

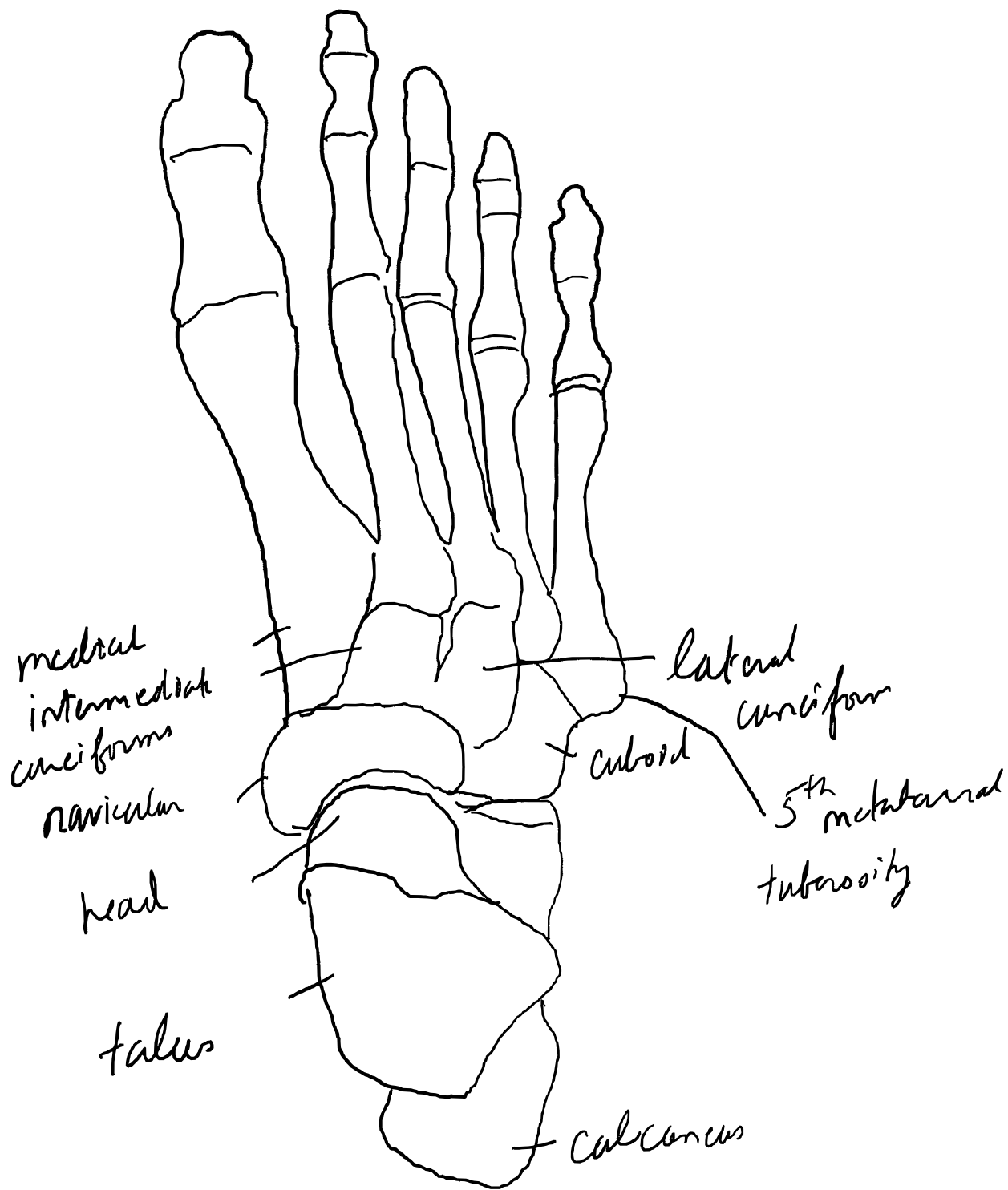
Chapter 1 Notes: Skeletal Structure

Tibia & Fibula

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

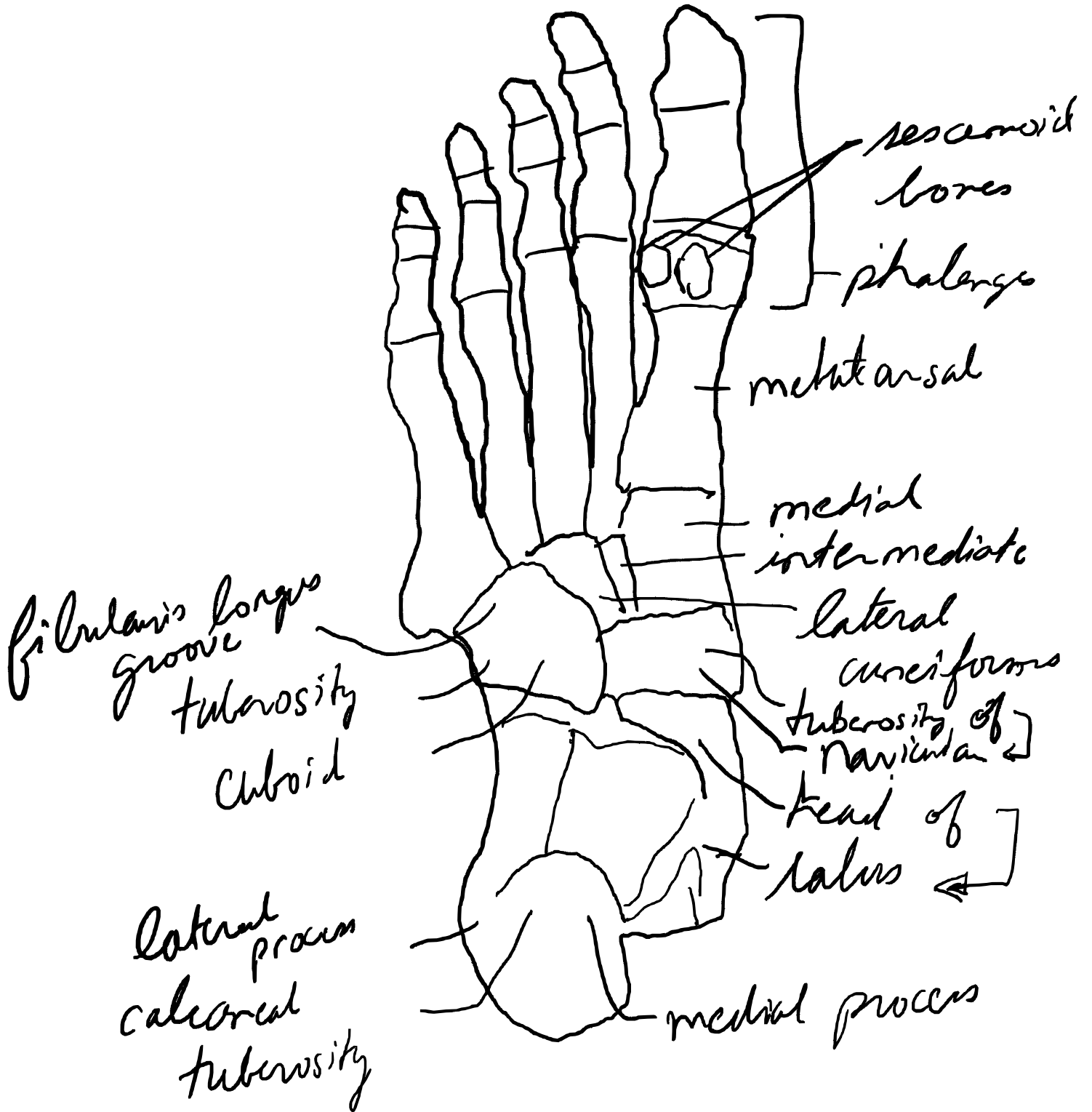
Segments

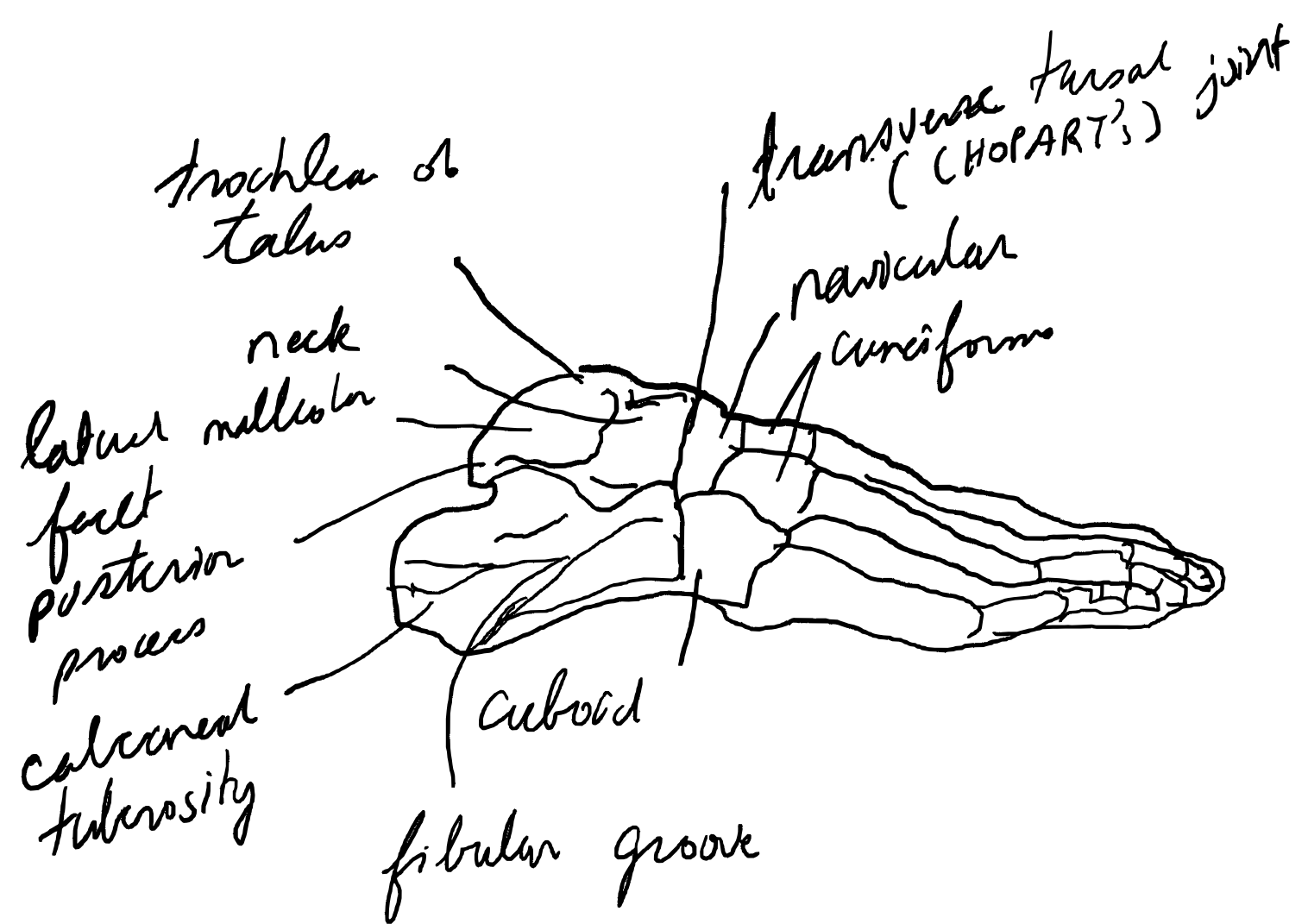
- 7 short bones make up tarus:
 - calcaneus } hindfoot
 - talus
 - navicular
 - cuboid
 - intermediate cuneiform } midfoot.
 - medial cuneiform
 - lateral cuneiform
- minimal movement above, but noticeable in conjunction



Dorsal View

Plantar View





Talus

- 2nd largest foot bone after calcaneus
- 5 articulating surfaces: tibia, 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 furrow
- 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 Cuneiforms

- nothing particular about muscular/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 meet plantarly forming tuberosity where peroneus longus inserts

- plantar aspect of head has two grooves separated by ridge

- mesaroid bases of FAB slide in

ignoring 2nd, 5th as descriptors are purely structurally. Refer to text if precise description required.

