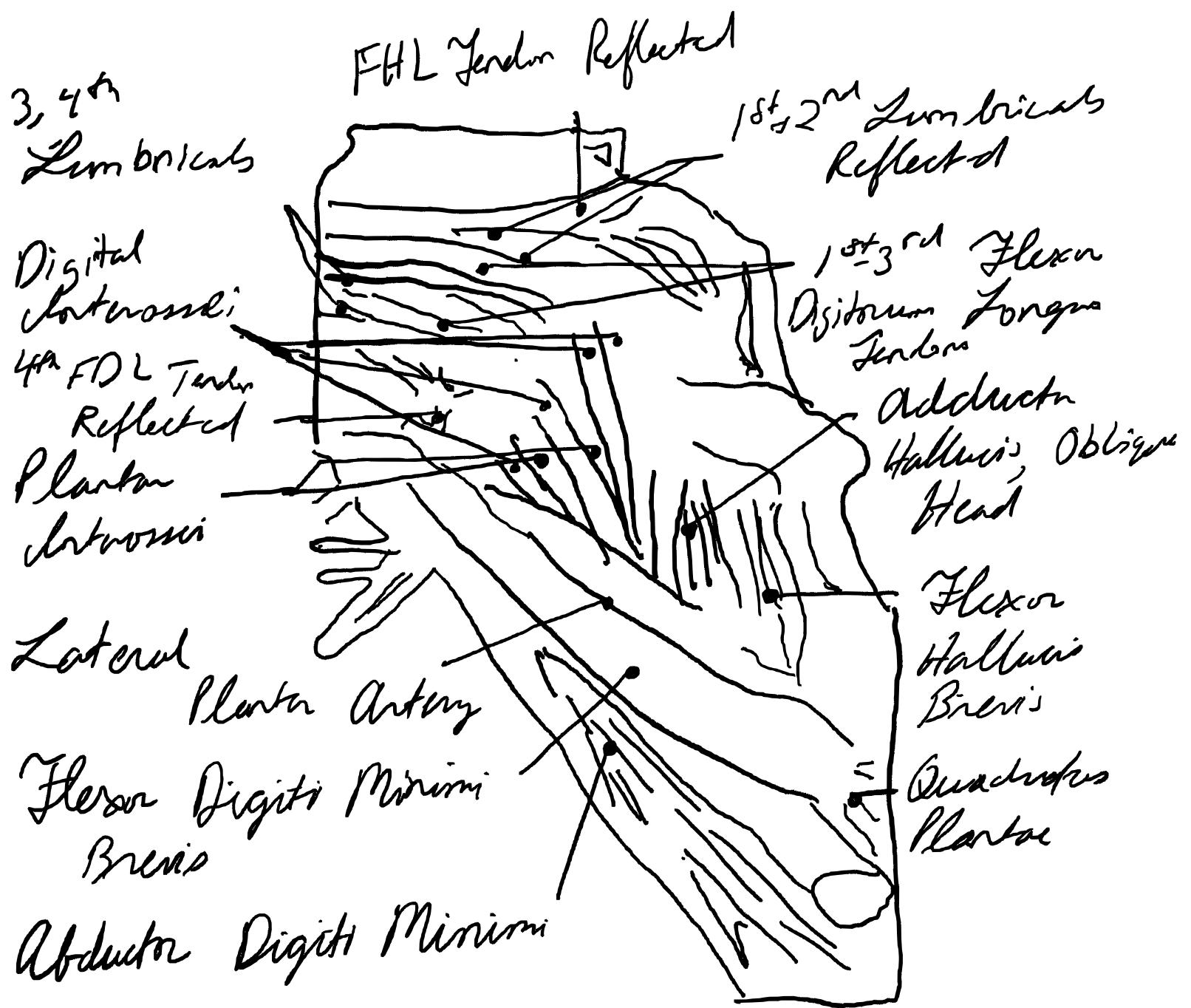
- Flexor Hallucis Brevis

- plantar & parallel to 1st metatarsal

- (inverse Y shape): medial, slip from Post Tib. insertion



- lateral arm from lateral cuneiform + cuboid
- runs lateral + inferior of 1st metatarsal
- complex insertion known as plantar plate
- flex
- Flexor Digiti Minimi Brevis
 - + inferior to 5th metatarsal
 - + starts from said metatarsal & fib. shaft / cuboid
 - + joins Abductor Digitii Minimi, inserts into proximal phalanx
- Adductor Hallucis
 - + 2 heads: oblique from tibular sheath + 2 - 4 metatarsal base, antero-medial to insert lateral to FHB



- + Smaller transverse head from metatarsophalangeal ligaments & 2-5 MTP joints
- + inserts onto lateral sesamoid
- Dorsal & Plantar Interossei
- + fill intermetatarsal space, bulging onto dorsum of foot