Phalanges

- Proximal

- all same form. Hallux largest

- reflects joint pressure and force transmission

- Middle

- only exist on lateral 4 toes

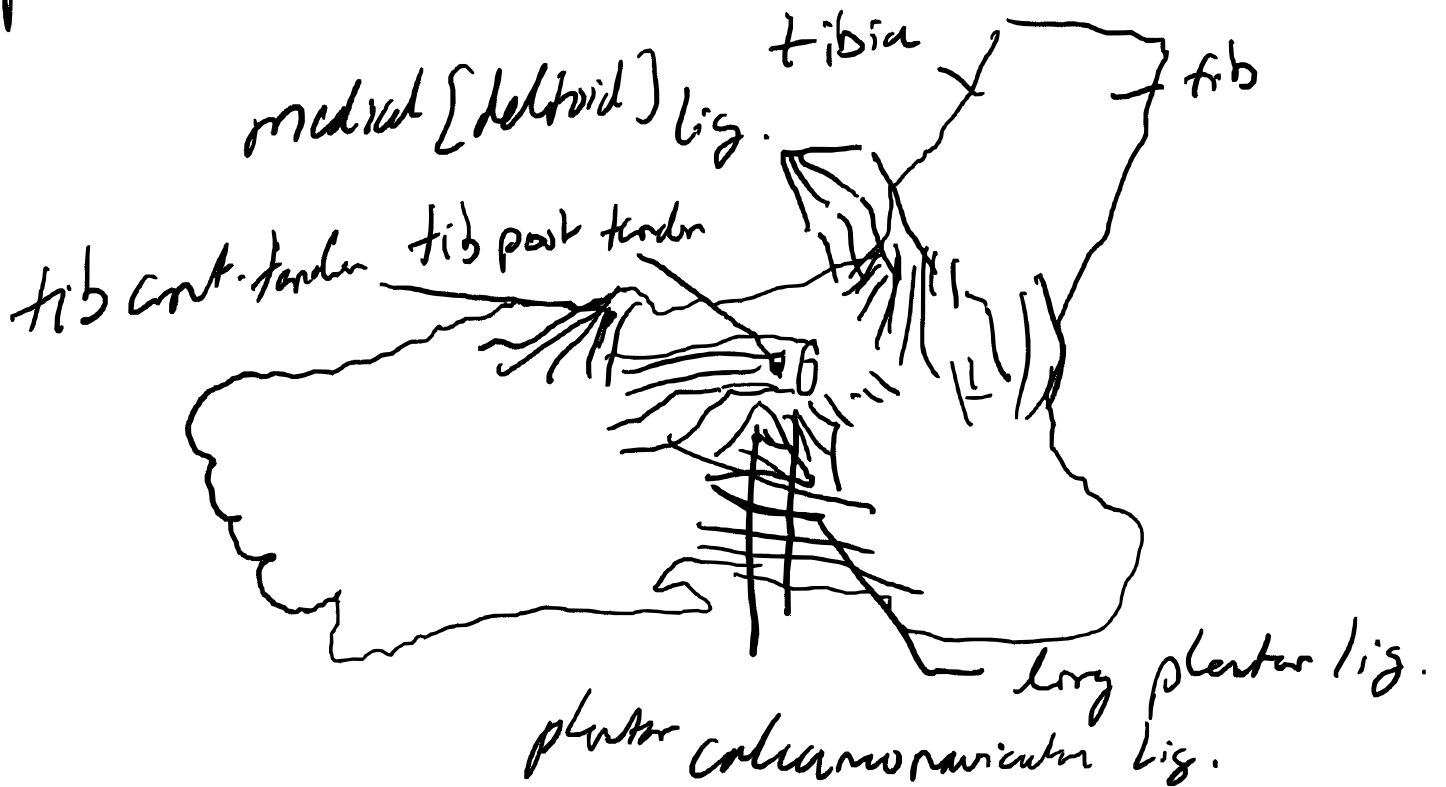
- Distal

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

Joints

- Tibiofibular syndemosis
 - joint distal ends of tibia on fibula
 - fibrous joint.
 - interosseus ligament: many strong bands prevent upward translation of tibia between leg bones
- Ankle joint (Talocrural)
 - talus trochlea fits into tibia + fibula
 - deltoid and lateral ligament strongly reinforce sides of ankle

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



- lateral aspect often "tibiocalcaneal lig" supports plantar calcaneonavicular lig., maintaining talus head pos. protecting arch.

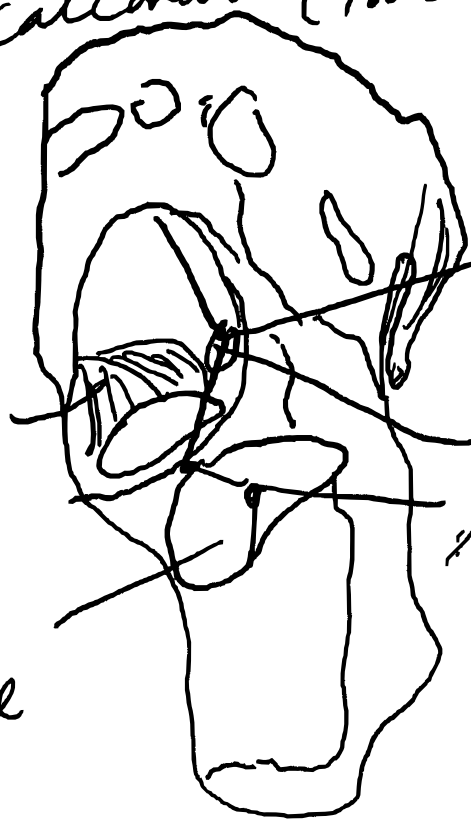
- Lateral ligament: 3 bands
 - post. talo fibula strongest
 - separates ankle and subtalar joints
 - lateral malleolus fossa to post. lateral talar tubercle.
- ligaments may cross multiple joints, synovial spaces are separate
- anterior/posterior spaces have fat to allow for movement

= Subtalar joint

- talus and calcaneus (talo calcaneal joint)

Plantar calcaneonavicular ligament.

Posterior talar articular surface



Talocalcaneonavicular joint

anterior talar articular surface

Subtalar joint

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
 - interosseus
 - cervical (strong): calcaneus to neck of talus

- Talocalcaneonavicular joint

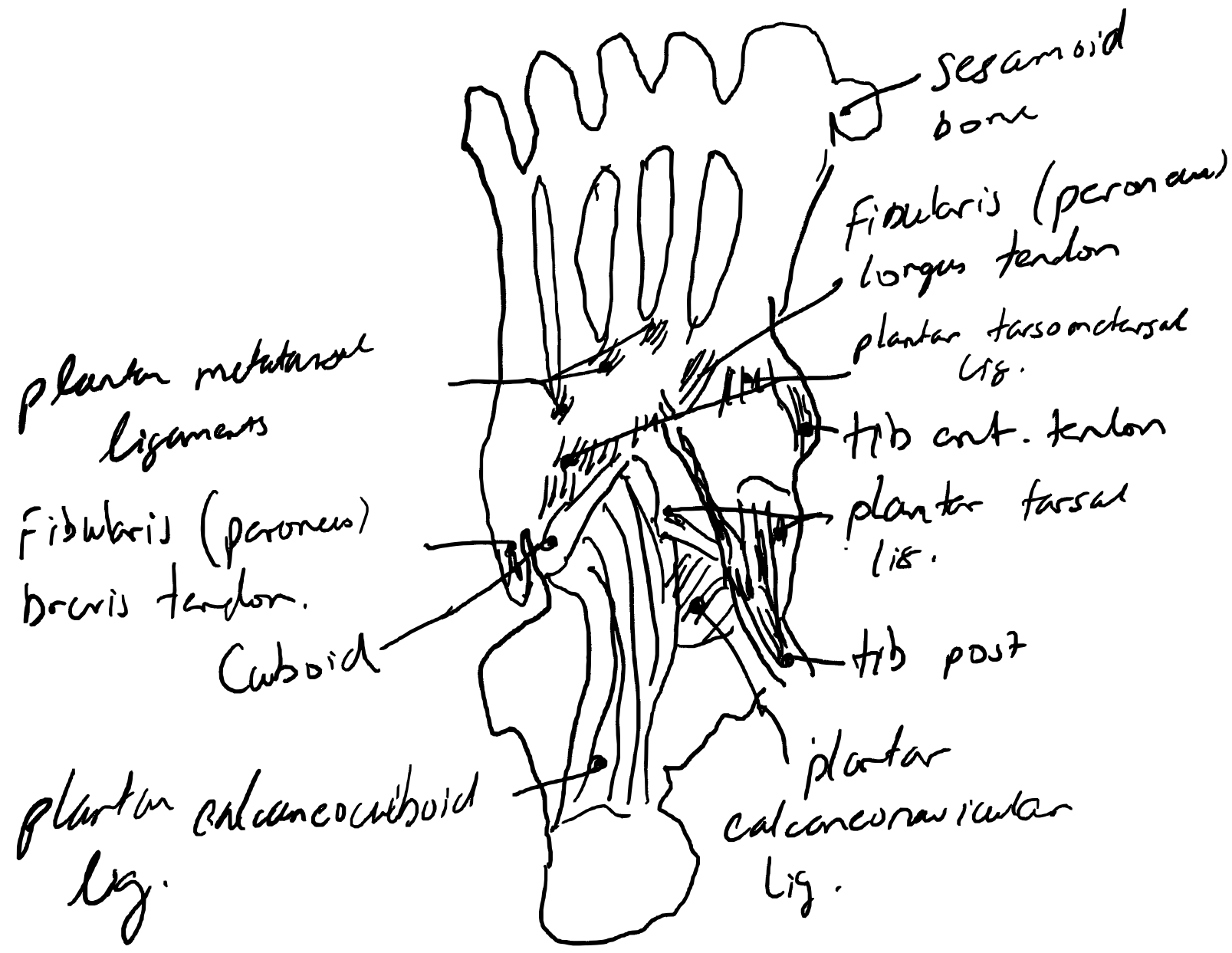
- When talus fits into calcaneus, navicular, and plantar calcaneonavicular lig.
- more mobility than expected

- extracapsular ligaments

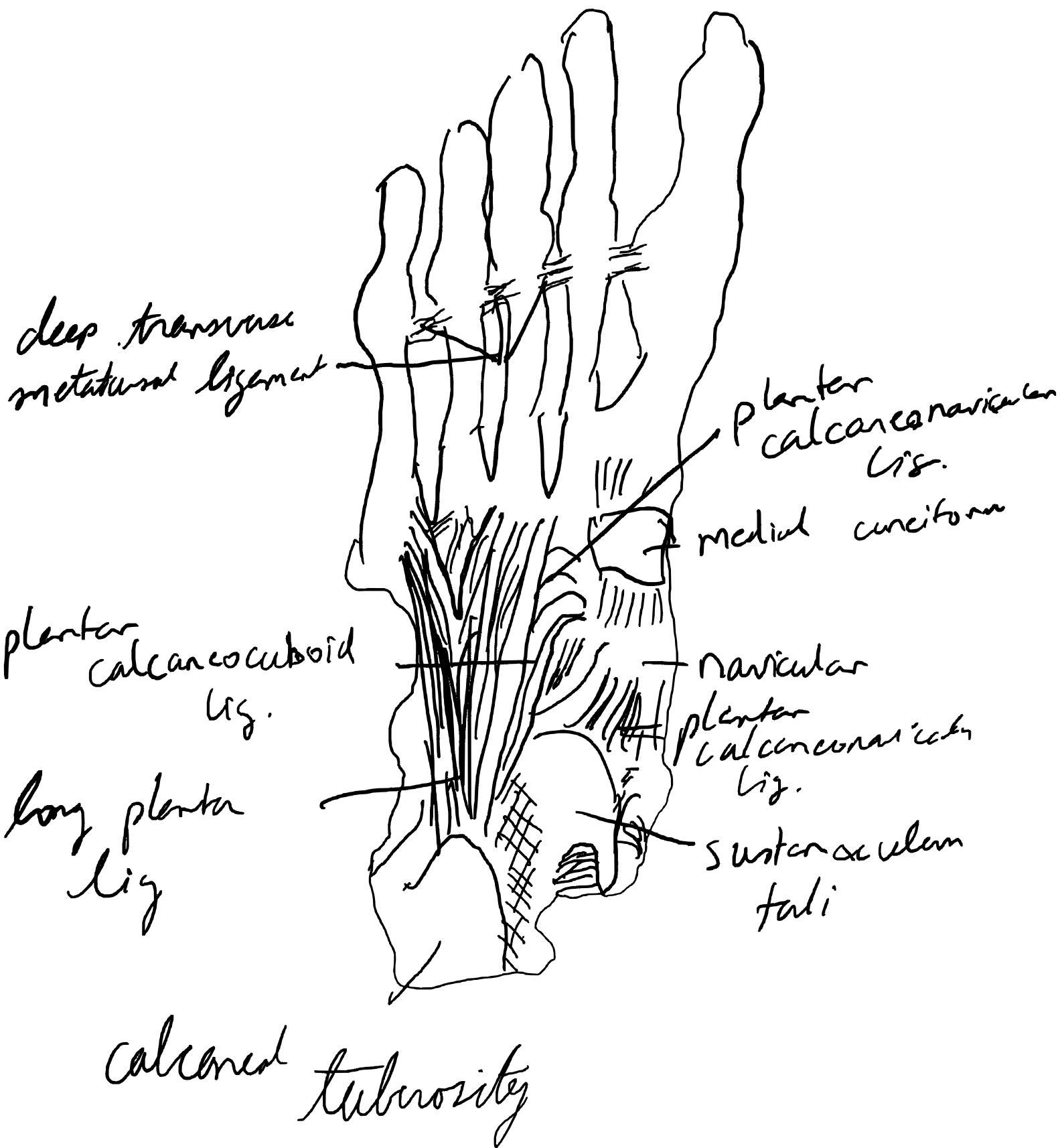
- reinforced by fibionavicular & fibiocalcaneal parts of deltoid lig on medial side
- strong lateral ligament: calcaneonavicular lig. OF bifurcate lig.

Calcaneocuboid Joint

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



Deep Plantar ligaments



deep transverse
metatarsal ligament

Plantar
calcaneonavicular
lig.

medial cuneiform

plantar
calcaneocuboid
lig.

navicular
plantar
calcaneonavicular
lig.

long plantar
lig

sustentaculum
tali

calcaneal
tuberosity

- Cuboideonavicular Joint
 - sometimes plane synovial, other syndesmosis
 - ligaments present regardless of joint type
 - 3 ligs:
 - dorsal, start dorsal lateral of navicular to lateral cuneiform, medial posterior cuboid
 - plantar
 - interosseus
- Cuneonavicular joint
 - small movement, interface via ridges on navicular
 - dorsal ligaments to each cuneiform
 - plantar ligaments do the same
 - synovial cavity is continuous = great tarsal synovial cavity
 - post. tib. merge + reinforce plantar lig.

- Cuneiform & Cuneocuboid
- little movement, strong attachments
- help create strong & stable arch.

- Tarsometatarsal Joints

- "Lisfranc's joint"
- 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 ligament" Strongest and most important.
 - lateral surface of medial cuneiform to medial surface of 2nd metatarsal base

- Proximal Intermetatarsal Joints

- 4 lateral firmly held in place at proximal end
- dorsal, plantar, interosseous ligs.
 - 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 phalanx, even loose 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 adductor hallucis

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

Interphalangeal joints

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

Muscles And Fascial Specializations

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

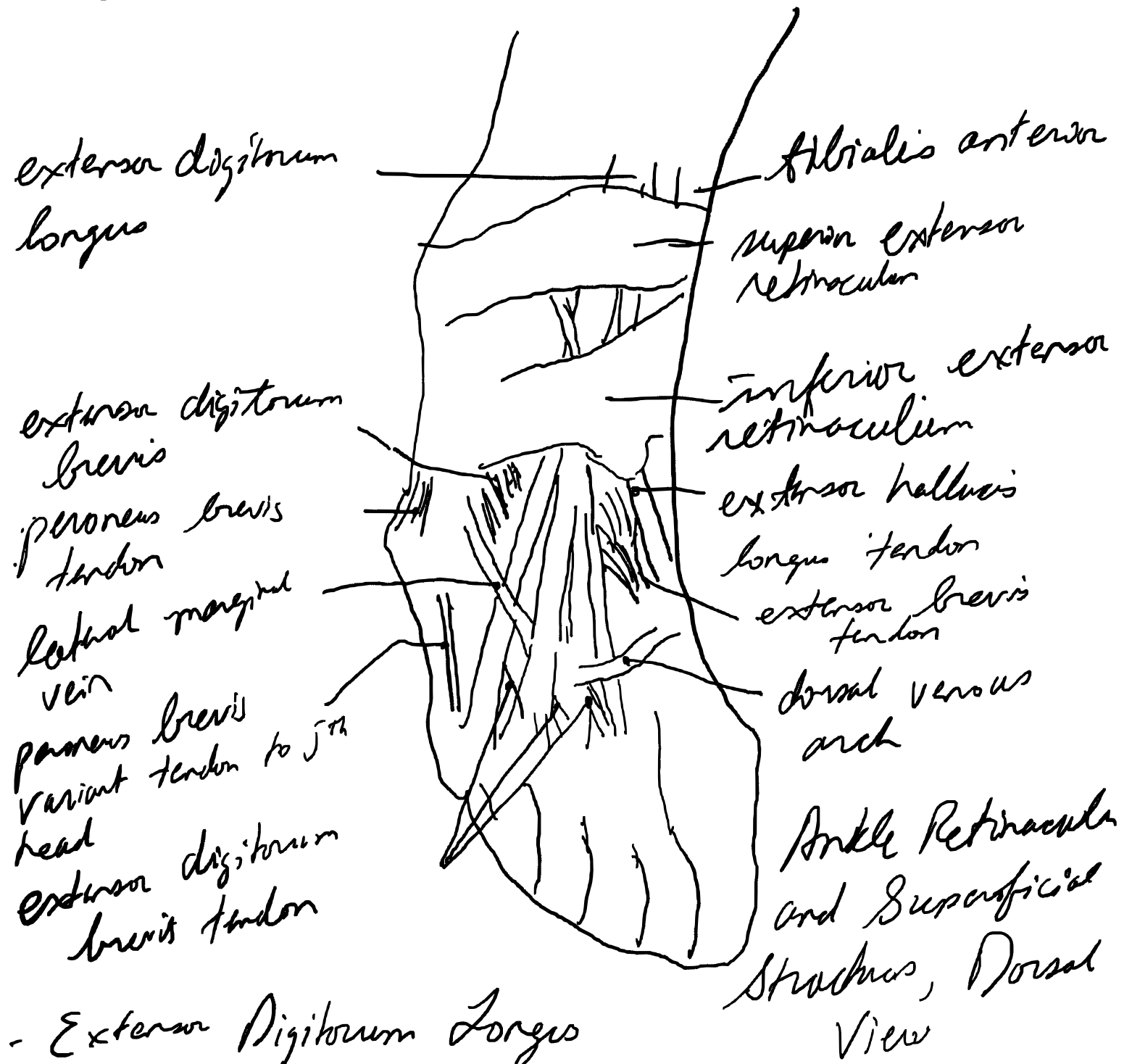
Fascial Specialization

- 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

- Fibularis 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 tib. ant.
- extensive origin from lateral tibial condyle, fibular head, $\frac{2}{3}$ of medial fibular surface, proximal interosseous membrane, crural fascia, etc.
- appears medial belly of leg, drops vertically