- + 2 groups:
- * 4 dorsal interossei: larger, bulge above
- * 3 plantarly: smaller, fill plantar space
- + form coffered plantar sheet
- + resting axis is through second toe
- * dorsal: ABduct, plantar ADduct
- + 1-4 dorsal, medial to lateral
- * bipinnate, from bones of metatarsal space, tarsometatarsal ligaments, adjacent fascia
- * insert proximal phalanx
- * plantar flex + abduct 2-4
- + plantar similar but opposite.
- * plantarflex and adduct 3-5th toes

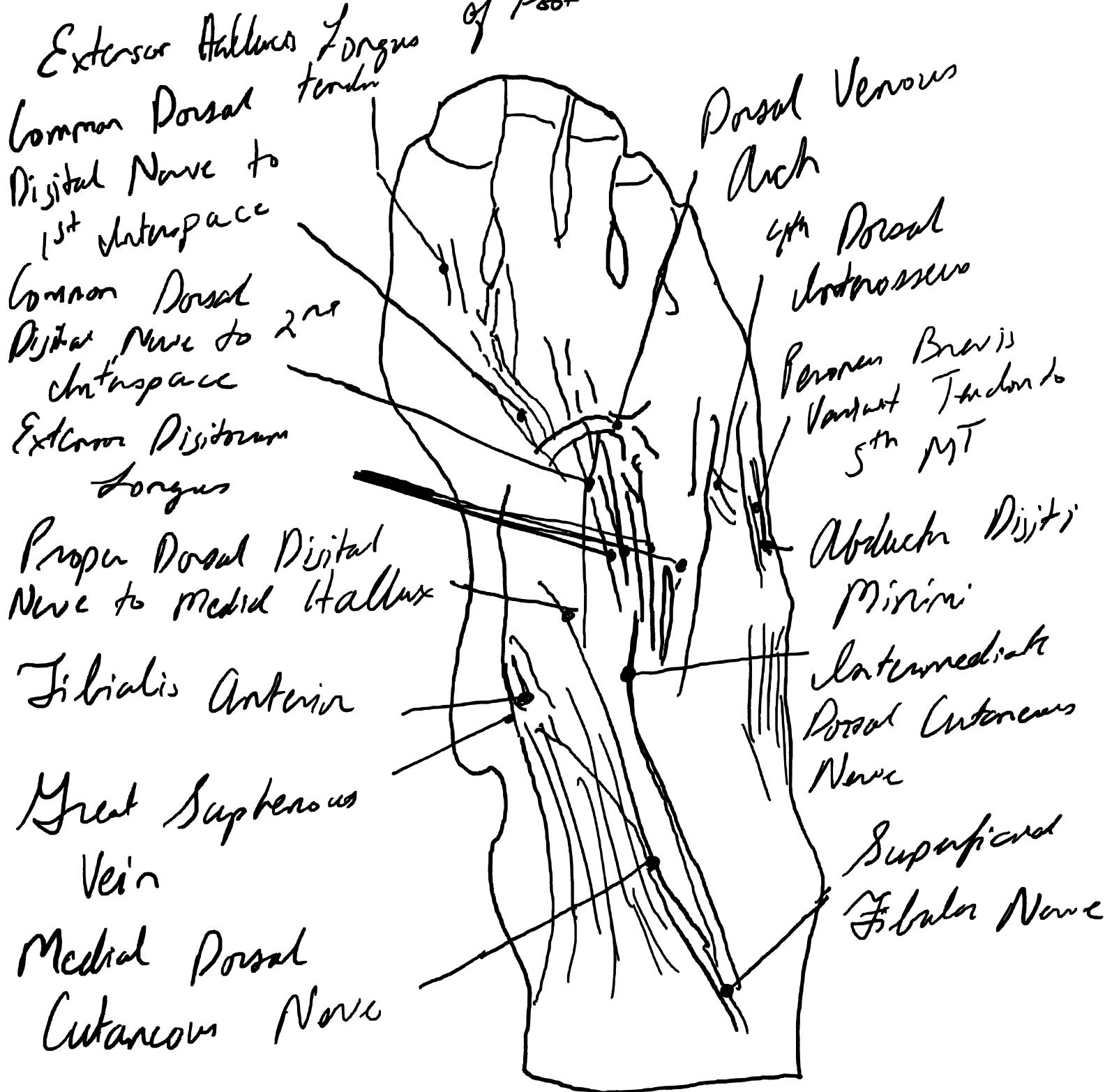
Nerves

- foot sensory & motor come from sacral plexus
- + tibial nerve (L4,5,S1,2,3)
- + common fibular nerve (L4,5,S1,2)
- + travel together in sheath (sciatic nerve) 2/3rds down thigh