Digitations of Plantar Aponeurosis

Proper Plantar neurovascular bundle to 5th toe

Abductor digiti Minimi through lateral part of Plantar Aponeurosis

Central part of Plantar Aponeurosis

Plantar Aponeurosis

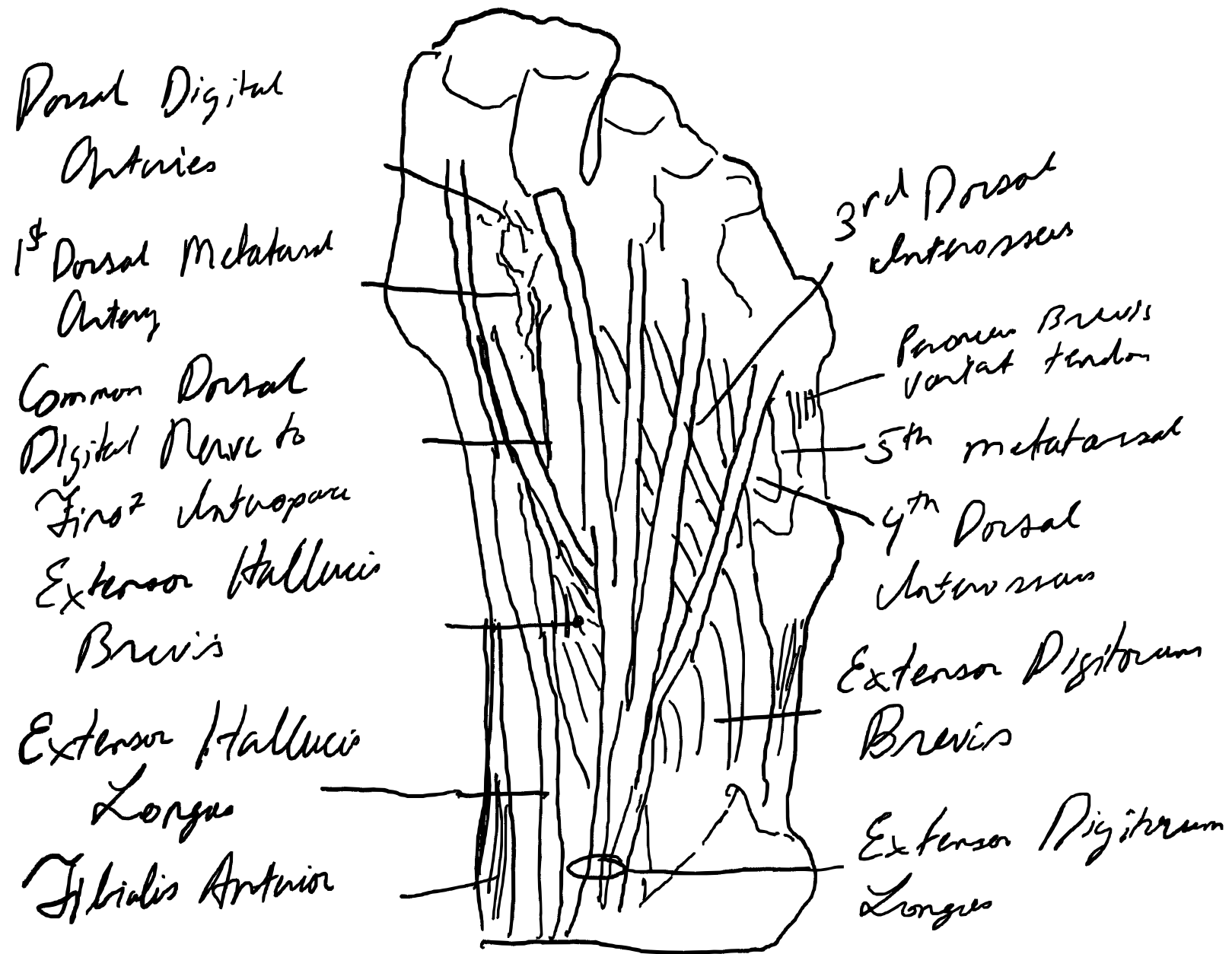


Common plantar neurovascular bundles in digital interspaces

Proper Plantar Neurovascular Bundle to Hallux

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

Extensor Tendons of Foot

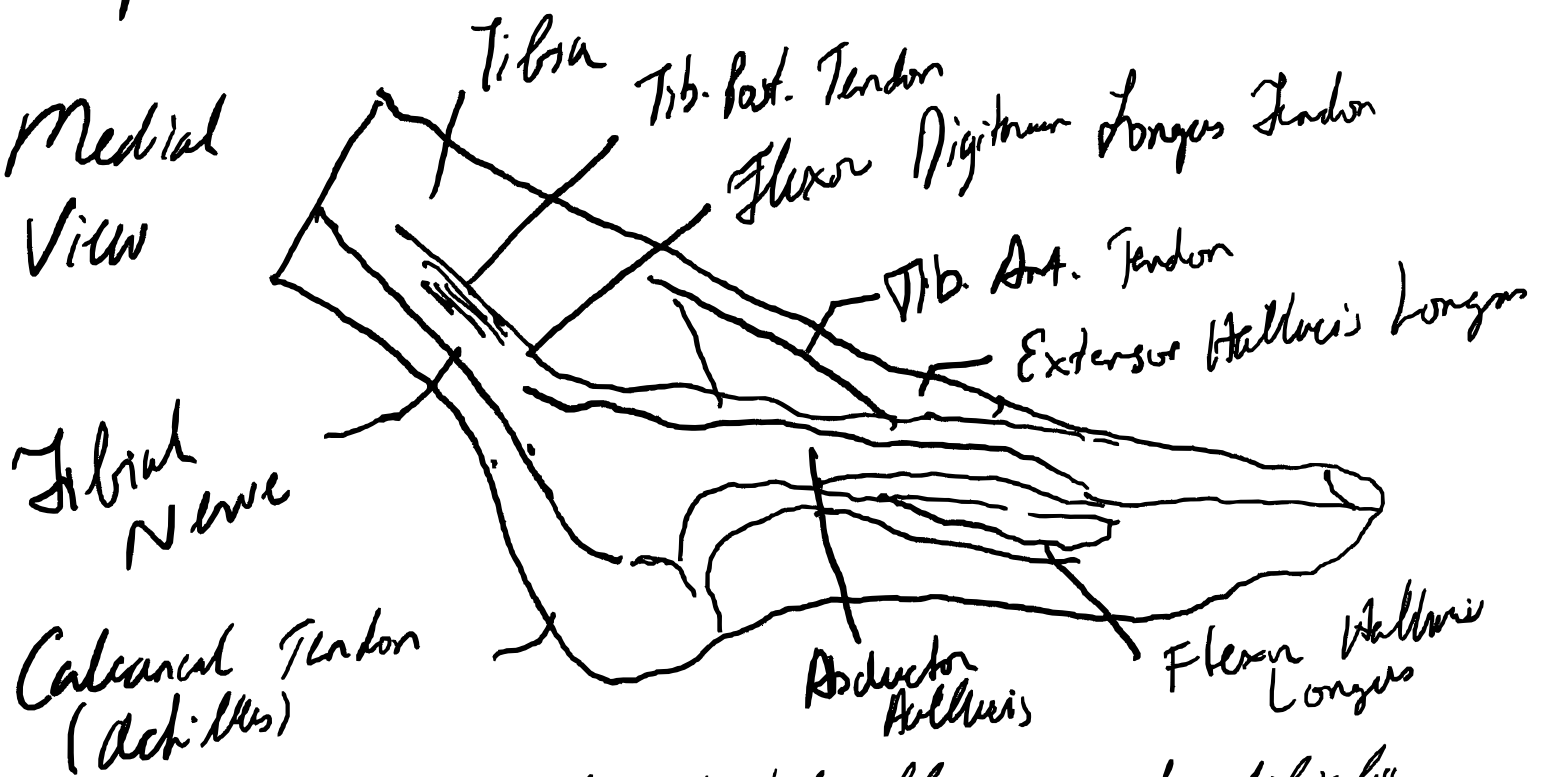


- helps keep tendons in place and provides way to extend toes
- other stubs include extensor digitorum longus + extensor digitorum brevis
- also dorsiflexes and extends lesser toes
- Extensor Hallucis Longus

- origin: middle medial surface of fibula
- deep to tib. ant. and extensor digitorum longus
- tendon passes through superior extensor retinaculum, etc
- insertion, dorsal distal 1st phalanx + medial slip into joint.
- hallux + interphalangeal joint are extended.
- Peroneus Tertius
 - variably fused with extensor digitorum longus
 - origin: inferior 1/3 of medial fib surface, fused belly insert 5th metatarsal, sometimes 4th
 - weak dorsiflexor and inverter

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

Plantar View

2nd Metatarsal Head

Lumbricals

Lateral Plantar Artery, Nerve, Vein

Abductor Digiti Minimi

Flexor Hallucis Longus Tendon

Calcaneus

Calcaneal Tendon

First Common Plantar Digital Nerve

Abductor Hallucis (Reflected)

1st Lumbrical

Medial Head Flexor Hallucis Brevis

Quadratus Plantae

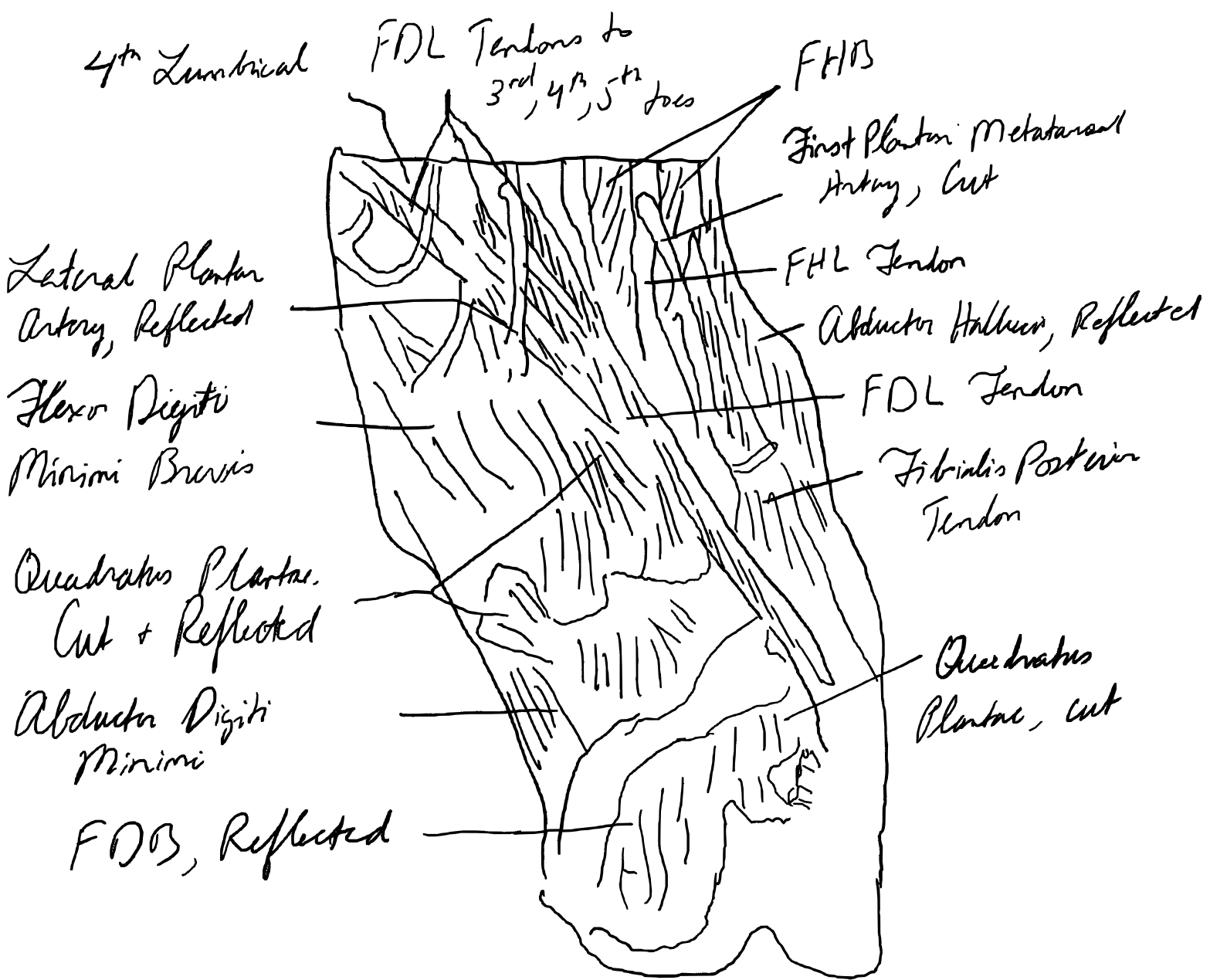
Flexor Digitorum Longus Tendon

Posterior Tibial Nerve

Tibial Nerve



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

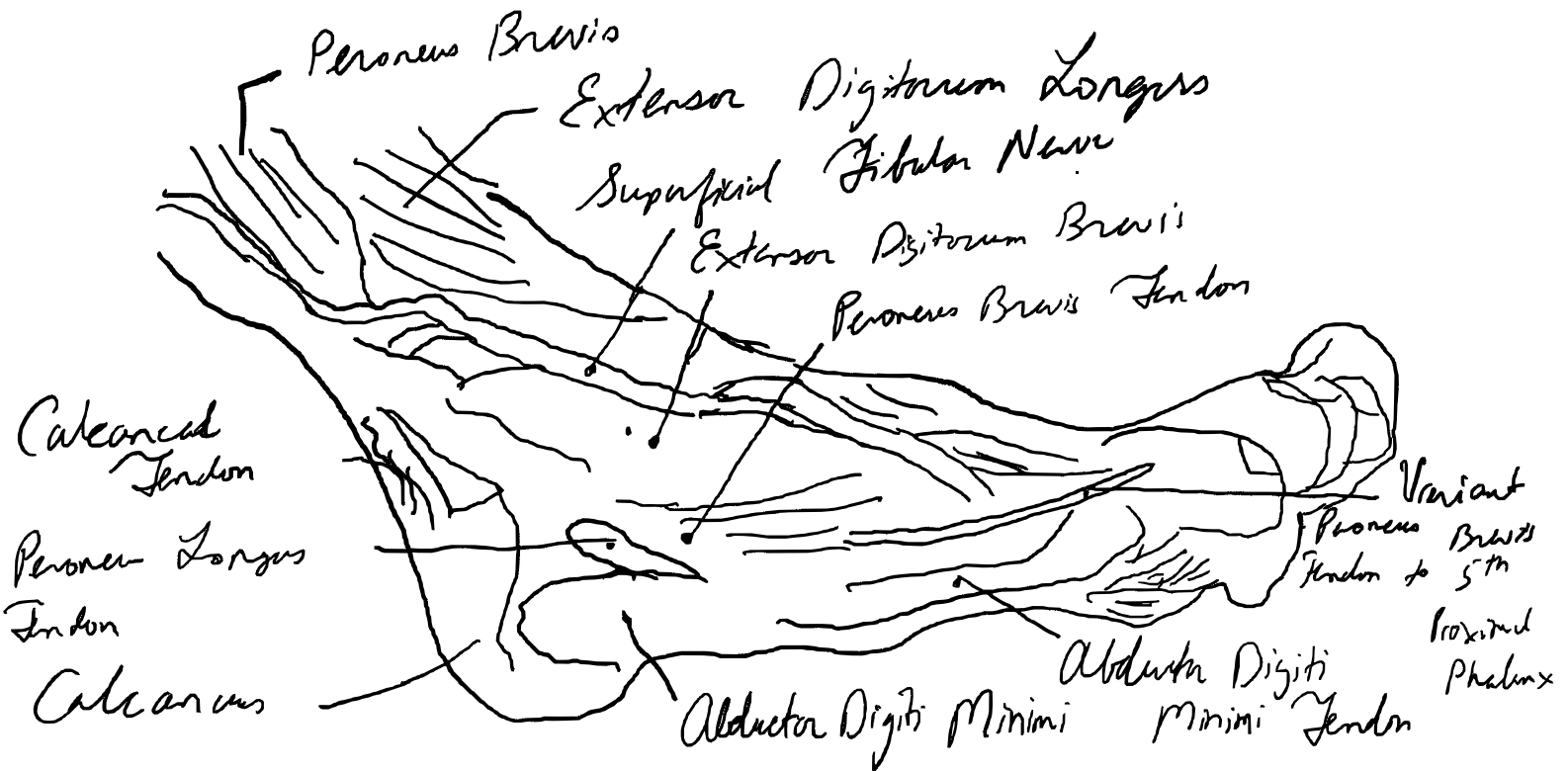


- tendon has strong band going to sustentaculum tali
- 2 other bundles
 - superficial, wider band to navicular tuberosity and inferior medial cuneiform
 - deep part become origin for FHL, inserts into metatarsals
- plantar flex and strongest inverter

Extensor Lateral Muscles

- fibula origin, vertically down, behind lateral malleolus
- Peroneus Longus
 - origin: head of fib, lateral condyle of tib.

Lateral View



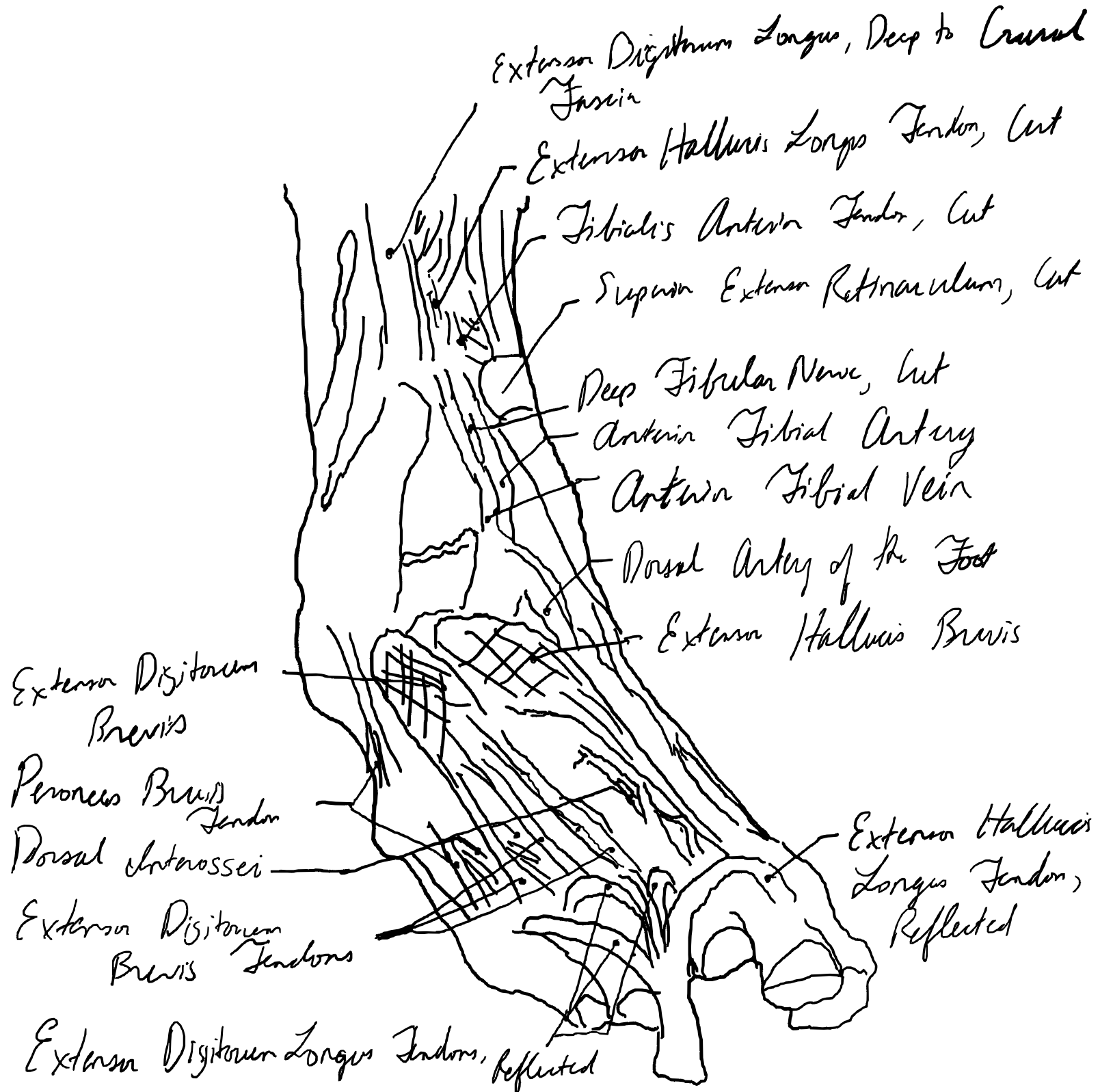
- tendon goes behind lateral malleolus, along lateral calcaneus
 - as far as fibular notch of lateral malleolus
- insertion: tuberosity of lateral first metatarsal base, plantarly
 - smaller slips insert lateral aspect of medial cuneiform + 1st metatarsal neck
- plantar flexor + evorser (tendon crosses sole lateral to medial)
- maintains longitudinal + transverse plantar arch via tendon orientation

Peroneus Brevis

- arises lateral $\frac{2}{3}$ fib. surface
- bipennate attachment on tendon above lateral malleolus
- along calcaneus inserts into 5th metatarsal tuberosity dorsally
- plantar flexor + evorser