Fibular Nerves of the Foot

- fibular nerve down anterior compartment
- + branch for sural nerve
- + deep and superficial split
- deep fibular nerve crosses superior extensor retinaculum, terminates medial + lateral branches
- superficial innervates dorsum

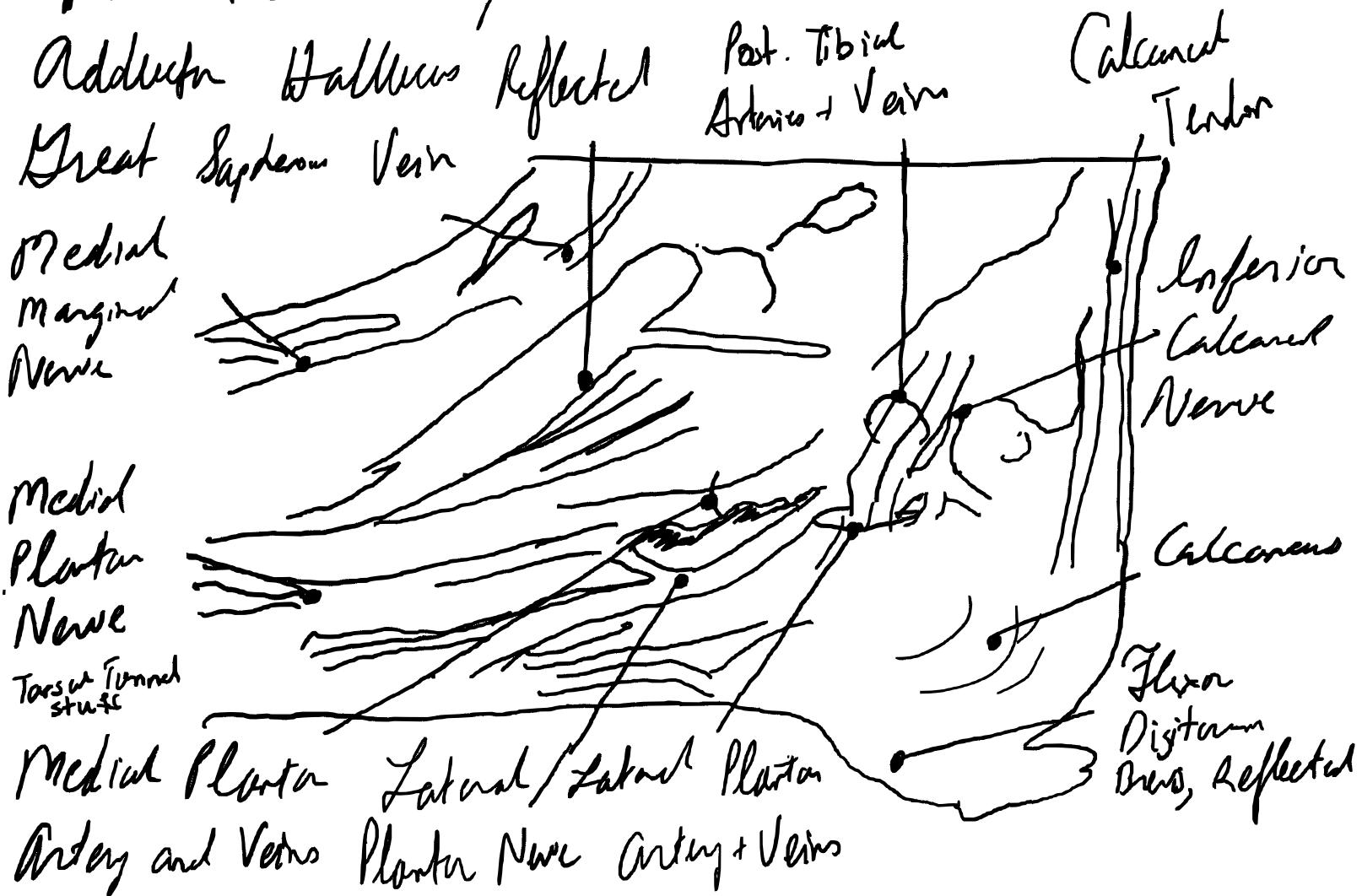
Superficial Structures of the Dorsum of Foot



- + medial + lateral branch of medial dorsal nerve
- * medial → hallux. lateral : 2, 3
- + intermediate dorsal : 4, 5th