Intrinsic Dorsal Foot Muscles

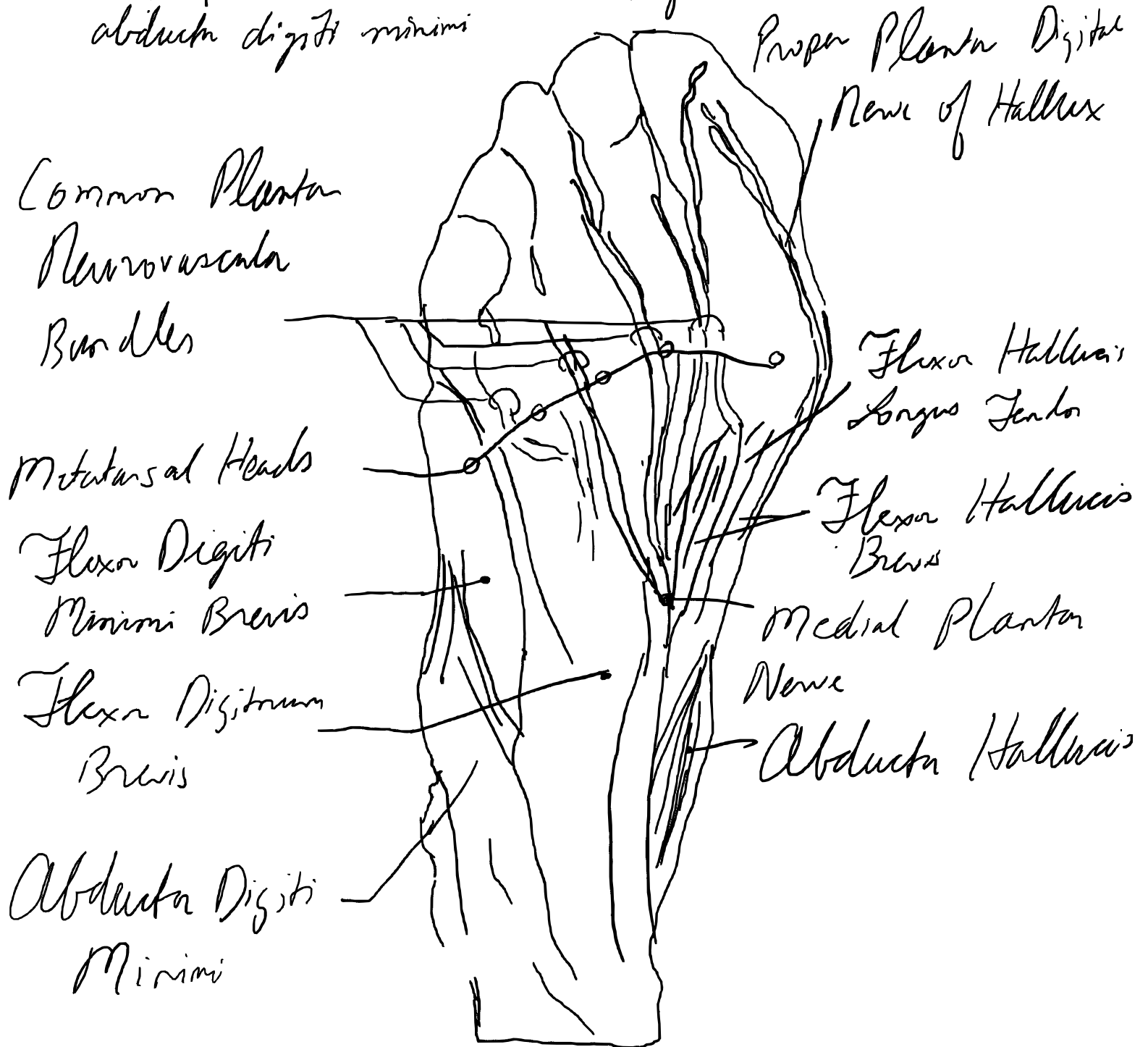
- Extensor Hallucis Brevis and Extensor Digitorum Brevis
 - Only one muscle mass on foot dorsum, from calcaneus splits
 - 4 wrap to hallux + 3 toes
 - Hallux split considered own muscle



- arise from lateral calcaneus, deep to EDL + PT
- long + short extensor tendons pass in digits
- hallux tendon dorsal insertion proximal phalanx
- digit 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



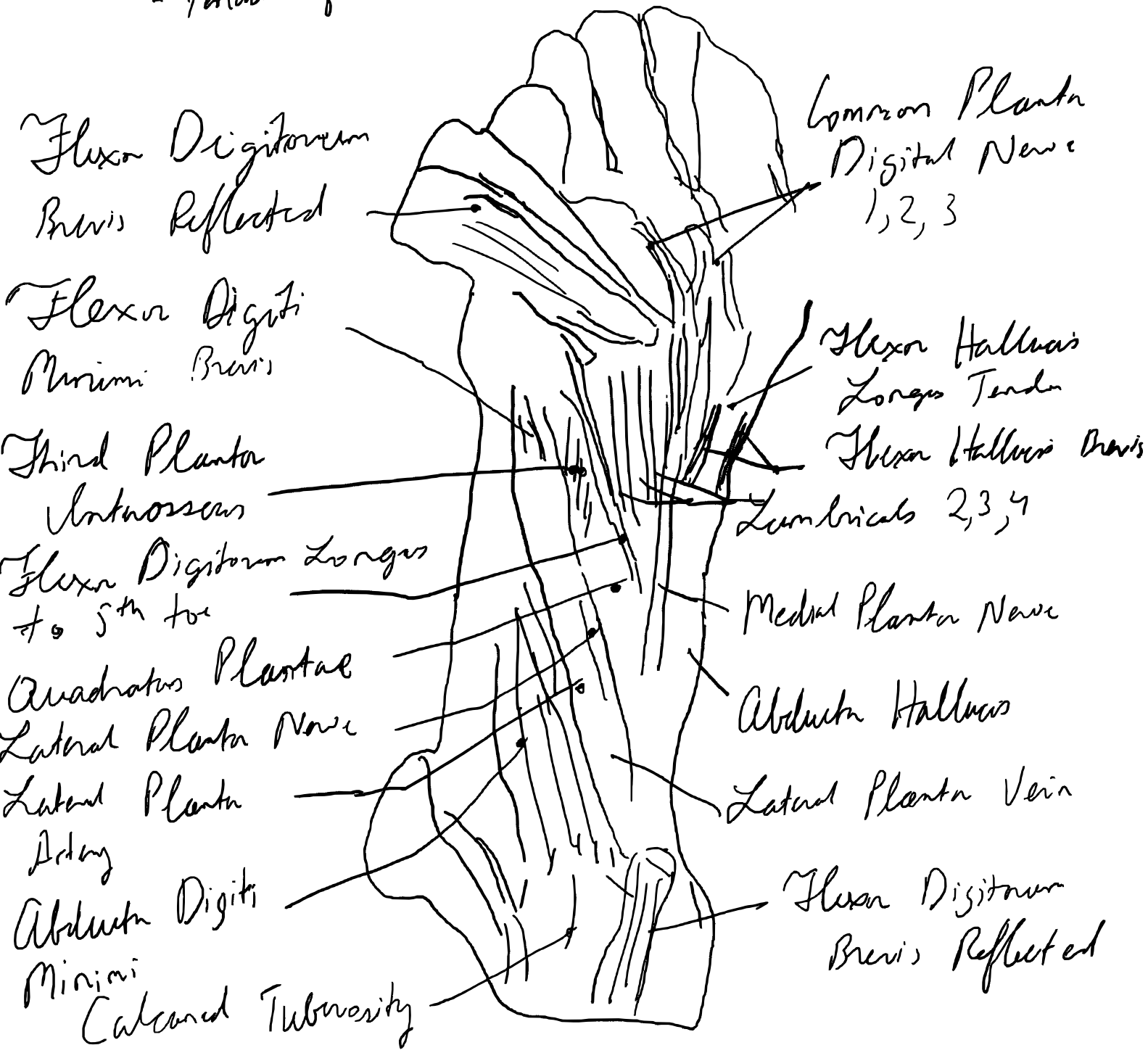
Superficial Plantar Muscles

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 interossei
- tendons of peroneus longus + post. tib. in this layer



Superficial Plantar Muscles + FDB reflected

- Abductor Hallucis

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

- Flexor Digitorum Brevis

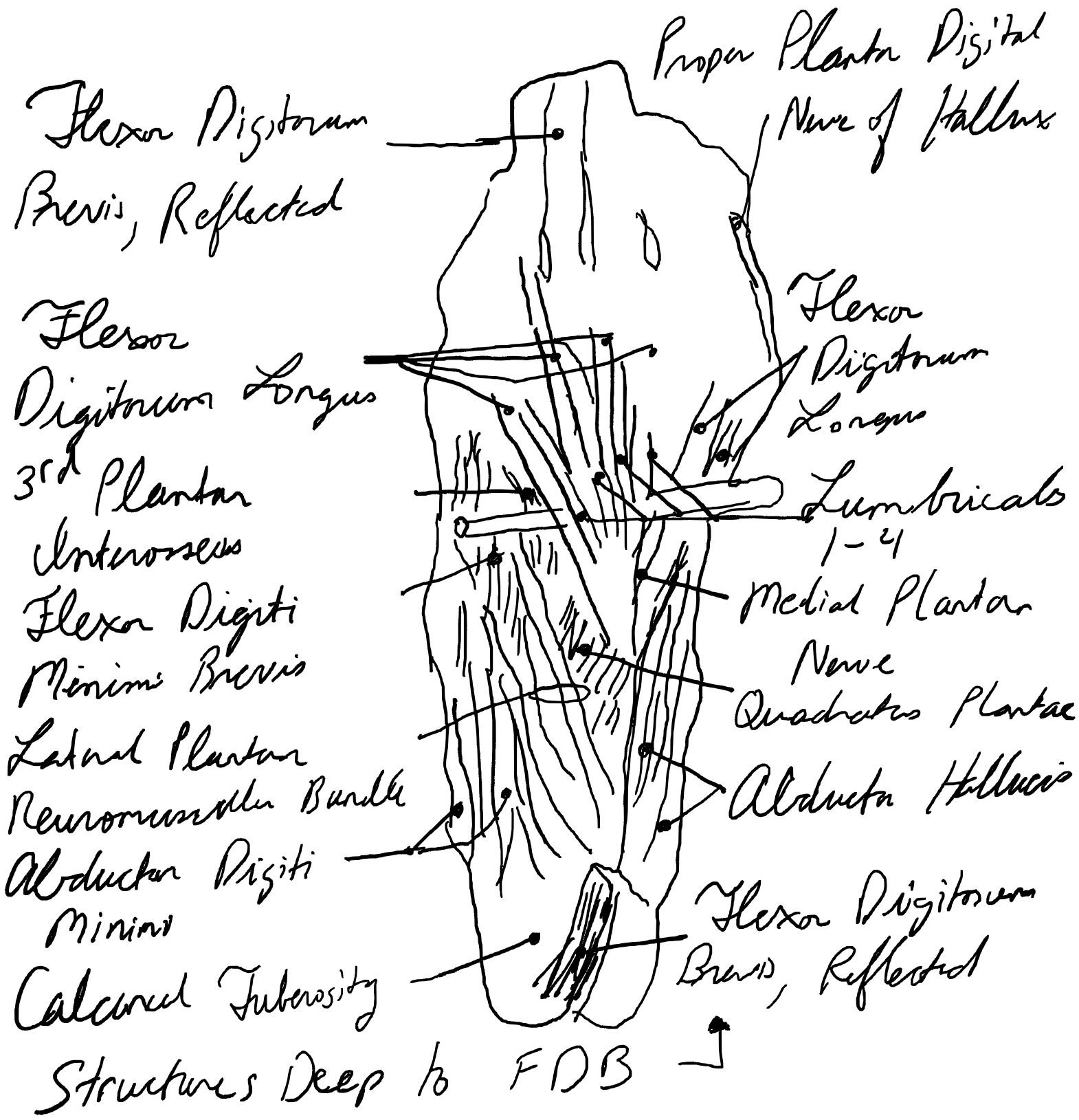
- origin calcaneal tuberosity, proximal intermedial plantar aponeurosis, intermuscular septa.
- runs anterior, 4 way split to each toe. Plantar to FDL
- Tendon splits to let FDL enter superficially.
- reforms insertions at sides of middle phalanx, plantar
- plantar flex

- Abductor Digiti Minimi

- slender muscle from lateral calcaneal tuberosity
- tendon starts on a calcaneocuboid joint, thick insertion into 5th proximal phalangeal base, plantar
- likely stronger flexor than abductor

- Quadratus Plantae

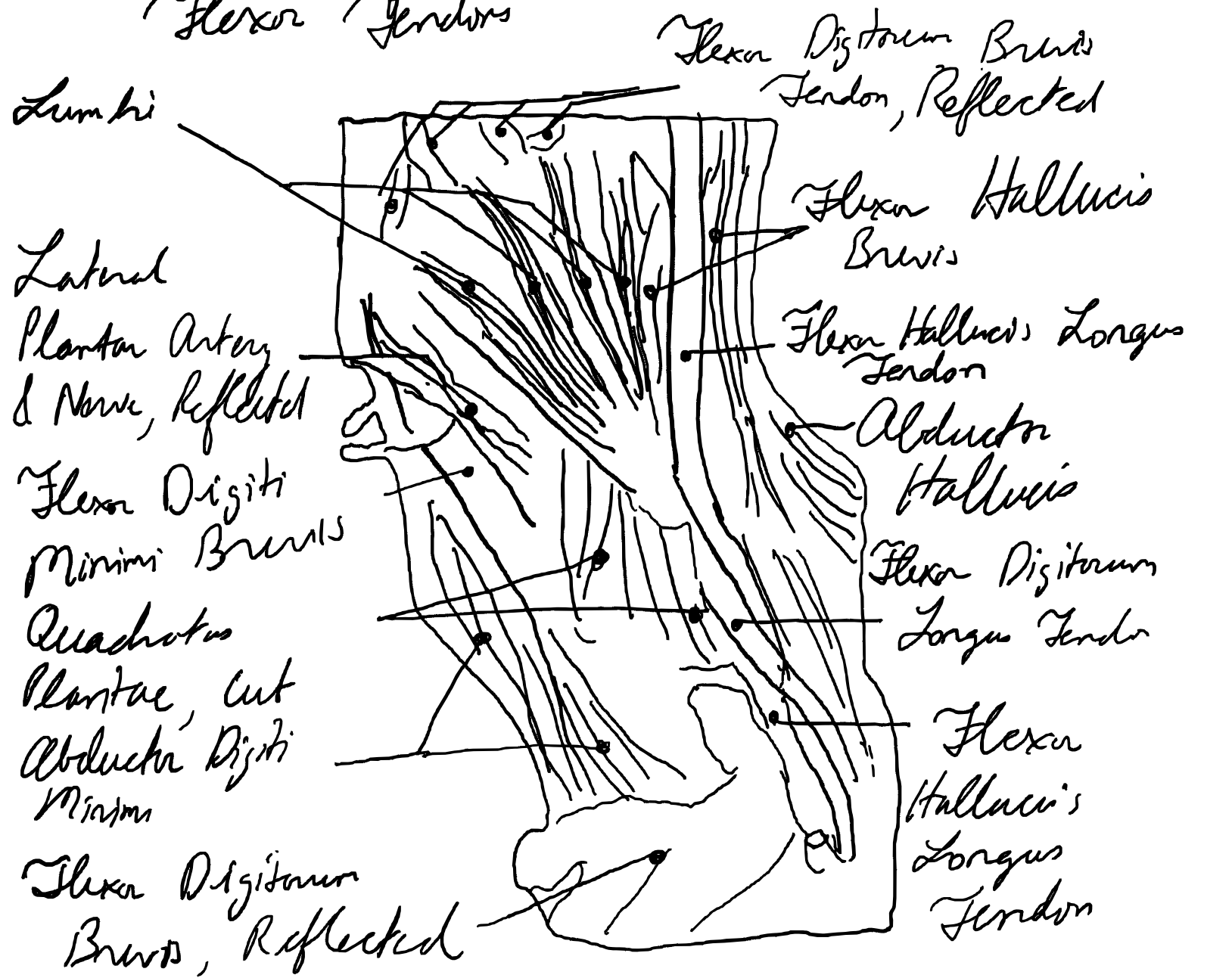
- "flexor accessorius"
- V shaped, from medial and lateral calcanei (2 heads)
- inserts into FDL tendons
- traction to FDL makes QP move too.



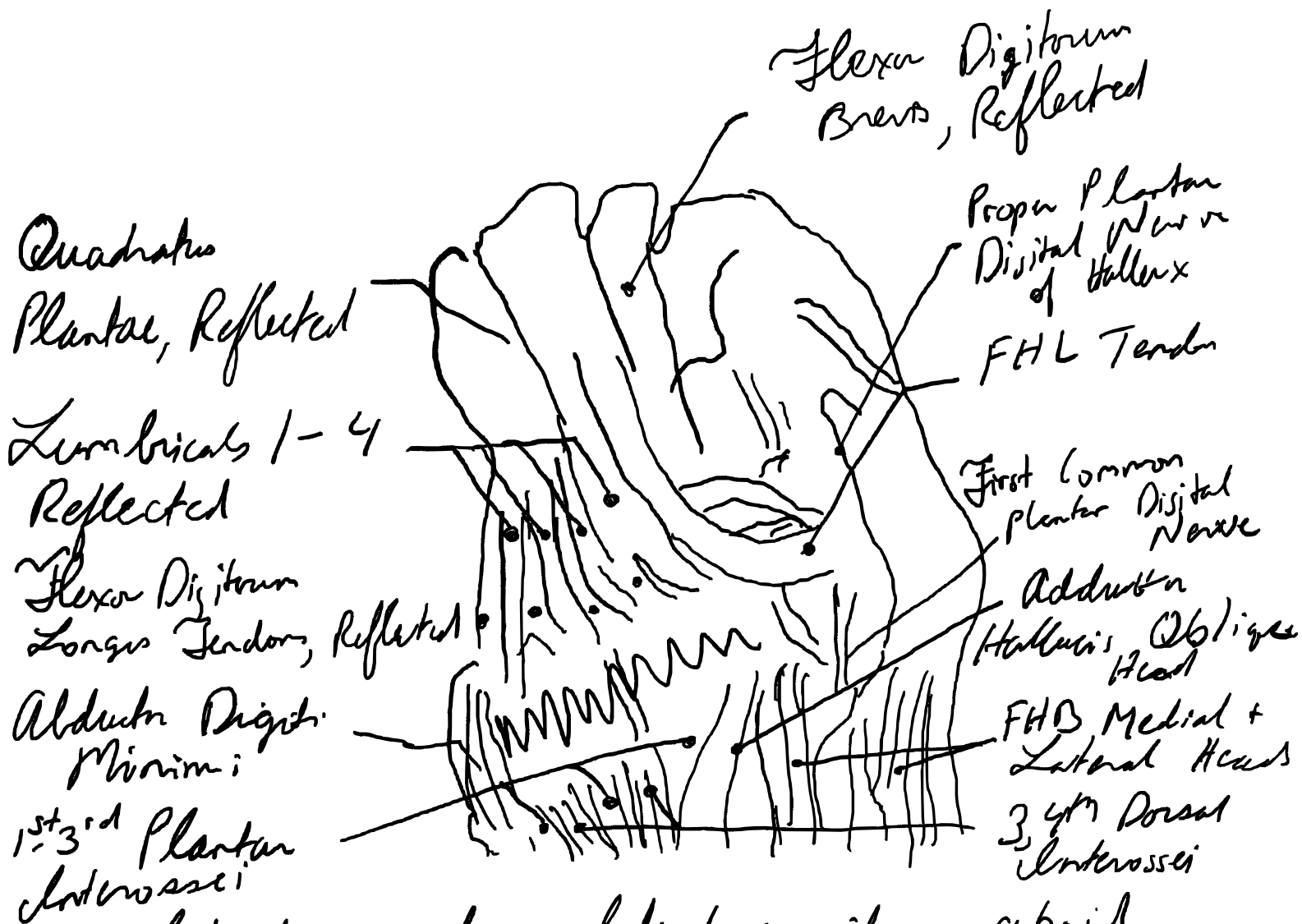
Structures Deep to FDB ↓

- Lumbricals
- 4 worm shaped muscles, 2-3rd toes
- soft tissue origin and insertion.

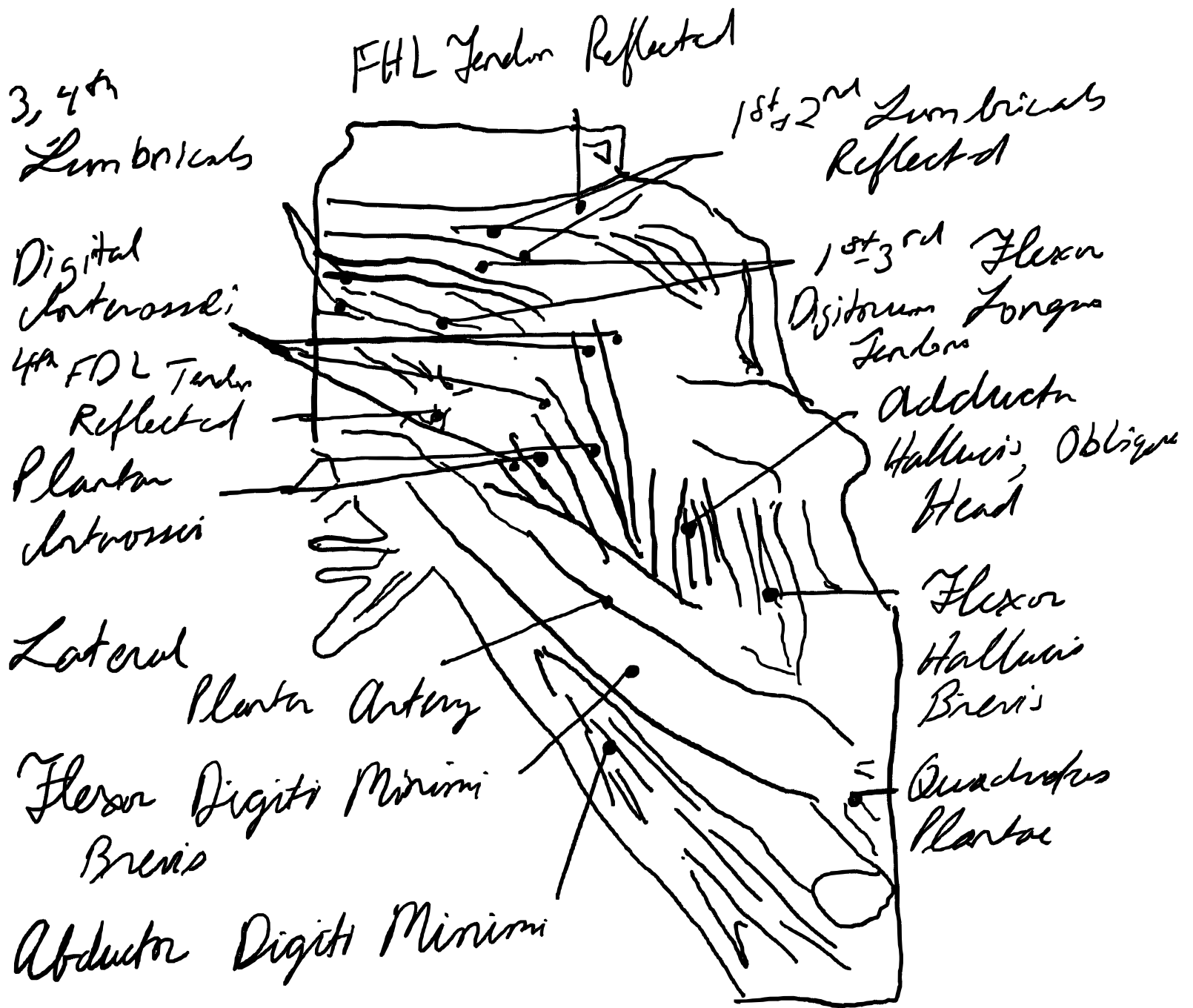
Relationships of the Long Flexor Tendons