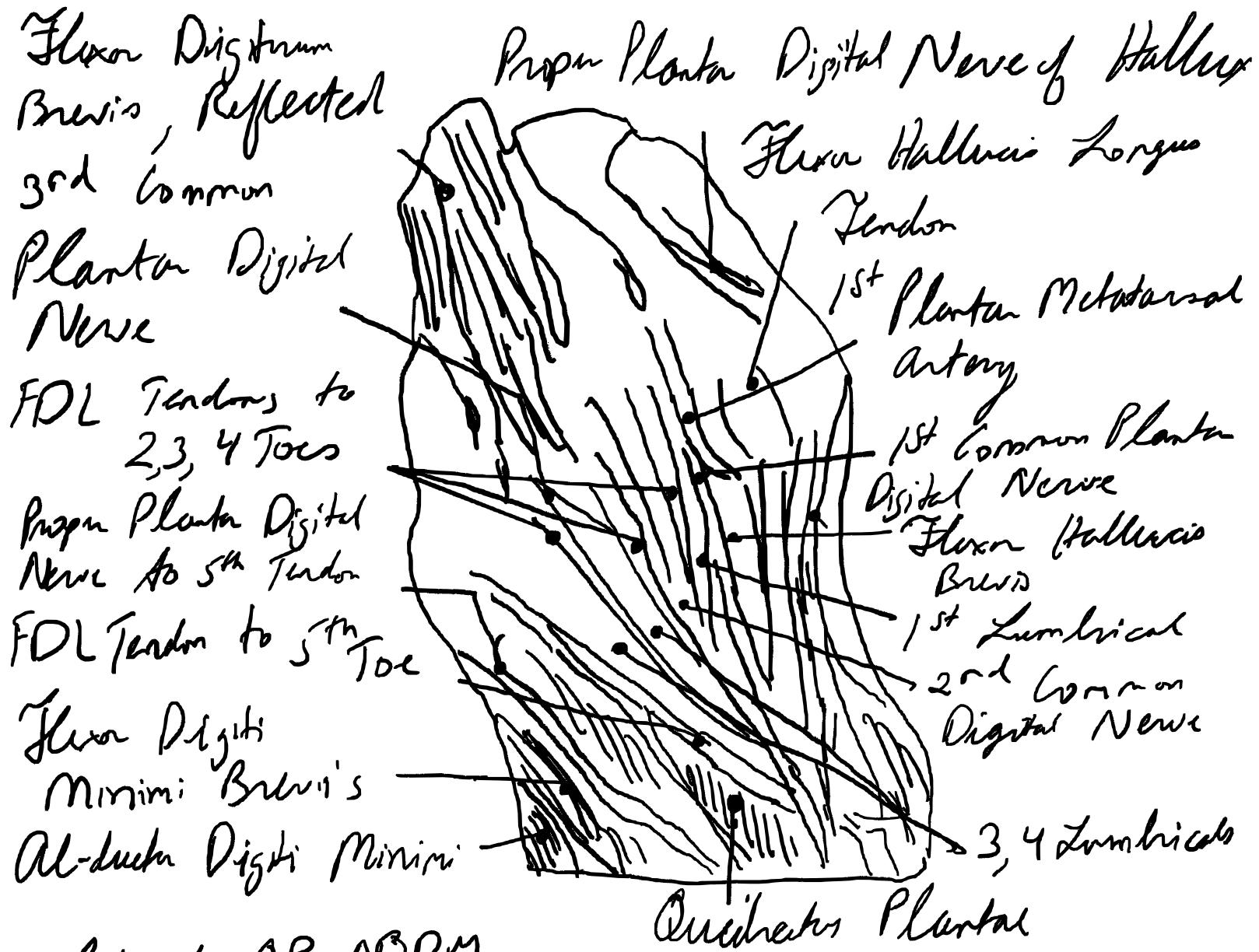
Tibial Nerves of the Foot

- inferior tibial
- branches off medial sural cutaneous nerve → goes superficial, joins lateral sural branch → dorsal nerve → innervates structures around lateral malleolus → lateral dorsal cutaneous nerve
- trunk of tibial nerve → flexor digitorum.
 - + branches to ankle, cutaneous branch of postero-medial sole
 - * medial / lateral plantar branches



- medial → APL+, FOB, 1st Lumbrical, tarsus + metatarsus joints

Nervovasculon Plantar Midfoot



- lateral: QP, ABDM.

+ superficial / deep branches

* superficial: FDMB, 3, 4 plantar interossei

* deep: AD; interossei, lateral 3 lumbricals

Blood Supply

Arteries

- 3: anterior tibial, posterior tibial, fibular
- + anterior: dorsal
- + posterior: inferomedial

- + fibula: lateral
- Key Details
- + dorsal continues along tibia, navicular, interosseous unciform
- * terminates deep plantar branch
- + posterior tibial artery → medial/lateral plantar + medial calcaneal
- * medial → A₁B₁C₁, FDB, 1st dorsal interossei.

Veins

- 2: superficial, deep