- 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 + later of 1st metatarsal
- complex insertion known as plantar plate
- flexor
- Flexor Digiti Minimi Brevis
- + inferior to 5th metatarsal
- + starts from said metatarsal & fib. shaft / cuboid
- + joins Abductor Digiti Minimi, inserts into proximal phalanx
- Adductor Hallucis
- + 2 heads: oblique from fibula 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 plantar: smaller, fill plantar space
- + form common plantar sheath
- + resting axis is through second toe
- * dorsal: ABduct, plantar ADduct
- + 1-4 dorsal, medial to lateral
- * bipennate, from bones of metatarsal space, transverse metatarsal ligaments, adjacent fascia
- * insert proximal phalanx
- * plantar flex + abduct 2-4
- + plantar similar but opposite.
- * plantar flex 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) 2/3rd 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

Extensor Hallucis Longus
Common Dorsal Digital Nerve to 1st interspace

Common Dorsal Digital Nerve to 2nd interspace

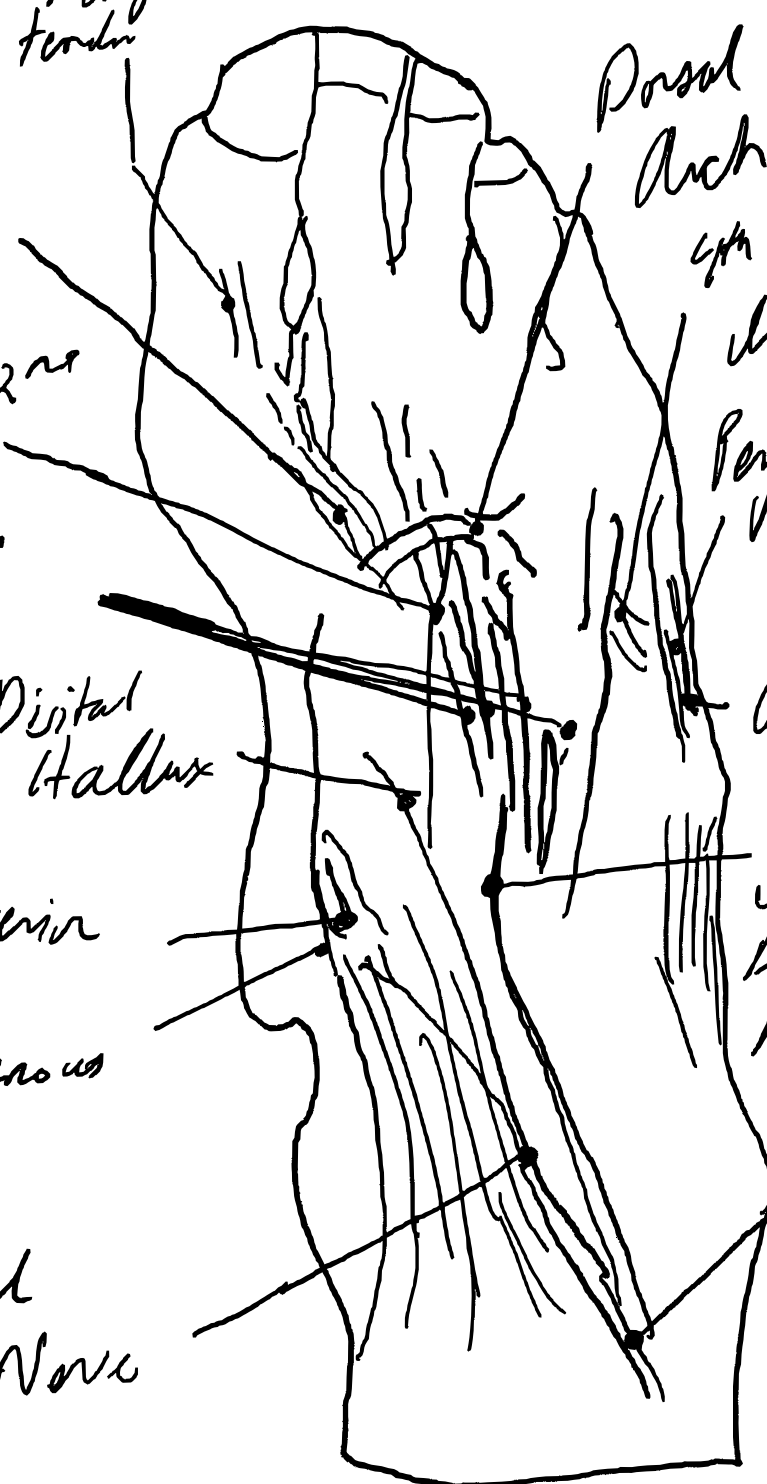
Extensor Digitorum Longus

Proper Dorsal Digital Nerve to medial Hallux

Tibialis Anterior

Great Saphenous Vein

Medial Dorsal Cutaneous Nerve



Dorsal Venous Arch

4th Dorsal Metatarsus

Peroneus Brevis Tendon to 5th MT

Abductor Digiti Minimi

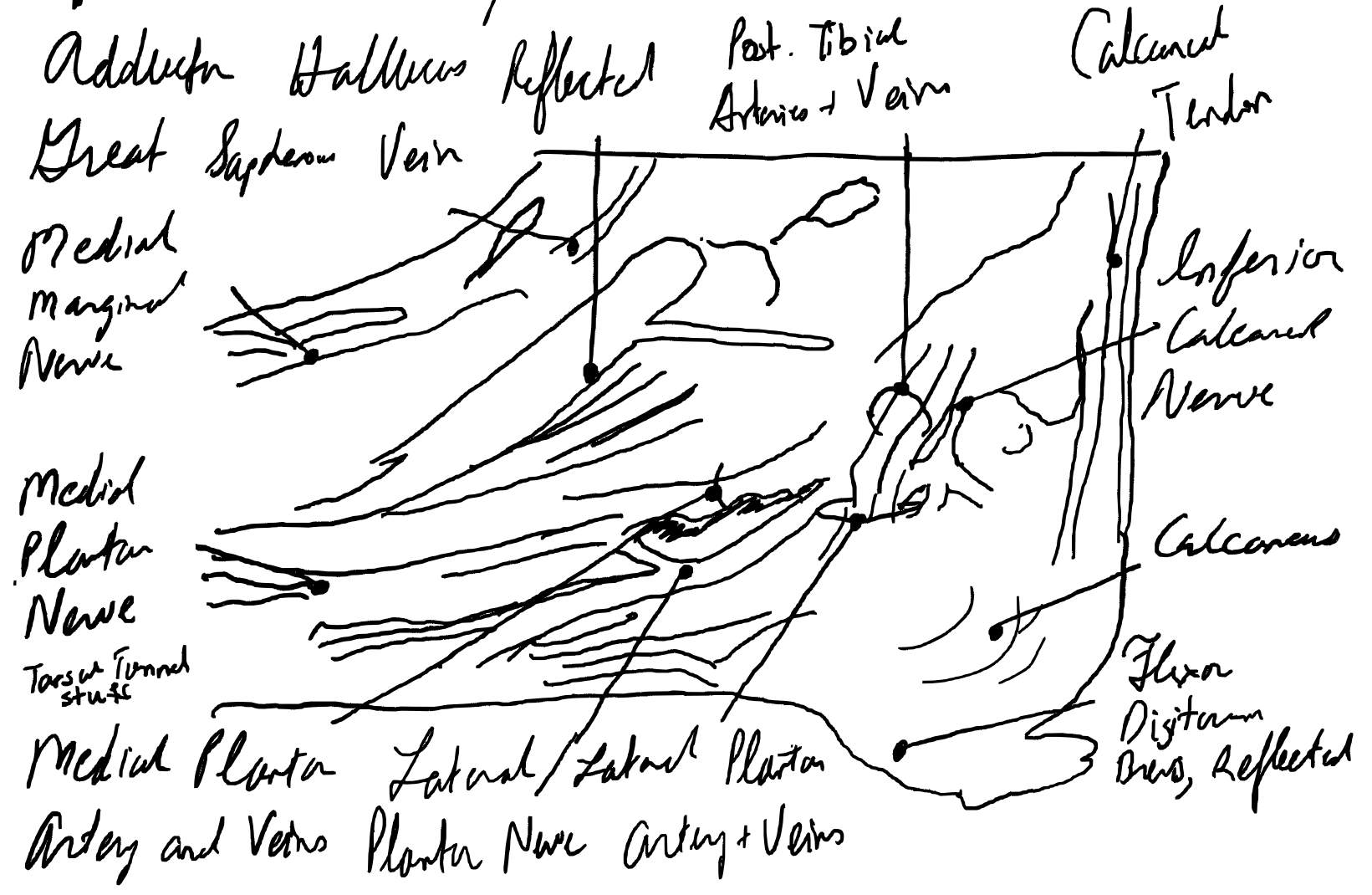
Intermediate Dorsal Cutaneous Nerve

Superficial Fibular Nerve

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

Tibial Nerves of the Foot

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



- medial → AB1+, FOB, 1st Lumbrical, tarsus + metatarsus joints

Neurovascular Planta Midfoot

Flexor Digitorum
Brevis, Reflected
3rd Common

Proper Planta Digital Nerve of Hallux

Plantar Digital
Nerve

Flexor Hallucis Longus

Tendon

1st Plantar Metatarsal
Artery

FDL Tendons to
2, 3, 4 Toes

1st Common Plantar
Digital Nerve

Proper Planta Digital
Nerve to 5th Tendon

Flexor Hallucis
Brevis

FDL Tendon to 5th
Toe

1st Lumbrical

Flexor Digiti
Minimi Brevis

2nd Common
Digital Nerve

Abductor Digiti Minimi

3, 4 Lumbricals

Quadratus Plantae

- lateral: QP, ABDM.

+ superficial / deep branches

* superficial: FDMB, 3, 4 plantar interossei

* deep: ADH, interossei, lateral 3 lumbricals

Blood Supply

Arteries

- 3: anterior tibial, posterior tibial, fibular

+ anterior: dorsal

+ posterior: inferomedial

+ fibula: lateral

- Key Details

+ dorsal continues down talus, navicular, intermedial

* ^{circifer} terminate deep plantar branch

+ posterior tibial artery → medial / lateral plantar & medial calcaneal

* medial → ABIT, FDD, 1st dorsal interosseus

Veins

- 2: superficial, deep